G.C.E.(Advanced Level) Examination

Structure of Question Papers and Prototype Questions
2019 and afterwards

Volume 1

01 - Physics
02 - Chemistry
07 - Mathematics
08 - Agriculture
09 - Biology
10 - Combined Mathematics
11 - Higher Mathematics

Curriculum
Assessment
&
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N E TS

Research and Development Branch
National Evaluation and Testing Service
Department of Examinations, Sri Lanka

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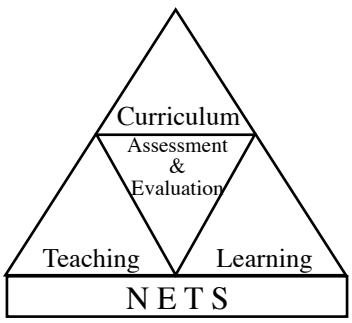

Research and Development Branch
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G.C.E.(Advanced Level) Examination - 2019 and afterwards
Structure of Question Papers and Prototype Questions
Volume 1

Department of Examinations, Sri Lanka
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Research and Development Branch
National Evaluation and Testing Service
Department of Examinations

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Message of the Commissioner General of Examinations

To measure the achievement of any course of studies, various methodologies can be adopted. Among those methodologies, written examinations are the most widespread method that is being used for this purpose at present. Hence, the fact that a connection is developed between the teaching-learning process and the summative evaluation methodology in order to maximize the efficiency of the teaching learning process is taken into account.

In the year 2017, new syllabi for Grade 12 has been introduced. Those students who are following the new syllabi will be sitting the G.C.E(A.L) Examination for the first time in 2019. This book is prepared including the structures of question papers and prototype questions based on the revised syllabi for the benefit of the candidates who sit the G.C.E(A.L) Examination in 2019 and afterwards.

With the revision of subject contents of the G.C.E(A.L) syllabi, it was necessary to effect changes in the structure of question papers to align with the syllabi revision introduced. Accordingly, an attempt has been made to gather subject groups and preserve the identity of the structure within each group. The structures were decided by the academic committees and the prototype questions were set according to the structures by them.

At a time when the confidence and consideration on Educational Measurement and Evaluation is increasing, it is important to raise awareness among the stakeholders on how the students will be evaluated. The G.C.E(A.L) Examination is mainly an achievement test conducted for the purpose of certification at the end of the collegiate level. However, the University Grants Commission and other National and International Higher Education institutes use the results of this examination to select candidates for their institutions to follow courses. Hence, this examination embodies features of a selection examination as well. The students will be able to know what type of an assessment they will have to face by examining the structures of question papers and prototype questions enclosed in this book. As such, this book will be of immense help to principals, teachers and the school community and also to those who provide guidance to prepare students for the G.C.E(A.L) Examination.

In this instruction manual, Part I contains general information about the examination. Part II comprises of the structure and nature of the question papers while part III consists of Prototype questions for each subject.

I wish to express my gratitude to the Secretary of Education and his staff, the Director General of the National Institute of Education and her staff, the Commissioner General of Publications and her staff, to all Controlling Chief Examiners, all resource persons, officers and the staff of the Research and Development Branch of the Department of Examinations, for the corporation extended in formulating the structures of question papers and setting prototype questions contained in the manual. I sincerely thank the Education Sector Development Programme (ESDP) for providing financial assistance and Vishwa Graphics (Pvt.) Ltd. for doing an excellent job to print this book.

B. Sanath Pujitha
Commissioner General of Examinations

10.10.2018
Research and Development Branch
Department of Examinations

Guidance	:	B. Sanath Pujitha Commissioner General of Examinations
Direction and Organization	:	Gayathri Abeygunasekara Commissioner of Examinations (Research and Development)
Co-ordination	:	J.A.J.R. Jayakody Deputy Commissioner of Examinations
Subject Co-ordination	:	K.A.H.H. Kuruppu Assistant Commissioner of Examinations L.G.S. Samarakoon Assistant Commissioner of Examinations N.N. Sooriyaarachchi Assistant Commissioner of Examinations A. Krishnagophy Assistant Commissioner of Examinations P. Rukmal Mahesh Perera Assistant Commissioner of Examinations K.W. Nilanka Kiriella Assistant Commissioner of Examinations
Computer typesetting	:	K.P.D. Anusha Maduwanthi Dissanayake ICT Assistant W.A.D. Chathurika Dissanayaka Data Entry Operator P. Madushani Mandalawatta Data Entry Operator
Cover Page	:	S.H. Saman Kumara Management Assistant

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Part I

General Certificate of Examination (Advanced Level)

General Information about the Examination

1. Introduction

The G.C.E.(Advanced Level) Examination is the final certification examination of senior secondary education in Sri Lanka. Even though this is conducted mainly as a certifying examination, it is also considered as a selection examination since the results of this examination is considered for selection to the University, other Higher Educational Institutions and Colleges of Education.

Moreover, the results of this particular examination are also regarded as a basic qualification to obtain middle level employment. The G.C.E.(Advanced Level) Examination was held under the subject streams, Biological Science, Physical Science, Commerce and Arts up to the year 2014 and from 2015 the examination was held under the subject streams, Biological Science, Physical Science, Commerce, Art, Engineering Technology and Biosystems Technology.

2 Applying for the Examination

2.1 School Candidates

The principal of each school should submit applications including information about the name of the school candidates who have completed the prerequisites to apply for the examination, the subjects offered and the medium. Here careful attention should be paid to write the names of candidates correctly as they appear in the birth certificate and to include the subjects, subject numbers and the medium correctly.

2.2 Private Candidates

The school based assessments take place in the classroom under new School Based Assessment Programme is not relevant to the Private candidates. Private candidates have been exempted from this need through the letter issued by the Ministry of Education No. ED/01/12/12/05/08/i and dated 2017.10.31. (Annex 03)

When the applications are called from private candidates through a newspaper advertisement published by the Department of Examinations the applicants who wish to appear for the examination should send their applications duly filled along with the receipt obtained for the payment of required examination fee by registered post to the Department of Examinations before the stipulated date mentioned in the newspaper advertisement.

3. Selection of Subjects

The selection of subjects for this examination should be done according to the circular No. 2016/13 dated 2016.04.26 (annex 01) issued by the Ministry of Education regarding "**G.C.E.(A.L.) Subject Combinations and the Subject Combinations for University Entrance**".

The new syllabi for G.C.E.(A.L.) were introduced for Grade 12 in 2017 and the G.C.E.(A.L.) examination based on these syllabi will be held for the first time in 2019. According to the regulations of the circular No. 2016/13 mentioned above, the candidates should select the subjects relevant to the streams of Biological Science, Physical Science, Commerce, Arts, Engineering Technology and Biosystems Technology.

Candidates should appear for three main subjects for the G.C.E.(A.L.) Examination and in addition the pupils who wish to apply for university entrance should pass in the **''Common General Test''** paper too. Even though not considered for university entrance, pupils have the option to sit the **''General English''** paper as well.

3.1 Subjects approved for G.C.E.(A.L.) Examination

The conditions regarding the subject combinations to be selected by pupils for all the subjects streams are mentioned in circular No. 2016/13 embodied in annex 1.

The subjects approved for G.C.E.(A.L.) Examination and the subject numbers are given below. When applying for the examination the relevant subject numbers should be used.

	Subject	Subject Numbers	
(01)	Physics	01	
(02)	Chemistry	02	
(03)	Mathematics	07	
(04)	Agricultural Science	08	
(05)	Biology	09	
(06)	Combined Mathematics	10	
(07)	Higher Mathematics	11	
(08)	Common General Test	12	
(09)	General English	13	
(10)	Civil Technology	14	
(11)	Mechanical Technology	15	
(12)	Electrical, Electronic and Information Technology	16	
(13)	Food Technology	17	
(14)	Agriculture Technology	18	
(15)	Bio Resource Technology	19	
(16)	Information & Communication Technology	20	
(17)	Economics	21	
(18)	Geography	22	
(19)	Political Science	23	
(20)	Logic and Scientific Method	24	
(21)	History of Sri Lanka	25	Paper I
(22)	History of India	25A	Paper II
(23)	History of Europe	25B	Paper II
(24)	Modern World History	25C	Paper II
(25)	Home Economics	28	
(26)	Communication & Media Studies	29	

(27)	Business Statistics	31
(28)	Business Studies	32
(29)	Accountancy	33
(30)	Buddhism	41
(31)	Hinduism	42
(32)	Christianity	43
(33)	Islam	44
(34)	Buddhist Civilization	45
(35)	Hindu Civilization	46
(36)	Islam Civilization	47
(37)	Greek and Roman Civilization	48
(38)	Christian Civilization	49
(39)	Art	51
(40)	Dancing (Indigenous)	52
(41)	Dancing (Bharatha)	53
(42)	Music (Oriental)	54
(43)	Music (Carnatic)	55
(44)	Music (Western)	56
(45)	Drama and Theatre (Sinhala)	57
(46)	Drama and Theatre (Tamil)	58
(47)	Drama and Theatre (English)	59
(48)	Engineering Technology	65
(49)	Biosystems Technology	66
(50)	Science for Technology	67
(51)	Sinhala	71
(52)	Tamil	72
(53)	English	73
(54)	Pali	74
(55)	Sanskrit	75
(56)	Arabic	78
(57)	Malay	79
(58)	French	81
(59)	German	82
(60)	Russian	83
(61)	Hindi	84
(62)	Chinese	86
(63)	Japanese	87

Three main subjects can be selected for the G.C.E.(A.L.) Examination from the above mentioned list of subjects in terms of circular No. 2016/13 issued by the Ministry of Education. Besides these main subjects candidates must sit the following two subjects.

* **Common General Test (12)**

It is essential to obtain a minimum mark as determined for this subjects in order to gain admissions to a university in Sri Lanka as an internal student. Obtaining the qualification on one occasion can be applied for admission to the university on a subsequent occasion. The mark obtained for this subject will not be considered for the calculation of the Z score.

* **General English (13)**

This subject is not a main subject at the G.C.E.(A.L.) Examination. The marks or the pass obtained for General English will not be considered for university admission. However, the result obtained for this subject will be inserted separately in the certificate of the G.C.E.(A.L.) Examination.

4. Deciding on Grades

According to the raw score obtained for each subject, the grades will be determined as given below.

Mark Range	Grade
75 - 100	A - Distinction Pass
65 - 74	B - Very Good Pass
50 - 64	C - Credit Pass
35 - 49	S - Ordinary Pass
00 - 34	F - Fail

5. School Based Assessment

This programme is functioning in the school system from 2017 according to the circular "Implementation of School Based Assessment Programme for grades 6 - 13 and No. 23/2017 dated 2017.06.01 issued by the Ministry of Education.

5.1 Objectives

The objectives of this programme are to measure the abilities and competencies of grade 12 and 13 students during the teaching learning process that cannot be assessed at the G.C.E (A.L) examination and to identify the strengths and weaknesses of students to give them feedback and conduct remedial programmes for weaker students. Under this programme, assessments will be carried out for the subjects learnt in the classroom while assessing the students' group projects as well.

5.2 How Assessments are carried out

5.2.1 Assessment based on the subjects learnt in the classroom.

(a) One assessment each for all subjects learnt in the classroom will be conducted per term.

(b) Assessment modalities that are introduced under the School Based Assessment Programme must be used for this purpose.

(c) Altogether there should be 05 sessions of assessment during the two years 1 each for a term for all subjects learnt in the classroom as three assessments for the 03 terms in grade 12 and 02 more assessments in grade 13 for terms 1 and 2.

(d) The marks for the aforementioned 05 assessments will be received by the Department of Examinations at the end of the second term in grade 13. The competency levels determined according to these scores will be included in the results sheet of G.C.E (A.L) in a separate column as follows.

School Based Assessment marks	Level of competency
9, 10	(Excellent Level Competency)
8	(High Level Competency)
6, 7	(Credit Level Competency)
4, 5	(Near Competency)
1, 2, 3	(Not reached the Competency Level)

5.2.2 Assessment based on the Group Project

Every student who sit the G.C.E (A.L) Examination for the first time will have to complete the Group Project.

5.2.2.1 Group Project

(a) 6-10 students should be named as a group by the teachers of the relevant section for the Group Project.

(b) The group has to submit a suitable topic for the project and get it approved.

(c) The Group Project should be completed during the 3rd week of Grade 12 and the 1st week of Grade 13.

(d) Through the completion of the project it is expected the students to work in team spirit, deal with various institutions and persons, and get an understanding about the field.

5.2.2.2 Assessment of Project

(a) The projects are subjected to assessment under 5 criteria and the teacher in charge of the project/ project committee, shall study how pupils have performed according to each criteria and awards marks.

(b) A total of 20 marks is awarded for a project and the score is converted out of 10, which is transmitted to the Department of Examinations.

(c) The competency level decided on according to the final average marks of these two projects, is also entered in the G.C.E.(A.L.) result sheet according to the levels mentioned in 5.2.1 (d)

Part II

G.C.E.(Advanced Level) Examination - 2019 and afterwards
Structure and nature of the question papers

Subject and Subject Number		Paper I								Paper II										
			Part A				Part B				Part A			Part B			Part C			
		** Time (hours)	* Nature of questions	Number of options	Number of questions	Number of questions to be answered	* Nature of questions	Number of questions	Number of questions to be answered	** Time (hours)	* Nature of questions	Number of questions	Number of questions to be answered	* Nature of questions	Number of questions	Number of questions to be answered	* Nature of questions	Number of questions	Number of questions to be answered	Total Number of questions to be answered
(01)	Physics	2	1	5	50	50				3	3	4	4	4	6	4/6				8/10
(02)	Chemistry	2	1	5	50	50				3	3	4	4	4	3	2/3	4	3	2/3	6/7
(07)	Mathematics	3	3, 4		10	10	4	7	5/7	3	4	10	10	4	7	5/7				15/17
(08)	Agricultural Science	2	1	5	50	50				3	3	4	4	4	6	4/6				8/10
(09)	Biology	2	1	5	50	50				3	3	4	4	4	6	4/6				8/10
(10)	Combined Mathematics	3	3, 4		10	10	4	7	5/7	3	4	10	10	4	7	5/7				15/17
(11)	Higher Mathematics	3	3, 4		10	10	4	7	5/7	3	4	10	10	4	7	5/7				15/17

* **Nature of questions**

1. Multiple choice
2. Other objective
3. Structured
4. Semi Structured
5. Essay
6. Practical

** Question papers for which **three** hours are allocated for answering **10 more minutes**, in addition to the three hours will be given for the candidate to read and select the questions that they intend to answer.

Part III
Prototype Questions

The G.C.E.(A.L.) Examination is the final certifying examination held at the end of secondary education. Since pupils are selected for universities and institutions such as other Higher Education Institutions and Colleges of Eduction too, this embodies the features of a selection examination.

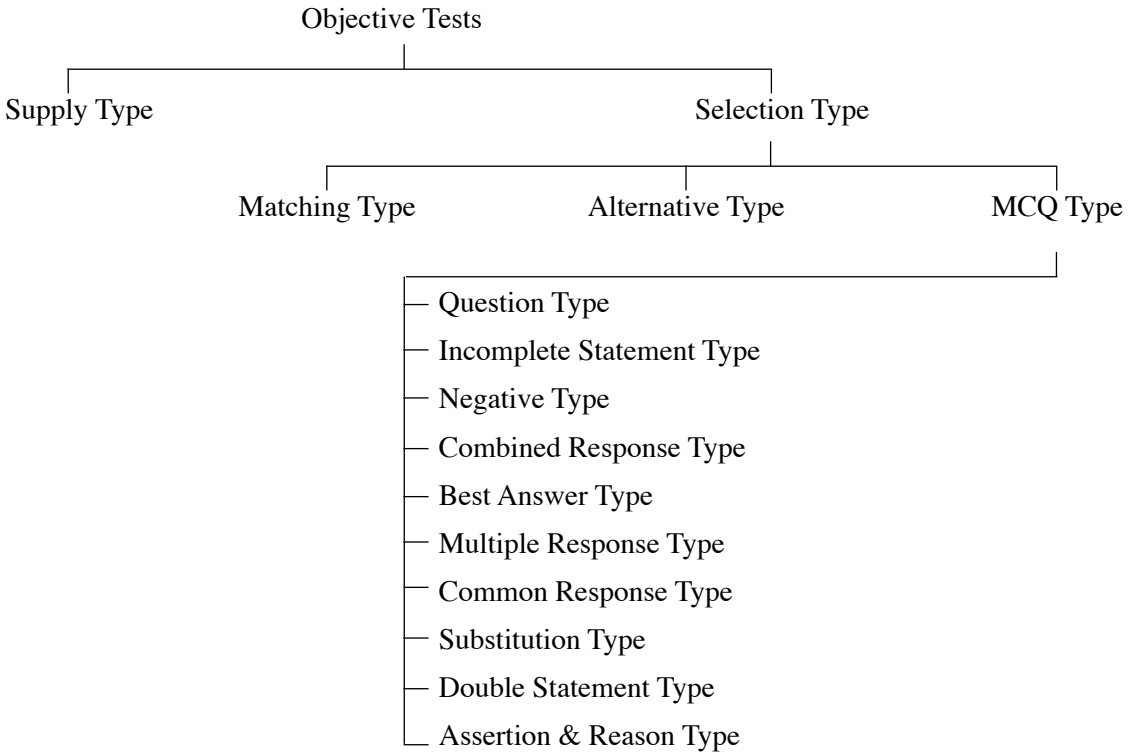
Accordingly when framing question papers for G.C.E.(A.L.) Examination, extra attention should be paid to the features an achievement test should have and since pupils are selected to universities and other Higher Education Institutions too, on the results of this examination, attention has also been paid to this aspect.

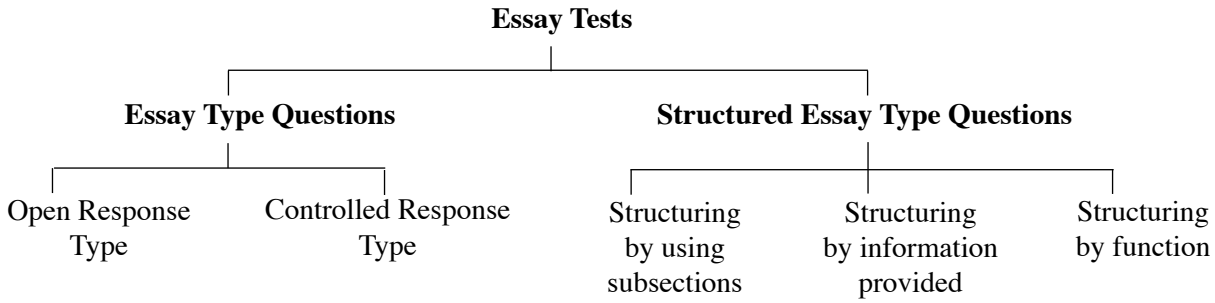
Accordingly, for the purpose of evaluating pupil achievement assay type test and objective type test are used mainly in the written examination system. The subjectivity of the examiner affects an essay type answer. In the case of an objective type of question, since there is only one correct answer it is completely devoid of subjectivity. More attention of the present examination is paid to the type of questions aimed at providing short structured answers, that are half way between these two extremes. Through a structured question the answer the should be provided is strictly controlled within certain limits laid down in the question itself. Accordingly since consistency among examiners in awarding marks can be assured, objective and structured type of questions received prominence in the examination sphere.

According in the drafting of question papers in the G.C.E.(A.L.) examination, essay type questions are used, only when necessary and more attention will be paid to framing objectives type of questions. Moreover in drafting question papers of G.C.E.(A.L.) examination attention has already been paid to framing questions of the type that measures advanced mental skills such as comprehension, application, analysis, synthesis and evaluation without merely depending on memory. Questions are framed in relation to practical events as much as possible and they are purported to measure the skills such as understanding something clearly, applying the principles they have learnt to other similar situations, solving problems, argument, presenting new suggestions/ plans, comparisons, proper presenting of the language, and expressing ideas clearly.

In this part III along with the structure of question papers and the method of awarding marks, prototype questions have been included, but **they are not model question papers.** As such, when drafting question papers depending on the **number of parts included in questions**, **the method of assigning weightage to questions may change as appropriate**, according to the subject matter used as the basis for framing questions.

In addition to the prototype questions mentioned here, the Commissioner General Examinations reserves the right to include, depending on the circumstances in the question papers for G.C.E.(A.L.) examination, **other types of questions too used for objective and essay type tests and any other type of questions including all types of questions mentioned on page 08**.


Objective Tests
Supply Type
Selection Type
Matching Type
Alternative Type
MCQ Type
Question Type
Incomplete Statement Type
Negative Type
Combined Response Type
Best Answer Type
Multiple Response Type
Common Response Type
Substitution Type
Double Statement Type
Assertion & Reason Type


Essay Tests
Essay Type Questions
Structured Essay Type Questions
Open Response Type
Controlled Response Type
Structuring by using subsections
Structuring by information provided
Structuring by function

(01) Physics

Structure of the Question Paper

Paper I - **Time : 02 hours**
This paper consists of **50** multiple choice questions with **5** options. **All** questions should be answered. Each question carries **01** mark. Total marks **50.**

Paper II - **Time : 03 hours.** (In addition, 10 minutes for reading.)
This paper consists of **two** parts as **Structured Essay** and **Essay**.

Part A - **Four** structured essay type questions. **All** questions should be answered. Each question carries 10 marks - altogether 40 marks.

Part B - **Six** essay type questions. **Four** questions should be answered. Each question carries 15 marks - altogether 60 marks.

Total marks for Paper II = 100

Calculation of the final mark	:	Paper I	=	50
		Paper II $100 \div 2$	=	50
		Final mark	=	100

Paper I

Important :
* Answer **all** the questions.
* Select the **correct or the most appropriate** answer.
(A separate sheet will be provided to mark answers for multiple choice questions.)

($g = 10\ N\ kg^{-1}$)

1. The ways that three students have written the units for linear momentum are given below.
(A) kgm/s (B) kg m s^{-1} (C) kg m/s
The correct form/s of the unit according to SI system is/are,
(1) (A) only. (2) (B) only. (3) (A) and (B) only.
(4) (A) and (C) only (5) (B) and (C) only.

2. Quark content of a proton is,
(1) uud (2) udd (3) uuu (4) uu (5) ud

3. If E is the electric field intensity and B is the magnetic flux density, the ratio E/B has the dimensions equal to the dimensions of,
(1) force (2) mass (3) momentum (4) speed (5) impulse

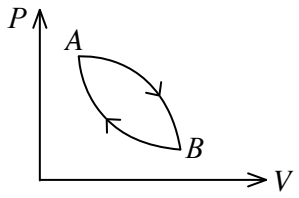
4. Specifications given for a filament bulb are 24 W and 12 V direct current (d.c.). If the bulb is lit for a period of 1 minute, the amount of charge passes through the filament is,
(1) 2 C (2) 20 C (3) 120 C (4) 2400 C (5) 3600 C

5. The amount of heat required to raise the temperature from 20 °C to 50 °C of a metal of mass 2 kg is 7.2×10^4 J. The specific heat capacity of the metal is,
(1) 100 J kg^{-1} K^{-1} (2) 120 J kg^{-1} K^{-1} (3) 600 J kg^{-1} K^{-1}
(4) 1200 J kg^{-1} K^{-1} (5) 6000 J kg^{-1} K^{-1}

6. The work function for gold is 4.1 eV. The minimum frequency of a photon required to remove an electron from a gold surface is (Planck constant = 4.1×10^{-15} eV s)

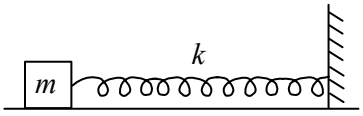
(1) 7.2×10^{13} Hz (2) 1.1×10^{14} Hz (3) 3.8×10^{14} Hz
(4) 0.8×10^{15} Hz (5) 1.0×10^{15} Hz

7. Figure shows a cyclic process of an ideal gas. When the gas expands from *A* to *B* it absorbs 50 J of heat. The path *B* to *A* is adiabatic and the work done on the gas is 60 J. The change in the internal energy of the gas in the path *A* to *B* is



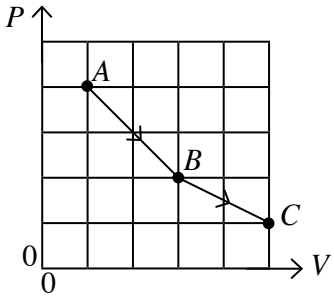
(1) –60 J (2) –30 J (3) –10 J
(4) 60 J (5) 110 J

8. The frequency of oscillation of a spring - mass system kept on a smooth surface is *f*. If the spring constant is increased by 4 times and the mass *m* is increased by 2 times, the new frequency of oscillation is



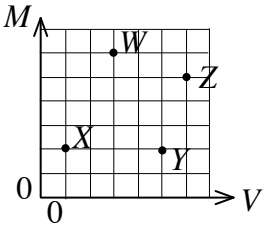
(1) $\frac{1}{\sqrt{2}} f$ (2) $\sqrt{2}\, f$ (3) $2f$ (4) $4f$ (5) $8f$

9. An ideal gas of volume *V* and pressure *P* undergoes a change from state *A* to state *C* via state *B* along the path as shown in the *P*-*V* graph. If the absolute temperatures of the gas corresponding to the states *A, B* and *C* are T_A , T_B and T_C respectively, the correct statement regarding temperature is



(1) $T_A < T_B < T_C$ (2) $T_A < T_C < T_B$
(3) $T_B < T_A < T_C$ (4) $T_B < T_C < T_A$
(5) $T_C < T_A < T_B$

10. The mass *M* and volume *V* of four solid blocks namely *W*, *X*, *Y* and *Z* are measured and the values are marked on the graph as shown. Which could be made out of the same material?



(1) *W* and *X* (2) *W* and *Y*
(3) *W* and *Z* (4) *X* and *Z*
(5) *Y* and *Z*

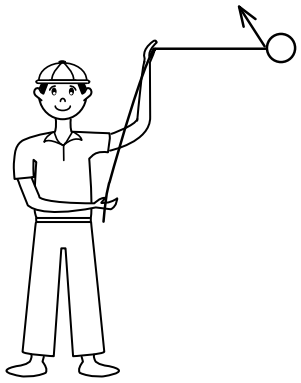
11. A cricket ball leaves a bat after striking at an upward angle of 30° to the horizontal with a velocity of 60 m s^{-1}. The ball lands on a roof of a building as shown in the figure. If the flight time taken to land on the roof is 5 s, the height (*h*) of the building is

(1) 20 m (2) 24 m (3) 25 m (4) 26 m (5) 28 m

12. A box of mass 5 kg is kept on a horizontal surface. The coefficient of static friction between the surface and box is 0.3. If a horizontal force of 10 N is applied on the box, the frictional force acting on the box is

(1) 1.5 N (2) 3 N (3) 4.5 N (4) 10 N (5) 15 N

13. As shown in the figure, a fire ball displayer of a procession twirls a fire ball on a horizontal circular path of radius r_1 with a uniform angular velocity ω_1. If he shortens the radius of the path to r_2 without applying an external torque, the new angular velocity ω_2 of the fire ball is given by

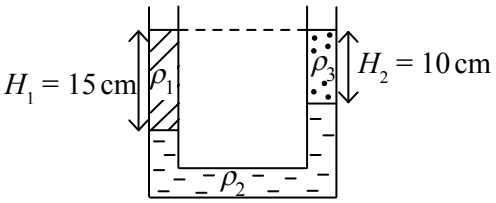


(1) $\omega_2 = \frac{r_1}{r_2}\omega_1$ (2) $\omega_2 = \left(\frac{r_1}{r_2}\right)^2 \omega_1$

(3) $\omega_2 = \left(\frac{r_2}{r_1}\right)^2 \omega_1$ (4) $\omega_2 = \frac{r_2}{r_1}\omega_1$

(5) $\omega_2 = \omega_1$

14. Three different liquids, with densities ρ_1, ρ_2 and ρ_3, are poured into a U-shaped container as shown in the diagram. Which of the following equations gives the correct relation between the densities of the liquids in the container?



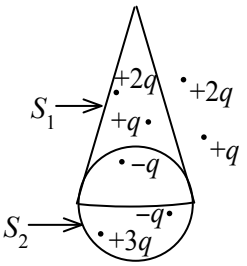
(1) $3\rho_1 = 2\rho_3 + \rho_2$ (2) $\rho_3 = 2\rho_1 + 3\rho_2$

(3) $2\rho_3 = 3\rho_1 + \rho_2$ (4) $\rho_3 = 3\rho_1 + 2\rho_2$

(5) $\rho_3 = \rho_1 + \rho_2$

15. S_1 is a surface of a cone with a base radius r and height $3r$ and S_2 is a spherical surface of radius r.

The ratio, $\frac{\text{Net electric flux through } S_1}{\text{Net electric flux through } S_2}$ is

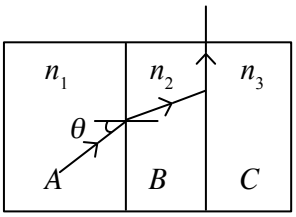


(1) 1 (2) 2 (3) 4 (4) 15 (5) 16

16. A wire of length 2 m and cross sectional area 0.1 cm^2 is made out of a material of Young's modulus $12 \times 10^{10}\,\text{N m}^{-2}$. When the wire is stretched by 0.01 mm, the energy stored in the wire is

(1) 6×10^{-4} J (2) 3×10^{-4} J (3) 10^{-4} J (4) 6×10^{-5} J (5) 3×10^{-5} J

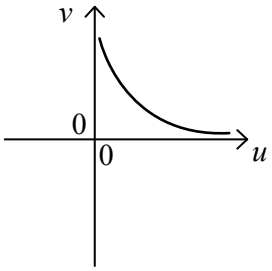
17. As shown in the figure, three parallel sided transparent media *A*, *B* and *C* of refractive indices n_1, n_2 and n_3 respectively are placed in contact with each other. The incident angle on the interface of the media *A* and *B* is θ. If the ray grazes the interface of the media *B* and *C*, $\sin\theta$ is given by,



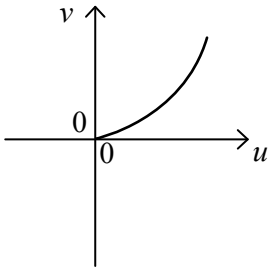
(1) n_1/n_3 (2) n_2/n_1 (3) n_2/n_3

(4) n_3/n_1 (5) n_3/n_2

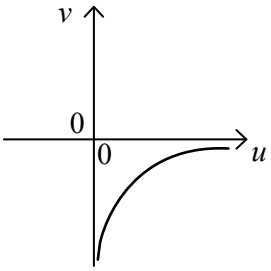
18. The graph of image distance (v) against object distance (u) for real images produced by a convex lens is best represented by



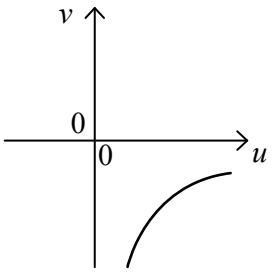
(1)



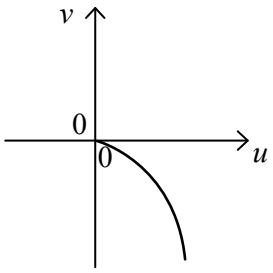
(2)



(3)

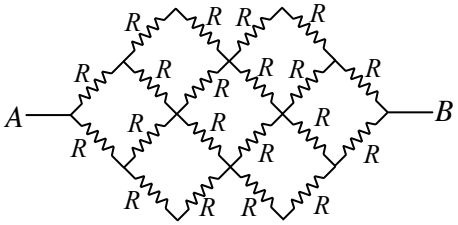


(4)



(5)

19. Each resistor in the resistor network shown has a resistance of R. The equivalent resistance of the network between the points A and B is



(1) R (2) $2R$ (3) $4R$
(4) $8R$ (5) $12R$

20. Consider the following statements made about longitudinal waves and transverse waves.
(A) Transverse waves cannot propagate along the surface of a solid medium.
(B) Mechanical transverse waves cannot propagate through a liquid or a gas.
(C) Sound waves are longitudinal where as Electro Magnetic (EM) waves are transverse.
Of the above statements,
(1) only (A) is true. (2) only (B) is true. (3) only (C) is true.
(4) only (A) and (B) are true. (5) only (B) and (C) are true.

21. Consider the following statements made about forces.
(A) A force is needed to keep an object moving.
(B) When a ball has been thrown, the force exerted by the hand on the ball remains with the ball.
(C) The product of mass × acceleration is not considered as a force.
Of the above statements,
(1) only (A) is true. (2) only (B) is true. (3) only (C) is true.
(4) only (A) and (B) are true. (5) only (B) and (C) are true.

22. A current of 10 A flows in opposite directions in each of two long straight parallel wires separated by a distance 1 m. The magnitude and the nature of the forces acting per one metre of each wire are, ($\mu_0 = 4\pi \times 10^{-7}\,\mathrm{T\,m\,A^{-1}}$)
(1) $2 \times 10^{-7}\,\mathrm{N\,m^{-1}}$, and attract each other (2) $2 \times 10^{-7}\,\mathrm{N\,m^{-1}}$, and repel each other
(3) $2 \times 10^{-5}\,\mathrm{N\,m^{-1}}$, and attract each other (4) $2 \times 10^{-5}\,\mathrm{N\,m^{-1}}$, and repel each other
(5) $2 \times 10^{-4}\,\mathrm{N\,m^{-1}}$, and repel each other

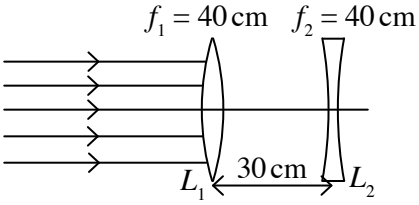
23. A narrow tube of adjustable length opened at both ends is kept in air. A sound source of frequency 680 Hz is placed near one end of the tube. The length of the tube was adjusted as follows (A, B, C). (speed of sound in air = 340 m s^{-1})

(A) 125 mm (B) 250 mm (C) 500 mm

Of the above lengths resonance may occur,

(1) only with (A). (2) only with (B).
(3) only with (C). (4) only with (A) and (B).
(5) only with (B) and (C).

24. The diagram shows two thin lenses L_1 and L_2 placed coaxially 30 cm apart. Focal lengths of lenses are 40 cm each. A beam of parallel light is incident on L_1. The final image formed by refraction though both lenses is

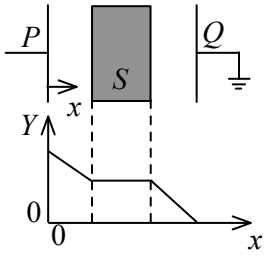


(1) real, between L_1 and L_2.
(2) real, on the right of L_2.
(3) virtual, on the left of L_1.
(4) virtual, on the right of L_1.
(5) at infinity.

25. Which of the following statements is **not true** about electric field lines?

(1) Electric field lines always point from high electric potential to low electric potential.
(2) Electric field lines are closer to each other where the electric field is stronger.
(3) Work has to be done externally in moving an electron along the direction of an electric field line.
(4) Electric field lines tend to attract one another.
(5) Electric field lines are always perpendicular to equipotential surfaces.

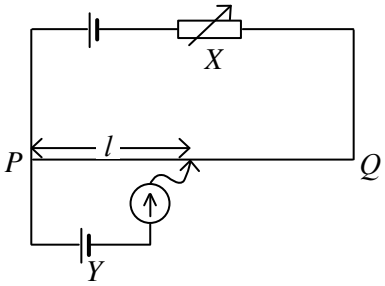
26. The plates P, Q of a capacitor are connected to a direct current (d.c.) power supply and a slab of material S is introduced between the plates. The value of a quantity Y is found to vary with distance x measured from plate P as shown.



Which of the following statements is true?

(1) S is a metal and Y is electric field intensity.
(2) S is an insulator and Y is electric field intensity.
(3) S is an insulator and Y is electric potential gradient.
(4) S is a metal and Y is electric potential.
(5) S is an insulator and Y is electric potential.

27. Figure shows a balanced potentiometer circuit.



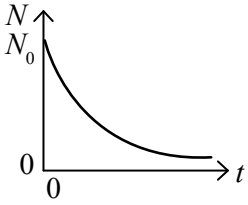
Consider the following statements.

(A) The currents through the potentiometer wire PQ and the cell Y are equal.
(B) An increase in the internal resistance of cell Y would require an increase in l to restore balance.
(C) An increase in the resistance of X would require an increase in l to restore balance.

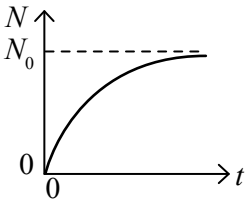
Of the above statements,

(1) only (A) is true. (2) only (B) is true.
(3) only (C) is true. (4) only (A) and (B) are true.
(5) only (B) and (C) are true.

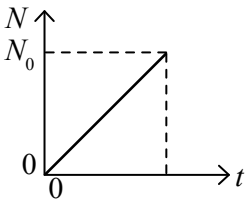
28. A sample of certain radioactive nuclei contains N_0 number of nuclei at time $t = 0$. The variation of the number of nuclei (N) decayed with time t is best represented by,



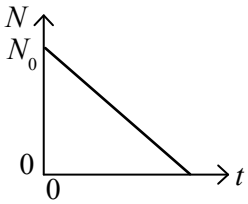
(1)



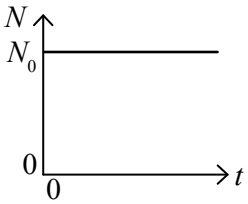
(2)



(3)



(4)

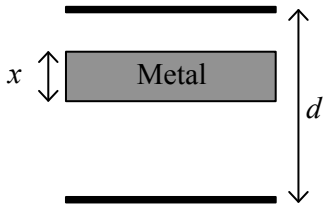


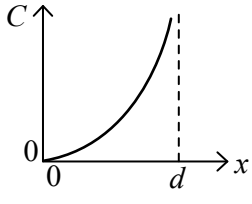
(5)

29. Silicon is doped with arsenic so that one in every million Si atoms is replaced by an arsenic atom. The density of free electrons due to arsenic is
(take the Avogadro's number = $6.0 \times 10^{23}\,\text{mol}^{-1}$; Molar mass of Si = $28.0\,\text{g mol}^{-1}$;
density of Si = $2.0\,\text{g cm}^{-3}$)

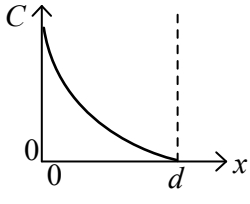
(1) $\frac{1}{28} \times 10^{16}\,\text{cm}^{-3}$ (2) $\frac{3}{28} \times 10^{16}\,\text{cm}^{-3}$ (3) $\frac{1}{7} \times 10^{17}\,\text{cm}^{-3}$ (4) $\frac{2}{7} \times 10^{17}\,\text{cm}^{-3}$ (5) $\frac{3}{7} \times 10^{17}\,\text{cm}^{-3}$

30. A metal block of thickness x is inserted into a parallel plate capacitor as shown in the figure. The separation between the two plates is d. The variation of the effective capacitance (C) of the above combination with the thickness (x) of the metal block inserted is best represented by,

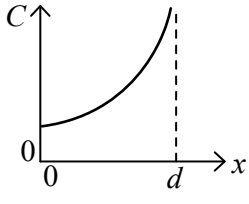




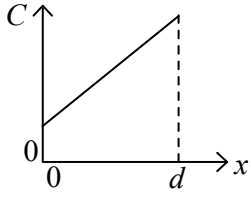
(1)



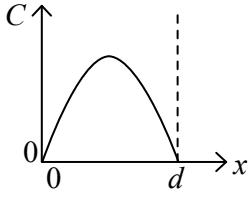
(2)



(3)

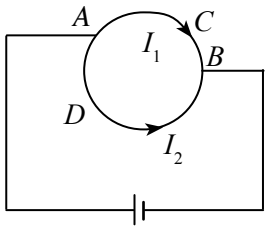


(4)



(5)

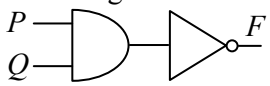
31. A uniform circular wire of radius r is connected to a battery at points A and B, as shown in the figure. The current through path ACB of length l_1 is I_1 and the current through path ADB of length l_2 is I_2. The magnitude of the magnetic flux density at the center of the circular wire is,



(1) zero (2) $\frac{\mu_0}{4\pi r^2}(I_1 l_2 - I_1 l_1)$ (3) $\frac{\mu_0}{4\pi r^2}(I_1 l_1 + I_2 l_2)$

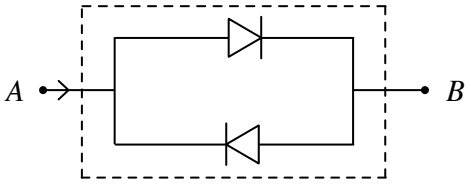
(4) $\frac{\mu_0}{2\pi r^2}(I_1 l_1 + I_2 l_2)$ (5) $\frac{\mu_0}{2\pi r^2}(I_1 l_2 - I_2 l_1)$

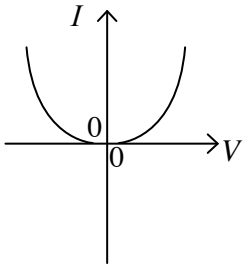
32. Consider the following statements made about the logic circuit shown in the figure.



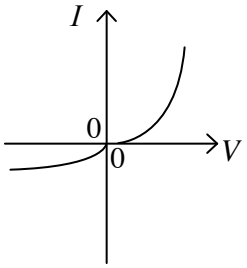
(A) When $P = 1$ and $Q = 1$ the output $F = 1$.
(B) When $P = 1$ and $Q = 0$ the output $F = 1$.
(C) When $P = 0$ and $Q = 1$ the output $F = 0$.
Of the above statements,
(1) only (A) is true. (2) only (B) is true. (3) only (C) is true.
(4) only (A) and (B) are true. (5) only (B) and (C) are true.

33. Figure shows an arrangement made out of two identical diodes. The most suitable I - V characteristic curve for the arrangement is given by, (Here V is the voltage across A and B, and I is the current through AB.)

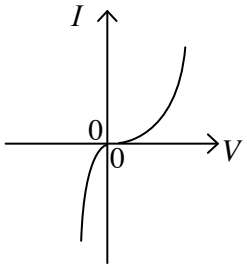




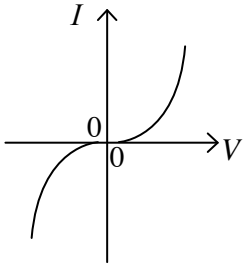
(1)



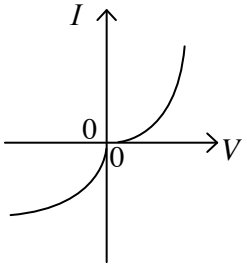
(2)



(3)

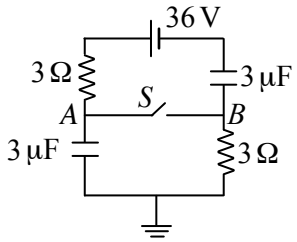


(4)



(5)

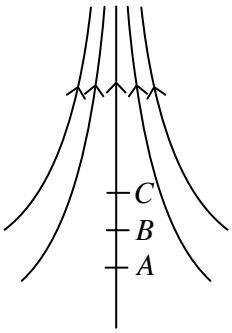
34. In the circuit shown, the potential difference ($V_A - V_B$) between the points A and B when the switch S is opened and closed are respectively given by, (The internal resistance of the cell is negligible.)



(1) 18 V, 9 V (2) 9 V, 9 V (3) 18 V, 0 V
(4) 0 V, 18 V (5) 36 V, 18 V

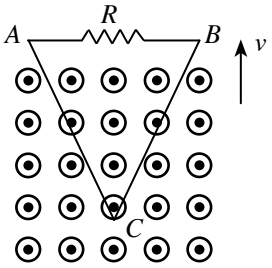
35. A charged particle enters perpendicular to a uniform magnetic field. Consider the following statements.
(A) Linear momentum of the particle changes.
(B) Kinetic energy of the particle remains constant.
(C) Work done by the magnetic field on the particle is zero.
Of the above statements,
(1) only (B) is true. (2) only (A) and (B) are true.
(3) only (B) and (C) are true. (4) only (A) and (C) are true.
(5) All (A), (B) and (C) are true.

36. The diagram represents an electric field and points *A, B* and *C* are marked along an electric field line. Here *AB* = *BC*. If the electric potential at *B* is zero, which of the following gives the possible potentials at *A* and at *C* respectively?



(1) −20 V and +20 V
(2) −20 V and −35 V
(3) −30 V and −70 V
(4) +20 V and −20 V
(5) +25 V and −40 V

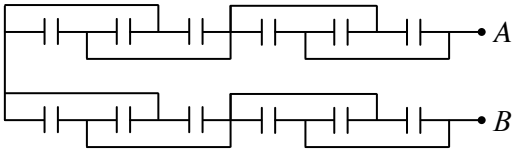
37. In the figure shown, a triangular coil is being pulled at a constant speed (*v*) out of a region of a uniform magnetic field pointing out of the paper. Consider the following statements.



(A) The magnitude of the induced e.m.f. in the coil *ABC* is decreasing with time at a uniform rate.
(B) An induced current flows from *B* to *A* through resistor *R*.
(C) The magnetic flux passing through the coil *ABC* is decreasing with time at a uniform rate.

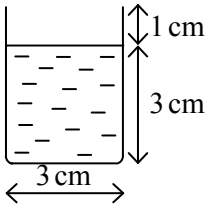
Of the above statements,
(1) only (A) is true.
(2) only (B) is true.
(3) only (C) is true.
(4) only (A) and (B) are true.
(5) only (A) and (C) are true.

38. The diagram shows a combination of 12 identical capacitors of capacitance *C* each. The equivalent capacitance between the points *A* and *B* is,



(1) 0.5 *C*
(2) 0.75 *C*
(3) 1.0 *C*
(4) 1.5 *C*
(5) 3.0 *C*

39. A person travelling in a car is holding a cylindrical cup of tea vertically as shown in the figure. Neglecting the vibration of the car, what is the maximum acceleration that the car can go without spilling any tea?



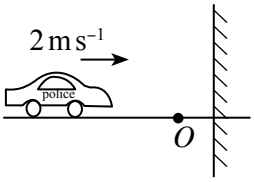
(1) $\frac{g}{3}$
(2) $\frac{g}{2}$
(3) $\frac{g}{1.5}$
(4) g
(5) $1.5g$

40. The drag force experienced by an object falling in air with velocity *v* is given by $\frac{1}{2} d_a C A v^2$, where d_a is the density of air, *A* is the cross-sectional area of the falling object perpendicular to the direction of fall and *C* is a constant. The terminal velocity v_t acquired by a raindrop of radius *r* falling through air is given by (d_w = density of water; Neglect the upthrust acting on the drop.)

(1) $v_t = \left[\frac{4}{3}\left(\frac{d_w}{d_a}\right)\left(\frac{rg}{C}\right)\right]^{\frac{1}{2}}$
(2) $v_t = \left[\frac{1}{3}\left(\frac{d_a}{d_w}\right)\left(\frac{rg}{C}\right)\right]^{\frac{1}{2}}$
(3) $v_t = \left[\frac{1}{2}\left(\frac{d_w}{d_a}\right)\left(\frac{C}{rg}\right)\right]^{\frac{1}{2}}$
(4) $v_t = \left[\frac{8}{3}\left(\frac{d_w}{d_a}\right)\left(\frac{rg}{C}\right)\right]^{\frac{1}{2}}$
(5) $v_t = \left[\frac{1}{2}\left(\frac{d_a}{d_w}\right)\left(\frac{C}{rg}\right)\right]^{\frac{1}{2}}$

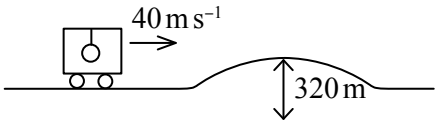
41. It is observed that water vapour has condensed on inner sides of glass walls of a closed room. Which of the following processes might remove water vapour condensed on glass walls?
(1) Switching off a computer located inside the room.
(2) Keeping a vessel inside the room containing boiling water.
(3) Switching on an air conditioner located inside the room.
(4) Switching off a refrigerator kept inside the room.
(5) Keeping a vessel containing ice inside the room.

42. A police car sounding a siren of frequency 338 Hz is moving with a uniform velocity of $2\,m\,s^{-1}$ towards a vertical barrier which reflects sound. The beat frequency heard by an observer standing at O in between the car and the barrier is (velocity of sound in air = $340\,m\,s^{-1}$)



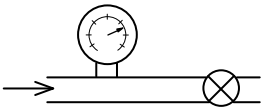
(1) 0 Hz (2) 2 Hz (3) 4 Hz (4) 6 Hz (5) 8 Hz

43. The period of a simple pendulum hung on the roof of a vehicle is T when it is moving with a uniform velocity of $40\,m\,s^{-1}$. As shown in the diagram the vehicle then enters a bridge with a curved surface of radius 320 m with the same speed. When the vehicle reaches the highest position of the bridge the new period of the pendulum is given by, (Diagram is not drawn to the scale)



(1) $\frac{1}{\sqrt{2}}\,T$ (2) $\sqrt{\frac{2}{3}}\,T$ (3) T (4) $\sqrt{\frac{3}{2}}\,T$ (5) $\sqrt{3}\,T$

44. A pressure gauge connected near to a closed valve of a water pipe line reads $3.5 \times 10^5\ N\,m^{-2}$. When the valve is opened, the reading of the gauge falls to $3.0 \times 10^5\ N\,m^{-2}$. The speed of water flow in the pipe is, (density of water = $10^3\ kg\,m^{-3}$)



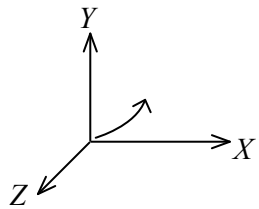
(1) $1\,m\,s^{-1}$ (2) $4\,m\,s^{-1}$ (3) $5\,m\,s^{-1}$ (4) $8\,m\,s^{-1}$ (5) $10\,m\,s^{-1}$

45. If the mass of 25 water droplets of radius R falling through a syringe of internal radius a is m, the surface tension T of water is given by,

(1) $T = \frac{mg}{50\pi R}$ (2) $T = \frac{mg}{25\pi R}$ (3) $T = \frac{mg\,R}{50\pi a^2}$

(4) $T = \frac{mg}{2\pi a}$ (5) $T = \frac{mg}{50\pi a}$

46. An electron is moving on the X - Y plane and its path is found to be curved, but non-circular. If the electron experiences electric and/or magnetic forces, the allowed condition that E_X, E_Y, E_Z and B_X, B_Y, B_Z should have is (E_X, E_Y and E_Z, and B_X, B_Y and B_Z are X, Y and Z components of the electric field intensity and magnetic flux density respectively. Neglect effect of gravity.)



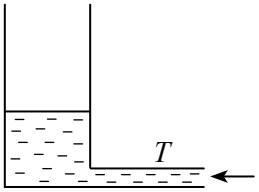
(1) $E_X = E_Y = E_Z = 0,\ B_X = B_Y = B_Z = 0$
(2) $E_X \neq 0,\ E_Y \neq 0,\ E_z = 0,\ B_X \neq 0,\ B_Y \neq 0,\ B_Z \neq 0$
(3) $E_X = 0,\ E_Y = 0,\ E_Z = 0,\ B_X = B_Y = 0,\ B_Z \neq 0$
(4) $E_X \neq 0,\ E_Y \neq 0,\ E_Z \neq 0,\ B_X = B_Y = B_Z = 0$
(5) $E_X \neq 0,\ E_Y \neq 0,\ E_Z = 0,\ B_X = B_Y = 0,\ B_Z \neq 0$

47. A satellite of mass m is orbiting the earth of mass M and radius R. The distance from the earth's surface to the satellite is $\frac{R}{2}$. The extra energy needed to increase the distance of the satellite from $\frac{R}{2}$ to R from the earth's surface is given by,

(1) $\frac{GMm}{12R}$ (2) $\frac{GMm}{6R}$ (3) $\frac{GMm}{4R}$

(4) $\frac{GMm}{2R}$ (5) $\frac{GMm}{R}$

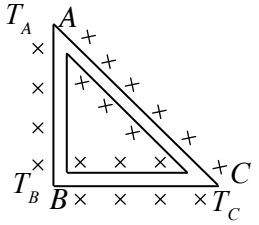
48. Figure shows an experimental set-up which could be used to find the speed of sound in air. Water is filled to a tall vertical tube of cross-sectional area $2.0 \times 10^{-3}\,m^2$ through a narrow tube T. With a low water level in the tube resonance was heard when the air column above the water level was vibrated with a tuning fork of frequency 180 Hz. When an additional amount water $2.0 \times 10^{-3}\,m^3$ was sent into the tube through T, the next resonance was heard and that was the last resonance that could be heard from the set-up. Wavelength of the vibrating air column and the speed of sound in air are respectively,



(1) 2.0 m, $360\,m\,s^{-1}$ (2) 1.0 m, $360\,m\,s^{-1}$ (3) 0.5 m, $360\,m\,s^{-1}$

(4) 1.0 m, $180\,m\,s^{-1}$ (5) 0.5 m, $180\,m\,s^{-1}$

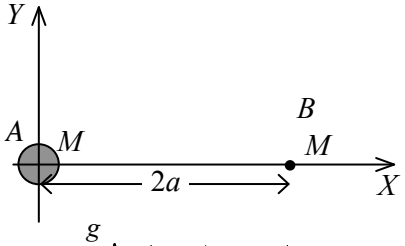
49. Three rods of identical cross-sectional area and made from the same material form the sides of an isosceles triangle ABC as shown in the figure. The rods are fully lagged except at the corners A and B. At the steady state, the temperatures at points A, B and C are T_A, T_B and T_C respectively. If $T_B > T_C > T_A$ then,

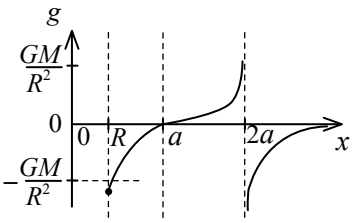


(1) $T_C = \frac{T_B + \sqrt{2}T_A}{\sqrt{2}+1}$ (2) $T_C = \frac{T_B + T_A}{\sqrt{2}+1}$ (3) $T_C = \frac{T_B + T_A}{2}$

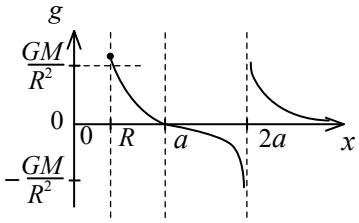
(4) $T_C = \frac{\sqrt{2}(T_B + T_A)}{\sqrt{2}+1}$ (5) $T_C = \frac{\sqrt{2}T_B + T_A}{\sqrt{2}+1}$

50. Two equal masses A and B of mass M are placed on the X-axis as shown in the figure. Radius of A is R, and B is a point mass. The variation of the gravitational field intensity (g) produced due to both masses with x ($x \geq R$) along the positive X direction is best represented by,

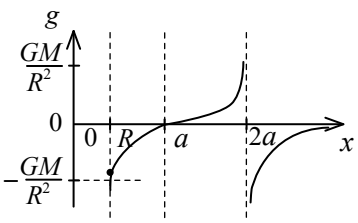




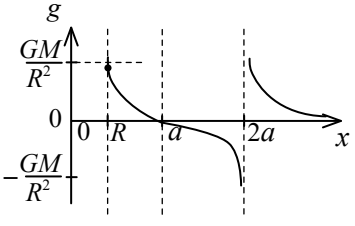
(1)



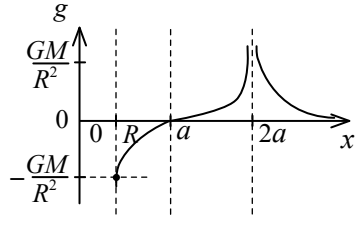
(2)



(3)



(4)



(5)

* * *

(01) Physics

Paper II

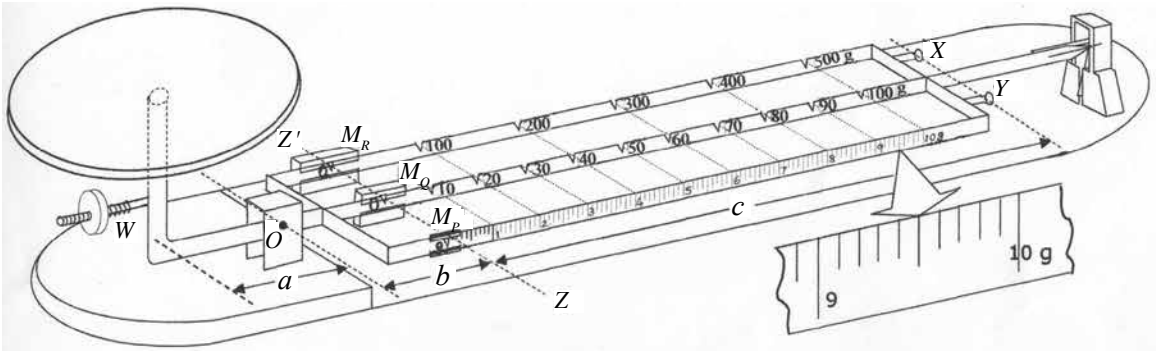
Important :

* Answer **all** the questions in Part **A**.
* Answer only **four** the questions from Part **B**.

Part A - Structured Essay

(g = 10 N kg^{-1})

1. Following figure shows a rough sketch of a triple beam balance. The masses on the beams M_P, M_Q and M_R are at the left hand end (at ZZ^1) when the balance is ready to use. When the system is at balance, the moment of weight of the pan and its attachments, about the horizontal axis passing through O perpendicular to the beams, is equal to sum of the moments of the weights of the masses M_P, M_Q and M_R and the moments of weights of the three beams. (The pan includes a screw weight W.)



(a) Using the enlarged measuring scale given in the diagram find the least count of the balance.

.....

(b) When there is no mass on the pan and the masses M_P, M_Q and M_R masses are at the left hand end (at ZZ^1) the system should be balanced. If it is not, how do you obtain the required balance?

.....

(c) To get a measurement of a mass on the pan, the masses M_P, M_Q and M_R should be positioned correctly to obtain the balance. Which mass/masses is/are adjusted in the way stated below?

(i) continuously .....

(ii) discretely (in steps) .....

(d) When a mass m is on the pan, the amounts by which M_P, M_Q and M_R masses are displaced from ZZ' along the relevant beams to obtain the balance, are d_1, d_2 and d_3 respectively. Write down an equation relating m, M_P, M_Q and M_R, d_1, d_2, d_3 and a.

.....

(e) What is the maximum mass which can be measured using this balance when there is no additional mass hung at X and/or Y at the right hand end of the beams?

.....

(f) When it is required to measure masses larger than the mass mentioned in your answer for (e) above, it can be done by hanging any one or both of the extra masses provided, marked 500 g and 1000 g on them, at X and/or Y.

(i) When only one mass marked 500 g on it is hung at Y, what are the measurable minimum and maximum masses?

Minimum mass .....

Maximum mass .....

(ii) With regard to above, calculate the effective value of the mass marked 500 g on it. (take the values for a, b and c in the diagram as $a = 6$ cm, $b = 3$ cm and $c = 18$ cm)

.....

.....

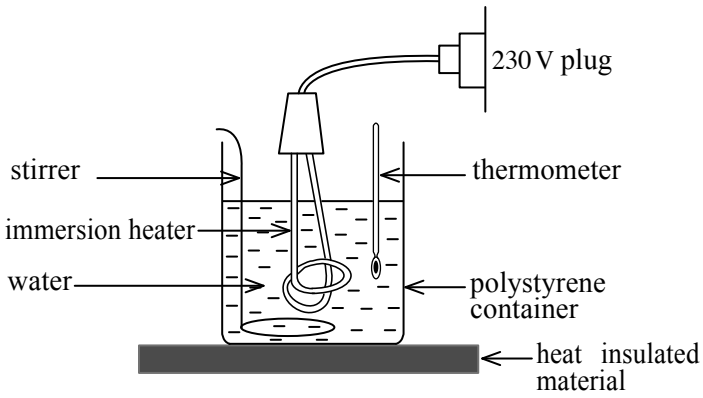
(g) State an important step to be taken when placing a mass/masses on the pan to get accurate measurements.

.....

(h) When the balance is obtained with a mass on the pan, what technique is used in the balance to minimize the oscillation about the axis through O ?

.....

2. Figure shows an experimental set-up designed to determine the wattage (P) of an household immersion heater. It is expected to find out the amount of heat absorbed by a certain mass of water.



(a) Name the other items that you would need in addition to the items given in the diagram.

(i) .....

(ii) .....

(b) What are the measurements that you would take before operating the heater ?

(i) ..... (say x_1)

(ii) ..... (say x_2)

(iii) ..... (say x_3)

(c) After operating the heater for a time period t, if the measurement that has to be taken is x_4, write down an expression for the heat absorbed (Q) by water during the time t in terms of x_1, x_2, x_3, x_4 and C_w (specific heat capacity of water). Neglect the mass of water removed due to the evaporation.

.....

.....

(d) Hence obtain an expression for the wattage (P) of the heater.

.....

.....

(e) Mention **two** assumptions that you have made in this experiment.

(i) .....

(ii) .....

(f) If the water is heated up to 100 °C explain as to how will it affect the determined value of P ?

.....

.....

(*g*) If a metal container is used instead of polystyrene container, what other data is needed in order to determine *P*?

.....

.....

(*h*) In order to find the specific latent heat of vaporization (*L*) of water, using the heater, temperature of water is raised to the boiling point and water is allowed to boil.

(i) To find the mass m_0 of water removed due to vaporization during a time period t_0 after boiling what measurement that you have to take?

.....

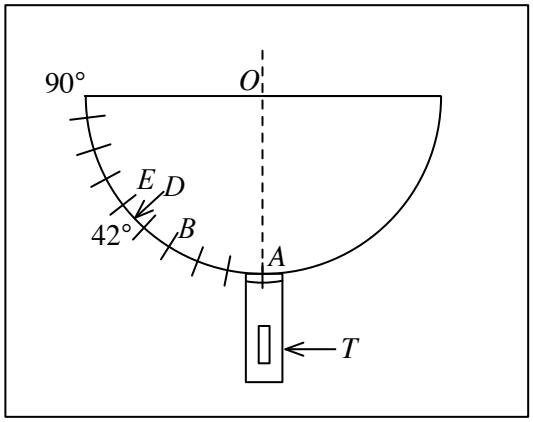
.....

(ii) If $t_0 = 100\,\text{s}$, $m_0 = 40.0\,\text{g}$ and $P = 1000\,\text{W}$, obtain a value for *L*.

.....

.....

3. A glass block with hemispherical cross - section is placed on a white sheet of paper fixed to a horizontal board. The hemispherical shape of the glass block is traced onto the paper and one half is calibrated in degrees with a least count of 1 degree. Small laser torch (*T*) is attached to a wooden strip which can rotate in a circular path with *O* as centre. The laser beam can enter the glass block grazing the surface of the paper. Top view of the set-up is shown in the diagram. This set-up can be used to find the refractive index of glass.



(*a*) When the laser torch is in the position *A* what is the path of the laser beam?

.....

(*b*) Draw the path of the laser beam that you can observe when the laser torch is rotated to the position *B*, on the Figure (1).

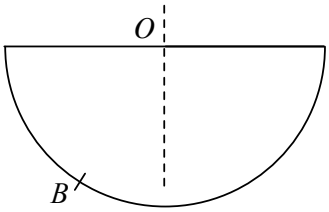


Figure (1)

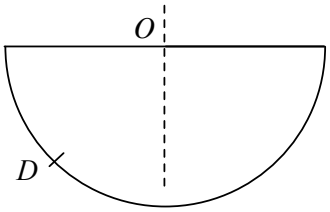


Figure (2)

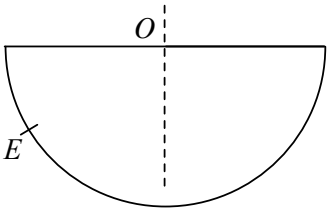


Figure (3)

(*c*) When the laser torch is rotated to the position *D* (42°) it is observed that the refracted laser beam grazes the plane surface of the glass block. In this situation what is the special name given to the incident angle and draw the path of the laser beam on the Figure (2).

.....

(*d*) If the refractive index of glass is *n*, write down an expression for *n* using the angle corresponding to the position *D*.

.....

(*e*) If the laser torch is rotated to the position *E*, draw the new path of the laser beam on the Figure (3).

(*f*) Name the phenomenon related to the above observation (*e*) and state the conditions for such occurrence.

.....

.....

.....

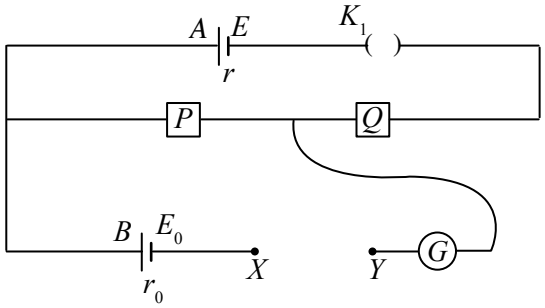
(*g*) A microscope slide is wetted with water and kept in contact with the plane surface of the glass block. When the laser torch is kept in the same position as in (*e*) can you get the same observation as above? Comment on your observation.

.....

.....

.....

4. A circuit that can be used to compare the e.m.fs of two cells *A* and *B*, is shown in the figure. E, E_0 and r , r_0 are e.m.fs and the internal resistances of the cells *A* and *B* respectively. *G* is a center zero galvanometer and *P* and *Q* are two resistance boxes. The minimum value that can be obtained from both *P* and *Q* is 1 Ω each.



(*a*) If a suitable resistor R_0 and a key K_2 are provided, complete the above circuit by connecting R_0 and K_2 in between *XY* in the above diagram, in order to protect the galvanometer from high currents passing through it.

(*b*) A student sets the resistance value of *P* to R_1 and varies the resistance value of *Q* to R_2, so that the reading of *G* becomes zero.

(i) Write down an expression for the current i in the circuit in terms of E, R_1, R_2 and r in this situation.

.....

.....

(ii) Write down another expression for the current i in terms of E_0 and R_1.

.....

.....

.....

(iii) Using the above two expressions, derive a suitable expression to plot a graph of (R_1+R_2) v*s* R_1.

.....

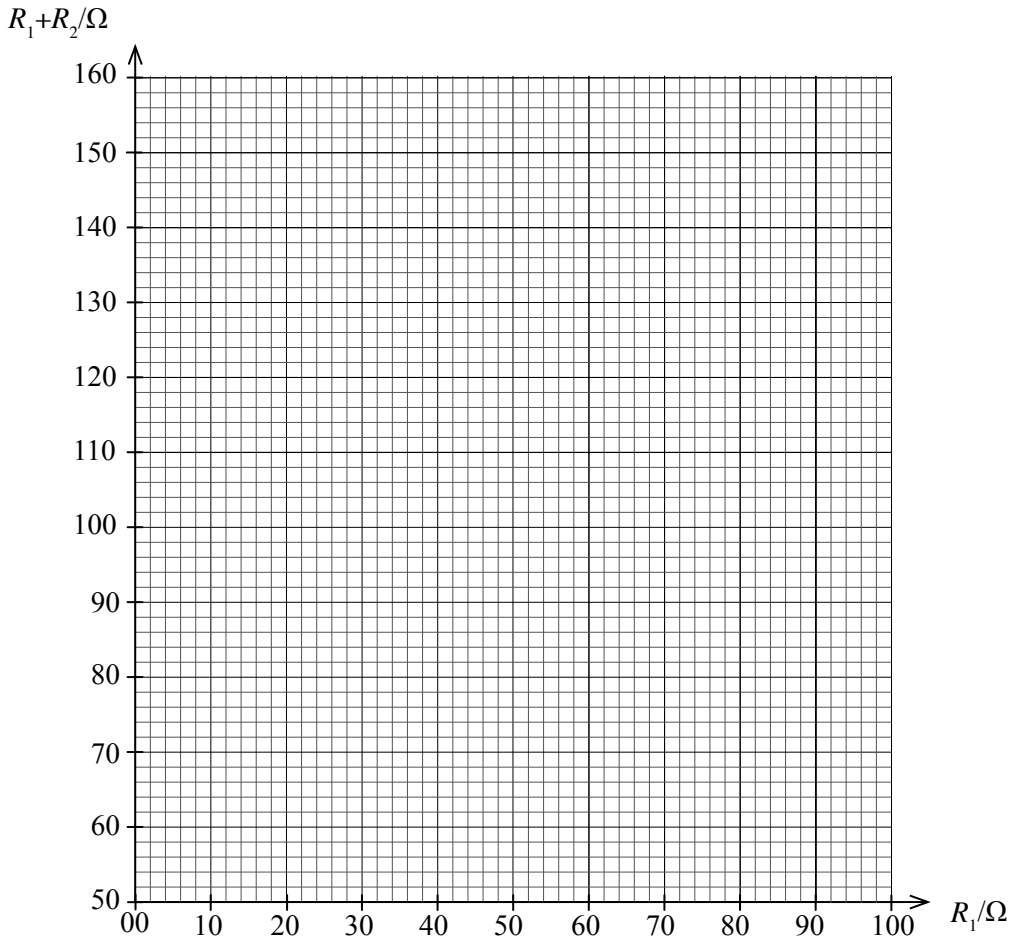
.....

.....

(*c*) The student doing this experiment obtained the data shown in the following table.

R_1/Ω	R_2/Ω	R_1+R_2 / Ω
30	27	
40	35	
50	42	
60	54	
70	66	
80	72	

Plot the graph (R_1+R_2) vs R_1 on the co-ordinate grid shown below.



(*d*) Obtain the ratio E/E_0 using the graph.

.....

.....

.....

(*e*) Explain briefly the practical difficulty arises when achieving the condition of zero reading in the galvanometer.

.....

.....

.....

* *

Part B - Essay

Answer **four** questions only.

($g = 10\,N\,kg^{-1}$)

5. Consider a situation where a motor car (*A*) with an engine trouble is being pulled by a breakdown truck (*B*) on a flat road as shown in the figure (1). The masses of vehicle *A* and vehicle *B* are 1000 kg and 3000 kg respectively. Assume that the resistive force acting on each vehicle against their motion is given by $4\,N\,kg^{-1}$.

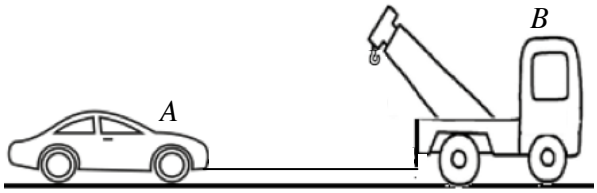


Figure (1)

(*a*) Sketch a diagram of the vehicle *A* on your answer sheet and draw the forces acting on it.

When the vehicle *B* is pulling the vehicle *A* with a constant velocity of $10\,m\,s^{-1}$,

(*b*) calculate the forward total force applied by the vehicle *B*?

(*c*) what is the power of the vehicle *B*?

(*d*) what is the tension in the cable used to pull the car in this situation?

(*e*) If the force constant of the cable is $40000\,N\,m^{-1}$,

(i) calculate the extension in the cable.

(ii) calculate the strain energy stored in the cable.

(*f*) If the maximum tension that the cable could withstand is 6000 N, determine the maximum acceleration that the car could be pulled.

Now the front wheels of the vehicle *A* are raised by attaching one end of the cable to the hook of the crane located in the vehicle *B* as shown in the figure (2). The vehicle *B* pulls the vehicle *A* with a uniform velocity. When the vehicle *A* is at this new position, the cable makes an angle of 30° to the horizontal, the resistive force acting on it is decreased to 3825 N and the resistive force acting on the vehicle *B* increases. (Diagrams are not drawn to scale.)

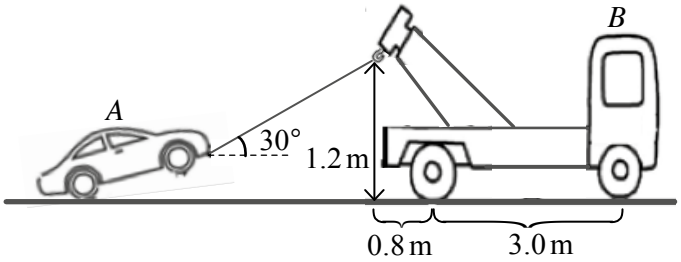


Figure (2)

In this situation,

(*g*) what is the tension in the cable ? (Take $\sqrt{3} = 1.7$)

(*h*) show that the vehicle *B* does not topple over. All relevant distances are marked in figure (2). Assume that the line of action of weight of the vehicle *B* act right in between the wheels of the vehicle *B*.

(*i*) explain giving reasons as to why the resistive force on vehicle *A* decreases and the resistive force on vehicle *B* increases.

6. Read the following passage and answer the questions.

The term LASER is an acronym of "Light Amplification by Stimulated Emission of Radiation". It is needed to select a suitable material (laser medium) for the production of a particular laser light and hence it is an essential item in a laser machine. When atoms in a laser medium are excited they may undergo two de-excitation processes to ground level or a lower energy level namely spontaneous emission and stimulated emission where the latter is responsible for the production of laser light. For convenience, consider a laser medium consisting of three energy levels where the ground, intermediate and highest energy levels are E_1, E_2 and E_3 respectively. (Figure 1) The excitation of atoms from E_1 level to E_3 level is carried out by some excitation (pumping) device (e.g. by a flash lamp) which is also an essential part of the laser light production. Some of the excited atoms at E_3 level first decay rapidly to the

intermediate energy level (E_2) and they may stay considerably long time (life time is about 1 m s) at E_2 level before it decays to the lower level (E_1). Such a long-lived intermediate level is called a metastable level. When an atom is in the metastable state, a photon of energy (E_2 - E_1) present in the medium can stimulate the de-excitation of the atom from the level E_2 to the level E_1 resulting in an emission of a photon of energy (E_2 - E_1). This process is called stimulated emission which is the laser transition. The most exciting feature of this transition is that the photon used to stimulate the de-excitation and the photon resulted from the de-excitation from level E_2 to level E_1 are in phase. This property is known as coherence.

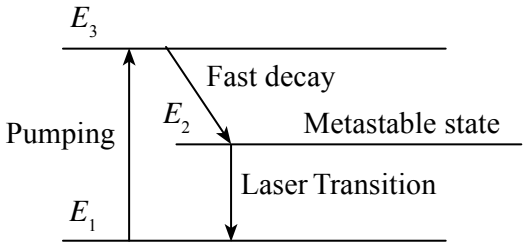


Figure (1) 3-level system

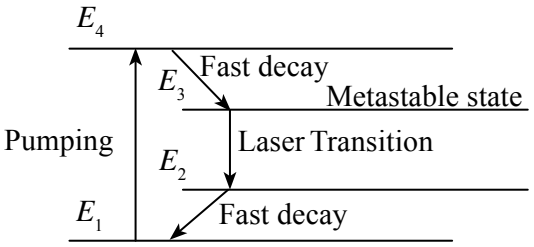


Figure (2) 4 – level system

For the stimulated emission to be efficient, the population of atoms at the metastable state (E_2) should be much higher than the population of atoms at the lowest level (E_1). This condition is known as population inversion which must be achieved for the production of laser photons from a given medium. Population inversion can also be achieved by a four-level laser medium too. (Figure 2) Here E_3 is the metastable state and the laser transition occurs from level E_3 to level E_2. In this case, E_2 level is fast depopulated by the rapid decay from E_2 level to E_1 thus reducing the population at level E_2 allowing population inversion to be more efficient between E_3 and E_2 levels.

In order to get a useful laser beam out of a laser machine, laser photons produced in the laser medium should be multiplied rapidly. This is done by using a resonator in which stimulated emission is enhanced by confining the movement of laser photons produced to the laser medium itself. This can be accomplished by the reflection of laser photons by highly reflective mirrors attached to the both ends of the laser medium. In the resonator, the laser light produce standing waves with nodes at both ends of the resonator so that different modes (harmonics) of standing waves occur. Hence, a resonator is also an essential part of a laser machine. There are two types of lasers i.e. pulsed lasers and continuous lasers. High power can be obtained using laser pulses with small pulse time.

(*a*) What is the emission process which is responsible for the production of laser light ?

(*b*) Explain how the existence of a metastable state in a laser medium contributes to laser transition.

(*c*) With regard to the laser action explain why a four energy level system is more efficient compared to a three energy level system.

(*d*) What are the three essential parts needed to produce a laser machine ?

(*e*) State three unique properties of a laser beam compared to a normal light beam.

(*f*) What is the part of a laser machine by which the colour of the laser light is determined ?

(*g*) In a three-level system, $E_2 - E_1 = 2.20$ eV. Calculate the wavelength (λ) of the laser light produced (Planck constant $h = 6.6 \times 10^{-34}$ J s, the speed of light in vacuum is 3.0×10^8 m s^{-1}, 1 eV = 1.6×10^{-19} J)

(*h*) A laser pulse is focused onto a small circular target of radius 1.5×10^{-5} m so that whole target is illuminated by laser light. The energy delivered by the laser pulse onto the target is 4.0×10^{-3} J and the time duration of the laser pulse is 1.0×10^{-9} s. Calculate the power delivered to the target per unit area (i.e intensity).

(*i*) The length (L) of the resonator in a laser machine is 30.0 cm and the refractive index (n) of the resonator medium is 1.8. This resonator gives out laser light of wave length (λ), 600 nm. In the resonator a standing wave of m^{th} harmonic is produced. Determine m.

7. A solid cylindrical rod of radius 3 cm is passed through along the axis of a hollow cylinder of radius 5 cm and length 10 cm as shown in the figure (1). The rod is passed through the two flat sides of the hollow cylinder using two frictionless oil seals which are placed around the rod. Assume that there is no leakage of fluid through the frictionless oil seals. A cooling fan (F) is attached to one of the flat sides of the hollow cylinder as shown in the figure (2). The empty space between the hollow cylinder and the rod is filled with a viscous fluid. When the rod rotates about its axis in the absence of viscous fluid the rod slides over the seals without rotating the hollow cylinder. (For calculations take $\pi = 3$)

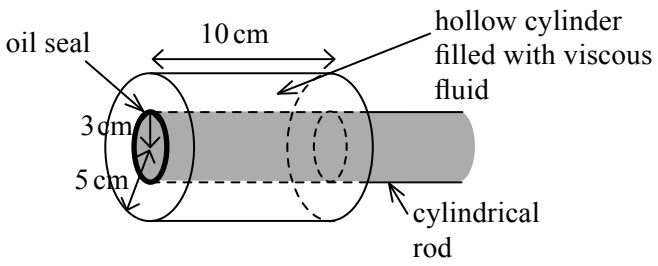


Figure (1)

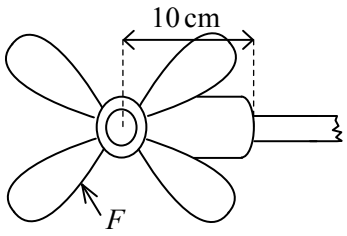


Figure (2)

(*a*) (i) When the rod rotates at a rate of 6000 revolutions per minute, find the tangential velocity of the layer of fluid just touching the curved surface of the rod.

(ii) In this situation the fan rotates at a rate of 3000 revolutions per minute. Explain why the cylinder rotates slower than the rod. Find the minimum tangential velocity that a fluid layer can have.

(iii) Determine the viscous force exerted on the hollow cylinder by the fluid. The coefficient of viscosity of the fluid is $2\,N\,s\,m^{-2}$.

(*b*) When the coefficient of viscosity of the fluid drops to $1\,N\,s\,m^{-2}$ the used fluid has to be removed and new fluid should be refilled. What is the reason for this?

(*c*) Determine the volume of the fluid inside the hollow cylinder.

(*d*) The used fluid is removed by pumping it through a hole available on the cylinder surface along a tube of radius of 1 mm and length 10 cm. Determine the pressure difference that has to applied across the tube in order to pump the total volume of fluid in 2 minutes.

8. Removal of microorganisms and other pathogens from a certain area is called sterilization. One of the modern techniques used to sterilize operation theaters is applying a sufficiently large electric field across two conducting plates, which are fixed to the walls situated at opposite sides of the operation theater.

Consider two identical microorganisms separated by a distance of 3 mm located in between the conducting plates. Take the charge of each microorganisms to be equal to 10000 times to that of a charge of an electron ($e = -1.6 \times 10^{-19}\,C$). For all your calculations microorganisms can be considered as point like particles.

(*a*) Calculate the electrostatic force acting between the two microorganisms.
($\frac{1}{4\pi\varepsilon_0} = 9\times 10^{9}\,N\,m^2\,C^{-2}$)

(*b*) Now the plates are connected to a 5 kV direct current (d.c.) voltage supply. The separation between the plates is 5 m.

(i) Find the electric field intensity between the two plates.

(ii) Calculate the electrostatic force experienced by a single microorganism due to this electric field.

(iii) Compare the force calculated in (*a*) above with the force calculated in (*b*) (ii) and comment on it.

(iv) Assuming that one of the microorganisms to be at rest at the centre of the operation theater initially, calculate the time taken by the microorganism to reach one of the plates. Take the mass of a microorganism to be equal to 2.0×10^{-14} kg. (Neglect the effect of gravity.)

(v) Find the kinetic energy gained by the microorganism in part (iv).

(*c*) By applying a suitable magnetic field this technique can be modified to separate charged microorganisms according to their masses. Consider three microorganisms with masses m_1, m_2 and m_3 ($m_1 > m_2 > m_3$) located at the vertical mid plane of the two plates. The three microorganisms start their journey at time $t = 0$ with velocities u_1, u_2, u_3 in the direction opposite to the electric field and travel a distance of 1.25 m under the influence of the electric field by spending the same time t. At this moment the electric field is turned off and a uniform magnetic field of flux density B is applied perpendicular to the direction of velocities of the microorganisms . Then these microorganisms travel the rest of the journey under the influence of this magnetic field.

(i) To complete a distance of 1.25 m by the three microorganisms within the same time period t, show that the initial velocities should satisfy the condition $u_1 > u_2 > u_3$.

(ii) Derive an expression for the radius (R_1) of the path of the microorganism of mass m_1 in terms of m_1, u_1, B and t.

9 Answer **either part (A) or part (B)** only.

(A) In order to achieve less environmental pollution there is a tendency of using electric vehicles now. There are three major units in an an electric car as shown in the following block diagram.

The battery unit consists of a low voltage (12 V) battery and a high voltage (about 200 V) battery. 12 V battery is used to supply power for horn, lamps, wipers etc. High voltage battery drives the electric motor which then rotate the wheels.

Making suitable voltage levels and various switching processes are the main functions of the control unit.

(*a*) The 12 V battery is charged by passing a constant current of 5 A through it for 10 hours. What is the amount of charge flown in this process?

(*b*) (i) When the motor is working with a power of 40 kW how much current is drawn from the high voltage battery of 160 V?

(ii) Some electric cars use 300 V battery instead of 160 V battery. State an advantage of using 300 V.

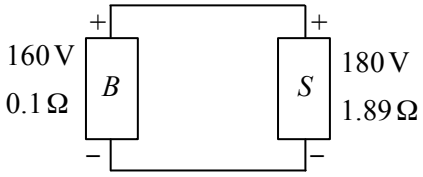
(*c*) The control unit reduces the voltage to charge the 12 V battery from the 160 V battery during the charging process. Is it possible to use a transformer for this reduction of voltage? Give reasons.

(*d*) The battery of e.m.f. 160 V has an internal resistance of 0.1 Ω. When a current of 100 A is drawn from the battery to drive the motor,

(i) what is the potential difference across the terminals of the battery?

(ii) what is the power dissipation in the battery?

(*e*) The electric car uses a regenerative braking system. The motor turns into the mode of a generator when breaking the car. The voltage produced by this generator is used to recharge the battery (*B*) of e.m.f. 160 V and internal resistance 0.1 Ω. The control unit supplies the generated voltage to the battery (*B*) as supply (*S*) of e.m.f. 180 V direct current (d.c.) with an internal resistance of 1.89 Ω as shown in the diagram.



The total length of the connecting wires is 4 m. Calculate the cross-sectional area of the connecting wires made of copper if the constant charging current is 10 A. (Resistivity of copper is 1.72×10^{-8} Ω m)

(*f*) A constant resistive force of 750 N acts on the car when it is moving with a constant velocity v. If the constant current drawn from the battery of e.m.f. 160 V and internal resistance 0.1 Ω is 100 A, find the value of the velocity v. Assume that the motor drives the car with an efficiency of 90%.

(B) (*a*) A person waiting in front of a lift of the F^{th} floor of a multi-story building, could push the button Δ (say B_1) or ∇ (say B_2) to select the direction, up or down that he wants to go.
The signal m sent by the motion detector M and the signals b_1 and b_2 sent by the push buttons B_1 and B_2 respectively are as indicated below.

$M \longrightarrow m$ $\quad m = 1$ when the lift is moving up
$\quad m = 0$ when the lift is moving down

B_1
$\Delta \longrightarrow b_1$ $\quad b_1 = 1$ when B_1 is pressed
$\quad b_1 = 0$ when B_1 is not pressed

B_2
$\nabla \longrightarrow b_2$ $\quad b_2 = 1$ when B_2 is pressed
$\quad b_2 = 0$ when B_2 is not pressed

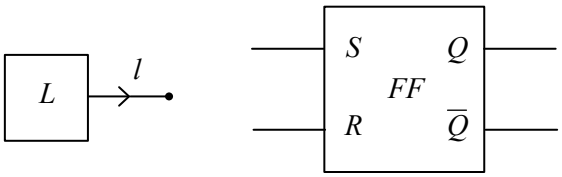
A logic circuit has to be designed to meet the following conditions.

1. When B_1 is pressed the lift stops at the F^{th} floor only if it is in upward motion.
2. When B_2 is pressed the lift stops at the F^{th} floor only if it is in downward motion.

(i) Taking m, b_1 and b_2 as the inputs and Q as the output prepare a truth table to satisfy above conditions.
Consider $Q = 1$ represents the lift stops at the F^{th} floor
$Q = 0$ represents the lift does not stop at the F^{th} floor

(ii) Using the truth table, obtain a Boolean expression for Q and draw the relevant logic circuit. (you may use logic gates with three inputs.)

(*b*) Whenever there is a failure of mains power supply, the lift is automatically driven by a battery backup. For this, another sensor (L) and a flip - flop (FF) are used.



The output (l) of the sensor (L) is as follows.
$l = 1$ when mains power is available.
$l = 0$ when mains power is not available.

The outputs Q and $\overline{Q}$ of the flip-flop (FF) controls the supply of power to the lift as follows.
When $Q = 1$ the lift is powered up by the mains power.
$Q = 0$ the lift is powered up by the battery backup.

(i) Draw a diagram showing how the signal l should be coupled to the inputs S and R of the flip - flop. You are allowed to use only one additional logic gate for this.

(ii) When the mains power is used, a green LED (G) should light to indicate it. When the battery backup is used, a yellow LED (Y) should light to indicate it. In your diagram show how the LEDs should be connected to Q and $\overline{Q}$ terminals.

10 Answer **either part (A) or part (B)** only.

(A) (*a*) Introduce (i) adiabatic and (ii) isothermal processes.

(*b*)

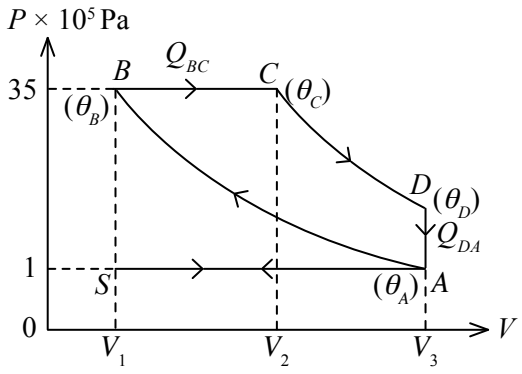


Figure (1)

Figure (1) shows the standard *PV* cycle for a Diesel engine. θ_A, θ_B, θ_C and θ_D are the temperatures of the air mixture at the situations *A*, *B*, *C* and *D* respectively.

Process *S→A* (suction stroke);

Air at atmospheric pressure 1.0×10^5 Pa is drawn into the cylinder under constant pressure.

Process *A→B* (compression stroke);

In this stroke temperature of air mixture increases from $\theta_A = 50\,°C$ to $\theta_B = 1000\,°C$ and the pressure increases from 1.0×10^5 Pa to 35.0×10^5 Pa under **adiabatic compression**.

Process *B→C* (fuel injection and combustion);

Diesel droplets sprayed into the cylinder and the air-diesel mixture ignites. Temperature increases from $\theta_B = 1000\,°C$ to $\theta_C = 2000\,°C$ under **constant pressure expansion**.

Process *C→D* (power stroke);

Temperature of air mixture decreases from $\theta_C = 2000\,°C$ to $\theta_D = 850\,°C$ under **adiabatic expansion**.

Process *D→A* (exhaust stroke);

Pressure reaches to initial pressure of 1.0×10^5 Pa **under constant volume**. Temperature decreases from $\theta_D = 850\,°C$ back to $\theta_A = 50\,°C$.

(i) During the process $A \rightarrow B$ what is the heat exchange (ΔQ_{AB})?

(ii) During the process $B \rightarrow C$ find the heat exchange (ΔQ_{BC}) for a air-diesel mixture of 100 g. (C_P for air-diesel mixture = $1000\,J\,kg^{-1}\,K^{-1}$).

(iii) During the process $C \rightarrow D$ what is the heat exchange (ΔQ_{CD})?

(iv) During the process $D \rightarrow A$ find the heat exchange (ΔQ_{DA}) for a air-diesel mixture of 100 g. (C_V for air-diesel mixture = $750\,J\,kg^{-1}\,K^{-1}$).

(v) For the complete process *ABCDA* find the net heat exchange (ΔQ_{Total}).

(vi) What is the change in the internal energy (ΔU_{Total}) for the complete process *ABCDA*?

(vii) For the complete process *ABCDA* find the net work done (ΔW_{Total})?

(viii) What is the energy liberated by the fuel (i.e. energy input)?

(ix) Calculate the efficiency (*e*) of the engine.

(B) PET (Positron Emission Tomography) scanners are used heavily in clinical oncology, medical imaging of tumors, and for clinical diagnosis of certain brain diseases. The widely used radiopharmaceutical in PET scanners is fluorodeoxy glucose ($C_6H_{11}{}^{18}FO_5$) commonly known as FDG, where positron emitting radionuclide fluorine -18 is substituted for the normal hydroxyl group at one of the C positions in the glucose molecule. The decay scheme of ${}^{18}_{9}F$ is given below.

(*a*) ${}^{18}_{9}F \rightarrow {}^{18}_{8}O + e^{+} + \nu_e$

(i) Name the particle ν_e.

(ii) Rewrite the above decay scheme using nucleons (i.e. using protons and neutrons).

(iii) Rewrite the above decay scheme using quarks and leptons.

(*b*) In a typical scanning application a dose of FDG solution is injected rapidly into a saline drip running into a vein in a patient. Assume that the initial activity of injected ${}^{18}_{9}F$ is 70 MBq and the half-life ($T_{½}$) of ${}^{18}_{9}F$ is 2.0 hours.

(i) Give reasons as to why the half -life of a radiopharmaceutical cannot be extremely small or very large.

(ii) The activity A of a radioactive sample with N number of radioactive atoms is given by the formula $A = \frac{0.7N}{T_{½}}$. Calculate the mass of FDG sample needed in order to acquire 70 MBq activity. Take the mass of one FDG molecule as 3.0×10^{-25} kg.

(iii) During 2.0 hours after injection if the brain absorbs only 10% of the injected FDG, calculate the activity of ${}^{18}_{9}F$ inside the brain after 2.0 hours.

(*c*) In practice, patients who have been injected with FDG are told to avoid the close vicinity of especially radiation-sensitive persons such as infants, children and pregnant women, for at least 24 hours.

(i) What is the reason for this?

(ii) Due to natural radioactivity (^{14}C, ^{40}K), an activity of about 10^4 Bq is present in the body of a typical person. Justify that 24 hours of waiting time is sufficient for a patient injected with FDG with initial activity of 70 MBq.(Take $\frac{7}{4096} = 1.7 \times 10^{-3}$)

(iii) Positrons emitted by ${}^{18}_{9}F$ annihilate with electrons present in the body and generate two gamma rays. State **two** advantageous of using the PET technique in clinical diagnosis.

(*d*) Since these radiopharmaceuticals have short half-lives one cannot store them for longer periods. Therefore these have to be imported in large quantities or be imported frequently and this process is very expensive. ${}^{18}_{9}F$ is produced by bombarding protons onto ${}^{18}_{8}O$ enriched water and the nuclear reaction that take place is given below.

$p + {}^{18}_{8}O \rightarrow {}^{18}_{9}F + ?$

(i) Identify the missing particle in the above reaction.

(ii) The protons need at least 18 Me V to initiate the above reaction. Name the field (electric or magnetic) that scientists are generally using to increase the kinetic energy of charged particles.

(iii) Name a machine that scientists are using to increase the kinetic energy of protons with the help of the field mentioned in (d) (ii) above.

* * *

(02) Chemistry

Structure of the Question Paper

Paper I - **Time : 02 hours**

This paper consists of **50** multiple choice questions with **5** options. **All** questions should be answered. Each question carries **01** mark. Total marks **50**.

Paper II - **Time : 03 hours.** (In addition, 10 minutes for reading.)

This paper consists of **three** parts as **A, B** and **C**. Some questions in these parts will be based on practicals prescribed in the syllabus.

Part A - **Four structured essay** type questions. **All** questions should be answered.

Question 1 : General Chemistry
Question 2 : Inorganic Chemistry
Question 3 : Physical Chemistry
Question 4 : Organic Chemistry

Each question carries 100 marks - altogether 400 marks.

Part B - **Three essay** type questions. **Two** questions should be answered.

Question 5 : Physical Chemistry
Question 6 : Physical Chemistry
Question 7 : Physical Chemistry and Inorganic Chemistry

Each question carries 150 marks - altogether 300 marks.

Part C - **Three essay** type questions. **Two** questions should be answered.

Question 8 : Organic Chemistry
Question 9 : Inorganic Chemistry
Question 10 : Industrial and Environmental Chemistry

Each question carries 150 marks - altogether 300 marks.

Total marks for paper II = 1000

Calculation of the final mark : Paper I = 50
Paper II = 1000 ÷ 20 = 50
Final mark = 100

(02) Chemistry
Paper I

Important :

* Answer **all** the questions.
* Select the **correct or the most appropriate** answer.

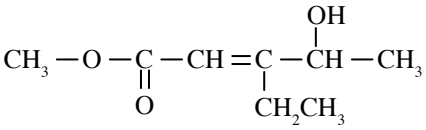
(A separate sheet will be provided to mark answers for multiple choice questions.)

Universal gas constant	R	=	$8.314\,J\,K^{-1}\,mol^{-1}$
Avogadro constant	N_A	=	$6.022 \times 10^{23}\,mol^{-1}$
Planck's constant	h	=	$6.626 \times 10^{-34}\,J\,s$
Velocity of light	c	=	$3 \times 10^{8}\,m\,s^{-1}$

1. Which of the following elements has the lowest third ionization energy?
(1) Mg (2) Ne (3) N (4) P (5) Cl

2. Which molecule from the molecules given below consists the highest number of pi (π) bonds?
(1) H_2SO_4 (2) H_2SO_3 (3) HNO_3 (4) H_3PO_4 (5) $HClO_4$

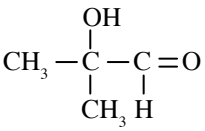
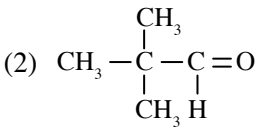
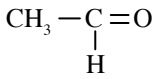
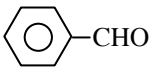
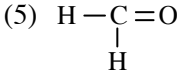
3. Which statement is true regarding $[Al(OH)_4]^-$ ion?
(1) Its central atom hybridization is sp^2.
(2) Its total number of lone pairs of electrons is 8.
(3) It contains d electrons.
(4) Its number of sigma (σ) bonds is 4.
(5) Its total number of electrons in the valence shell is 28.

4. The IUPAC name of the compound  is

(1) methyl-3-ethyl-4-hydroxypent-2-enoate
(2) methyl 3-ethyl-4-hydroxypent-2-enoate
(3) 3-ethyl-1-methoxy-1-oxopent-3-en-4-ol
(4) 3-ethyl-5-methoxy-5-oxopent-3-en-2-ol
(5) methyl 3-ethyl-2-hydroxypent-3-enoate

5. The production process which produces a gas as a by-product giving the highest contribution to global warming is,
(1) Soap production
(2) Nitric acid production
(3) Iron production
(4) Sulphuric acid production
(5) Bio - diesel production

6. Which one of the following compounds undergoes self condensation in basic condition?

(1) 
(2) 
(3) 
(4) 
(5) 

7. Consider the following reaction at 25 °C.

$$CO_2(g) + 2NH_3(g) \longrightarrow CO(NH_2)_2(s) + H_2O(l) \;;\; \Delta H^\circ = -134\,kJ\,mol^{-1}$$

Which of the following is correct regarding this reaction?
(1) ΔS° is always a negative value for the reaction.
(2) ΔH° increases with the temperature.
(3) The decrease in the entropy change can determine the spontaneity of the reaction.
(4) The reaction is spontaneous at all temperatures.
(5) At high temperatures the value of ΔG° becomes more negative.

8. At a given temperature, k is the rate constant of the first order elementary reaction $\mathbf{A}(g) \rightarrow \mathbf{B}(g) + \mathbf{C}(g)$. At the initial stage ($t$=0) pressure of the system is P_1 and after time t, pressure is P_2. What is the rate of the reaction at this instant?

(1) $k(P_2 - P_1)$ (2) $k(P_1 - P_2)$ (3) $k(2P_1 - P_2)$ (4) $k(P_1 - 2P_2)$ (5) $2k(P_1 - P_2)$

9. Which of the following solutions **cannot** be used to distinguish two aqueous solutions of $BaCl_2$ and $Ba(OH)_2$ from each other?

(1) $MgCl_2(aq)$ (2) $AgNO_3(aq)$ (3) $(NH_4)_2SO_4(aq)$ (4) $Na_2Cr_2O_7(aq)$ (5) $Na_2CO_3(aq)$

10. The mole fraction of NH_4NO_3 is $\frac{5}{6}$ in a solid mixture that consists only NH_4NO_3 and $CaCO_3$. The percentage mass of $CaCO_3$ in the mixture is, (N = 14, H = 1, O = 16, Ca = 40, C = 12)

(1) 20% (2) 40% (3) 60% (4) 67% (5) 80%

11. Which of the following statement is **incorrect** with regard to water pollution.

(1) NO_3^- and PO_4^{3-} ions contribute for the reduction of dissolved oxygen in water.
(2) Amount of dissolved oxygen in water is decreased when dissolved organic matter is present.
(3) Amount of dissolved oxygen in water is decreased when heavy metal ions are present.
(4) Oxygen circulation process in the blood is affected by taking water containing excessive amount of NO_3^- ions.
(5) Certain bacteria contributes for the addition of iron into water.

12. Which of the following statement is correct for the membrane cell used in the production of NaOH?

(1) Anode of the cell is graphite rod.
(2) NaOH is produced and Cl_2 gas is evolved in the cathode compartment.
(3) OH^- ions travel from cathodes to anode through membrane.
(4) NaOH is produced and H_2 gas is evolved in the cathode compartment.
(5) 60% NaOH solution is obtained as the final product.

13. Which of the following statement is **false** regarding $C_2H_5NH_2$? It

(1) is more basic than Aniline.
(2) reacts with $NaNO_2$/dil. HCl and evolves N_2 gas as a product.
(3) reacts with alkyl halide and give mixture of products.
(4) shows nucleophilic substitution reactions with aldehydes and ketones.
(5) forms salts with dilute mineral acids.

14. Consider the following reaction.

$$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g) + \text{Energy}$$

At 25 °C in a rigid closed container, certain amounts of $PCl_3(g)$ and $Cl_2(g)$ are mixed and allowed to reach above equilibrium. The following statements are mentioned as reasons to increase number of moles of $PCl_5(g)$ in equilibrium.

A - reduce the volume of the container at a constant temperature.
B - increase the temperature at a constant volume.
C - addition of a certain amount of Ar gas into the container at constant temperature and volume.

What is/are true among above statements?

(1) A only. (2) B only. (3) A and B only.
(4) A and C only. (5) B and C only.

15. The volume of 0.01 mol dm^{-3} $K_2Cr_2O_7$ (cm^3) required to react completely with 25.00 cm^3 of 0.02 mol dm^{-3} of FeI_2 aqueous solution in acidic medium is,

(1) 8.33 (2) 10.00 (3) 16.67 (4) 20.00 (5) 25.00

16. At room temperature solute **X** is dissolved in a system with two immiscible solvents **A** and **B**, which are in contact with each other. **X** present as single molecule (**X**) in solvent *A*. In solvent **B**, n number of molecules of **X** associated to form $\mathbf{X}_n$ molecules. Then $n\mathbf{X} \rightleftharpoons \mathbf{X}_n$ equilibrium exists, with equilibrium constant K_c. In addition, a few single molecules of **X** also present in solvent **B**. If C_1 is the concentration of **X** in solvent **A**, C_2 is the concentration of free - **X** in solvent **B** and C_3 is the concentration of $\mathbf{X}_n$ in solvent **B**, and partition coefficient of the system is K_D; which of the following gives the $\frac{K_D}{\sqrt[n]{K_C}}$ ratio?

(1) $\frac{C_1}{\sqrt[n]{C_3}}$ (2) $\frac{C_3}{\sqrt[n]{C_1}}$ (3) $\frac{C_1}{C_2}$ (4) $\frac{C_3}{C_2^n}$ (5) $\frac{C_1}{C_3^n}$

17. Consider the following bond energies at 25 °C,

Bond	Bond energy / kJ mol^{-1}
A - **A**	150
B - **B**	250
A - **B**	200

The enthalpy change $\Delta H°$ (kJ mol^{-1}) of the reaction, $\mathbf{A}_2(g) + 3\mathbf{B}_2(g) \longrightarrow 2\mathbf{AB}_3(g)$ is,

(1) −300 (2) 300 (3) −500 (4) 500 (5) 1200

18. Consider the following equilibrium in a closed rigid container of volume 1.0 dm^3 at 50 °C.

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

At 50 °C ***a*** moles of $SO_2(g)$ and ***b*** moles of $O_2(g)$ are placed in the vessel. After reaching the equilibrium, it was found that ***x*** moles of $SO_3(g)$ were present in the container. Equilibrium constant K_C for the forward reaction is,

(1) $\frac{(a-2x)^2(b-x)}{x^2}$ (2) $\frac{x^2}{(a-x)^2(b-x)}$ (3) $\frac{x^2}{(a-x)^2(b-0.5x)}$

(4) $\frac{(a-x)^2(b-0.5x)}{x^2}$ (5) $\frac{x^2}{(a-2x)^2(b-x)}$

19. Which of the following organic compound shows geometrical isomerism?

(1) 3,3-dibromo-1-butene (2) 2-bromo-1-butene
(3) 1- bromo-2-methylpropene (4) 1-bromo-2-butene
(5) 1,1-dibromo-1-butene

20. Upon the addition of 42.5 g of a mixture of K and Na metal pieces, to 1.0 dm^3 of distilled water at 25 °C, mass of the gas evolved was 0.5 g. The pH value of the solution produced is,
(Na = 23, K = 39, H = 1, O = 16)

(1) 0.3 (2) 1.7 (3) 13.0 (4) 13.7 (5) 14.0

21. A required mass of solid NaI is dissolved in a certain quantity of water to prepare a 1.00 mol dm^{-3} solution of NaI at 25 °C. When two Pt electrodes were dipped in this solution and connected by a conducting wire, which of the following shows overall cell reaction and electro motive force (e.m.f.) of the cell at 25 °C?

$E°_{I_2/I^-} = 0.53$ V, $E°_{H_2O/H_2} = -0.83$ V

(1) $2I^-(aq) + 2H_2O(l) \longrightarrow I_2(s) + H_2(g) + 2OH^-(aq)$; −0.30 V

(2) $2I^-(aq) + 2H_2O(l) \longrightarrow I_2(s) + H_2(g) + 2OH^-(aq)$; +0.30 V

(3) $I_2(s) + H_2(g) + 2OH^-(aq) \longrightarrow 2I^-(aq) + 2H_2O(l)$; −1.36 V

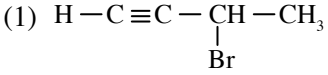
(4) $I_2(s) + H_2(g) + 2OH^-(aq) \longrightarrow 2I^-(aq) + 2H_2O(l)$; +1.36 V

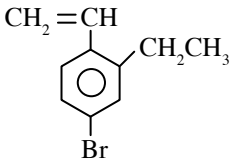
(5) $I_2(s) + H_2(g) + 2OH^-(aq) \longrightarrow 2I^-(aq) + 2H_2O(l)$; 0.00 V

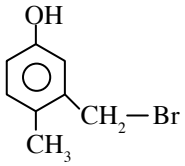
22. At 25°C, what is the pH of a buffer solution prepared by mixing 250.00 cm^3 of 2.20 mol dm^{-3} CH_3COOH and 250.00 cm^3 of 2.00 mol dm^{-3} NaOH?
(For CH_3COOH acid, at 25°C $K_a = 1.0 \times 10^{-5}$ mol dm^{-3})

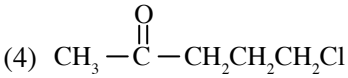
(1) 4 (2) 5 (3) 6 (4) 7 (5) 8

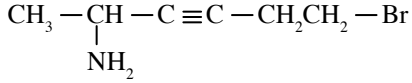
23. Of the compounds given below, which can be used to prepare Grignard reagent?

(1) 

(2) 

(3) 

(4) 

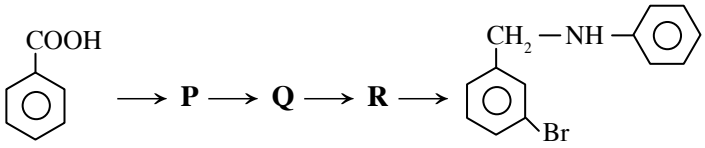
(5) 

24. Electroplating of a metal X with molar mass M was done by electrolyzing aqueous solution of XCl_2 for 10 hours with a constant current of I A. Which of the following gives the maximum mass of X that could be plated? (Faraday constant is F).

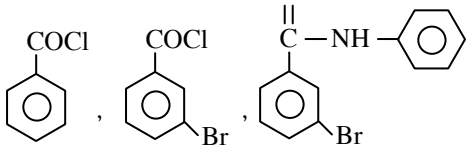
(1) $\frac{3600 \times 10 \times I \times M}{F}$ (2) $\frac{3600 \times 10 \times I \times M}{2F}$ (3) $\frac{10 \times 60 \times I \times M}{F}$

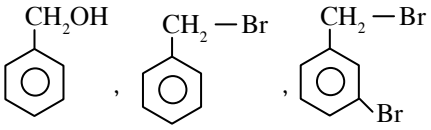
(4) $\frac{10 \times 60 \times I \times M}{2F}$ (5) $\frac{10 \times I \times M}{2F}$

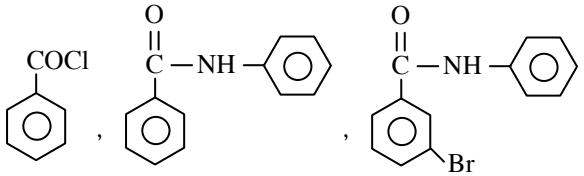
25. Consider the reaction sequence given below;

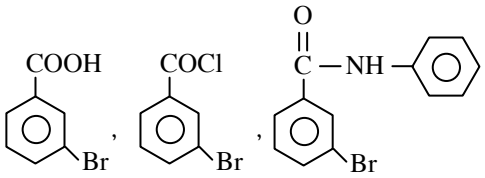


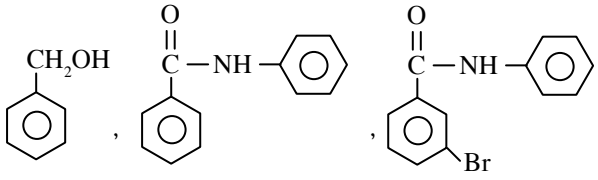
Which answer in the following shows the most appropriate structures for **P, Q, R** respectively?

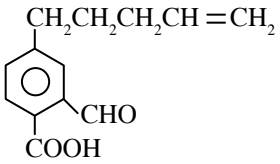
(1) 

(2) 

(3) 

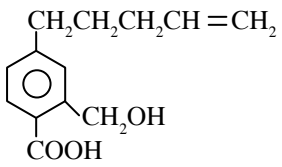
(4) 

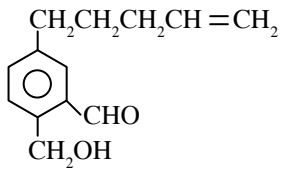
(5) 

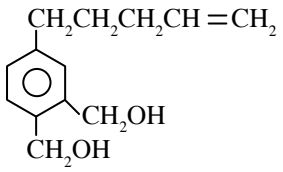
26. 

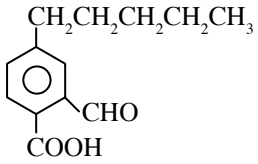
A

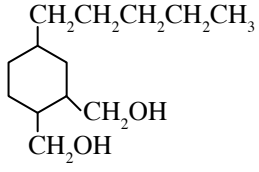
The product formed, when compound **A** was reacted with $LiAlH_4$ followed by the addition of water is,

(1) 

(2) 

(3) 

(4) 

(5) 

27. Given below are some experimental information of three isomers of **A**, **B**, **C** with molecular formula $C_5H_{10}O$.

A - shows geometrical isomerism and decolourizes Br_2 water.

B - shows enantiomerism and does not gives an orange colour precipitate with Brady's reagent.

C - gives silver mirror with Tollens' reagent.

Answer with correct structures of **A**, **B**, **C** are respectively,

(1) $CH_3CH=\overset{\overset{CH_3}{|}}{C}-CH_2OH$, $CH_3CH_2-\overset{\overset{CH_3}{|}}{CH}-CHO$ and $CH_3CH_2CH_2CH_2CHO$

(2) $CH_2=\overset{\overset{CH_3}{|}}{C}-CH_2CH_2OH$, $CH_2=CH-\overset{\overset{OH}{|}}{CH}-CH_2CH_3$ and $H-\overset{\overset{O}{||}}{C}-\overset{\overset{CH_3}{|}}{CH_2CH}CH_3$

(3) $CH_3CH_2-\overset{\overset{CH_2OH}{|}}{C}=CH_2$, $CH_3CH_2-\overset{\overset{CH_3}{|}}{CH}-CHO$ and $CH_3CH_2-\overset{\overset{O}{||}}{C}-CH_2CH_3$

(4) $CH_3CH=CHCH_2CH_2OH$, $CH_2=CH-\overset{\overset{CH_3}{|}}{CH}-CH_2OH$ and $CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-CHO$

(5) $CH_3CH_2CH=CHCH_2OH$, $CH_2=CH-\overset{\overset{OH}{|}}{CH}-CH_2CH_3$ and $CH_3-\overset{\overset{CH_2OH}{|}}{CH}-CH=CH_2$

28. Which of the following is correct for the energy range of a photon of visible light in the wave length range λ_1 to λ_2, (nm) ($\lambda_1 < \lambda_2$)?
(h = planck constant, c = velocity of light)

(1) $hc\left(\frac{1}{\lambda_1}-\frac{1}{\lambda_2}\right)\times 10^9\,J$ (2) $hc\left(\frac{1}{\lambda_2}-\frac{1}{\lambda_1}\right)\times 10^9\,J$ (3) $hc\left(\frac{\lambda_2-\lambda_1}{\lambda_1\lambda_2}\right)\times 10^{-19}\,J$

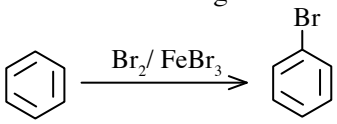
(4) $hc\left(\frac{\lambda_1-\lambda_2}{\lambda_1\lambda_2}\right)\times 10^{-19}\,J$ (5) $hc\left(\frac{1}{\lambda_1}-\frac{1}{\lambda_2}\right)\times 10^{-19}\,J$

29. In an experiment $V\,cm^3$ of $H_2(g)$ was collected at the pressure P and at temperature T by downward displacement of water. Saturated vapor pressure of water at this temperature is $P^\circ_{H_2O}$. The ratio of number of moles of $H_2(g)$ to $H_2O(g)$ and ratio of average speeds of $H_2(g)$ to $H_2O(g)$ are respectively.

(1) $\frac{P-P^\circ_{H_2O}}{P^\circ_{H_2O}}$ and 3 (2) $\frac{P-P^\circ_{H_2O}}{P^\circ_{H_2O}}$ and $\frac{1}{3}$ (3) $\frac{P^\circ_{H_2O}}{P}$ and 3

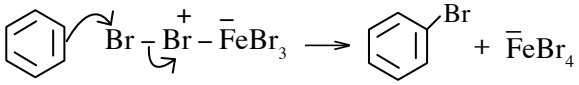
(4) $\frac{P}{P^\circ_{H_2O}}$ and 3 (5) $\frac{P}{P^\circ_{H_2O}}$ and $\frac{1}{3}$

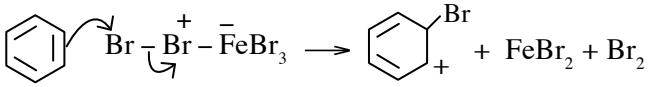
30. Consider the following reaction.

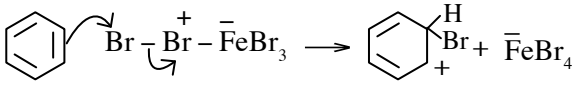


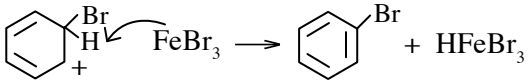
Which answer shows a correct step in mechanism of the above reaction.

(1) $Br_2 + FeBr_3 \longrightarrow Br - Br - \bar{F}eBr_2 + Br^+$

(2) 

(3) 

(4) 

(5) 

- For each of the questions **31** to **40**, one or more responses out of the four responses (*a*), (*b*), (*c*) and (*d*) given is/are correct. Select the correct response/responses. In accordance with the instructions given on your answer sheet, mark
  - (1) if only (*a*) and (*b*) are correct.
  - (2) if only (*b*) and (*c*) are correct.
  - (3) if only (*c*) and (*d*) are correct.
  - (4) if only (*d*) and (*a*) are correct.
  - (5) if **any other** number or combination of responses is correct.

Summary of above Instructions

(1)	(2)	(3)	(4)	(5)
Only (*a*) and (*b*) are correct.	Only (*b*) and (*c*) are correct.	Only (*c*) and (*d*) are correct.	Only (*d*) and (*a*) are correct.	**Any other** number or combination of responses is correct

31. Ions consisting ^{16}O and ^{15}N are given below. Among these ion(s) contain(s) higher number of neutrons than electrons?

(*a*) NO_2^+ (*b*) N_3^- (*c*) NO_3^- (*d*) O_2^{2-}

32. Which of the following statement/s is/are true regarding O_3 and O_2,

(*a*) Bond length of O_3 is less than the bond length of O_2.

(*b*) Dipole moment of both species is zero.

(*c*) O_3 gas is a green house gas eventhough O_2 is not.

(*d*) Ozone layer consist of O_2 and O_3.

33. In an experiment to determine the molar enthalpy change of dissolution ($\Delta H_{dissolution}$) of urea in water, 6 g of urea (H_2NCONH_2) was dissolved in 100 g of water in a calorimeter at 25°C. The final temperature of the solution was found to be 22 °C. Assume that no volume change occurs during dissolution of urea in water and density of solution is same as that of water ($1.0\,g\,cm^{-3}$), no heat loss occurred and specific heat capacity of the solution is $4.0\,J\,g^{-1}\,K^{-1}$. Which of the following statement/s is/are better describe the above experiment?

(H = 1, C = 12, N = 14, O = 16)

(*a*) During the dissolution of 6 g of urea 1.2 kJ of heat is released to the surroundings.

(*b*) During the dissolution of 6 g of urea 1.2 kJ of heat is absorbed by the system.

(*c*) During the dissolution of 1 mole of urea 12 kJ of heat is absorbed by the system.

(*d*) During the dissolution of 1 mole of urea 12 kJ of heat is released to the surrounding.

34. In any unimolecular reaction which is not at equilibrium,

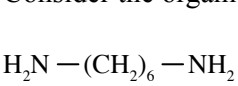
(*a*) Only one reactant is present in the rate determining step.

(*b*) In the slowest step both molecularity and order is one.

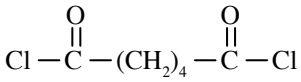
(*c*) Molecularity is one and it is zeroth order.

(*d*) Both molecularity and order are zero.

35. Consider the organic compounds given below.

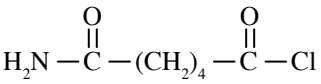


A

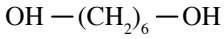


B

C



D



E

Which statement/statements below is/are true about the above organic compounds.

(*a*) A and B can be used to prepare a type of polyester.

(*b*) A and B can be used to prepare a type of nylon.

(*c*) C can be used to prepare a type of addition polymer.

(*d*) D can be used to prepare a type of nylon.

36. 1.0 mol of HI(g), 0.2 mol of $H_2(g)$ and 0.5 mol of $I_2(g)$ were placed in a rigid closed container with volume 1.0 dm^3, and allowed to reach equilibrium at 750 K.

$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$; $K_C = 2.5 \times 10^{-2}$. Q_C is reaction quotient.

Which of the following statement(s) is/are correct regarding this system?

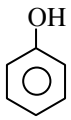
(*a*) Initially $Q_C > K_C$; reaction proceeds to produce more HI(g).

(*b*) Initially $Q_C > K_C$; reaction proceeds to produce more $I_2(g)$ and $H_2(g)$.

(*c*) Initially $Q_C > K_C$; more $H_2(g)$ and $I_2(g)$ consumed.

(*d*) Initially $Q_C < K_C$; more $H_2(g)$ and $I_2(g)$ consumed.

37.



A

CH_3CH_2OH

B

What is/are the most correct statement/s about two compounds A and B given above.

(*a*) Rate of nucleophilic substitution reactions of A is higher that of B.

(*b*) A undergoes electrophilic substitution reactions whereas B does not do so.

(*c*) In A, C — O bond has partial double bond nature and in B, C — O bond is a single bond.

(*d*) Carbon which is combined to oxygen in A is more electron deficient than carbon atom corresponds to B.

38. Cooling of the following equilibrium system changes its colour from green to blue.

$Cu^{2+}(aq) + 4Br^{-}(aq) \rightleftharpoons [CuBr_4]^{2-}(aq)$

blue green

Which of the following statement/s is/are correct regarding the above system when cooled?

(*a*) The value of K_C decreases.

(*b*) Initial Q_C is greater than K_C.

(*c*) Forward reaction is exothermic

(*d*) The value of K_C increases.

39. In endothermic reaction $\mathbf{A}_2(g) + \boldsymbol{B}_2(g) \longrightarrow 2\mathbf{AB}(g)$ which occurs in a closed container at 298 K, rate equation is, rate = $\boldsymbol{k}[\mathbf{A}_2(g)][\mathbf{B}_2(g)]$. Which of the following statement(s) is/are better describe this reaction?

(*a*) When $A_2(g)$ is added at constant temperature and volume, rate increases.

(*b*) When volume of container is increased at constant temperature, rate decreases.

(*c*) When a catalyst is added at constant temperature and pressure, activation energy of the reaction decreases.

(*d*) When $A_2(g)$ is added keeping temperature and volume constant, rate decreases.

40. Heating of small amount of $KMnO_4(s)$ by using platinum wire,

(*a*) Turns the Bunsen flame in to dark green.

(*b*) Increases the brightness of the Bunsen flame.

(*c*) The solid residue formed consists of K_2MnO_4 and MnO_2.

(*d*) Disproportionation reaction occurs.

- In question numbers **41** to **50**, two statements are given in respect of each question.
  From the Table given below, select the response out of the responses (1), (2), (3), (4) and (5) that best fits the two statements and mark appropriately on your answer sheet.

response	First statements	Second statements
(1)	True	True, and correctly explains the first statement
(2)	True	True, but does not explain the first statement correctly
(3)	True	False
(4)	False	True
(5)	False	False

	First statement	Second statement
41.	Black colour precipitate is formed when H_2S gas is bubbled through aqueous solution of $AgNO_3$.	Ag^+ is precipitated as Ag_2S in group I in the group analysis of cations.
42.	Temperature of the lower part of the blast furnace is around 1300 °C.	All the reactions occur in the blast furnace are exothermic.
43.	Nucleophilic substitution reaction rate of carboxylic acid is greater than acid chlorides.	Electron deficiency at carbonyl carbon of carboxylic acid is greater than carbon of acid chlorides.
44.	At room temperature when a Zn rod is immersed in a $ZnSO_4(aq)$ solution, the potential difference between the Zn rod and the solution is the electrode potential.	At room temperature when two different electrodes are connected through a salt bridge, the potential difference between the two electrodes is the electromotive force of the cell.
45.	Covalent character of NaI is greater than that of NaF.	Polarizability of halide ions increases with increasing radii.
46.	$NaClO_3$ can be obtained by the reaction between NaOH and Cl_2.	NaOH can act as an oxidizing agent.
47.	All the addition polymers are saturated.	Addition polymers can be formed by only unsaturated monomers.
48.	Aqueous solutions of Cu^{2+}, Zn^{2+} and Fe^{2+} produce clear transparent solutions with excess aqueous NH_3.	All 3*d* cations containing vacant valence orbitals form complex ions by gaining lone pairs of electrons from NH_3.
49.	For an equilibrium system with an endothermic forward reaction, increasing of temperature causes the position of equilibrium to shift towards left.	Increasing temperature of endothermic equilibrium reaction causes to increase the value of equilibrium constant.
50.	$CH_4(g)$ does not behave as an ideal gas at high pressures.	Gaseous molecules get closer at high pressures and the volume of the gas is a considerable percentage of the volume of the vessel.

* * *

(02) Chemistry

Paper II

Important :

* Answer **all** the questions in Part **A**.
* Answer **four** questions selecting **two** questions from Part **B** and **two** questions from Part **C**.

Part A - Structured Essay

1.(*a*) Consider the first seven elements in the third period of the periodic table.

(i) Identify and write the symbols of the elements showing the following properties.

I. highest second ionization energy .....

II. highest melting point .....

III. amphoteric property .....

(ii) Write the chemical formula of the compound formed by the reactions of elements having the highest and the lowest electro-negativities from the above elements.

.....

(iii) Explain briefly why the above compound in (ii) has a very high melting point.

.....

.....

.....

(25 marks)

(*b*) NO and NO_2 are odd electron compounds of nitrogen containing an unpaired electron on each N.

(i) Draw the most acceptable Lewis structures for NO and NO_2.

(ii) Write the chemical formula and IUPAC name of the compound formed when NO and NO_2 react with each other.

.....

(iii) Draw the most acceptable Lewis structure for the compound state in (ii) above.

(iv) Draw the resonance structures associated with the compound in (iii) above.

(v) From the resonance structures drawn above (iv) which structure/structures largely contribute to the true structure?

(vi) Which is the weakest bond in a molecule of the compound in (ii) above? State the reason for your choice.

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(vii) If the compound in (ii) above is heated to a higher temperature, what would you expect to happen?

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(viii) Label the two N atoms as N_1 and N_2 in the structure in part (iv) above and complete the table below.

	N_1	N_2
hybridization		
electron pair geometry		
shape around the atom		
Oxidation number		

(50 marks)

(*c*) Arrange the following (i) - (v) in the ascending order of the property as given in parentheses.

(i) K_2CO_3, $MgCO_3$, $CaCO_3$, $BaCO_3$ (decomposition temperature)

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(ii) H_2CO, CO, CO_2, $COCl_2$ (electronegativity of carbon)

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(iii) NO_2^-, NO_3^-, NO^+, NOF (N — O bond length)

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(iv) energy released in the process $M(g) + e \rightarrow M^-(g)$ Where M is C, F, Mg and Cl.

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(v) C_3H_7OH, CH_3CH_2COOH, C_2H_5CHO, $C_2H_5OCH_3$ (saturated vapour pressure at STP)

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(25 marks)

2 (*a*) An alloy containing Al and Mg metals only and is weighing 3.0 g reacted with 0.10 mol dm^{-3}, aqueous solution of NaOH. The volume of gas evolved at STP was 1680 cm^3.
(Al = 27, Mg = 24 ; 1 mole of gas at STP occupies a volume of 22400 cm^3)

(i) Write relevant balanced chemical equations for above process.

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(ii) Calculate the mass percentage of Al in the alloy.

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(iii) Another portion of the alloy weighing 3.0 g of the above alloy is completely reacted with dilute HCl solution. Write the relevant balanced chemical equations for the reactions with HCl.

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(iv) Calculate the volume of gas evolved at STP in part (iii) above.

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(v) State **two** industrial uses of the gas/gases evolved in part (i) and (iii) above?

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(50 marks)

(*b*) $TiFeO_3$ is a stable compound. Given that the oxidation states of the two metal ions are different,

(i) Stare the oxidation states of the two metal ions.

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(ii) Write the electronic configuration of the constituent metal ions of the above compound.

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(iii) Predict the colour of the solution giving reasons, when $TiFeO_3$ is dissolved in HCl acid.

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(iv) State the observation when dilute NaOH solution is added to the solution in (iii) above?

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(25 marks)

(*c*) Five test tubes labelled as **A**, **B**, **C**, **D** and **E** contain white solids. These are $ZnCO_3$, $Ca(NO_3)_2$, NH_4NO_2, Li_2CO_3 and $NaNO_3$ (not in the same order). The observations of experiments done to identify each compound is given below.

Compound	Vigorous heating	Residue
A	no solid residue	–
B	yellow solid residue + colourless gas	became white on cooling.
C	white solid residue + brown gas	dissolve in dilute HCl and subjected to the flame test. Brick red colour observed.
D	white solid residue + colourless gas	dissolve in water giving a clear solution which turns pink with phenolphthalein.
E	white solid residue + colourless gas	gives brown colour gas with dilute HCl.

(i) Identify the compounds **A**, **B**, **C**, **D** and **E**.

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(ii) Write balanced chemical equations for the thermal decomposition of each compound above.

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(25 marks)

3 (*a*) $I^-(aq)$ ion is oxidized to hypoiodite, $[IO^-(aq)]$, when reacted with hypochlorite, $[ClO^-]$ in basic medium as follows.

$$I^-(aq) + ClO^-(aq) \xrightarrow{OH^-(aq)} IO^-(aq) + Cl^-(aq)$$

Initial rate method was used to study the kinetics of the above reaction at 25 °C. The time taken to occur a known concentration change in $IO^-(aq)$, $\Delta[IO^-(aq)]$ was measured. The results obtained in such an experiment are shown in the following table.

Experiment	Initial $[I^-(aq)]$ / mol dm^{-3}	Initial $[ClO^-(aq)]$/ mol dm^{-3}	$\Delta[IO^-(aq)]$/ mol dm^{-3}	Time/(s)	Initial rate / mol dm^{-3} s^{-1}
1	0.010	0.020	0.015	100	.....
2	0.030	0.020	0.090	200	.....
3	0.010	0.080	0.180	300	.....

(i) Calculate the initial rates in each experiment and fill the relevant column.

(ii) By taking **a** and **b** as orders of the reaction with respect to $I^-(aq)$ and $OCl^-(aq)$ respectively and **k** as the rate constant of the reaction at 25 °C, Calculate values of **a**, **b** and **k**.

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(iii) Write the rate law of the reaction.

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(iv) A separate set of rate measurement experiments was carried out by keeping the concentration of $[I^-(aq)]$ constant with different concentrations of $[ClO^-(aq)]$. Compare the variation of rate with $[ClO^-(aq)]$ in a graph, if such experiments carried out with and without a catalyst.

(60 marks)

(*b*) (i) Write a mathematical expression for Raoult's Law, and define the terms appearing in it.

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(ii) At 50 °C, 43 g of liquid hexane(C_6H_{14}) is mixed with 39 g of liquid benzene (C_6H_6). At 50 °C saturated vapor pressures of pure hexane and benzene are 75 kPa and 50 kPa respectively. Calculate the total vapor pressure of the mixture at 50 °C. (C = 12, H = 1)

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(iii) State the assumptions made in the above calculation.

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(40 marks)

4. (*a*) **A**, **B**, **C** and **D** are four compounds which are isomers of molecular formula C_4H_9Br. Only **A** shows optical isomerism. The carbon skeletons of **B** and **D** are same and it differs from the skeleton of **A**. Dehydrobromination followed by addition of HBr to **D** produces **B**.

(i) Draw the structures of **A**, **B**, **C** and **D** in the boxes given below.

A	**B**
C	**D**

with aqueous NaOH to give compounds with molecular formula $C_4H_{10}O$.

I. Draw the structures of the products **X** and **Y** formed by **B** and **C** with aqueous NaOH.

B $\xrightarrow{\text{aqueous NaOH}}$ **X** :

C $\xrightarrow{\text{aqueous NaOH}}$ **Y** :

II. What are the type(s) of reactions that occur in **B** and **C** from types given below? (Electrophilic addition $\boldsymbol{A_E}$, Electrophilic substitution $\boldsymbol{S_E}$, Neucleophilic substitution $\boldsymbol{S_N}$, Neucleophilic addition $\boldsymbol{A_N}$, Elimination reaction ***E***)

B ☐ **C** ☐

(iii) State a simple experiment to distinguish **X** and **Y** from each other with the relevant observations.

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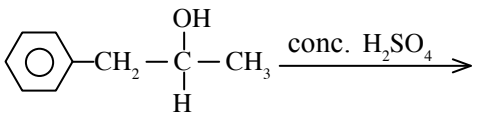
(40 marks)

(*b*) Draw the structures of the main product formed in reactions given below in the boxes given below.

(i) $CH_3CH_2-\underset{\displaystyle CH_2CH_3}{\overset{\displaystyle CH_2CH_3}{\overset{|}{\underset{|}{C}}}}-Br \xrightarrow{\text{alcoholic KOH}}$ ☐

(ii)  ☐

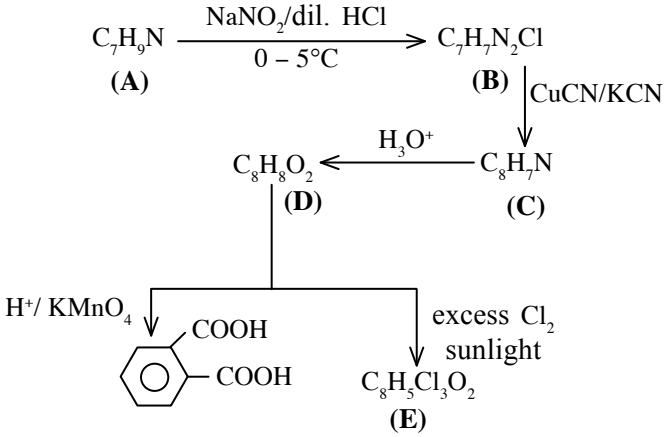
(iii) $CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-CH_2-\overset{\displaystyle O}{\overset{\|}{C}}-O-CH_3 \xrightarrow[\text{(ii) } H_2O]{\text{(i) excess } \langle\!\bigcirc\!\rangle\text{-MgBr, (dry ether)}}$ ☐

(iv) $CH_3CH_2-C\equiv C-H \xrightarrow[60\,^\circ C]{HgSO_4/\text{dil. } H_2SO_4}$ [ ]

(v) $CH_3-C\equiv C-H \xrightarrow[\text{(ii) } CH_3CH_2Br]{\text{(i) } NaNH_2}$ [ ]

(25 marks)

(*c*) Primary aromatic amine of **A** was subjected to the following reaction sequence.



(i) Draw the structures of **A**, **B**, **C**, **D** and **E** in the boxes given below.

A

B

C

D

E

(ii) Draw the structure of the product formed when compound **A** reacts with $CH_3-\overset{\overset{O}{\|}}{C}-CH_3$.

(iii) Draw the structure of the product formed when compound **B** reacts with phenol in the presence of NaOH at 0 - 5 °C.

(35 marks)

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Part B - Essay

5 (*a*) At 600 K, a rigid closed 5.00 dm^3 vessel contains 56 g of $N_2(g)$ and 64 g of $O_2(g)$. At 600 K , $RT = 5.0\times10^3\ J\ mol^{-1}$ (N = 14, O = 16)

(i) What is the total pressure of the gas mixture in the vessel?

(ii) Temperature of the above gas mixture is decreased to 300 K. Calculate the partial pressures of $N_2(g)$ and $O_2(g)$ under the new condition. At 300 K, $RT = 2.5 \times 10^3\ J\ mol^{-1}$.

(iii) In a separate experiment, 0.16 mol of $NO_2(g)$ was introduced into a 5.00 dm^3 rigid container at 600 K, allowed to reach the following equilibrium and the pressure in the container was found to be 2.0×10^5 Pa.

$$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$$

Calculate K_P and K_C for the above equilibrium at 600 K.

(iv) At 600 K, 0.20 mol of $NO_2(g)$, 0.10 mol of NO(g) and 0.05 mol of $O_2(g)$ are placed in 1.00 dm^3 rigid closed container and allowed to reach the equilibrium. With the help of your answer for K_C in part (iii) above, compare (increase or decrease) the equilibrium concentrations of $NO_2(g)$, NO(g) and $O_2(g)$ with their initial concentrations, by considering reaction quotient (Q_c) at the initial point.

(v) In an another experiment, 0.20 mol of $O_2(g)$ were added to 5.00 dm^3 rigid vessel containing 0.20 mol of NO(g) at 600 K. The added $O_2(g)$ reacts with the NO(g) in the container.

I. Write balanced chemical equation for the reaction occurring in the container.

II. Calculate the total pressure in the container assuming that the reaction take place completely. **(75 marks)**

(*b*) Liquid heptane $C_7H_{16}(l)$ undergoes complete combustion as follows.

ΔH°_C = Standard Enthalpy of Combustion

$$C_7H_{16}(l) + 11O_2(g) \rightarrow 7CO_2(g) + 8H_2O(l) \qquad \Delta H^\circ_C = -4850\ kJ\ mol^{-1}$$

(i) Using the information given below, calculate Standard Enthalpy of Formation ΔH°_f of $C_7H_{16}(l)$ in $kJ\ mol^{-1}$

	ΔH°_f / $kJ\ mol^{-1}$
$CO_2(g)$	−393.5
$H_2O(l)$	−285.8

(ii) In a practical examination, a student was instructed to determine the standard neutralization enthalpy ($kJ\ mol^{-1}$) ΔH°_{neu} for the reaction, $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$.

1.00 mol dm^{-3} HCl and 1.00 mol dm^{-3} NaOH solutions, measuring cylinders, polystyrene cup and a thermometer were provided.

I. Explain how you would design the above experiment and the necessary assumptions to be made in the process.

II. What are the measurements those have to be made for the estimation of the heat, **q** released in the experiment?

III. In a certain experiment, 200.00 cm^3 of 1.00 mol dm^{-3} HCl and 200.00 cm^3 of 1.00 mol dm^{-3} NaOH solutions at 25 °C were mixed in a polystyrene cup and the maximum temperature was found as 31.5 °C. Calculate the ΔH°_{neu} ($kJ\ mol^{-1}$) for the reaction. You are given that density of water is 1.00 g cm^{-3} and specific heat capacity of water is 4.2 J $g^{-1}\ K^{-1}$.

IV. The student repeated the experiment with the same volumes in (III) by using of 2.00 mol dm^{-3} HCl and 2.00 mol dm^{-3} NaOH solutions. Here,

(A) Is the value of **q** increased, decresed or stable? Give reasons for your answer.

(B) Is the value of ΔH°_{neu} increased, decresed or stable? Give reasons for your answer.

V. If there was a significant amount of heat lost during the experiment, how would this affect the value of ΔH°_{neu}?

(75 marks)

6 (*a*) At 25 °C propanoic acid $C_2H_5COOH(aq)$ ionizes in aqueous solution as given below.

$C_2H_5COOH(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + C_2H_5COO^-(aq)$

at 25 °C $K_a = 1.00 \times 10^{-5}\,mol\,dm^{-3}$

(i) Write the expression for the acid dissociation constant K_a.

(ii) Calculate the pH of $0.100\,mol\,dm^{-3}$ $C_2H_5COOH(aq)$ solution at 25 °C.

(iii) At 25 °C, 25.00 cm^3 the solution in (ii) was titrated with $0.100\,mol\,dm^{-3}$ NaOH solution.

I. State whether the mixture at the equivalence point is acidic or basic by using an appropriate reaction.

II. Calculate the value of pH.
(at 25 °C, $K_w = 1.0 \times 10^{-14}\,mol^2\,dm^{-6}$)

(60 marks)

(*b*) At 25 °C, following equilibrium exists in an aqueous saturated solution of Ag_2CrO_4.

$Ag_2CrO_4(s) \rightleftharpoons 2Ag^+(aq) + CrO_4^{2-}(aq)$ $\quad K_{sp} = 3.2 \times 10^{-11}\,mol^3\,dm^{-9}$ at 25 °C

(i) Write the expression for solubility product constant of the above system.

(ii) Determine the concentration of $[Ag^+(aq)]$ in a saturated solution of Ag_2CrO_4 at 25 °C.

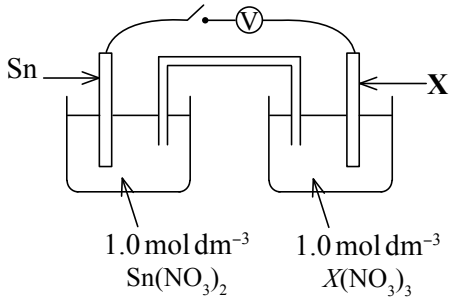
(iii) Calculate the maximum mass of $Ag_2CrO_4(s)$ in grams that can be dissolved in 100.00 cm^3 of water at 25 °C. ($Ag_2CrO_4 = 332\,g\,mol^{-1}$)

(60 marks)

(*c*) State the conditions to be satisfied for the application of distribution law in the determination of partition coefficient, K_D of a system formed by dissolving a solute in two immiscible solvents.

(30 marks)

7 (*a*)



An electrochemical cell was constructed by using Sn and unknown metal **X** electrodes as shown in the above diagram at 25 °C. When the switch is kept 'ON' for some time, the mass of the Sn electrode was increased.

(i) Giving reasons identify the anode and cathode.

(ii) Write down the half - reactions of above cell by identifying the oxidation state of **X**.

(iii) Indicate the direction of electron flow.

(iv) At 25 °C $E°_{Sn^{2+}/Sn} = -0.14$ V. It was found that electro motive force of cell $E°_{cell}$ as +0.60 V. What is the value of $E°_{X^{3+}/X}$ electrode. Is the answer consistent with the half reactions identified in (ii) above?

(v) Write the overall cell reaction when the cell is operation.

(vi) How many moles of electrons are transferred when 1.0 mol of $Sn^{2+}(aq)$ is consumed in the cell.

(vii) At 25 °C, an electric current of 1.0 A is passed through the cell for one hour. Calculate the mass of Sn (in grams) that is deposited on the Sn electrode.
(Sn = 119, Faraday constant (F) = 96500 C)

(75 marks)

(*b*) (i) **A** and **B** are two octahedral coordination compounds with molecular formula $CoN_5H_{12}Br_2O_2$. H atoms exists as NH_3 only. In both compounds cobalt is in the same oxidation state. Only compound **B** gives a pale yellow precipitate with $AgNO_3$(aq) that is insoluble in dilute NH_3 but soluble in conc.NH_3.

I. Of above compounds what is the oxidation state of Co?
II. Write the complete electronic configuration of Co ion given in above.
III. Identify common ligands coordinated in compounds **A** and **B**.
IV. Give the structural formule of compounds **A** and **B** giving reasons.
V. Give a chemical test to identify the anion in compound **A**.

(25 marks)

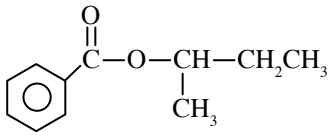
(*c*) This question is based on an experiment carried out to determine dissolved oxygen content in a water sample. An amber colour bottle was completely filled with the water sample that has to be tested and alkaline KI and $MnSO_4$ solutions are added immediately using a dropper in small amounts. The bottle was closed and mixed and then a small amount of conc. H_2SO_4 solution was added. When reactions are completed, 50.0 cm^3 from solution was taken into a titration flask, and titrated with 0.002 mol dm^{-3} $Na_2S_2O_3$ solution.

(i) Explain why an amber colour bottle should be used in this experiment.
(ii) Explain why KI solution used in here should be alkaline.
(iii) Why H_2SO_4 acid used should be concentrated?
(iv) What is the indicator used in the titration? The indicator is usually not added at the beginning but closer to the end point. Explain the resons.
(v) Identify the chemical species that reacts with dissolved oxygen in the water sample and write the balanced ionic equation.
(vi) Write balanced ionic equations for all other reactions taking place.
(vii) If the burette reading is 20.00 cm^3, calculate the dissolved oxygen content in mol dm^{-3} and in ppm. Assume that the density of the solution is 1.0 g cm^{-3}. (O = 16)

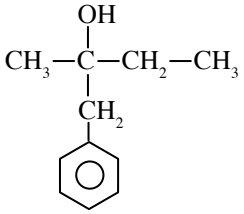
(50 marks)

Part C - Essay

8 (*a*) Consider the organic compounds **A** and **B** given below.



A

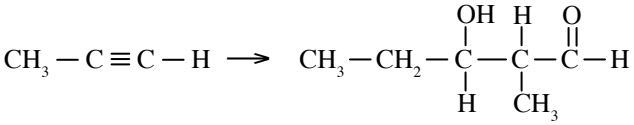


B

Write down the appropriate path for the conversion of **A** to **B**. Your conversion should **not** be more than eight steps and no other organic compound can be used as reagents.

(50 marks)

(*b*) Work out the following conversion using not more than **six** steps.



(30 marks)

(*c*) Consider the compounds **E**, **F**, **G** and **H** given below.

E $CH_3-\overset{\overset{O}{\|}}{C}-NH_2$ **F** $CH_3-\overset{\overset{O}{\|}}{C}-Cl$

G CH_3CH_2Cl **H** $CH_3CH_2NH_2$

(i) Indicate whether the reactant pair of **E** and **G** or **F** and **H** can be used to prepare the compound, $CH_3-\overset{\overset{O}{\|}}{C}-NH-CH_2CH_3$.

(ii) Give reasons for selecting particular pair of reactant and also not to select the other reactant pair.

(iii) Draw the structures of the products formed by the reaction between **G** and **H** above.

(40 marks)

(*d*) (i) Draw the structure of the intermediate positive-ion formed in the reaction between $CH_2=CH_2$ and Br_2/CCl_4.

(ii) When the above reaction is carried out in the aqueous medium, $Br-CH_2-CH_2-OH$ is formed as a product. Suggest a mechanism considering that H_2O molecule can act as a nucleophile.

(30 marks)

9 (*a*) **A** is a coloured solid. Addition of dil. H_2SO_4 to it gives a colorless gas **B** and solution **C**. Precipitate **D** is formed by the addition of dil. $NH_3(aq)$ to solution **C**. Further addition of $NH_3(aq)$ dissolves the precipitate and gives a dark blue solution **E**. Addition of dil.HCl to the solution **C**, followed by bubbling $H_2S(g)$ doesn't form a precipitate. When gas **B** is bubbled through acidic $K_2Cr_2O_7$, a green turbid solution is formed.

(i) Write chemical formulae of **A**, **B**, **C**, **D** and **E**.

(ii) Write the balanced chemical equation for the reaction between **A** + H_2SO_4.

(iii) Write the balanced chemical equation for the reaction between **B** + $K_2Cr_2O_7$ using half ionic equations.

(30 marks)

(*b*) **R** is a well water soluble crystalline white compound with high boiling point (1304 °C) and high melting point (661 °C). Tests were carried out using an aqueous solution of **R** and the observations obtained are given in the following table.

Experiment	Observation
1. Addition of acidic KIO_3 solution	Brown color solution
2. Addition of aqueous $Cu(NO_3)_2$ solution	Reddish brown turbid solution labeled as **S**.
3. Addition of $Na_2S_2O_3$ solution to solution **S**	Disappearance of reddish brown colour and appearance of a white precipitate
4. Flame test with solid **R**	Yellow colour flame

(i) Identify **R**.

(ii) Write balanced chemical equations for the above tests 1, 2 and 3.

(iii) Briefly explain why should **R** has high boiling and melting point.

(30 marks)

(*c*) 10.0 g of alloy containing only Fe, Cr and Ni when heated with dil. HNO_3 dissolved to give Fe^{3+}, Cr^{3+} and Ni^{2+} respectively. The resulting solution was diluted to a total volume of 250.00 cm^3 by adding distilled water. 25.00 cm^3 of the diluted solution was treated with excess NaOH and H_2O_2. The obtained precipitate **P** was filtered and yellow colour filtrate **Q** was acidified with dil. H_2SO_4 acid, and titrated with 1.0 mol dm^{-3} Fe^{2+} solution. The volume of Fe^{2+} required to reach the end point was 30.00 cm^3.

(i) Name the species responsible for yellow colour in the above filtrate **Q**.

(ii) Write balanced ionic equation for the reaction of metal ion in filtrate **Q**.

(iii) Give the colour of the solution formed by acidifying the filtrate **Q** and chemical species responsible for this colour.

(iv) Write balanced ionic equations for the reactions between chemical species given in (iii) above with Fe^{2+} in acidic medium.

(v) Calculate the mass percentage of the metal in the alloy given in part (ii).

(vi) Precipitate **P** was dissolved completely in H_2SO_4 and excess KI was added. The volume of 0.20 mol dm^{-3} $Na_2S_2O_3$ required to titrate I_2 evolved was 20.00 cm^3. Write balanced chemical equations for all reactions that occur in this process.

(vii) Calculate mass percentages of the remaining two metals in the alloy separately.

(viii) How you would confirm the presence of Ni metal in alloy by using a solution / precipitate in above experiment.

(90 marks)

10(*a*) Production of ammonia by using Haber process is one of the major chemical industry.

(i) State the main raw materials of the Haber process.

(ii) Write the balanced chemical equation along with the appropriate conditions for the reaction occuring.

(iii) Though the optimum conditions have been used, raw materials are not converted completely to NH_3 within the reaction container. Give reasons.

(iv) How does the unreacted raw materials used effectively in ammonia production.

(v) Production of NH_3 decreases with increasing temperature. Explain this by using enthalpy change, entropy change, Gibbs energy change related to the reaction.

(vi) Name **one** renewable resource that can be used for the energy generation in this process. State an environmental advantage of it.

(vii) Give **one use** of NH_3 except for the use in the production of fertilizers.

(50 marks)

(*b*) Effluent gases released by various industries causes acid rain.

(i) Name **two** gases that contribute to acid rain.

(ii) Explain how the gases stated in (i) contribute to acid rain by using balanced chemical equations.

(iii) Identify **two** industries that contribute to acid rain.

(iv) Briefly explain the gases stated in (i) are evolved to the atmosphere by these industries.

(v) Give **two** effects to the soil due to acid rain.

(50 marks)

(*c*) Natural rubber is used to produce number of commercially valuable products.

(i) Draw the repeating unit of natural rubber molecule.

(ii) Elasticity of natural rubber should be controlled in some production processes.

I. Name the above mentioned process.

II. Name the main reagent (chemical) other than rubber that is being used in this process.

III. State the structural change that occurs in rubber molecule during this process.

IV. Name **two** mechanical properties other than controlling elasticity of the product obtained from the above process.

(iii) Explain why the process described in (ii) I is not appropriate for poly propylene.

(iv) Name **two** pollutants present in effluent water from a natural rubber latex storing center.

(50 marks)

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(07) Mathematics

Structure of the Question Paper

Paper I - **Time : 03 hours** (In addition, 10 minutes for reading.)
This paper consists of **two** parts.
Part A : Ten questions. **All** questions should be answered. 25 marks for each question - altogether 250 marks.
Part B : Seven questions. **Five** questions should be answered. Each question carries 150 marks - altogether 750 marks.
Total marks for paper I = 1000

Paper II - **Time : 03 hours** (In addition, 10 minutes for reading.)
This paper consists of **two** parts.
Part A : Ten questions. **All** questions should be answered. 25 marks for each question - altogether 250 marks.
Part B : Seven questions. **Five** questions should be answered. Each question carries 150 marks - altogether 750 marks.
Total marks for paper II = 1000

Calculation of the final mark :

Paper I	=	1000
Paper II	=	1000
Final mark	=	2000 ÷ 20 = 100

(07) Mathematics

Paper I

Part A

1. Let $A = \{x \in \mathbb{R} : |x + 3| < 2\}$ and $B = \{x \in \mathbb{R} : |x| \geq 4\}$ be subsets of the universal set $\mathbb{R}$. Find $A \cap B$ and $A' \cap B$.

2. Let A and B be subsets of a universal set S. The set $A \setminus B$ is defined, in the usual notation, by $A \setminus B = A \cap B'$. Show that $A \setminus (B \cup C) = (A \setminus B) \cap (A \setminus C)$ and $A \setminus (B \cap C) = (A \setminus B) \cup (A \setminus C)$.

3. Let p and q be propositions. Show that the compound propositions $\sim(p \vee (\sim p \wedge q))$ and $\sim p \wedge \sim q$ are logically equivalent.

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4. Using the method of **proof by contradiction**, prove that if $3n^2 + 2$ is odd, then n is odd.

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5. Solve the simultaneous equations $y - \frac{1}{3}\log_2 x = 0$ and $8^{2y-1} - 2(x-4) = 0$ for x and y.

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6. Find all real values of x satisfying the inequality $x - \frac{4}{x} \leq 3$.

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7. Let $f(x) = \sqrt{x+3} - 5$ be a function defined on $[-3,\infty)$. Find the range of the function f and show that f is one-to-one. Find $f^{-1}(x)$.

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8. The line l has gradient -3 and passes through the point $A(2,1)$. A point B is on the line l such that the distance AB is $3\sqrt{10}$. Find the possible coordinates for the point B.

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9. Find the points at which the tangents to the parametric curve given by $x = 2t^3,\ y = 2 - 4t + t^2$ has a slope of -1.

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10. Find the area of the region bounded by the curves $y = x^2$ and $x + y = 2$.

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Part B

11. (*a*) Fifty students sat for an examination in the subjects, Mathematics, Physics and Chemistry. Out of these 50 students, 37 passed Mathematics, 24 passed Physics and 43 passed Chemistry. Further, it is given that at most 19 students passed Mathematics and Physics, at most 29 passed Mathematics and Chemistry and at most 20 passed Physics and Chemistry. Find the largest possible number of students that could have passed all three subjects.

(*b*) Determine whether the compound proposition $[\sim p \wedge (p \vee q)] \rightarrow q$ is a tautology or a contradiction.

12. (*a*) Using the **Principle of Mathematical Induction**, prove that

$\sum_{r=1}^{n}(3r^2 + 5r + 1) = n(n+2)^2$ for all $n \in \mathbb{Z}^+$.

(*b*) Let $U_r = \dfrac{2}{(2r-1)(2r+1)}$ for $r \in \mathbb{Z}^+$.

Verify that $U_r = \dfrac{1}{(2r-1)} - \dfrac{1}{(2r+1)}$ for $n \in \mathbb{Z}^+$, and show that $\sum_{r=1}^{n} U_r = \dfrac{2n}{2n+1}$ for $n \in \mathbb{Z}^+$.

Also, find $\sum_{r=10}^{20}(2U_r + 3r)$.

13. (*a*) The roots of the quadratic equation $x^2 + (4 + k)x - (25 + k) = 0$ are α and $-\alpha^2$, where k is a real constant.

Show that α is a root of the equation $x^3 - x^2 + x - 21 = 0$.

Show that $(x - 3)$ is a factor of $x^3 - x^2 + x - 21$ and show that the equation $x^3 - x^2 + x - 21 = 0$ has only one real root.
Hence, find the value of k.

(*b*) Let $f(x) = -2x^2 + 12x - 16$.

Write the function $f(x)$ in the form $a(x-h)^2 + k$, where a, h and k are constants to be determined.

Find the coordinates of the vertex, equation of the axis of symmetry, and the maximum value of f. Sketch the graph of the function $y = f(x)$.

The function g is defined by $g(x) = -2 - f(x + 1)$. Determine the axis of symmetry, and the minimum value of the function g.

14. (*a*) Write down, in the usual notation, the binomial expansion of $(a + b)^n$, where a and b real numbers and n is a positive integer.

(i) If the sum of the coefficients of the first, second and the third terms of the binomial expansion of $\left(x^2 + \dfrac{1}{x}\right)^n$ is 46, find n.

(ii) Find the value of k if the coefficient of x^4 in the expansion of $\left(kx + \dfrac{1}{x}\right)^{10}$ is equal to $\dfrac{15}{16}$. For this value of k, find the term of the expansion that is independent of x.

(*b*) A person has the following 3 investment options:

Option 1: Invest under 14% simple interest per annum
Option 2: Invest under 12% compound interest per annum
Option 3: Invest under quarterly compounded 8% interest per annum

(i) Select the best investment option based on the interest accumulated at the end of 5 years.

(ii) The person also has the 4th option of investment where the interest is calculated quarterly at an annual rate of r%. If the interest under option 4 is larger than that is under option 2 for a period of 10 years, what is the minimum value of r?

15. Let $y = m_1 x + c_1$, $y = m_2 x + c_2$ and $x = 0$ be the equations of the sides AB, BC and AC of the triangle ABC respectively. Show that the area of triangle ABC is given by $\dfrac{(c_1 - c_2)^2}{2|m_1 - m_2|}$.

Let $3x - y + 5 = 0$, $2x + 3y - 1 = 0$ and $x + 2y - 3 = 0$ be the equations of the sides BC, CA and AB respectively of the triangle ABC.

A straight line passing through the point A with gradient $-\dfrac{1}{3}$ intersects at the point D with a straight line passing through the point B and parallel to CA. If O is the origin, show that the equation of OD is given by $y + x = 0$.

The straight line passing through the point D and perpendicular to the side AB meet the y -axis at the point E. Find the area of the triangle ODE.

16. (*a*) Find $\lim\limits_{x \to 2} \dfrac{\sqrt{x} - \sqrt{2}}{x^2 - 4}$.

(*b*) Differentiate each of the following with respect to x.

(i) $\left(\dfrac{x}{1 - x}\right)^6$

(ii) $\dfrac{e^{2x} + e^{-2x}}{e^{2x} - e^{-2x}}$

(iii) $x^2 \ln (x^4 + 1)$

(*c*) An open tank of volume 4000 m^3 having a square base and vertical walls is to be constructed from thin sheet material. Find the dimensions of the tank such that the material used is a minimum.

17. (*a*) Using **integration by parts**, evaluate $\displaystyle\int_0^1 x^2 e^{2x}\, \mathrm{d}x$

(*b*) Using **partial fractions**, find $\displaystyle\int \frac{2x + 3}{(x + 1)(x + 2)^2}\, \mathrm{d}x$.

(*c*) The following table gives the values of the function $f(x) = \sqrt{2x + 1}$, correct to three decimal places for values of x between 0 and 1 at intervals of length 0.25.

x	0	0.25	0.50	0.75	1.00
$f(x)$	1	1.225	1.414	1.581	1.732

Using **Simpson's rule**, find an approximate value for $I = \int_0^1 \sqrt{2x + 1}\, dx$ correct to two decimal places.

Using the substitution $u = 2x + 1$, find I and compare the value of I with the approximate value obtained above.

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(07) Mathematics

Paper II

Part A

1. Find values of x satisfying $\begin{vmatrix} 1 & 1 & x \\ 4 & 4 & x+1 \\ 3 & x+1 & x+2 \end{vmatrix} = 0$.

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2. Let $A = \begin{pmatrix} 2 & 0 \\ 3 & -1 \\ 1 & 4 \end{pmatrix}$, $B = \begin{pmatrix} -1 & 1 \\ 0 & -3 \\ -2 & 1 \end{pmatrix}$ and $C = \begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix}$.

Find $A - 2B$, AC and BC. Verify that $(A - 2B)\,C = AC - 2BC$.

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3. Certain IQ test scores follow a normal distribution with mean of 100 and standard deviation of 16. Compute the cut off value that bounds the highest 5% of all IQ test scores.

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4. The mean, median and standard deviation of a particular distribution are 61, 52 and 10 respectively. Calculate the coefficient of skewness and comment on the shape of the distribution. Is mean a reasonable measure of central tendency for this distribution? Justify your answer.

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5. In a production process, biscuits are packed in two sizes, viz. 100 g and 200 g. Following summary measures were calculated based on testing done on samples of packets.

Size	Sample size	Sample mean	Standard deviation
100 g	20	102 g	2.5 g
200 g	20	203 g	3.1 g

Calculating coefficient of variation, determine the size of packet which is more consistent in weight.

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6. A continuous random variable X is uniformly distributed over the interval $[a, 6a]$, where a is a positive constant. Find the distribution function of X.

Another continuous random variable Y is uniformly distributed over the interval $[-2, 8]$. If $P(X < 3) = P(Y < 4)$, find the value of a.

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7. A certain type of knee surgery has a 75% chance of success. The surgery was performed on four patients. Find the probability of the surgery being successful on exactly two patients.

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8. The random variable X has the following probability distribution:

x	1	2	3	4	5
$P(X = x)$	p	0.2	q	0.3	0.1

If $E(X) = 3.1$, find p and q. Find Var(X).

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9. Let A and B be two events of a sample space S. If $P(A \cap B) = \frac{1}{5}$ and $P(A) = P(A|B') = \frac{7}{15}$, then find $P(B|A)$ and $P(B)$.

Determine whether the two events A and B are independent.

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10. The random variable X has probability density function $f(x)$ given by $f(x) = \begin{cases} x - k, & \text{if } 0 \le x \le 2, \\ 0, & \text{otherwise} \end{cases}$, where k is a constant. Show that $k = \frac{1}{2}$ and find the mean of X.

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Part B

11. A company produces 2 types of products A and B, where each of the product should go through 2 different processes. The time required at each process to produce one unit of product depends on the type of product. The hours needed at each process to produce one unit of product A and B, and the number of hours of work that can be handled by each process per week is given in the table below.

		Time required (hours) per unit		**Number of hours of work that can be handled by the process per week**
		Process 1	**Process** 2	
Product	A	2	4	40
	B	4	4	32

Suppose that the company needs to produce at least 2 units from each of the products A and B.

The profit per unit of products A and B are 10 rupees and 5 rupees respectively. Assume that all units produced can be sold. It is required to determine the number of units to be produced per week from each product to maximize the total profit.

(a) Formulate this as a linear programming problem.
(b) Sketch the feasible region and **hence** solve the problem graphically.

12. (a) If $A = \begin{pmatrix} 2 & -1 \\ -1 & 2 \end{pmatrix}$, $B = \begin{pmatrix} 1 & 0 \\ 0 & 3 \end{pmatrix}$ and $X = \begin{pmatrix} x & 2 \\ 3 & -y \end{pmatrix}$, find the values of x and y such that $AX = XB$.

(b) Let $A = \begin{pmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{pmatrix}$. Show that $A^2 - 4A = 5I$, where I is the identity matrix of order 3.

Hence or otherwise, find the square matrix B of order 3 such that $BA = I$.

Consider the following system of linear equations:

$$\begin{aligned} x + 2y + 2z &= -1, \\ 2x + y + 2z &= 2, \\ 2x + 2y + z &= -1. \end{aligned}$$

Taking $C = \begin{pmatrix} -1 \\ 2 \\ -1 \end{pmatrix}$ and $X = \begin{pmatrix} x \\ y \\ z \end{pmatrix}$, show that the matrix equation $AX = C$ represents the above system of linear equations.

Hence, solve the above system of linear equations.

13. (*a*) Three cards are numbered as 1, 3, and 4. A game consists of picking one card at random and rolling a six sided fair die with faces numbered 1, 2, 3, 4, 5 and 6. Let the number on the card picked be x and let the number on the die facing up be y. The events A and B are defined as follows:
A : $x \geq y$,
B : $x + y$ is an even number.

(i) Find the $P(A)$, $P(B)$ and $P(A|B)$.

(ii) Determine whether the events A and B are mutually exclusive.

(*b*) (i) Find the number of different permutations that can be formed from the eleven letters of the word "COEFFICIENT".

(ii) Find the number of different combinations of four letters that can be formed from eleven letters of the word "COEFFICIENT".

14. (*a*) An ice- cream seller has to decide whether to order more stock for the holiday weekend. From past experience he knows that there is an 85% chance of selling all his stock, if the weather is sunny; if it is cloudy his chance is 65%; and if it rains, his chance is only 10%. According to weather forecast, the probability of sunny is 40%, the probability of cloudy is 35% and the probability of rainy is 25%.

(i) What is the probability that the seller will sell all his stock?

(ii) What is the probability that the weather was sunny, given that he sold all his stock of ice- cream?

(*b*) The Body Mass Index (BMI) is used to classify people as under-weight, normal-weight and over-weight. The classification is shown below.
Under-weight : if BMI $\leq$ 18.5
Normal-weight : if 18.5 < BMI < 25.0
Over-weight : if BMI $\geq$ 25.0
In a particular population, Body Mass Index (BMI) is normally distributed with mean 20 and standard deviation 4.

(i) Calculate the percentage of people belonging to each of the above weight categories.

(ii) If 200 people were randomly selected from the above described population, how many under-weight people can be expected among the selected people.

15. Assume that an insurance policy holder is two times more likely to file 2 claims as to file 3 claims per month. Suppose that the number of claims X of that policy holder in a month follows a Poisson distribution with probability mass function given by $P(X=x) = \frac{e^{-\lambda}\lambda^x}{x!}$, for $x = 0, 1, 2, 3, \ldots$.

(*a*) Find λ .

(*b*) Find the probability that the insurance policy holder files at least one claim per month (you may take $e^{-5} \cong 0.6065$).

(*c*) If the insurance policy holder continues to file claims in every month in a similar manner, find the expected number of claims that will be filed a year.

16. Monthly income figures of 50 families are summarized in the table below.

Income (Rupees)	No. of families
10 000 - 14 999	2
15 000 - 19 999	8
20 000 - 24 999	15
25 000 - 29 999	9
30 000 - 34 999	6
35 000 - 39 999	5
40 000 - 44 999	3
45 000 - 49 999	2

(i) Using a suitable coding method calculate mean, median and mode of the monthly income.

(ii) Estimate the inter-quartile range of the monthly income.

(iii) Families with monthly income less than Rs. 20 000 are considered as low income families. Calculate the percentage of low income families.

(iv) A subsidiary was given to all the low income families to bring up their monthly income upto Rs. 20 000. What is the inter-quartile range of the monthly income after giving this subsidiary?

17. The relationships between the activities of a project and the duration of each activities are given below.

Activity	Immediate predecessor/s	Duration (in weeks)
A	–	2
B	A	3
C	A	5
D	B	8
E	B, C	4
F	E	6
G	D, F	7
H	G	9

(i) Construct the project network.

(ii) Write down the critical activities of the project.

(iii) Prepare a time schedule for each activity including earliest start time, earliest finish time, latest start time, latest finish time and float.

(iv) What are the activities that cannot be delayed without extending the total duration of the project?

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(08) Agricultural Science

Structure of the Question Paper

Paper I - **Time : 02 hours**
This paper consists of **50** multiple choice questions with **5** options. **All** questions should be answered. Each question carries **01** mark. Total marks **50**.

Paper II - **Time : 03 hours.** (In addition, 10 minutes for reading.)
This paper consists of two parts as **Structured Essay** type and **Essay** type.

Part A - **Four structured essay** type questions. **All** questions should be answered. Each question carries 100 marks - altogether 400 marks.

Part B - **Six essay** type questions. **Four** questions should be answered. Each question carries 150 marks - altogether 600 marks.

Total marks for paper II = 1000

Calculation of the final mark			
	Paper I		= 50
	Paper II	= 1000 ÷ 20	= 50
	Final mark		= 100

Paper I

Important :

* Answer **all** questions.
* Select the **correct** or the **most appropriate** answer.
  (A separate sheet will be provided to mark answers for multiple choice questions.)

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1. The element needed for stomata movement and to regulate the osmotic pressure in the plant cells is
(1) N (2) P (3) K (4) Ca (5) Mg

2. A group of Bacteria living symbiotically with plants in family Poaceae while fixing nitrogen is
(1) *Azotobacter.* (2) *Clostridium.* (3) *Bacillus.*
(4) *Rhizobium.* (5) *Azospirillum.*

3. Height of the dwarf plants can be increased by applying
(1) Gibberellin. (2) Cytokine. (3) Auxin.
(4) Abscisic acid. (5) Ethylene.

4. Following are some chemicals used in tissue culture laboratories.
A - Clorox solution B - Ethanol
C - Teepol D - Formalin
Of above, the chemicals used for surface sterilization of an explant are,
(1) A and B only. (2) A, B and C only. (3) A, B and D only.
(4) A, C and D only. (5) B, C and D only.

5. Factor/s affecting the rooting in layering would be

(1) plant species.
(2) maturity of the branch.
(3) plant species and maturity of the branch.
(4) plant species and bark thickness of the branch.
(5) maturity and bark thickness of the branch.

6. The process of the production of homozygous plants through self-pollination is known as

(1) cross breeding. (2) inbreeding. (3) cloning.
(4) mutation breeding. (5) pedigree breeding.

7. Amount of available water to a plant in a soil is expressed as,

(1) saturation – field capacity
(2) saturation – permanent wilting point
(3) field capacity – permanent wilting point
(4) saturation – hygroscopic water
(5) field capacity – hygroscopic water

8. In a soil, water holding capacity increases with the increase of,

(1) coarseness. (2) fineness. (3) compaction.
(4) random roughness. (5) consistency.

9. Few combinations of plant diseases and the way of spreading are given in the following table. The correct combination of the disease and the way of spreading is,

	Disease	**way of spreading**
(1)	ring spot	water
(2)	wilt	vector
(3)	rust	air
(4)	Soft rot	seeds
(5)	late blight	equipments

10. A pesticide bottle is labeled as "organic pesticide of plant origin". The chemical compound found in this pesticide would be,

(1) Endosulfan. (2) Diazinon. (3) Metaldehyde. (4) Pyrethrum. (5) Captan.

11. Following are nutritional compositions of 3 feed stuffs.

A - 40% protein, 10% fibre and 40% starch
B - 10% protein, 40% fibre and 10% Ash
C - 41% protein, 30% fat and 10% starch

Of above,

(1) A and C are protein supplements having similar energy values.
(2) A and B are roughage feeds.
(3) B and C are suitable for feeding poultry birds.
(4) A and B are suitable for feeding cattle.
(5) A and C are suitable for feeding poultry.

12. Consider the following statements in relation to human nutrition.

A - Both macronutrients and micronutrients are essential

B - Vitamins are classified as macronutrients

C - Essential fatty acids **cannot** be synthesized in a human body in required quantities

D - Lipid is a micronutrient

Of above, the correct statements are,

(1) A and B only.

(2) A and C only.

(3) B and C only.

(4) B and D only.

(5) C and D only.

13. The most suitable examples of food, to represent diversification and value addition are,

(1) flavored black tea and roasted rice flour respectively.

(2) rice flour noodles and bread respectively.

(3) chicken sausage and virgin coconut oil respectively.

(4) yoghurt and tomato sauce respectively.

(5) sterilized milk and ice-cream respectively.

14. Consider the following statements in relation to maturity indices.

A - Maturity indices are helpful in determining the correct stage of harvesting

B - Harvesting at the proper maturity stage gives higher yield

C - pH and starch granule shape are good maturity indices

D - Specific gravity and firmness are good maturity indices

Of above, the correct statements are,

(1) A and B only.

(2) B and C only.

(3) A, B and C only.

(4) A, B and D only.

(5) A, C and D only.

15. The soil health can be improved by,

(1) continuous application of inorganic fertilizers.

(2) continuous cultivation without a fallow period.

(3) frequent ploughing to a constant depth.

(4) practicing continuous monocropping.

(5) draining of excess water from the field.

16. "Hydroponics" can be best explained as growing plants in,

(1) misty environment containing plant nutrients.

(2) liquid media containing plant nutrients.

(3) soilless solid media containing plant nutrients.

(4) media containing demineralized water.

(5) any media using liquid fertilizer.

17. Following are some good harvesting and postharvest practices applicable for fruits.

A - Use of appropriate Brix value

B - Dipping in warm water

C - Harvesting in the evening

Of the above, the commonly used practice/s in harvesting mango to maintain its postharvest quality would be,

(1) A only. (2) B only. (3) A and B only. (4) A and C only. (5) B and C only.

18. A change that occurs in soil due to primary land preparation is

(1) increasing bulk density.
(2) increasing particle density.
(3) improving soil aeration.
(4) decreasing random roughness.
(5) decreasing soil porosity.

19. An agriculture student observes that a Dry Zone farmer practices the following:

A - Cultivation of a single crop.

B - Production of planting materials by himself.

C - Planning his farming according to the weather pattern.

Of above, example/s for traditional agricultural practice/s would be

(1) A only. (2) B only. (3) C only. (4) A and B only. (5) B and C only.

20. Following are some factors influencing the demand and supply of rice.

A - Labour cost

B - Selling price of the product

C - Fertilizer subsidy

D - Consumer income

Of the above, the factors that directly affect only to the market supply would be

(1) A and B only. (2) A and C only. (3) A and D only. (4) B and C only. (5) C and D only.

21. GPS technology is mainly used in

(1) conservation farming.
(2) organic farming.
(3) precision farming.
(4) bio dynamic farming.
(5) integrated farming.

22. The following are some of the problems faced by the agriculture sector today.

A - Loss of agricultural biodiversity.

B - Reduction of farming population.

C - Susceptibility of plants to pest and diseases.

Of above, the example/s for **negative impact/s** of the green revolution would be

(1) A only. (2) B only. (3) C only. (4) A and B only. (5) A and C only.

23. Following are some characteristics of a transmissible disease in livestock.

- Zoonatic disease
- Infected through non pasteurized milk or raw meat from infected animals
- causal organism is a bacteria
- muscle pain and excessive sweating are the major symptoms

The above disease would be,

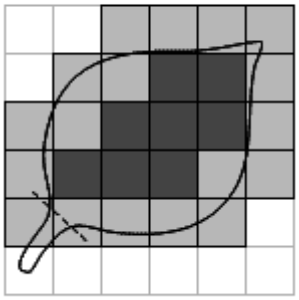
(1) Mad cow disease. (2) Leptospirosis. (3) Brucellosis. (4) Bird flu. (5) Swine flu.

24. Main steps of making grass silage in correct order are, cutting grasses
(1) filling the silo, making it air tight and pressing.
(2) filling the silo, pressing and closing.
(3) wilting, mixing, filling the silo and closing.
(4) filling the silo, adding water, pressing and closing.
(5) mixing with inoculants, filling the silo and closing.

25. The fat content of the cow's milk depends on
(1) the breed and the stage of the lactation.
(2) the breed and the method of milking.
(3) stage of lactation and the amount of minerals in the diet.
(4) method of milking and the amount of minerals in the diet.
(5) the amount of minerals in the diet and the breed.

26. An example for a rice value chain is,
(1) harvesting → collecting → storing → selling.
(2) harvesting → bulk storing → collecting → grading.
(3) Bulk storing → packing → grading → selling.
(4) Bulk storing → processing → packing → grading.
(5) harvesting → processing → collecting → marketing.

- **Use the following diagram to answer the question No. 27.**



27. According to the above diagram, the area of the leaf is
(1) 6 cm^2 . (2) 8 cm^2 . (3) 14 cm^2 . (4) 26 cm^2 . (5) 36 cm^2 .

28. The flow path of water from a water source to the main line in a drip irrigation system is given as,
(1) suction line, filter unit, pump and delivery line.
(2) suction line, pump, delivery line and filter unit.
(3) suction line, pump, filter unit and delivery line.
(4) suction line, delivery line, pump and filter unit.
(5) delivery line, pump, suction line and filter unit.

29. Examples for a fodder grass and a fodder legume are,
(1) CO_3 and *Erythrina* respectively.
(2) *Brachiaria* and *Erythrina* respectively.
(3) CO_3 and *Puraria* respectively.
(4) *Brachiaria* and *Puraria* respectively.
(5) *Guinea grass* and *Centrocema* respectively.

30. In relay cropping,

(1) Reproductive stages of the first crop and the second crop could be observed at the sametime in the field.

(2) Vegetative stages of the first crop and the second crop could be observed at the sametime in the field.

(3) Vegetative stage of the first crop and reproductive stage of the second crop could be observed at the sametime in the field.

(4) Reproductive stage of the first crop and vegetative stage of the second crop could be observed at the sametime in the field.

(5) Second crop is planted after harvesting the first crop.

31. With the increase of environmental temperature,

(1) hens will lay eggs with thick shells.

(2) physical activities and panting of cows will increase.

(3) all farm animals will drink more water.

(4) all farm animals will start sweating.

(5) production in some farm animals will be reduced.

32. Mist propagator is mainly used for rooting of cuttings. In a mist propagator, optimum

A - RH is maintained

B - temperature is maintained

C - level of nutrients is maintained

Of above, correct statement/s would be,

(1) A only. (2) B only. (3) C only.

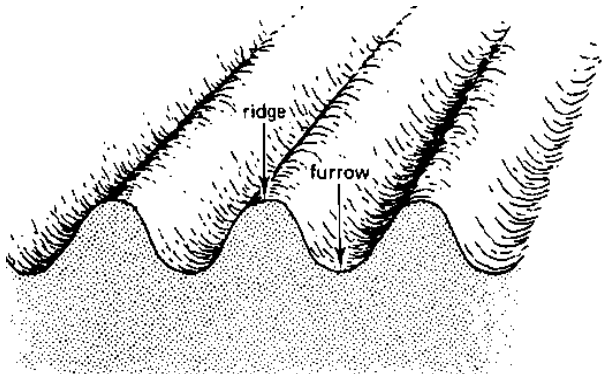
(4) A and B only. (5) A and C only.

33. The most suitable vegetative propagation technique for Rambutan is

(1) wedge graffing. (2) patch budding. (3) Air layering.

(4) Stem cuttings. (5) root cuttings.

• Use following diagram to answer question no. 34



34. A farmer wants to prepare soil beds in a large extent of his farm land as shown in the above diagram. The most suitable equipments he should use for this task in correct order are,

(1) Disc plough, ridger and rotavator. (2) Rotavator, mammoty and ridger.

(3) Mammoty, rake and mammoty fork. (4) Disc plough, tine tiller and ridger.

(5) Disc plough, tine tiller and moldboard plough.

35. Following are some characteristics of certain substrates

A - Good aeration
B - Good drainage
C - High bulk density
D - High water holding capacity

Of the above, suitable characteristics for a potting mixture would be,

(1) A and B only. (2) A, B and C only. (3) A, B and D only.
(4) A, C and D only. (5) B, C and D only.

36. A vegetable crop has a root depth of 400 mm and the soil is irrigated when the total available water level of 60 mm depletes by 50%. The net irrigation requirement is

(1) 200 mm. (2) 120 mm. (3) 75 mm. (4) 60 mm. (5) 30 mm.

37. Consider the following data pertaining to a production process.

Urea (kg)	1	2	3	4	5
Yield (kg)	20	50	90	140	180

The average product when 4 kg of urea is used, and the marginal product when urea usage is increased from 4kg to 5 kg are,

(1) 35 and 40 respectively.
(2) 35 and 35 respectively.
(3) 35 and 50 respectively.
(4) 40 and 35 respectively.
(5) 40 and 50 respectively.

38. In designing a poly-tunnel for low country, the main factor to be considered is the reduction of

(1) relative humidity. (2) temperature.
(3) insect pest damages. (4) disease incidences.
(5) wind effects.

39. Following are some statements on active absorption of plant nutrients.

A - Nutrients are absorbed against the concentration gradient
B - Energy (ATP) is used in the process of nutrient absorption.

Of above,

(1) A is correct and B is incorrect.
(2) A is incorrect and B is correct.
(3) Both A and B are correct and A explains B.
(4) Both A and B are correct and B explains A.
(5) Both A and B are correct and there is no relationship between A and B.

40. The correct statement about weeds is,

(1) *Panicum repens* can be controlled through deep ploughing.
(2) All weeds serve as alternative hosts to insects and disease causing organisms.
(3) Weeds with hibernating seeds are easy to control.
(4) The weeds having both sexual and asexual propagation are difficult to control.
(5) All weeds can be destroyed by submerging in water.

41. Few statements about the biological control of pest are given below.

A - Both adult and larval stages of the parasitic insects always contribute to the biological control

B - There should be a good ability for the parasites to find the host

C - Predators must be host specific

D - Pathogens enter into the pest's body through mouth, cuticle and wounds.

Of the above, the correct statements would be,

(1) A and B only. (2) A and C only. (3) B and C only.

(4) B and D only. (5) C and D only.

42. In a poultry farm, it is observed that when the output increases average cost decreases. If so the marginal cost

(1) declines. (2) increases.

(3) changes. (4) remains below the average cost.

(5) remains above the average cost.

43. The most possible and the least possible reasons for spoilage of deep-fried food are,

(1) microbial actions and physical damages respectively.

(2) microbial actions and lipolytic enzymic reaction respectively.

(3) lipid oxidation and microbial action respectively.

(4) lipid oxidation and enzymatic browning reaction respectively.

(5) non-enzymatic browning reaction and lipolytic enzymic reaction respectively.

44. A student obtained two milk samples at the beginning and the end of a morning milking session, labeled them as A and B respectively and analyzed. The most possible observations would be,

(1) Lactose content in sample A is higher than sample B.

(2) Lactose content in sample B is higher than sample A.

(3) Fat content in sample A is higher than sample B.

(4) Fat content in sample B is higher than sample A.

(5) Fat and lactose content in both A and B samples remain constant.

45. When the difference between wet and dry bulbs' readings of wet and dry bulb thermometer is zero

(1) plants are subjected to wilt.

(2) evapotranspiration is increased.

(3) fungal diseases distribution is increased.

(4) plants are subjected to wilt and fungal diseases distribution is increased.

(5) evapotranspiration is increased and fungal diseases distribution is increased.

46. Of the following combinations of weather parameters and plant functions, a direct relationship can be observed in,

(1) rain fall and shoot: root ratio.

(2) quality of light and photoperiodism.

(3) duration of light and vernalization.

(4) wind velocity and transpiration.

(5) intensity of light and root growth.

47. An irrigation engineer recorded the following two factors which could be considered in selecting a water source for designing an irrigation system.

A - Seasonal water level fluctuations of a water source.

B - Seasonal water yield of the water source.

In designing an irrigation system using above water source

(1) Only A is important.

(2) Only B is important.

(3) Both A and B are important.

(4) Both are important and A depends on B.

(5) Both are important and B depends on A.

48. Following are two statements on primary land preparation

A - Compacted soil is opened or turned.

B - Weeds and stubbles are removed and soil is levelled.

Of above,

(1) A is correct and B is incorrect.

(2) A is incorrect and B is correct.

(3) Both A and B are correct.

(4) Both A and B are incorrect.

(5) Both A and B are correct and B further explains A.

49. Two statements about a soil profile are given below.

A - By studying a soil profile, eluviation and illuviation that take place in soil horizons can be identified.

B - More minerals are retained in "A horizon" due to the eluviation process.

Of the above statements,

(1) A is correct and B is incorrect.

(2) B is correct and A is incorrect.

(3) Both A and B are correct.

(4) A is correct and B further explains A.

(5) B is correct and A further explains B.

- **Use following statement and reason to answer questions No. 50.**

Statement :- Integrated farming is a sustainable farming system

Reason :- It is mainly due to the low labour requirement.

50. Of the above statement and reason,

(1) Both statement and reason are correct, statement is further explained by the reason

(2) Both statement and reason are correct, but statement is not explained by the reason.

(3) Statement is correct but reason is incorrect

(4) Statement is incorrect but reason is correct

(5) Both statement and reason are incorrect

* * *

(08) Agricultural Science

Paper II

Important

* Answer **all** questions of Part A.
* Answer **four** questions only of part B.

Part A -Structured Essay

1. (A) Wet and dry bulb thermometer and maximum and minimum thermometer are placed in the Stevenson screen to record different weather parameters.

(i) State a reason for keeping the above instruments inside the Stevenson Screen.

.....

(04 marks)

(ii) State the reason for law temperature in the wet bulb thermometer compare to that of the dry bulb thermometer

.....

(04 marks)

(iii) A Student noticed both wet and dry bulb thermometer readings are similar while recording the data. State a reason for this error and a measure to rectify it.

Reason for Error **Rectification**

..... **(02 marks)** ..... **(02 marks)**

(iv) State how the maximum and minimum thermometer is adjusted after recording the data.

.....

(04 marks)

(B) Sustainable management of soil is vital to maintain high agricultural productivity in crop fields.

(i) State the importance of "A horizon" in a soil profile with respect to soil productivity.

.....

(04 marks)

(ii) Write **two** important information that can be inferred from soil colour.

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(iii) State **two** visible characters of a degraded upland soil.

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(C) A Student obtained the following data from an experiment on determining the soil texture by the hydrometer method.

- Wet weight of the soil sample - 50 g
- Moisture factor - 1.004
- Corrected hydrometer reading of the soil solution in two minutes - 12.43
- Corrected hydrometer reading of the blank solution in two minutes - 2.00

(i) Calculate the dry weight of the soil sample

.....

..... **(04 marks)**

(ii) Calculate the clay and silt percentages

.....

..... **(04 marks)**

(iii) Calculate the sand percentage

.....

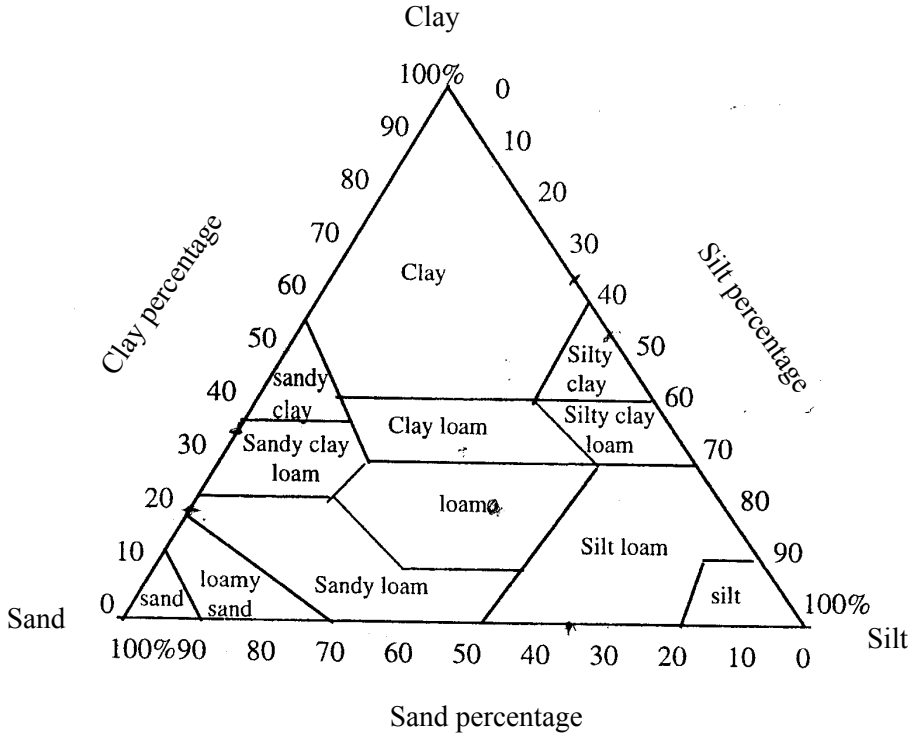
..... **(04 marks)**

(iv) If the silt percentage is 8.9%, Calculate the clay percentage

.....

..... **(04 marks)**

(v) Write texture category of the soil sample by using the given soil texture triangle.



..... **(04 marks)**

(D) State **three** government agencies that are responsible for fisheries and livestock sector development.

(1) ..... **(04 marks)**

(2) ..... **(04 marks)**

(3) ..... **(04 marks)**

(E) The Elements required for plant growth are known as plant nutrients.

(i) Name **three** properties that can be used to classify an element as an essential element.

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(3) ..... **(02 marks)**

(ii) Name the character of an element which used to classify it as a mobile element.

..... **(02 marks)**

(iii) State **one** function for each of the following essential elements.

Element	**Function**	
(1) Phosphorus	.....	**(04 marks)**
(2) Pottasium	.....	**(04 marks)**

(iv) State an inorganic fertilizer in-order to correct each plant nutrients deficiency.

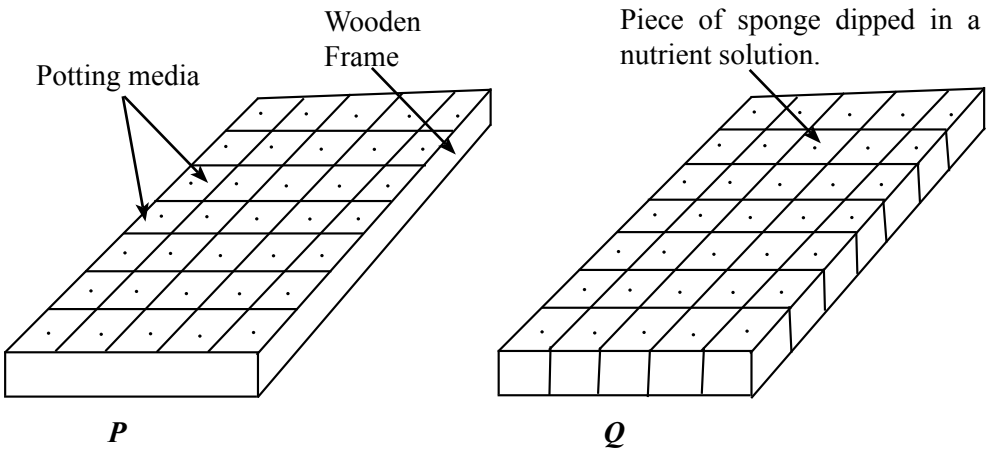
(1) Leaves of cereal crops turning purple ..... **(02 marks)**

(2) yellowing the matured leaves and deformed flowers and fruits ..... **(02 marks)**

(3) edges of leaves become burned like ..... **(02 marks)**

(4) curling and deforming of leaf tips ..... **(02 marks)**

(F) Nursery techniques are important in obtaining good quality planting materials in commercial agriculture.



P ***Q***

(i) Name the **two** types of nurseries shown in figure "***P"*** and "***Q"***

(1) ***P*** - ..... **(02 marks)**

(2) ***Q*** - ..... **(02 marks)**

(ii) Name **two** suitable potting media to be used in *"P"*

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(iii) Name **two** crops that are suitable to be propagated in "*P"* type nurseries, but unsuitable to be propagated in commonly used nurseries.

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(iv) State a reason why the crop seeds mentioned above are unsuitable to be propagated in a common nursery

.....

.....

.....

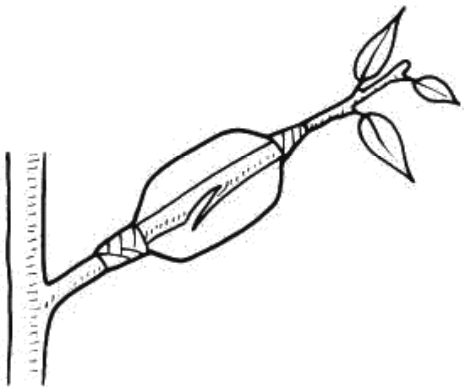
.....

..... **(02 marks)**

(v) Name a nutrient solution that can be used in nursery *"Q"*.

..... **(02 marks)**

2. (A) A common propagation method is shown in the following diagram.



(i) Name the above propagation method.

..... **(02 marks)**

(ii) State **two** fruits crops, which are commonly propagated by the above method.

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(iii) State the physiological process leading to root initiation in above propagation method.

.....

.....

..... **(04 marks)**

(iv) State **two** advantages of the above propagation method compare to other vegetative propagation methods.

(1) ..... **(04 marks)**

(2) ..... **(04 marks)**

(B) Different vegetative propagation methods are use to propagate different crops.

(i) State most suitable vegetative propagation method for each of the following crops.

(1) Roses ..... **(02 marks)**

(2) Begonia ..... **(02 marks)**

(3) Mango ..... **(02 marks)**

(4) Rambutan ..... **(02 marks)**

(ii) State the vegetative propagation method suitable for combining desirable characters of two or more plants in a single plant.

..... **(04 marks)**

(iii) State **two** main differences between rhizome and corm.

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(C) There are many factors need to be considered in designing a suitable irrigation system.

(i) State **two** important factors to be considered in selecting a water pump for a sprinkler irrigation system?

(1) ..... **(04 marks)**

(2) ..... **(04 marks)**

(ii) If the gross irrigation requirement of a crop field is 20 cm and water losses in the field is 5 cm, calculate,

(a) net irrigation requirement

.....

..... **(04 marks)**

(b) Irrigation efficiency

.....

..... **(04 marks)**

(iii) State an environmental problem created due to continuous excess irrigation.

..... **(04 marks)**

(iv) State a remedical measure to overcome above problem.

..... **(04 marks)**

(D) State the main function of each of the following plant hormones.

	Hormone	Main function	
(i)	Gibberellin		**(02 marks)**
(ii)	Auxin		**(02 marks)**
(iii)	Cytokinine		**(02 marks)**
(iv)	Ethylene		**(02 marks)**
(v)	Abscisic acid		**(02 marks)**

(E) Modern plant breeding methods to have many advantages as well as disadvantages.

(i) Define recombinant DNA technology.

.....

.....

.....

.....

.....

..... **(04 marks)**

(ii) State **two** advantages and two disadvantages of genetically modified foods.

(1) Advantages

(a) ..... **(02 marks)**

(b) ..... **(02 marks)**

(2) Disadvantages

(a) ..... **(02 marks)**

(b) ..... **(02 marks)**

(F) Protective structures are commonly use in commercial agriculture.

(i) State the most suitable protected structure for following crops.

(a) Bell paper ..... **(02 marks)**

(b) Tea nursery ..... **(02 marks)**

(ii) State the purpose of using temporary protected structures.

.....

..... **(04 marks)**

(G) Soilless culture is more popular in urban agriculture.

(i) State the reason for soilless culture has become popular in urban agriculture.

..... **(04 marks)**

(ii) State **two** soilless culture techniques commonly use in Sri Lanka.

(1) ..... **(04 marks)**

(2) ..... **(04 marks)**

3. **(A)** Pesticide application is used in pest control. Sprayers are used to apply pesticides.

(i) Name **two** types of sprayers used for pesticide application

(1) ..... **(04 marks)**

(2) ..... **(04 marks)**

(ii) State **two** data which are required to obtain for the calibration of a sprayer.

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(iii) List **two** safety measures farmer should adopt prior to spraying of pesticides.

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(B) Given below some weeds found in agricultural lands.

A – *Mimosa pigra*

B – *Cypres rotandus*

C – *Ageratum conyzoids*

D – *Panicum maximum*

Answer the following questions using the above weeds

(i) Mention the weed which could be classified under sedges with a underground stem

..... **(02 marks)**

(ii) Name the weed species that belong to poeceae family and difficult to control.

..... **(02 marks)**

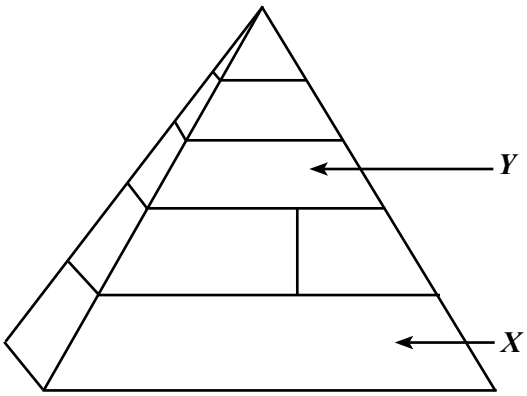
(iii) State the invasive weed species

..... **(02 marks)**

(C) Correct identification of pests is important to control pests successfully. Name the order and an insect pest with agricultural importance based on the characters given below.

Characters	Order	Pest
Possesses two pairs of wings and the first pair has become an elytra. Three pairs of legs attached to the thorax. Larvae and adult have biting mouth parts.	(i) ..... **(02 marks)**	(ii) ..... **(02 marks)**
Though the front pair of wings are uniformly hardened, it does not contribute for flying. Hind legs are adapted to jump. Nymph and the adult possess biting mouth parts.	(iii) ..... **(02 marks)**	(iv) ..... **(02 marks)**
The front wings of the adult are membranous and the second pair has become halters. The larvae damage the crops.	(v) ..... **(02 marks)**	(vi) ..... **(02 marks)**
Adults have pair of scaly wings. Though the larvae possesses biting type mouth parts, adults have spiral proboscis for sucking.	(vii) ..... **(02 marks)**	(viii) ..... **(02 marks)**

(D) Use the following diagram to answer the questions **(i)** and **(ii)**.



(i) Name **two** foods that falls into the group ***"X"***

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(ii) Name **two** macronutrients provided by the food group ***"Y"***

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(E) Malnutrition has become a serious nutrition problem in Sri Lanka.

(i) Name **four** factors causing under nutrition

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(3) ..... **(02 marks)**

(4) ..... **(02 marks)**

(ii) Name **two** main micronutrient deficiencies found in Sri Lanka

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(iii) State **two** nutritent complexities that can arise from obesity among school children

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(F) Sustainable agricultural practices are important to minimize the impact of climate change.

(i) Define sustainable resource management in agriculture

.....

.....

.....

..... **(04 marks)**

(ii) Name **two** sustainable cropping pattern

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(G) (i) Fruits can be categorized into two groups based on their ripening process. Name these two groups.

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(ii) State the most significant maturity index for each of the following fruits.

Fruit	**Maturity index**	
(a) Mango	.....	**(02 marks)**
(b) Orange	.....	**(02 marks)**
(c) Banana	.....	**(02 marks)**

(iii) State **one** reason for each of the following postharvest practices.

Postharvest practice	**Reason**	
(a) Washing of latex from the fruit skin	.....	**(02 marks)**
(b) Dipping of fruits in cool water	.....	**(02 marks)**
(c) Grading of fruits based on maturity	.....	**(02 marks)**

(iv) Storage conditions are important in determining the shelf-life of agriculture produces. State the most important storage condition needed to be controlled in storing each of the following produces.

Produces	**storage conditions**	
(a) Paddy	.....	**(02 marks)**
(b) Onion	.....	**(02 marks)**
(c) Potato	.....	**(02 marks)**

(H) Excessive noise is a physical hazard resulted when heavy machinery is used in agriculture.

(i) State **two** causes for the generation of excessive noise in machines.

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(ii) State **two** harmful impacts of excessive noise.

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

4. (A) Parts of the digestive systems of cattle and chicken are given below. Using arrow marks, match the parts of two digestive systems that are having similar main functions.

	Cattle digestive system	**Chicken digestive system**	
(1)	Mouth	Provarticulus	**(02 marks)**
(2)	Rumen	Gizzard	**(02 marks)**
(3)	Abomasum	Small intestine	**(02 marks)**
(4)	Duodenum	Large intestine	**(02 marks)**

(B) Before milking a cow, a farmer cleaned the cattle shed, washed the udder of the cow and slightly massaged the teats. He finished milking within 6 minutes after performing strip cup test. State the main reason for each of following activities.

	Activity		**Reason**	
(i)	Cleaning the cattle shed and the udder	-	.....	**(02 marks)**
(ii)	Massaging teats	-	.....	**(02 marks)**
(iii)	Performing strip cup test	-	.....	**(02 marks)**
(iv)	Completing milking within 6 minutes	-	.....	**(02 marks)**

(C) Compare to the artificial incubation, natural incubation of eggs have certain limitations. Indicate **three** such limitations.

(i) ..... **(02 marks)**

(ii) ..... **(02 marks)**

(iii) ..... **(02 marks)**

(D) Fill in the blanks of the following paragraph using appropriate words.

After the birth, calves should be fed with (i) ..... during first 3 days as it contains nutrients that can be absorbed without (ii) ..... When the calve is (iii) ..... months old, it can be weaned and fed with (iv) ..... and (v) ..... .

(2 × 5 marks)

(E) Name **two** bacterial diseases of cattle

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(F) Dairy animals were imported to Sri Lanka to increase the milk production in the country.

(i) Name **two** cattle breeds imported for the above purpose

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(ii) Name **three** government farms where these imported animals are rearing

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(3) ..... **(02 marks)**

(iii) State **two** most critical weather parameters that affect milk production of these breeds

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(iv) Write **two** technological applications used to provide the suitable environmental conditions for these animals

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(G) (i) (1) State **two** main types of business management techniques.

(a) ..... **(02 marks)**

(b) ..... **(02 marks)**

(2) Of above,

(a) Name more suitable business management technique to Sri Lankan agri-business.

.....

..... **(02 marks**

(b) State the reason for the above answer.

.....

..... **(02 marks**

(3) Provide **four** major components of a business plan?

(a) ..... **(02 marks)**

(b) ..... **(02 marks)**

(c) ..... **(02 marks)**

(d) ..... **(02 marks)**

(ii) Assume the demand and supply functions for cowpea as P = 200 - 4QD and P = 6QS respectively where;

P = price per kg (in Rs.)

QD = quantity demanded per year in thousand metric tons.

QS = quantity supplied per year in thousand metric tons.

(1) Find the equilibrium price (Rs. per kg) and the quantity (in thousand metric tons)

(a) equilibrium price ..... **(04 marks)**

(b) equilibrium quantity ..... **(04 marks)**

(2) If the government imposes a certified price of Rs. 150 per kg of cowpea, what are the changes occur in quantity demand and quantity supplied?

(a) change in quantity demanded ..... **(04 marks)**

(b) change in quantity supplied ..... **(04 marks)**

(H) Suppose that the bird fever attacks the chicken production. What will happen to the demand, supply and the price of fish? (Assume fish is a substitute for chicken).

(Select the suitable answer: No change, shift to right, shift to left, increase, decrease)

(i) Market demand curve for fish ..... **(02 marks)**

(ii) Market supply curve for fish ..... **(02 marks)**

(iii) Equilibrium price of fish ..... **(02 marks)**

(I) (i) State **two** anthropogenic activities which leads to climate change.

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

(ii) State **two** changes occur in the rainfall pattern and the distribution due to climate change.

(1) ..... **(02 marks)**

(2) ..... **(02 marks)**

*** ***

Part B - Essay

5. **(i)** Explain the factors to be considered when selecting a suitable site for a plant nursery. **(50 marks)**

(ii) Compared to deep litter system, describe the advantage and disadvantages of free-range system of rearing laying hens. **(50 marks)**

(iii) Describe how adverse climatic conditions affect farm animal production **(50 marks)**

6. **(i)** Explain the ways the growth parameters can be used to measure plant growth. **(50 marks)**

(ii) Describe the impacts of soil erosion on agricultural productivity of a land. **(50 marks)**

(iii) Explain the importance of sustainable agriculture to maintain the eco-system health. **(50 marks)**

7. **(i)** Explain how plant breeding improves the genetic makeup of plants. **(50 marks)**

(ii) A student collected the following information from a crop field to determine irrigation requirements of the crop.

Field capacity of the Soil (volume basis)	=	40%
Permanent Wilting Point of the soil (volume basis)	=	25%
Depth of the root zone	=	40 cm
Management Allowed Depletion level	=	50%

(a) Calculate the net irrigation requirement.

(b) Calculate the gross water requirement if the irrigation efficiency of the irrigation system is 60%.

(c) Calculate the irrigation interval if the crop evapotranspiration is 4.8 mm/day. **(50 marks)**

(iii) Explain the physical factors that affect for food spoilage. **(50 marks)**

8. **(i)** Postharvest losses of fruits and vegetables are estimated to be approximately 40% is Sri Lanka. Explain the means by which the postharvest losses of fruits and vegetables can be minimized. **(50 marks)**

(ii) Describe the changes happened in the Sri Lankan agricultural sector after introduction of open economic policies in 1977. **(50 marks)**

(iii) Explain how to improve the inefficiencies in agricultural marketing in Sri Lanka. **(50 marks)**

9. **(i)** Describe the primary land preparation process of low land paddy cultivation in chronological order. **(50 marks)**

(ii) Describe the challenges faced by the present agriculture and the strategies to overcome those challenges. **(50 marks)**

(iii) Explain the importance of applying bio-fertilizer which is produced using soil microorganisms. **(50 marks)**

10. **(i)** Using appropriate examples, describe the role of different life forms in biological pest control. **(50 marks)**

(ii) Mention the occupational hazards which would be possible to occur in an agricultural farm and explain the measures to prevent them. **(50 marks)**

(iii) Explain the importance of identifying agroecological zones in Sri Lanka to increase the productivity in agriculture sector. **(50 marks)**

* * *

(09) Biology

Structure of the Question Paper

Paper I - **Time : 02 hours**
This paper consists of **50** multiple choice questions with **5** options. **All** questions should be answered. Each question carries **01** mark. Total marks **50**.

Paper II - **Time : 03 hours.** (In addition, 10 minutes for reading.)
This paper consists of two parts as **Structured Essay** type and **Essay** type.

Part A - **Four structured essay** type questions. **All** questions should be answered. Each question carries 100 marks - altogether 400 marks.

Part B - **Six essay** type questions. **Four** questions should be answered. Each question carries 150 marks - altogether 600 marks.

Total marks for paper II = 1000

Calculation of the final mark

Paper I		= 50
Paper II	= 1000 ÷ 20	= 50
Final mark		= 100

Paper I

Important :

- Answer **all** the questions.
- Select **the correct or the most appropriate** answer.

(A separate sheet will be provided to mark answers for multiple choice questions.)

---

1. Which of the following responses shows several hierarchial levels of biological organization in correct order?

(1) Molecules, Organelles, Cells, Organs, Tissues, Organ systems, Organism
(2) Molecules, Cells, Organelles, Organs, Tissues, Organ systems, Organism
(3) Molecules, Organelles, Cells, Tissues, Organs, Organ systems, Organism
(4) Molecules, Organelles, Cells, Tissues, Organ systems, Organs, Organism
(5) Molecules, Cells, Tissues, Organ systems, Organelles, Organs, Organism

2. Select the correct statement regarding carbohydrates.

(1) H:O ratio of all carbohydrates is 1:2.
(2) Genetic material of organisms contains carbohydrates.
(3) All carbohydrates are macromolecules.
(4) All carbohydrates possess glycosidic bonds.
(5) All carbohydrates are water soluble.

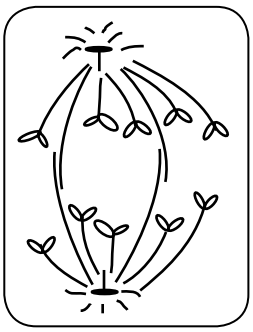
3. Functions of some orgenelles are given below.

A - Conversion of fatty acids to sugars
B - Production of transport vesicles
C - Production of cell wall components such as cellulose and pectin
D - Removal of residual material from cells by exocytosis

Functions of lysosomes and endoplasmic reticulum are stated respectively by

(1) A and C. (2) B and C. (3) C and D. (4) D and A. (5) D and B.

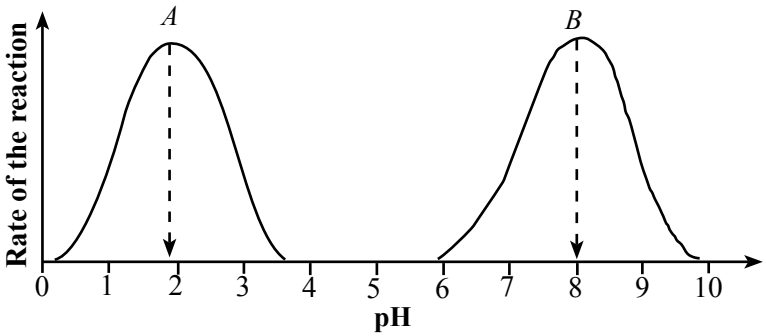
4. A stage of cell division is shown in the following diagram.



Which of the following statements is correct with respect to the above diagram?

(1) It may be a diploid cell.
(2) It may be a cell of an angiosperm.
(3) It cannot be a stage of meiosis.
(4) It may not be a stage mitotic division.
(5) The daughter cells produced by this division are haploid.

5. Effect of pH on the rate of reaction of two enzymes *A* and *B* is illustrated in the following graphs.



Which of the following statements regarding enzymes *A* and *B* is correct?

(1) Both the enzymes *A* and *B* can be functional within a single organ of an organism.
(2) Enzymes *A* and *B* could be tripsin and pepsin respectively.
(3) Rate of reaction of enzyme *A* at pH 1 and 3 could be more or less equal to the rate of reaction of enzyme *B* at pH 7 and 9.
(4) Optimum pH range of enzyme *A* is 0-2 while that of enzyme *B* is 6-8.
(5) Most of the enzymes of man are similar to enzyme *B*.

6. Select the correct statement with regard to the C_4 mechanism of photosynthesis.

(1) First carbohydrate derivative produced is a carbon 4 compound.
(2) Photorespiration does not occur due to the absence of RuBisCo enzyme.
(3) Fixation of atmospheric CO_2 occurs within the cytoplasm of leaf mesophyll cells.
(4) Calvin cyle occurs in leaf mesophyll cells under high CO_2 concentrations.
(5) 3-phosphoglycerate is not an intermediate product.

7. The three eras of phanerozoic eon in correct chronological sequence are

(1) proterozoic, paleozoic and cenozoic.
(2) paleozoic, mesozoic and cenozoic.
(3) hadean, archaean and proterozoic.
(4) mesozoic, paleozoic and proterozoic.
(5) cenozoic, proterozoic and mesozoic.

8. Carolus Linnaeus proposed a system of binomial nomenclature of species which was accepted worldwide. Given below are the scientific names of some species.

A - *Dipterocarpus zeylanicus* B - *Homo sapiens sapiens*

C - *Cocos nucifera L* D - *Panthera pardus* kotiya

Which of the above species names is/are in accordance with the Linnaeus system binomial nomenclature?

(1) A only. (2) B only. (3) A and B only.

(4) B and D only. (5) A, B and C only.

9. A trait that **cannot** be observed in the first land plants that evolved from green algae is

(1) production of spores surrounded by a wall within sporangia.

(2) formation of multicellular gametangia.

(3) presence of an embryo that depends on the gametophyte.

(4) presence of an apical meristem.

(5) formation of roots.

10. In which one of the following, the invertebrate phylum and its characters are **not** correctly matched?

(1) Platyhelminthes - Eye spots and flame cells

(2) Nematoda - Setae and cuticle

(3) Cnidaria - Diploblastic body and cnidocyst

(4) Arthropoda - Exoskeleton and jointed appendages

(5) Mollusca - Haemocoel and radula

11. Which of the following statements is correct regarding the root of dicotyledonous plant?

(1) Epidermis is multi-layered.

(2) Cork cambium originates from the cortex.

(3) Pericycle has meristematic capability.

(4) Collenchyma is present inner to the epidermis.

(5) Distinct pith is present.

12. Which one of the following external factors contributes to an increase in the rate of photosynthesis and a decrease in the rate of transpiration?

(1) Light intensity (2) Temperature (3) Humidity

(4) CO_2 concentration (5) Available water content in the soil

13. Three parts of the lower epidermal peel of a Rhoeo leaf were immersed separately in three sugar solutions *A, B* and *C* with solute potential of -1200 kPa, -1500 kPa and -1800 kPa respectively. After 20 minutes, it was observed that 50% of the cells in the tissue immersed in solution *B* had plasmolysed. From the statements given below select the correct statement.

(1) Solution *A* is hypertonic relative to the tissue.

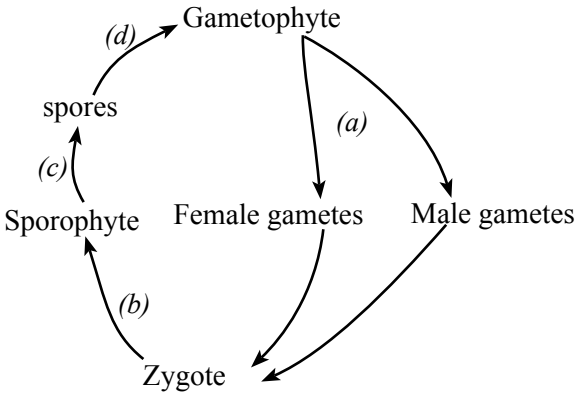
(2) Solution *C* is hypotonic relative to the tissue.

(3) Cells in the equilibrated tissue in solution *C* are turgid.

(4) Endosmosis will occur if the tissue that was equilibrated in solution *A* was moved to solution *C*.

(5) If the tissue immersed in solution *C* was moved to distilled water, pressure potential of cells at equilibrium will be +1500 kPa.

14. Shown below is the life cycle of a terrestrial plant.



Which of the following responses indicates the processes *(a), (b), (c)* and *(d)* in correct sequence?

(1) Meiotic division, growth and development, mitotic division, germination
(2) Mitotic division, germination, meiotic division, growth and development
(3) Mitotic division, growth and development, meiotic division, germination
(4) Germination, mitotic division, meiotic division, growth and development
(5) Growth and development, germination, meiotic division, mitotic division

15. The main events that are initiated by light during plant growth and development, when taken collectively, are known as photomorphogensis. Which of the following **cannot** be considered as a photomorphogenesis process in plants?

(1) Photosynthesis (2) Phototropism (3) Geotropism
(4) Photoperiodism (5) Seed germination

16. Which of the following responses is correct regarding the transport in xylem vessels and phloem sieve tubes?

	Xylem vessels	**Phloem sieve tubes**
(1)	Passive transport	Active transport
(2)	Occurs bi-directionally.	Occurs uni-directionally.
(3)	Transport water and minerals only.	Transport organic compounds only.
(4)	Transport occurs in the apoplast pathway.	Transport occurs in the symplast pathway.
(5)	Transport occurs under hydrostatic pressure.	Transport occurs under a pulling force.

17. Which of the following statements is correct?

(1) Activity of skeleton muscles and heart muscles is controlled by sympathetic nervous system.
(2) Contraction of all muscular tissues in the human body commences due to nerve impulses.
(3) Functional unit of all muscle types is the sarcomere.
(4) During the formation of a skeletal muscle, the muscle fibres join with each other through intercalated discs.
(5) The basic functional characteristic of all muscles is contractility.

18. Which of the following statements is correct regarding regulation of digestion in man?
(1) Secretion of saliva is inhibited by secretin.
(2) Secretion of gastric juice is inhibited by gastrin.
(3) Release of bile into the duodenum is stimulated by CCK.
(4) Mobility of stomach is inhibited by enterokinase.
(5) Secretion of gastric juice is stimulated by hormones secreted by pancreas.

19. Which one of the following statements is correct regarding the respiratory process of man?
(1) Muscles in the neck and back muscles can also participate in the ventilation of lungs during exercise.
(2) Curvature of the diaphragm increases as a result of the contraction of its muscles.
(3) Muscular contraction during expiration increases the volume of thoracic cavity.
(4) When the volume of the thoracic cavity is increased, the pressure of the pleural cavity is increased.
(5) During the ventilation of lungs alternating inhalation and exhalation occur continuously.

20. In which one of the following responses the animal and excretory structure are **incorrectly** indicated?

Animal	**Excetory structure**
(1) Prawn	Green glands
(2) Beetle	Malphigian tubules
(3) Shark	Kidneys
(4) Turtle	Salt glands
(5) Earth worm	Body covering

21. A disorder of the human nervous system is
(1) Addison's disease. (2) Huntington disease. (3) stroke.
(4) pellagra. (5) leptospirosis.

22. Some sensory structures in the human body are given below.
A - Krause's end bulbs B - Merkel discs
C - Ruffini corpuscles D - Meissner corpuscles
Out of these, touch receptors are
(1) A and B only. (2) A and C only. (3) A and D only.
(4) B and C only. (5) B and D only.

23. Which of the following statements regarding the spematogenesis of man is correct?
(1) FSH stimulates Leydig cells to secrete testosterone.
(2) Spermatogenesis is stimulated by GnRH.
(3) Development of spermatids into spermatozoa is stimulated by testosterone.
(4) Increase in testosterone secretion, increases GnRH secretion by the hypothalamus.
(5) When spermatogenesis reduces, secretion of inhibin is stimulated by Sertoli cells.

24. The center in the human brain engaged in the summation of sensory information is
(1) thalamus. (2) hypothalamus.
(3) corpora quadrigemina. (4) pons varolii.
(5) medulla oblongata.

25. The blood group of a donor whose blood can be transfused without matching the blood group of any recipient is
(1) AB^+. (2) AB^-. (3) O^+. (4) O^-. (5) B^- .

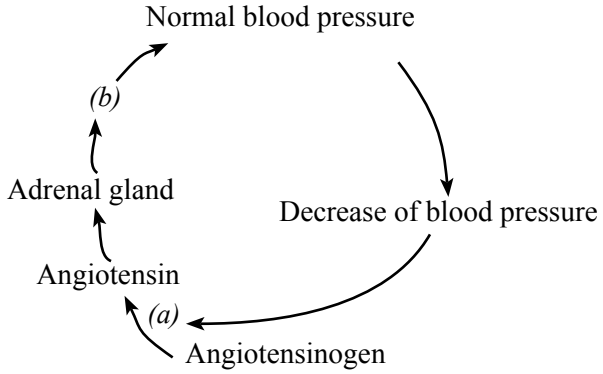
26. Na^+ K^+ pump activates when the plasma membrane is
(1) in the polarized state.
(2) in the depolarized state.
(3) transforming from depolarized state to repolarize state.
(4) transforming from repolarized state to hyperpolarized state.
(5) transforming from polarized state to depolarized state.

27. Which of the following is **not** a suitable indicator to measure the basal metabolic rate of an organism?
(1) O_2 consumption rate
(2) CO_2 releasing rate
(3) Amount of heat released per unit area
(4) Amount of urine produced
(5) Rate of oxidation of food

28. Which of the following statements regarding human birth control methods is correct?
(1) Menstrual cycle is temporarily stopped due to oral controceptive pills.
(2) Ovulation is stopped due to fallopian tube ligation.
(3) Thickening of cervical mucosa occurs due to IUD loop.
(4) Spermatogenesis is stopped due to vasectomy.
(5) Ovulation is stopped due to Depo Provera.

29. Which of the following statements regarding to the skeletal systems of animals is correct?
(1) Hydrostatic skeleton is seen only in coelomates.
(2) Bony skeleton always serves as an internal skeleton of an organism.
(3) Skeletons formed by calcium carbonate can be found as internal or external skeletons of organisms of the same phylum.
(4) Human skeleton is formed only by bones.
(5) Movable joints between bone parts could be seen only in internal skeletons.

30. Flow chart illustrating the contribution of kidneys to maintain the normal blood pressure of man is shown below.



The two hormones *(a)* and *(b)* are respectively
(1) renin and aderenalin.
(2) aldosteron and aderenalin.
(3) renin and aldosteron.
(4) ADH and renin.
(5) aldosteron and ADH.

31. Which of the following statements regarding red-green colour blindness in man is correct?
(1) It is a dominant trait linked to X chromosome.
(2) It is a dominant trait linked to Y chromosome.
(3) A colour-bilnd father transmits the trait to all his daughters.
(4) A colour-blind mother transmits the trait to all her sons.
(5) The disease is common among females than in males.

32. If individuals of genotype AabbCc are interbred, the number of different genotypes that can be produced in the progeny is
(1) 6. (2) 8. (3) 9. (4) 21. (5) 27.

33. Which of the following statements is correct regarding agarose gel electrophoresis?
(1) DNA fragments are made single strands before electrophoresis.
(2) Rate of movement of DNA through the gel depends on the agarose concentration of the gel.
(3) DNA fragments move towards the cathode during electrophoresis.
(4) Large DNA fragments move faster through the gel than small DNA fragments.
(5) Stained DNA fragments in the gel can be observed under visible light.

34. Probes used in gene technology are labeled
(1) single stranded DNA fragments only.
(2) double stranded DNA fragments only.
(3) single stranded RNA fragments only.
(4) double stranded RNA fragments only.
(5) single stranded DNA fragment or single stranded RNA fragments.

35. Which of the following statements regarding ecological niche is **incorrect**?
(1) Niche is the role that a particular organism plays in the ecosystem.
(2) Niche represents the physical area where a species lives.
(3) Niche includes the organism's role in the flow of energy through the ecosystem.
(4) An organism's niche also includes how it interacts with other organisms in recycling of nutrients.
(5) Niche is how an organism makes a living.

36. Which of the following is the factor that contributes indirectly to biodiversity loss?
(1) Invasive alien species (2) Climate change
(3) Human population increase (4) Habitat loss
(5) Overexploitation of resources

37. An infectious pathogen which uses gastrointestinal tract of man as portal of entry is
(1) *Clostridium tetani.* (2) *Streptococcus pneumoniae.*
(3) *Staphylococcus aureus.* (4) *Neisseria gonorrhoeae.*
(5) *Mycobacterium tuberculosis.*

38. This question is based on the following.
A - Use of disinfectants B - Use of antiseptics
C - Immunization D - Sanitization
E - Use of antibiotics
In Sri Lanka, the most commonly used methods to prevent microbial diseases are
(1) B and C only. (2) A, B and C only.
(3) A, B and E only. (4) A, B, C and D only.
(5) A, B, D and E only.

39. Which of the following statements is true?

(1) Some spices have natural anti-microbial chemical components.
(2) Botulism toxin can be destroyed by pasteurization.
(3) Sterilized milk is more nutritious than pasteurized milk.
(4) Yoghurt is a sterilized milk food.
(5) Aflotoxin is a form of bacterial toxin present in many cereal seeds.

40. Which of the following is **not** a biological application of nanotechnology?

(1) Purification of blood
(2) use as DNA probes
(3) Delivering drugs to target cells
(4) use as anti-microbial agents
(5) Identification of proteins

- For each of the question **41** to **50** one or more of the responses is/are correct. Decide which response/ responses is/are correct and then select the correct number.

If only A, B and D are correct ..... (1)
If only A, C and D are correct ..... (2)
If only A and B are correct ..... (3)
If only C and D are correct ..... (4)
If any other response or combination of responses is correct ..... (5)

Directions summarized

(1)	(2)	(3)	(4)`	(5)
A, B, D correct.	A, C, D correct.	A, B correct.	C, D correct.	Any other response or combination of responses correct.

41. Which of the following properties of water enable/enables some insects to walk on the surface of water?

(A) High surface tension
(B) Cohesive forces of water molecules
(C) High specific heat capacity
(D) Adhesive forces of water molecules
(E) High latent heat of vaporization

42. Which of the following phyla has/have a dorsoventrally flattened independent gametophytes?

(A) Hepatophyta
(B) Bryophyta
(C) Anthocerophyta
(D) Pterophyta
(E) Lycophyta

43. Which of the following animal groups possesses/possess bony endoskeletons and internal fertilization?

(A) Amphibia
(B) Osteichthyes
(C) Reptilia
(D) Aves
(E) Chondrichthyes

44. Which of the following responses indicates/indicate one internal and one external defence type that are important in innate immunity respectively?

(A) Inflamatory responses and secretions
(B) Skin and mucus membranes
(C) Phagocytic cells and mucus membranes
(D) Antimicrobial proteins and skin
(E) Secretions and inflamatory responses

45. Hypothalamus

(A) is located in the forebrain.
(B) regulates hunger.
(C) integrates sensory information.
(D) controls autonomic nervous system.
(E) receives sense of smell.

46. Deficiency in which of the following elements is/are a cause for chlorosis?

(A) Nitrogen (B) Magnesium (C) Potassium (D) Calcium (E) Iron

47. Which of the following processes is/are used in the preparation of a DNA library?

(A) Cutting of DNA
(B) Extraction of DNA
(C) Polymerase chain reaction
(D) Ligation of DNA fragments
(E) Determination of base sequence of DNA

48. Select the invasive species found in Sri Lanka from among the following.

(A) *Ichthyophis* (B) *Lingula* (C) Knife fish (D) *Lantana* (E) *Sonneratia*

49. A viroid

(A) is a prokaryote.
(B) has heterotrophic mode of nutrition.
(C) infects higher plants.
(D) consists of a naked RNA molecule.
(E) consists of a fatty acid molecule and a protein coat.

50. Choose the method/methods which is/are **not** used for postharvest food preservation in the modern society.

(A) Use of genetically modified organisms
(B) Drying
(C) Pasturization
(D) Salting
(E) Ray treatment

* * *

(09) Biology

Paper II

* Answer **All** question in part **A**.
* Answer only **four** questions from part **B**.

Part A - Structured Essay

1. (A) (i) (a) Explain the cell theory.

.....

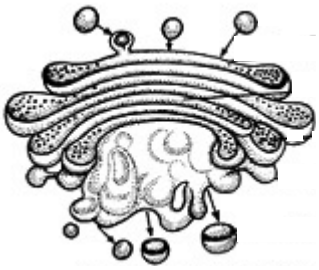
.....

.....

(b) State the ecologically important physiological function that can be seen only in prokaryotic cells.

.....

(ii)



(a) What is the organelle shown in the above diagram?

.....

(b) What is the sub cellular structure which produces new vesicles that join with this organelle?

.....

(c) State **two** functions of the organelle shown in the above diagram.

.....

.....

(iii) Why amino acids are known as amphoteric?

.....

.....

(iv) Name **two** types of bonds that help to maintain the tertiary structure of a protein.

.....

.....

(v) (a) How it can be shown experimentally that proteins are present in a particular solution?

.....

.....

.....

(b) Which strucutral property of the protein can be confirmed by the above experiment?

.....

(B) (i) What is a photosystem?

.....

.....

.....

(ii) On what basis photosystems are named as photosystem I (PS I) and photosystem II (PS II)?

.....

.....

.....

(iii) Write **three** major events that take place in a photosystem.

.....

.....

.....

(iv) State **two** functions of carotenoid pigments in photosynthesis.

.....

.....

(C) (i) What is meant by natural classification ?

.....

.....

.....

(ii) What are the criteria used by Aristotle in the classification of animals ?

.....

.....

.....

(iii) State **three** molecular biological criteria that are considered as base of the present classification system.

.....

.....

.....

(iv) Name **two** plant phyla that possess vessels in the xylem tissue.

....

(v) Complete the following dichotomous key to identify hook worm, earthworm, liver fluke, millipede and tusk shell based on their external features.

(1) (a) Exoskeleton is present. : .....
(b) Exoskeleton is absent. : .....

(2) (a) Jointed legs are present. : .....
(b) Jointed legs are absent. : .....

(3) (a) Clitellum is present. : .....
(b) Clitellum is absent. : .....

(4) (a) Body is dorsoventrally flattened. : .....
(b) Body is not dorsoventrally flattened . : .....

2. (A) (i) State the feeding mechanism of each of the following animals.

(a) Bee : .....
(b) Oyster : .....
(c) Maggot : .....

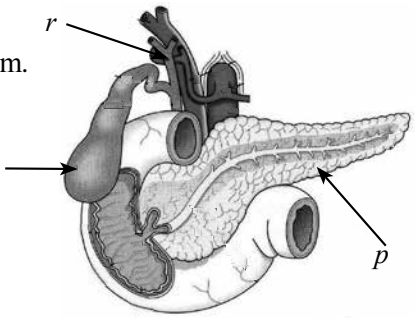
(ii) What is a digestive tract?

.....
.....
.....

(iii) This question based on the given diagram.

(a) Name the parts labelled as *p, q* and *r* in the diagram.

p - .....
q - .....
r - .....



(b) How the structure labelled as *p* contributes for the digestion of food?

.....

(c) Name **two** components present in the fluid contained in the structure labelled as *q* that are important for the digestion of food.

.....
.....

(iv) (a) What is a balanced diet?

.....
.....

(b) What are stored by lipids in the human body?

.....
.....

(v) Name one vitamin each that performs the following functions.

(a) Acting as antioxidants .....

(b) Maintaining healthy bones .....

(c) Clotting of blood .....

(B) (i) What is adaptive immunity?

.....

.....

(ii) What are the **two** types of cells important for adaptive immunity?

....

(iii) State the **two** adaptive immunity responses.

.....

.....

(iv) Name an autoimmune disease and immuno dificiency disease of man.

(a) Autoimmune Disease : .....

(b) Immune Deficiency Disease : .....

(v) State the main difference between autoimmune diseases and immune dificiency diseases.

.....

.....

.....

.....

(C) (i) State the structure of the human brain associated with each of the following functions.

- Controlling the size of the pupil - .....
- Structurally connecting the two hemispheres of the cerebrum - .....
- Controlling the basic rhythm of respiration - .....
- Regulation of hemostatic mechanisms - .....

(ii) State **two** places where cerebrospinal fluid in present in the human brain.

....

(iii) State **three** functions of cerebrospinal fluid.

.....

.....

.....

(iv) (a) Name the most abundant cell type in nerve tissue.

.....

(b) State **three** main functions of the cell type named in (iv) (a) above.

.....

.....

.....

(v) Name **three** disease conditions of the human nervous system.

.....

.....

.....

3. (A) (i) Draw and label a line diagram of a cross section of a dicot leaf taken through the central vein.

(ii) State **two** structural features seen in a cross section of a typical grass leaf by which it differs from the cross section drawn in (A) (i) above.

.....

.....

(iii) What is a stomata?

.....

.....

(iv) Briefly describe the stomata opening mechanism according to the K^+ flux hypothesis.

.....

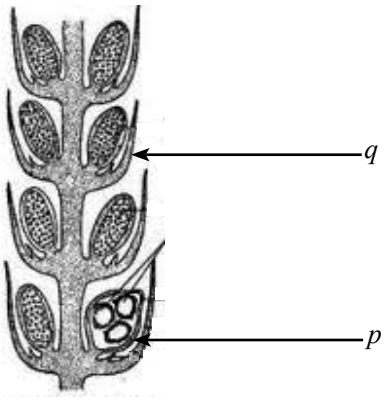
.....

.....

.....

.....

(B) (i) Name the structures labelled as *p* and *q* in the diagram given below and write one function of each of them.



	Structure	**Function**
p	.....	.....
q	.....	.....

(ii) What is the significant features seen in the life cycle of *Selaginella* which was the cause for the evolution of seed habit?

.....

(iii) What is seed dormancy ?

.....

.....

(iv) State **two** adaptation shown by seeds for terrestrial life other than dormancy and indicate **one** usefulness of each of them.

Adaptation	**Usefulness**
.....	.....
.....	.....

(v) (a) State **two** abiotic stresses faced by plants.

.....

.....

(b) State **two** protective mechanisms present in plants as responses to biological stresses.

.....

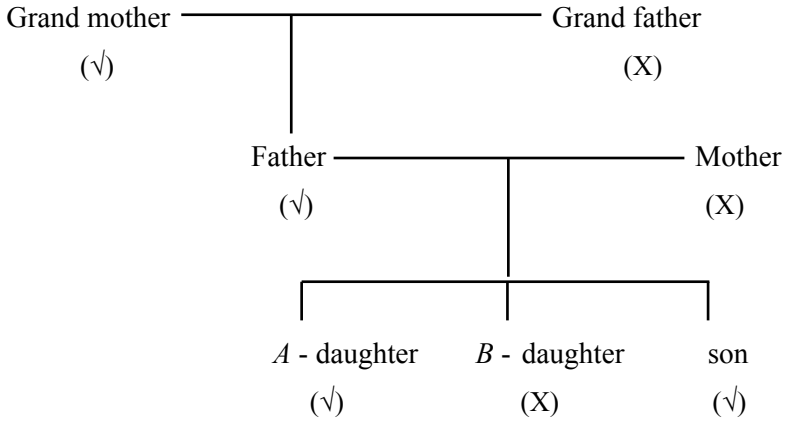
.....

(c) Name **two** groups of organic compounds found in plants that help them to face biotic stresses successfully.

.....

.....

(C) The following family tree shows inheritance pattern of tongue rolling ability. Ability of tongue rolling is shown by (√) and inability of tongue rolling is shown by (X).



(i) State the genotype of each of the following individuals considering the allele for tongue rolling ability as 'R' and its recessive allele as 'r'.

(a) Grand mother : .....

(b) Mother : .....

(c) *A* - Daughter : .....

(ii) If *A* - Daughter is married to a man having the genotype of son,

(a) what is the probability that their first child does **not** have the ability of tongue rolling?

.....

(b) what is the probability that their first child is a boy who has the ability of tongue rolling?

.....

(iii) State the number of phenotypes and genotypes found in the progeny when a plant having genotype XxYYTt is subjected to self fertilization.

Number of phenotypes : .....

Number of genotypes : .....

(iv) What is meant by 'Pleiotropy'?

.....

.....

.....

(v) Name a human genetic disorder which can be considered as an example for pleiotropy.

.....

(vi) Name a microorganism used to produce each of the following genetically modified organisms.

(a) Golden rice :- .....

(b) Insect pest resistant crops :- .....

4. (A) (i) (a) What is the main difference between introns and exons?

.....

.....

(b) What is the significance of introns in DNA analysis?

.....

.....

(ii) (a) What are **three** steps in a polymerase chain reaction cycle?

.....

.....

.....

(b) For what the polymerase chain reaction cycle is used in the human genome project.

.....

(iii) Name an enzyme used in each of the following.

(a) Synthesis of complemenrtary DNA : .....

(b) DNA fingerprinting technology : .....

(iv) (a) What is meant by a restriction map in gene technology?

.....

(b) State **two** importances of restriction maps in gene cloning.

.....

.....

(B) (i) (a) What is meant by sterilization in microbiology?

.....

.....

(b) Name **two** gases used as sterilization agent.

.....

.....

(ii) What is a vaccine ?

.....

.....

(iii) State **three** types of vaccines used in immunization.

.....

(iv) What are **three** infectious diseases that can be prevented by MMR vaccine?

.....

(v) State **two** environmental applications of microorganisms.

.....

.....

(C) (i) (a) State the major importance of culturing aquatic organisms.

.....

(b) State **two** desirable characteristics that should be present in a species for aquaculture.

.....

.....

(ii) (a) Name **two** popular ornamental fish species cultured in Sri Lanka.

....

(b) Name **two** common diseases found among cultured ornamental fish in Sri Lanka.

.....

.....

(c) State **two** ways that ornamental fish culture would have an impact on the environment.

.....

.....

(iii) (a) What is an invasive species?

.....

.....

.....

(b) Name **one** invasive animal and **one** invasive plant found in Sri Lankan water bodies.

Animal : .....

Plant : .....

(iv) What is the aim of CITES?

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(v) (a) What are stem cells?

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(b) State **two** sources of stem cells.

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(c) State **one** application of stem cells.

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Part B - Essay

5. (a) What is meant by cellular respiration ?

(b) Briefly describe the process of cellular respiration that takes place in cytosol.

(c) Describe steps of an experiment carried out in the laboratory to determine the respiratory rate of germinating seeds based on oxygen absorption.

6. (a) Briefly describe the structure of a cross section of a typical primary dicot stem and state the functions of different tissues seen in it.

(b) Describe how the structure of a cross section of a primary dicot root differs from the above structure.

7. (a) What is meant by homeostasis ?

(b) Describe how the blood glucose level of man is regulated.

8. (a) Explain the effect of virulence factors on pathogenicity.

(b) Describe the strategies used to control diseases caused by microorganisms to man.

9. (a) Explain what is an ecosystem.

(b) Briefly describe the characteristics of the four major types of forest ecosystems in Sri Lanka.

10. Write short notes on the following.

(a) Theory of natural selection

(b) Cardiac cycle of man

(c) Cloning vectors

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(10) Combined Mathematics

Structure of the Question Paper

Paper I - **Time : 03 hours** (In addition, 10 minutes for reading.)
This paper consists of **two** parts.
Part A : Ten questions. **All** questions should be answered. 25 marks for each question - altogether 250 marks.
Part B : Seven questions. **Five** questions should be answered. Each question carries 150 marks - altogether 750 marks.
Total marks for paper I = 1000

Paper II - **Time : 03 hours** (In addition, 10 minutes for reading.)
This paper consists of **two** parts.
Part A : Ten questions. **All** questions should be answered. 25 marks for each question - altogether 250 marks.
Part B : Seven questions. **Five** questions should be answered. Each question carries 150 marks - altogether 750 marks.
Total marks for paper II = 1000

Calculation of the final mark :

Paper I	=	1000
Paper II	=	1000
Final mark	=	$2000 \div 20 = \underline{\underline{100}}$

(10) Combined Mathematics

Paper I

Part A

1. Using the **Principle of Mathematical Induction**, prove that $6^n - 1$ is divisible by 5 for all $n \in \mathbb{Z}^+$.

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2. Find the set of all real values of x satisfying the inequality $2|x - 3| \leq 2 + x$.

Hence, solve $2|x + 3| \leq 2 - x$.

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3. Shade the region R that represents the complex numbers z satisfying the conditions $|z - i| \leq 1$ and $\frac{\pi}{4} \leq \text{Arg}\,(z - i) \leq \frac{3\pi}{4}$ in an Argand diagram.

Write down the maximum value of $\text{Re}\,z + \text{Im}\,z$ for z in the region R.

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4. Show that $\lim_{x \to 0} \frac{\left((8 + x)^{\frac{1}{3}} - 2\right) \sin 2x}{x^2} = \frac{1}{6}$.

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5. Show that the equation of the tangent to the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$ at the point $P \equiv (4\cos\theta, 3\sin\theta)$ is $\frac{x}{4}\cos\theta + \frac{y}{3}\sin\theta = 1$.

Find the value θ $(0 < \theta < \frac{\pi}{2})$ such that the normal to the above ellipse at P passes through the point $\left(0, -\frac{7}{6}\right)$.

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6. Differentiate $\tan^{-1}\left[\frac{5}{3}\tan\left(\frac{x}{2}\right) + \frac{4}{3}\right]$ with respect to x. **Hence,** find $\int \frac{dx}{5 + 4\sin x}$.

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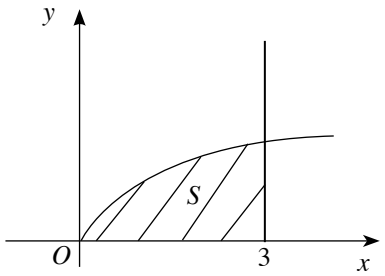
7. Let S be the region bounded by the curve $y = \frac{x}{\sqrt{x^2+9}}$, the straight line $x = 3$ and the x–axis (see the figure). Show that the volume of the solid generated by rotating S about the x–axis through 2π radians is $3\pi\left(1-\frac{\pi}{4}\right)$.



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8. A variable straight line through the point (2, 1) meets the x–axis and the y–axis at the points P and Q respectively. The point R is the mid-point of PQ. Show that the point R lies on the curve $x + 2y = 2xy$.

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9. Find the equation of the circle through the points $(0, 0)$ and $(0, 2)$ which bisects the circumference of the circle $x^2 + y^2 - 2x + 4y - 6 = 0$.

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10. Express $\sqrt{3}\cos x - \sin x$ in the form $R\cos(x+\alpha)$, where $R > 0$ and $0 < \alpha < \frac{\pi}{2}$.

Hence, solve the equation $\sqrt{3}\cos 2x - \sin 2x + 1 = 0$.

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Part B

11. (*a*) Let a and b be two distinct real numbers. Show that the roots of the equation $x^2 + 2bx + 2ab = a^2$ are real and distinct.

Show that the roots of the above equation α and β are both non-zero if and only if $a \neq 2b$ and $a \neq 0$.

Now suppose that $a \neq 2b$ and $a \neq 0$. Find the quadratic equation with $\frac{\alpha}{\beta}$ and $\frac{\beta}{\alpha}$ as its roots.

(*b*) Let $f(x)$ be a polynomial of degree greater than 2, and let p and q be distinct real numbers. Applying the Remainder Theorem twice, show that the remainder when $f(x)$ is divided by $(x - p)(x - q)$ is $\frac{f(q) - f(p)}{q - p}(x - p) + f(p)$.

Let $g(x) = x^3 + ax^2 + bx + 1$, where $a, b \in \mathbb{R}$. It is given that the remainder when $g(x)$ is divided by $(x - 2)$ is thrice the remainder when it is divided by $(x - 1)$, and that the remainder when $g(x)$ is divided by $(x - 1)(x - 2)$ is $kx + 5$, where $k \in \mathbb{R}$. Find the values of a, b and k.

12. (*a*) Show that the term independent of x in the expansion of $(1 + x)^2 \left(2x^2 - \frac{1}{2x}\right)^{10}$ is -15.

(*b*) A relay team consisting of 4 sprinters is to be selected from among 8 sprinters of different performance records. If the least performer among them is selected, then the best performer is also selected; but the best performer can be selected without the least performer being selected. Find the number of different relay teams that can be formed.

(*c*) Let $u_r = \frac{2r^2 - 5}{(r + 1)^2 (r + 2)^2}$ and $f(r) = \frac{\lambda r + \mu}{(r + 1)^2}$ for $r \in \mathbb{Z}^+$, where λ and μ are real constants.

Find the values of λ and μ such that $u_r = f(r) - f(r + 1)$ for $r \in \mathbb{Z}^+$.

Let $S_n = \sum_{r=1}^{n} u_r$ for $n \in \mathbb{Z}^+$. Show that $S_n = \frac{1}{4} - \frac{(2n + 1)}{(n + 2)^2}$ for $n \in \mathbb{Z}^+$.

Deduce that the infinite series $\sum_{r=1}^{\infty} u_r$ is convergent and find its sum.

13. (*a*) Let $a, b, c \in \mathbb{R}$. Also, let $\mathrm{A} = \begin{pmatrix} 1 & 2 & 1 \\ a & 3 & -1 \end{pmatrix}$, $\mathrm{B} = \begin{pmatrix} 2 & b & 1 \\ b & 1 & c \end{pmatrix}$ and $\mathrm{C} = \begin{pmatrix} c & 2a + c \\ 1 & b \end{pmatrix}$.

Find the values of a, b and c such that $\mathrm{AB}^{\mathrm{T}} = \mathrm{C}$.

For these values of a, b and c, find $(\mathrm{C}^{\mathrm{T}})^{-1}$ and **hence**, find the matrix P such that $\mathrm{C}^{-1}\,\mathrm{P}\,\mathrm{C}^{\mathrm{T}} = 5\mathrm{C}$.

(*b*) Using de Moivre's Theorem for a positive intergral index, show that if $z = \cos\theta + i\sin\theta$, then $z^{-n} = \cos n\theta - i\sin n\theta$, where $\theta \in \mathbb{R}$ and $n \in \mathbb{Z}^+$.

Express each of the complex numbers $-1 + i\sqrt{3}$ and $\sqrt{3} + i$ in the form $r(\cos\theta + i\sin\theta)$, where $r > 0$ and $-\pi < \theta \leq \pi$.

Let $m, n \in \mathbb{Z}^+$. Show that if $\frac{(-1 + i\sqrt{3})^n}{(\sqrt{3} + i)^m} = 8$, then $n = m + 3$ and $n = 4k - 1$, where $k \in \mathbb{Z}$.

14. (*a*) Let $f(x) = \dfrac{(x+1)}{(x+2)^2}$ for $x \neq -2$. Show that $f'(x)$, the derivative of $f(x)$, is given by $f'(x) = \dfrac{-x}{(x+2)^3}$ for $x \neq -2$.

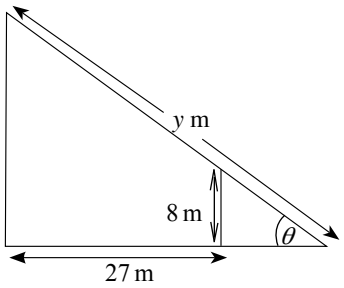
It is given that $f''(x) = \dfrac{2(x-1)}{(x+2)^4}$ for $x \neq -2$, where $f''(x)$ denotes the second derivative of $f(x)$.

Sketch the graph of $y = f(x)$ indicating the asymptotes, turning point and the point of inflection.

(*b*) A fence, 8 m tall, is at a distance of 27 m from a vertical wall of a building. A ladder with its lower end on the horizontal ground goes just over the fence and reaches the wall as shown in the figure. Let y m be the length of the ladder and θ be the angle it makes with the horizontal. Express y as a function of θ.

Show that $\dfrac{dy}{d\theta} = 0$ if and only if $\theta = \tan^{-1}\left(\dfrac{2}{3}\right)$.

By considering the sign of $\dfrac{dy}{d\theta}$ in appropriate intervals, find the length of the shortest such ladder.



15. (*a*) Express $\dfrac{4}{(x-1)(x+1)^2}$ in partial fractions.

Hence, find $\displaystyle\int \frac{1}{(1-e^{-x})(1+e^{x})^2}\,dx$.

(*b*) Using integration by parts, find $\displaystyle\int x^2(\sin x + 2\cos x)\,dx$.

(*c*) Establish the formula $\displaystyle\int_0^{\pi} x f(\sin x)\,dx = \frac{\pi}{2}\int_0^{\pi} f(\sin x)\,dx$.

Hence, show that $\displaystyle\int_0^{\pi} \frac{x\sin x}{(2-\sin^2 x)}\,dx = \frac{\pi^2}{4}$.

16. Let $A \equiv (-1, 1)$ and l be the straight line given by $x + y = 7$. Find the coordinates of the points B and C on l such that $A\hat{B}C = A\hat{C}B = \tan^{-1}(7)$.

Also, find the equation of the bisector m of the angle $B\hat{A}C$.

Write down the equation of the circle with BC as a diameter and **hence** write down the equation of any circle through B and C in terms of a parameter.

Deduce the equation of the circle S that passes through the points A, B and C.

Also, find the coordinates of the points of intersection, of the circle S and the straight line m.

17.(*a*) Show that $\cos^3 x \cos 3x + \sin^3 x \sin 3x = \cos^3 2x$.

Hence, solve $8(\cos^3 x \cos 3x + \sin^3 x \sin 3x) = 1$.

(*b*) Let *ABC* be a triangle. The points *D* and *E* are taken on *BC* such that *BD* : *DE* : *EC* = 1 : 2 : 3. Also, let $B\hat{A}D = \alpha$, $D\hat{A}E = \beta$ and $E\hat{A}C = \gamma$. Using the sine rule for suitable triangles, show that $\sin(\alpha+\beta)\sin(\beta+\gamma) = 5\sin\alpha \sin\gamma$.

(*c*) Let $|x| \leq 1$, $|y| \leq 1$ and $|z| \leq 1$. Show that if $\sin^{-1} x + \sin^{-1} y + \sin^{-1} z = \pi$, then $x\sqrt{1-x^2} + y\sqrt{1-y^2} + z\sqrt{1-z^2} = 2xyz$.

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(10) Combined Mathematics

Paper II

Part A

1. Two particles of masses m and λm move towards each other on a smooth horizontal table with speeds u and $\frac{2u}{3}$ respectively. Given that the particles move with equal speeds $\frac{u}{2}$ away from each other after their direct impact, show that the coefficient of restitution is $\frac{3}{5}$, and that the value of λ is $\frac{9}{7}$.

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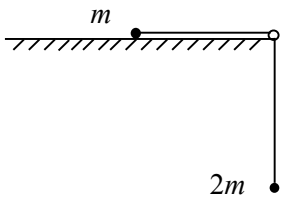
2. A particle of mass m lying on a rough horizontal table is connected by a light inextensible string which is perpendicular to the edge of the table and which passes over a small smooth pulley fixed at the edge of the table, to a particle of mass $2m$ which hangs freely as shown in the figure. The system is released from rest with the string taut. The coefficient of friction between the particle of mass m and the table is $\frac{1}{4}$. Show that the tension in the string is $\frac{5}{6}mg$.



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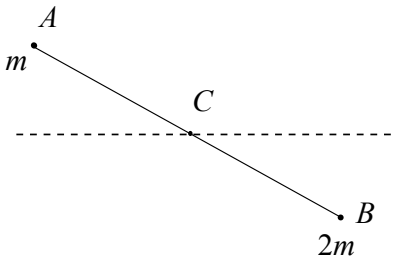
3. Two particles of masses m and $2m$ are attached to the two ends A and B respectively of a light rod AB of length $2a$. The rod is held in a horizontal position with its middle point C smoothly hinged to a fixed point, and released from rest. (See the figure.) Using the Principle of Conservation of Energy, show that the speed v of the particles when the rod makes an angle θ with the horizontal is given by $v^2 = \frac{2ga}{3}\sin\theta$.



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4. Two cars A and B move along a straight road in parallel lanes in the same direction. At time $t = 0$, the cars A and B pass a bridge with speeds u and $\frac{u}{4}$, respectively. Car A moves with the same constant speed u and car B moves with constant acceleration until it reaches the speed $\frac{5u}{4}$ at time $t = T$, and maintains that speed afterwards. In the same diagram, sketch the velocity - time graphs for the motions of car A and car B.

Hence, obtain an equation to determine the time taken by B to overtake A.

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5. A train of mass 300 metric tons is moving in a straight level track, with constant speed 15 m s^{-1} and the resistance to motion is 50 N per metric ton. Find the power of the train in kilowatts. Rear coach of mass 50 metric tons gets dislodged while the tractive force of the engine is unaltered. Find the acceleration of the remaining portion of the train.

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6. In the usual notation, let $4\mathbf{i} + \mathbf{j}$, $\lambda\mathbf{i} + \mu\mathbf{j}$ and $\mathbf{i} + 5\mathbf{j}$ be the position vectors of three points A, B and C respectively, with respect to a fixed origin O, where λ and μ are positive constants. The diagonals of the quadrilateral $OABC$ are equal in length and perpendicular to each other. Write down $\overrightarrow{AC}$ in terms of $\mathbf{i}$ and $\mathbf{j}$. Using scalar product, show that $\lambda = 4$ and $\mu = 3$.

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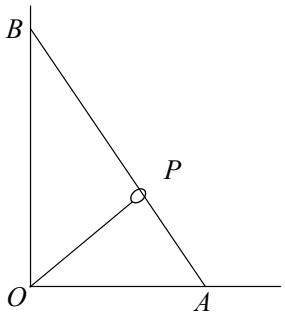
7. A smooth uniform rod AB of length $2a$ and weight W which passes through a small smooth ring P has its end A on a smooth horizontal ground and the other end B in contact with a smooth vertical wall. The rod is kept in equilibrium, at an angle 60° to the horizontal, in a vertical plane perpendicular to the wall by a light inextensible string which connects the ring to the point O as shown in the diagram. Show that $O\hat{P}A = 90^\circ$ and write down equations sufficient to determine the tension of the string.



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8. A particle of mass m is placed on a rough plane inclined at an angle α to the horizontal, where the coefficient of friction between the plane and the particle is μ (< tan α). The particle is held in equilibrium with a force P applied upwards to the particle along a line of greatest slope of the plane. Show that $mg(\sin\alpha - \mu\cos\alpha) \le P \le mg(\sin\alpha + \mu\cos\alpha)$.

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9. Find the probability that the sum of the number of dots obtained in at most three tosses of an unbiased standard die with 1, 2, 3, 4, 5 and 6 dots marked on its six faces, is exactly six.

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10. The mean and the mode of the seven numbers a, b, 4, 5, 7, 4 and 5 are equal, where a and b are positive integers. Find the values of a and b, and show that the variance of the seven numbers is $\frac{6}{7}$.

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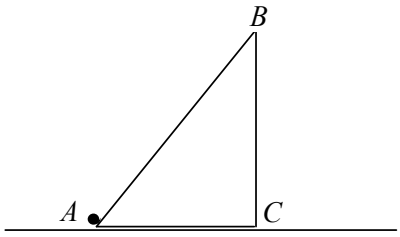
Part B

11. (*a*) A particle projected from a point *O* on a horizontal ground with a velocity $u=\sqrt{2ga}$ making an angle $\theta\left(0<\theta<\frac{\pi}{2}\right)$ to the horizontal, moves under gravity and hits a target at a point *P*. The horizontal and vertical distances of *P* measured from *O* are *a* and *ka*, respectively, where *k* is a constant. Show that $\tan^2\theta-4\tan\theta+4k+1=0$ and **deduce** that $k\le\frac{3}{4}$. Now, let $k=\frac{11}{16}$. Show that the angle between the two possible directions of projection is $\tan^{-1}\left(\frac{4}{19}\right)$.

(*b*) An airport *A* is situated at an angle θ East of South, at a distance *d* from an airport *B*. On a certain day, an air plane flies directly from *A* to *B* with a speed *u* relative to the wind which blows from North at a velocity *v* (< *u*). Sketch the velocity triangle for this flight, and show that the time taken to fly from *A* to *B* is $\frac{d}{\sqrt{u^2-v^2\sin^2\theta}-v\cos\theta}$.

A few days later, the plane flies back directly from *B* to *A* with a speed $\frac{u}{2}$ relative to the wind which blows from South at a velocity $\frac{v}{2}$. Sketch the velocity triangle for the return journey and show that the time taken to fly from *B* to *A* is twice as much as the time taken from *A* to *B*.

12. (*a*) The triangle *ABC* in the given figure represents a vertical cross section through the centre gravity of a uniform smooth wedge of mass 3*m*. The line *AB* is a line of greatest slope of the face containing it. Also $B\hat{A}C=\frac{\pi}{3}$. The wedge is placed with the face containing *AC* on a smooth horizontal floor. A particle of mass *m* is placed at the point *A* and given a velocity *u* along $\overrightarrow{AB}$. Assuming that *AB* is smooth and the particle does not leave the wedge, find the time taken by the particle to come to **rest relative to the wedge.** Now, suppose that the particle gets glued to the wedge in this position. Find also the time taken by the wedge with the particle glued to move an additional distance *d*.



(*b*) A bead *P* of mass *m* is free to move along a smooth circular wire of radius *a* and centre *O* which is fixed in a vertical plane. The bead is held at the upper-most point *A* of the wire and released from rest at a slightly displaced position. Show that the speed *v* of the bead when *OP* has turned through an angle θ is given by $v^2=2ga(1-\cos\theta)$.

Find the speed of the bead when the bead reaches the lowest point *B*. As *P* reaches the point *B*, it collides and coalesces with another bead of mass *m* which is at rest at *B*. Show that the composite bead *Q* comes to instantaneous rest when *OQ* has turned through an angle $\frac{\pi}{3}$.

13. One end of a light elastic string of natural length a and modulus mg is attached to a fixed point O. Two equal particles, each of mass m are fastened together to the other end P of the string and the system hangs in equilibrium. Show that the extension of the string in this position is $2a$.
Now, one of the particles gets gently detached and the remaining particle of mass m, still attached to the end of the string begins to move. Obtain the equation for motion of P, $\ddot{x} + \frac{g}{a}(x - 2a) = 0$, where $x(\geq a)$ is the length of the string.
Find the centre C and the amplitude of this simple harmonic motion.

At the point C, a vertical impulse is applied to the particle so that its velocity is trebled. Show that the centre of the motion, while the string is taut remains the same, and that the amplitude of this motion is $3a$.
Hence show that the string becomes slack after a total time $\sqrt{\frac{a}{g}}\left(\frac{\pi}{2} + \sin^{-1}\left(\frac{1}{3}\right)\right)$.
Find the speed of the particle at the instant when the string becomes slack.

14. (*a*) Let $PQRS$ be a parallelogram and let T be the point on QR such that $QT : TR = 2 : 1$. Also, let $\overrightarrow{PQ} = \mathbf{a}$ and $\overrightarrow{PS} = \mathbf{b}$. Express vectors $\overrightarrow{PR}$ and $\overrightarrow{ST}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

Let U be the point of intersection of PR and ST. Suppose that $\overrightarrow{PU} = \lambda\overrightarrow{PR}$ and $\overrightarrow{SU} = \mu\overrightarrow{ST}$, where λ and μ are scalar constants. By considering the triangle PSU, show that $(\lambda - \mu)\,\mathbf{a} + \left(\lambda + \frac{\mu}{3} - 1\right)\mathbf{b} = \mathbf{0}$ and find the values of λ and μ.

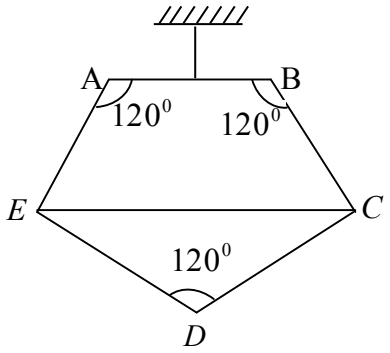
(*b*) A system consisting of three forces in the Oxy-plane act at the points indicated below:

Point	**Position Vector**	**Force**
A	$2a\mathbf{i} + 5a\mathbf{j}$	$F\mathbf{i} + 3F\mathbf{j}$
B	$4a\mathbf{j}$	$-2F\mathbf{i} - F\mathbf{j}$
C	$-a\mathbf{i} + a\mathbf{j}$	$F\mathbf{i} - 2F\mathbf{j}$

Here $\mathbf{i}$ and $\mathbf{j}$ denote unit vectors in the positive directions of coordinate axes Ox and Oy, respectively, and F, a are positive quantities measured in newtons and metres, respectively. Mark these forces in a single diagram, and show that their vector sum is zero.
Find the anti-clockwise moment, G, of the system about a point P with position vector $x\mathbf{i} + y\mathbf{j}$ and show that G is independent of x and y. Hence show that the system is equivalent to a couple, and find the moment of this couple.

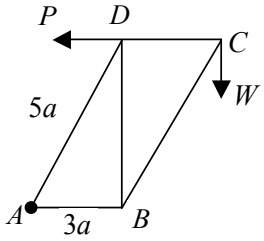
An additional force $X\mathbf{i} + Y\mathbf{j}$ is now applied at the point D with position vector $\mathbf{d} = -\frac{5a}{2}\,\mathbf{i}$, so that the resultant of the four forces acting at A, B, C and D, passes through the origin O. Find the values of X and Y.

15. (*a*) The figure represents a frame in the form of a pentagon *ABCDE* formed of five uniform rods of weight *w* **per unit length** jointed at their ends. $AE = BC = 2a$, and $ED = CD = 2b$. The angles at vertices *A, B* and *D* are 120° each. The frame is suspended from the mid-point of *AB* and is in equilibrium with the symmetrical shape maintained by a light rod *CE* of length $2b\sqrt{3}$ connecting the joints *C* and *E*. Show that the reaction at the joint *D* is of magnitude $b\sqrt{3}w$ and find the thrust in the light rod *CE*.



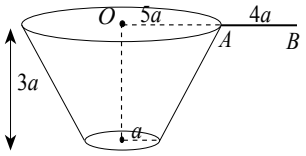
(*b*) The figure represents a framework of light rods *AB*, *BC*, *CD*, *DA* and *DB* freely jointed at their ends, and movable in a vertical plane about the joint *A*. Here $AB = CD = 3a$, $BC = DA = 5a$ and $DB = 4a$. It carries a weight *W* at the joint *C* and equilibrium is maintained with *AB* and *DC* horizontal and *BD* vertical by a horizontal force *P* applied along *CD* at the joint *D*. Find *P* in terms of *W*.

Sketch a stress diagram using Bow's notation and hence find the stresses in all the rods. State whether these are tensions or thrusts.



16. Show, by integration, that the distance of the centre of gravity of a frustum of a uniform hollow right circular cone with circular rims having radii r and $\lambda r (\lambda > 1)$ at a distance *h* apart, from the centre of its smaller rim is $\frac{h}{3}\left(\frac{2\lambda+1}{\lambda+1}\right)$.

A saucepan is made by fastening the edge of a thin uniform circular plate of radius *a* having a surface density σ to the smaller circular rim of a frustum of height 3*a* of a hollow right circular cone with circular rims of radii *a* and 5*a* having the same surface density σ, and fastening a thin uniform rod *AB* of length 4*a* and linear density ρ to the larger rim of the frustum such that the points *O, A* and are collinear, where *O* is the centre of the larger rim of the frustum, as shown in the figure. Find the position of the centre of gravity of the saucepan.



Show that if $\frac{\rho}{\sigma} < \frac{31}{24}\pi a$, then the saucepan can stay is equilibrium when placed on a horizontal table with its bottom touching it.

It is given that $\rho = \pi a\sigma$. Find the angle *BA* makes with the downward vertical when the saucepan is suspended freely from the end *B*.

17. (*a*) A box contains six red balls, three green balls and three blue balls, which are identical except for colour. A ball is drawn at random from the box. Find the probability that the ball is blue.

If the ball drawn is either green or red, one additional red ball and one additional blue ball are added to the box, together with the original ball. If the ball drawn is blue, there is no replacement.

Now, a second ball is drawn from the box at random. What is the probability that the second ball drawn is blue?
Find the probability that the first ball drawn is a blue one, given that the second ball drawn is a blue one.

(*b*) Marks obtained by 100 students in an examination are given in the following table.

Marks	5 - 19	20 - 34	35 - 49	50 - 64	65 - 79	80 - 94
Mid point (x_i)	12	27	42	57	72	87
Frequency (f_i)	10	20	30	15	15	10

Using the transformation $y_i = \frac{1}{15}(x_i - 42)$, estimate the mean and the variance of this distribution of marks.

The mean and the standard deviation of marks obtained by another 100 students in the same examination are 40 and 15, respectively. Estimate the mean and the variance of the marks obtained by all 200 students in this examination.

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(11) Higher Mathematics

Structure of the Question Paper

Paper I - **Time : 03 hours** (In addition, 10 minutes for reading.)
This paper consists of **two** parts.
Part A : Ten questions. **All** questions should be answered. 25 marks for each question - altogether 250 marks.
Part B : Seven questions. **Five** questions should be answered. Each question carries 150 marks - altogether 750 marks.
Total marks for paper I = 1000

Paper II - **Time : 03 hours** (In addition, 10 minutes for reading.)
This paper consists of **two** parts.
Part A : Ten questions. **All** questions should be answered. 25 marks for each question - altogether 250 marks.
Part B : Seven questions. **Five** questions should be answered. Each question carries 150 marks - altogether 750 marks.
Total marks for paper II = 1000

Calculation of the final mark :

Paper I	=	1000
Paper II	=	1000
Final mark	=	$2000 \div 20 = \underline{\underline{100}}$

Higher Mathematics
Paper I

Important :

* Answer **all** questions of part **A**.
* Answer **five** questions only of part **B**.

Part A

1. Factorize : $x^3(y-z)+y^3(z-x)+z^3(x-y)$.
Hence show that $(a-b)^3(a+b-2c)+(b-c)^3(b+c-2a)+(c-a)^3(c+a-2b)=0$.

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2. Let $k \in \mathbb{R}$. A relation R on $\mathbb{R}$ is defined by xRy if $x^4-y^4-kx^2+ky^2=0$. Show that R is an equivalence relation on $\mathbb{R}$.

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3. Let $f(x) = \dfrac{x+1}{x-1}$ for $x \neq 1$ and let $g(x) = ax^3 + 1$ for $x \in \mathbb{R}$, where a is a real constant. Also let $h(x) = (g \circ f)(x)$ for $x \neq 1$. It is given that $h(2) = 28$. Show that $a = 1$. Write down $h^{-1}(x)$.

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4. Show that $x + y + z$ is a factor of the determinant

$$\Delta = \begin{vmatrix} x & x^3 & y+z \\ y & y^3 & z+x \\ z & z^3 & x+y \end{vmatrix}$$

and express Δ as a product of linear factors.

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5. Find the equation of the normal to the rectangular hyperbola $xy = c^2$ at the point $(ct\ ,\ \frac{c}{t})$ and show that if it passes through $(0, c)$ then $t^4 + t - 1 = 0$.

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6. Let $a, b \in \mathbb{R}$ and let $f : \mathbb{R} \longrightarrow \mathbb{R}$ be the function given by

$$f(x) = \begin{cases} \dfrac{\sqrt[3]{1+ax} - 1}{x} & , \text{ if } x > 0 \\ b & , \text{ if } x = 0 \\ \dfrac{1}{3(1 - e^{\frac{1}{x}})} & , \text{ if } x < 0 \end{cases}$$

If f is continuous at $x = 0$, find the values of a and b.

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7. Let $f : \mathbb{R} \longrightarrow \mathbb{R}$ be the function given by

$$f(x) = \begin{cases} |x^2 - 1| & \text{if } x \geq -1 \\ -(x^2 - 1) & \text{if } x < -1 \end{cases}$$

Show that f is **not** differentiable at $x = 1$.

Write down $f'(x)$ for all $x \neq 1$.

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8. Using the substitution $z = \frac{1}{y}$, transform the differential equation $\frac{dy}{dx} - y \tan x = y^2 \cos^2 x$ into linear form and **hence**, solve it.

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9. Let f and g be real-valued functions defined on the interval [0,1]. Suppose that f and g', the derivative of g, are continuous on [0, 1] and that $3f(1-x)+2xg'(x)=4x^3$ for $x \in [0,1]$.

Show that if $\int_0^1 f(x)\,=2$ and $g(1)=1$, then $\int_0^1 g(x)\mathrm{d}x=\frac{7}{2}$

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10. Sketch the curves whose polar equations are given by $r-2\sin\theta=0$ and $r^2-2r(\sqrt{2}\cos\theta+\sin\theta)+2=0$ in the same diagram.

Show that these curves intersect at right angles.

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Part B

11. (*a*) Let A, B and C be subsets of a universal set S. Stating clearly the laws of Algebra of sets that you use, prove that

(i) $A \cup B = A \cup (A' \cap B)$,

(ii) $B = (A \cap B) \cup (A' \cap B)$ and

(iii) $(A - B) \cap C = (A \cap C) - (B \cap C)$,

where the $A - B$ is defined by $A - B = A \cap B'$.

(*b*) A survey of 150 students was conducted to determine which sports they like from among cricket, hockey and football. It was revealed that 60 students like cricket, 50 like hockey, 70 like football, 35 like hockey and football, 20 like cricket and football, 42 like cricket and hockey and 10 like all three sports. Find the number of students who

(i) do not like any of these three sports,

(ii) like only cricket,

(iii) like at most one sport.

12. (*a*) Let a, b and c be positive numbers.

Show that $\sqrt{a\,b} \leq \frac{1}{2}(a + b)$.

Deduce that $(abc)^{\frac{1}{3}} \leq \frac{1}{3}(a + b + c)$.

Show each of the following :

(i) $(a + 4b)(b + 4c)(c + 4a) \geq 64abc$.

(ii) $a(1 - a)^2 \leq \frac{4}{27}$, for $0 < a < 1$.

(*b*) The transformation $\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} 1 & 2 \\ -1 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix}$ in the xy–plane maps the point $(a, a + 2)$ into the point $(2a, b)$, where a and b are real constants. Find the values of a and b. Find the vertices of the parallelogram in the $x'y'$ –plane to which the square in the xy –plane with vertices (0,0), (1,0), (1,1) and (0,1) gets mapped onto.

13. State and prove de Moivre's theorem for a positive integral index.

Let $\omega_k = \cos\left(\frac{2k\pi}{7}\right) + i\sin\left(\frac{2k\pi}{7}\right)$ for $k = 1, 2, 3, \ldots$. Show that $\omega_k^{\,7} = 1$ for $k = 1, 2, 3, \ldots$ and **hence**, write down the six distinct non real roots of the equation $z^7 = 1$.

Show that $1 + \omega_1 + \omega_2 + \omega_3 + \omega_4 + \omega_5 + \omega_6 = 0$ and that $\omega_k + \omega_{7-k} = 2\cos\left(\frac{2k\pi}{7}\right)$ for $k = 1, 2, 3$.

Deduce that $\cos\left(\frac{2\pi}{7}\right) + \cos\left(\frac{4\pi}{7}\right) + \cos\left(\frac{6\pi}{7}\right) = -\frac{1}{2}$. Also, show that

$1 + z + z^2 + z^3 + z^4 + z^5 + z^6 = \{z^2 - 2\cos\left(\frac{2\pi}{7}\right) z + 1\}\{z^2 - 2\cos\left(\frac{4\pi}{7}\right) z + 1\}\{z^2 - 2\cos\left(\frac{6\pi}{7}\right) z + 1\}$.

14. (*a*) Solve the differential equation $(1 - x^2)\dfrac{dy}{dx} + y = x^2\,(1 + x)\,(1 - x)^{\frac{3}{2}}$ for $-1 < x < 1$ and **hence**, find the solution satisfying $y = 1$ when $x = 0$.

(*b*) Find the differential equation satisfied by the family of curves $y = \lambda(x - 1)^2 + 3$, where λ is a real parameter.

Hence, find the general equation of the family of the orthogonal trajectories.

15. (*a*) Let $I_n = \displaystyle\int_0^1 x^n \cos\left(\frac{\pi}{2}x\right) dx$, where n is a non-negative integer.

Show that $I_n + \dfrac{8}{\pi^3}\,n(n-1)\,I_{n-1} = \dfrac{2}{\pi}$ for $n \geq 2$.

Hence, find I_4.

(*b*) Let $y = e^{\tan^{-1}x}$. Show that $(1 + x^2)\dfrac{d^2y}{dx^2} = (1 - 2x)\dfrac{dy}{dx}$.

Obtain the Maclaurin expansion of y upto and including the term of x^4.

Hence, find an approximate value of the integral $\displaystyle\int_0^{\frac{1}{2}} e^{\tan^{-1}x}\,dx$

16. (*a*) Show that the tangent to the ellipse $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1$ at the point $P(a\cos\theta, b\sin\theta)$ is given by $\dfrac{x}{a}\cos\theta + \dfrac{y}{b}\sin\theta = 1$. The line $y = x + c$ is a tangent to the ellipse $\dfrac{x^2}{4} + y^2 = 1$. Show that $c = \pm\sqrt{5}$. Find the coordinates of the points P and Q of contact and show that the chord PQ passes through the origin.

(*b*) Show that the area A enclosed by the parabola $y^2 = 4ax$ and the chord joining the points $(ap^2, 2ap)$ and $(aq^2, 2aq)$ is given by $9A^2 = a^4\,(p - q)^4$.

Let $P \equiv \left(\dfrac{4}{\sqrt{5}}, \dfrac{-1}{\sqrt{5}}\right)$. Show that P lies on the parabola $y^2 = \dfrac{1}{4\sqrt{5}}\,x$.

Show that the equation of the normal drawn to the parabola $y^2 = \dfrac{1}{4\sqrt{5}}\,x$ at the point P is $\sqrt{5}\,y - 8\sqrt{5}\,x + 33 = 0$.

Find the area bounded by the line PQ, the normal $\sqrt{5}\,y - 8\sqrt{5}\,x + 33 = 0$ and the parabola $y^2 = \dfrac{1}{4\sqrt{5}}\,x$.

17. (*a*) Let $A = \left(-\frac{\pi}{2}, \frac{\pi}{2}\right) - \{0\}$ and let $f(x) = \left(\frac{\text{cosec}x + \sec x}{\tan x + \cot x}\right)^2 - \frac{2}{\text{cosec}^2 x}$ for $x \in A$.

Show that $f(x) = \sin 2x + \cos 2x$ for $x \in A$.

Express $f(x)$ in the form $R \sin(\alpha x + \theta)$ for $\alpha > 0$ where R, α and θ are to be determined.

Sketch the graph of f for $x \in A$.

(*b*) The following table gives the values of $f(x) = \frac{1}{1+x^2}$ correct to two decimal places for values of x between 0 and 1 at intervals of length 0.25 :

x	0	0.25	0.50	0.75	1
$f(x) = \frac{1}{1+x^2}$	1	0.94	0.80	0.64	0.50
$xf(x) = \frac{x}{1+x^2}$	0	0.23	0.40	0.48	0.50

Applying **the Simpson rule**, find an approximation for $\int_0^1 \frac{1+x}{1+x^2}\,dx$.

Find the exact value of $\int_0^1 \frac{1+x}{1+x^2}\,dx$

Hence, find an approximation for $\pi + \ln 4$.

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Higher Mathematics
Paper II
Part A

1. The position vectors of three points A, B and C with respect to a fixed origin O are $\mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$, $\beta\mathbf{i} - \mathbf{j} + \mathbf{k}$ and $\mathbf{i} + 5\mathbf{j} + 5\mathbf{k}$, respectively, where β is a constant. It is given that the point C lies on the plane OAB. Find the value of β.

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2. Two forces $\boldsymbol{P} = \mathbf{i} + 2\mathbf{j} - 2\mathbf{k}$ and $\boldsymbol{Q} = \mathbf{i} + 2\mathbf{j} + 2\mathbf{k}$ each of magnitude 3 N act at the points A and B with position vectors $3\mathbf{k}$ and $-\mathbf{k}$, respectively. Find their vector sum $\boldsymbol{R}$ and their moment vector $\boldsymbol{G}$ about the origin O. **Hence**, show that these two forces reduce to a single resultant force.

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3. A uniform solid right circular cone floats with its vertex above, axis vertical and two thirds of the axis above the free surface in a liquid of constant density ρ. Show that the density of the cone is $\frac{19}{27}\rho$.

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4. The position vector of a particle P at time t, is given by $\mathbf{r} = a(\cos\omega t)\,\mathbf{i} + a(\sin\omega t)\,\mathbf{j} + (c\,\omega t)\,\mathbf{k}$, where a, c and ω are positive constants. Show that the velocity $\mathbf{v}$ of P is of constant magnitude $\omega\sqrt{a^2 + c^2}$ and $\mathbf{v}$ makes a constant angle with the OZ - axis. Find the displacement of P from its initial position, when $t = \frac{2\pi}{\omega}$.

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5. A small smooth sphere moving vertically downwards with speed u strikes a fixed smooth plane of inclination $\frac{\pi}{6}$ to the horizontal and rebounds horizontally. Show that the coefficient of restitution between the sphere and the plane is $\frac{1}{3}$ and that the kinetic energy retained in the sphere is $\frac{1}{3}$ of its value just before impact.

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6. A uniform circular hoop of mass m and radius a can rotate freely in a vertical plane about a horizontal axis through a point A in the hoop. The hoop is held with its centre C vertically above A and then given a small displacement. Show that the speed of the centre C when it is vertically below A is $\sqrt{2ga}$.

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7. The discrete random variable X takes values ± 3, ± 1 only, with probabilities $P(X = x) = k|x|$; where k is a positive constant.

(i) Find the value of k and $E(X^2)$.

(ii) Show that the standard deviation of X is $\sqrt{7}$.

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8. The random variable X takes values 0, 1, 2 and 3 only. Given $P(X \leq 1) = 0.5$, $P(X \leq 2) = 0.9$ and $E(X) = 1.3$, obtain the probability distribution of X. Show that the value of Var(X) is approximately equal to 1.

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9. The probability density function $f(x)$ of a continuous random variable X defined only for non-negative x, is as follows :

$f(x) = kx$, for $0 \leq x \leq 1$ and $f(x) = \frac{k}{x^4}$, for $x \geq 1$.

Find,

(i) the value of the constant k,

(ii) $E(X)$, the mean of X, and

(iii) the mode of this probability distribution.

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10. The cumulative distribution function $F(x)$, of a random variable X that is defined for $0 \leq x \leq 1$ is given by $F(x) = ax^2 - 2x^3$. Find the value of the constant a, and show that $E(X) = \frac{1}{2}$. Also, find the probability $P(\frac{1}{4} \leq X \leq \frac{3}{4})$.

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Part B

11. A system consists of six forces each of magnitude P N act (in the directions as indicated), along the six edges $\overrightarrow{OA}$, $\overrightarrow{AB}$, $\overrightarrow{OB}$, $\overrightarrow{BC}$, $\overrightarrow{OC}$, $\overrightarrow{CA}$ of a regular tetrahedron $OABC$. Three vertices A, B, C of the tetrahedron have coordinates, $(a, a, 0)$, $(a, 0, a)$ and $(0, a, a)$ where a is a length measured in metres, with respect to Cartesian axes Ox, Oy, Oz, with the vertex O as the origin. Write down unit vectors in the directions of these forces and **hence**, express the six forces in vector form. Show that, the system can be reduced to a force $\boldsymbol{R}$ of magnitude $R = \sqrt{6}\,P$ N acting at the origin O and a couple of moment vector $\boldsymbol{G}$. Express $\boldsymbol{R}$ and $\boldsymbol{G}$ in terms of unit vectors $\mathbf{i}, \mathbf{j}, \mathbf{k}$ and the scalar P.

Hence show that the system is equivalent to a wrench of pitch $p = \dfrac{\boldsymbol{R} \,.\, \boldsymbol{G}}{R^2}$, and that its axis is along the line whose vector equation is $\boldsymbol{G} - \boldsymbol{r} \times \boldsymbol{R} = p\boldsymbol{R}$. Find p in terms of a and obtain the position vector equation of the axis of the wrench, in the standard parametric form $\boldsymbol{r} = \boldsymbol{r_0} + \lambda \boldsymbol{N}$, where suitable vectors $\boldsymbol{r_0}$ and $\boldsymbol{N}$ are to be found. Deduce Cartesian equation of the axis of the wrench, and the direction cosines of this line.

12. A circular plate of radius a is completely immersed vertically in a homogeneous liquid, of density ρ with its centre O at a depth $h(\geq a)$ below the free surface of the liquid. Write down the liquid thrust on the plate. Using integration, show that the centre of pressure of the plate lies on its vertical diameter at a depth $\dfrac{a^2}{h}$ below the centre O..

A plane door S in the shape of the region between two concentric circles of radii a and $2a$ is located on a vertical side of a tank filled with a homogeneous liquid of density ρ. The depth of the liquid in the tank is $6a$. The door is freely hinged at its uppermost point A which is at a depth a below the free surface. Find the force that should be applied perpendicular to the door at its lowest point B to keep it closed.

13. A particle is projected vertically upwards with speed U from a point A on the horizontal ground, in a medium which offers a resistance kv per unit mass when its speed is v, where k is a constant. Show that, the particle comes to rest instantaneously after a time $T = \dfrac{1}{k}\ln\left(\dfrac{g + kU}{g}\right)$, at the point B at a height H above A, where $kH = U - gT$.

If the time taken by the particle for its downward motion, starting from rest at B, until it reaches A is T_1 and its speed at A is U_1 show that $T + T_1 = \dfrac{1}{k}\ln\left(\dfrac{g + kU}{g - kU_1}\right)$.

14. A particle P of mass m is attached to one end of a light inextensible string of length $2a$, and another particle Q of equal mass is attached to the other end of the string. Particle P is held at a point A and particle Q held at the point B distant a vertically below the point A. Initially, the particle P is given a horizontal velocity u and simultaneously, particle Q is released from rest at point B.

By considering the motion of particle P relative to Q, or otherwise, show that when the string becomes taut the inclination of the string to the vertical is $\frac{\pi}{3}$.

By considering conservation of angular momentum of the system about its centre of mass, G, show further that

(i) just after the string becomes taut **and also** in the subsequent motion of the system, the angular velocity of the string remains constant and equal to $\frac{u}{4a}$;

(ii) the time at which the string becomes vertical with P below Q is $t_1 = \frac{a}{u}\left(\sqrt{3} + \frac{8\pi}{3}\right)$.

By considering the motion of G, and the motion of the system relative to G

(iii) show that the path of G in the subsequent motion of the system is a parabola, and find the horizontal and vertical distances of G from the point A, at time $t = t_1$.

15. State the moment of inertia of a thin uniform circular ring of mass M and radius a about an axis through its centre and perpendicular to its plane.

Show, by integration that the moment of inertia of a uniform circular disc of mass M and radius a about an axis through its centre and perpendicular to its plane is $\frac{1}{2}Ma^2$.

The ring and the disc independently roll (without slipping) down lines of greatest slope of a fixed plane inclined at an angle α to the horizontal, each body starting from rest with their centres on the same straight horizontal line, at time $t = 0$.

Using the principle of conservation of energy, show that the speeds v and V, of the centres of the ring and the disc, after rolling through a distance x down the plane are given by $v^2 = gx \sin\alpha$ and $V^2 = \frac{4g}{3}x \sin\alpha$, respectively.

Hence, or otherwise, find the acceleration of each body, and show that the disc moves through a distance $\frac{1}{12}gt^2 \sin\alpha$ more than the distance moved by the ring.

16. (*a*) Let X denote the random variable "the number of successes in n independent trials, each with success probability p $(0 < p < 1)$.", and let X follow a binomial distribution, with probability function $P(X = x) = {}^{n}C_{x}\,(1-p)^{n-x}p^{x}$, $x = 0, 1, 2, \ldots. n$.

Show that $P(X = x) \leq P(X = x + 1)$, if and only if $x \leq (n + 1)\,p - 1$.

Suppose a particular marksman makes several independent trials to hit a specified target, and the probability that he succeeds in hitting the target in each trial is 0.3.

(i) If the number of independent trials the marksman makes is 8, find the number of successes with the highest probability.

(ii) Find the least number of trials the marksman should make, in order that the probability of hitting the target at least once is greater than 80%.

(*b*) A discrete random variable R follows a geometric distribution whose probability function is given by $P(R = r) = q^{r-1}p$, $r = 1, 2, 3, \ldots$, where $0 < p < 1$ and $q = 1 - p$.

Show that

(i) the cumulative distribution function, $P(R \leq r) = 1 - q^{r}$, and

(ii) $P(R > s + t \mid R > s) = P(R > t)$, for any two positive integers s and t.

17. (*a*) Time interval X (in minutes) between consecutive arrival times of buses (in a certain route) at a bus stop A is a random variable and X follows an exponential distribution with density function

$$f(x) = \begin{cases} \lambda e^{-\lambda x}, & \text{if } x \geq 0, \\ 0, & \text{otherwise.} \end{cases}$$

Here λ is a positive parameter. Find the mean μ and the standard deviation σ of the random variable X, in terms of the parameter λ.

Now let the parameter $\lambda = \frac{1}{10}$ and suppose that a bus (in this particular route) arrived at the stop A at 7.00 a.m. Find the probability that the next bus (in the same route) will arrive at the stop A between 7.15 a.m. and 7.30 a.m.

[**It may be assumed that** $e^{-1.5} \approx 0.2231$.]

(*b*) The time Y (in minutes) taken by an express train to travel from one station S_1 to the next station S_2 is a random variable which follows a normal distribution with a mean of 40 minutes and a standard deviation of 5 minutes.

Suppose an express train left the station S_1 at 2.00 p.m. and started to travel towards the station S_2,

(i) Find the probability that the train will reach station S_2 before 2.45 p.m.

(ii) Given that the train had arrived at station S_2 before 2.45 p.m., find the probability that the train had arrived at station S_2 before 2.30 p.m.

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ඇමුණුම/ **இணைப்பு/ Annex 01**

චක්‍රලේඛ අංක/ சுற்றுநிருப இலக்கம்/ Circular No. - 2016/13

අ.පො.ස.(උ.පෙළ) විෂය සංයෝජන හා විශ්ව විද්‍යාල ප්‍රවේශය සඳහා වූ විෂය සංයෝජන

க.பொ.த. (உயர்தர) பாடச் சேர்மானங்களும் பல்கலைக்கழகப் பிரவேசம் தொடர்பான பாடச் சேர்மானம்

G.C.E.(A.L.) Subject Combinations and the Subject Combinations for University Entrance

අධ්‍යාපන අමාත්‍යාංශය, 'ඉසුරුපාය', බත්තරමුල්ල
கல்வி அமைச்சு, 'இசுறுபாய', பத்தரமுல்லை
Ministry of Education 'Isurupaya', Battaramulla

චක්‍රලේඛ අංක : 2016/13

මගේ අංකය : ඊඩී/01/12/02/06/02-(I)
පාසල් කටයුතු ශාඛාව,
අධ්‍යාපන අමාත්‍යාංශය,
"ඉසුරුපාය" බත්තරමුල්ල.
2016.04.26

පළාත් ප්‍රධාන ලේකම්වරු,
පළාත් අධ්‍යාපන ලේකම්වරු,
පළාත් අධ්‍යාපන අධ්‍යක්ෂවරු,
කලාප අධ්‍යාපන අධ්‍යක්ෂවරු,
කොට්ඨාස භාර නියෝජ්‍ය/සහකාර අධ්‍යාපන අධ්‍යක්ෂවරු,
රජයේ හා රජයේ අනුමත පෞද්ගලික පාසල් ප්‍රධානීන් වෙත.

අ.පො.ස. (උසස් පෙළ) විෂය සංයෝජන හා විශ්වවිද්‍යාල ප්‍රවේශය සඳහා වූ විෂය සංයෝජන

අ.පො.ස. (උසස් පෙළ) විෂය සංයෝජන හා විශ්වවිද්‍යාල ප්‍රවේශය සඳහා වූ විෂය සංයෝජන සම්බන්ධයෙන් මීට පෙර නිකුත් කර ඇති 2009.05.18 දිනැති අංක 2009/16 දරන චක්‍රලේඛය හා 2010.04.21 දිනැති අංක 2009/16 (I) චක්‍රලේඛ සංශෝධනය හා ඊට අදාළ ව නිකුත් කර ඇති 2013.06.11 දිනැති චක්‍රලේඛ ලිපියේ සියලු විධිවිධාන අභිබවා 2016 වර්ෂයේ හා ඉන්පසුව 12 වන ශ්‍රේණියට ඇතුළත්වන සිසුන් සඳහා මෙම චක්‍රලේඛ විධිවිධාන බල පැවැත්වේ.

2.0 අ.පො.ස. (සාමාන්‍ය පෙළ) සමත්වන සිසුන් විසින් අ.පො.ස. (උසස් පෙළ) පන්තියේ දී හැදෑරීමට අපේක්ෂිත විෂය ධාරා තෝරා ගැනීමේ දී විෂයයන් හෝ විෂය සංයෝජන පිළිබඳ නිසි ආකාරව අවබෝධයක් නොමැති බැවින් ගැටළු සහගත තත්ත්වයන්ට මුහුණ දීමට සිදු වේ. තව ද විශ්වවිද්‍යාලවල දැනට ක්‍රියාත්මක වන ප්‍රථම උපාධි පාඨමාලා සඳහා අවශ්‍ය වන විෂය සංයෝජන පිළිබඳව ද සිසුන්ට නිසි අවබෝධයක් නොමැති බැවින් විශ්වවිද්‍යාලවලට ඇතුළත් වීමේ දී නොයෙකුත් දුෂ්කරතාවලට මුහුණ දීමට සිදුව ඇත. මෙම ගැටළු නිරාකරණය කිරීම සඳහා ත් සිසුන්ට මග පෙන්වීම සඳහා ත් අදාළ වන පරිදි මෙම චක්‍රලේඛය නිකුත් කෙරේ. එම නිසා මෙම චක්‍රලේඛයේ සඳහන් අ.පො.ස. (උසස් පෙළ) විෂය සංයෝජන හා විශ්වවිද්‍යාල ප්‍රථම උපාධි පාඨමාලා සඳහා වන විෂය සංයෝජන පිළිබඳ 12 ශ්‍රේණියට ඇතුළත්වන සියලුම සිසුන් දැනුවත් කිරීමට විදුහල්පතිවරුන් වග බලා ගත යුතු ය.

3.0 අ.පො.ස. (උසස් පෙළ) පංතිවල ප්‍රධාන විෂයයන් තුනක් ඉගැන්වෙන අතර, එක් විෂයක් සඳහා සතියකට කාලච්ඡේද 10ක් වෙන් කෙරේ. ඒ අනුව, එම නිර්දේශිත ප්‍රධාන විෂයයන් 03 සඳහා කාලච්ඡේද 30ක් වැය වේ. ඉතිරි කාලච්ඡේද 10න් 06ක් සාමාන්‍ය ඉංග්‍රීසි විෂය සඳහා වෙන් කළ යුතු අතර, සාමාන්‍ය තොරතුරු තාක්ෂණය (GIT) විෂය සඳහා 12 ශ්‍රේණියේ පමණක් කාලච්ඡේද 02ක් වෙන් කළ යුතු ය. 12 ශ්‍රේණියේ ඉතිරි කාලච්ඡේද 02 ද 13 වන ශ්‍රේණියේ ඉතිරි කාලච්ඡේද 04 ද පාසල් කළමනාකරණ කණ්ඩායමේ අභිමතය පරිදි සිසුන්ගේ අධ්‍යාපන දියුණුවට අදාළ වන ආකාරයෙන් යොදා ගත යුතු වේ.

4.0 නියම කර ඇති මූලික අවශ්‍යතා සපුරා ඇති සිසුන් 13 වන ශ්‍රේණියේ අවසානයේ දී ප්‍රධාන විෂයයන් 03 සමග සාමාන්‍ය පොදු පරීක්ෂණය හා සාමාන්‍ය ඉංග්‍රීසි විෂය සඳහා විභාගයට පෙනී සිටිය යුතු ය. සාමාන්‍ය ඉංග්‍රීසි විෂය සඳහා ලබාගන්නා ලකුණු හෝ සාමර්ථ්‍යය විශ්වවිද්‍යාල ප්‍රවේශය සඳහා උපයෝගී කර ගනු නොලැබේ. එහෙත් එම විෂය සඳහා ලබා ගන්නා ප්‍රතිඵලය අ.පො.ස. (උසස් පෙළ) විභාග ප්‍රතිඵල සහතිකයේ සටහන් කෙරේ.

5.0 අ.පො.ස. (උසස් පෙළ) විෂයධාරා සඳහා විෂය සංයෝජන

පාසල්වල දැනට අ.පො.ස.(උසස් පෙළ) පන්ති සඳහා අංශ තුනක් යටතේ (කලා/වාණිජ්‍යය, විද්‍යා, තාක්ෂණවේදය) විෂය ධාරා හයක් (6) ක්‍රියාත්මක කෙරේ.

5.1 කලා විෂය ධාරාව

ශිෂ්‍යයන් කලා විෂය ධාරාව යටතේ අධ්‍යාපනය ලැබීම සඳහා පහත දක්වා ඇති කොන්දේසිවලට අනුකූලව විෂය සංයෝජන තෝරා ගත යුතු ය.

5.1.1 පහත දැක්වෙන සමාජයීය විද්‍යාව/ව්‍යවහාරික සමාජ අධ්‍යයන විෂය කාණ්ඩයෙන් (5.1.6 හි අ) අවම වශයෙන් එක් විෂයයක් තෝරා ගත යුතු ය. (භාෂා විෂයයන් 2ක් හෝ ජාතික භාෂා තුනම හෝ තෝරා ගන්නා සිසුන්ට මෙය අදාළ නොවේ.) ශිෂ්‍යයාගේ මනාපය අනුව, මේ කාණ්ඩයෙන් විෂයයන් දෙකක් හෝ තුනම හෝ තෝරා ගත හැකි ය.

5.1.2 පහත දැක්වෙන ආගම් හා ශිෂ්ටාචාර විෂයයන් (5.1.6හි ආ) අතුරින් යම් ආගමක් තෝරා ගන්නේ නම්, ඊට අදාළ ශිෂ්ටාචාර විෂය තෝරා ගත නොහැකි ය.

5.1.3 පහත දැක්වෙන සෞන්දර්ය අධ්‍යයන විෂයයන් (5.1.6හි ඇ) අතුරින්, විෂයක් හෝ දෙකක් හෝ තෝරා ගත හැකි ය.

5.1.4 පහත දැක්වෙන භාෂා විෂයය කාණ්ඩයේ (5.1.6හි ඈ) දැක්වෙන භාෂා විෂයයන්ගෙන් ඕනෑම භාෂා විෂයක් හෝ විෂයයන් 2ක් හෝ තෝරාගත හැකි ය. එහෙත්, විෂයයන් තුනම භාෂා විෂයයන්ගෙන් තෝරා ගන්නේ නම්, පහත සඳහන් ආකාරයට ම පමණක් විය යුතු ය.

- 5.1.6 (ඈ) (1)හි සඳහන් විෂයයන් 3ම,
- 5.1.6 (ඈ) හි (1) හා (2) යන උපකාණ්ඩ දෙකෙන් පමණක් වන පරිදි විෂයයන් තුනක්.

5.1.5 භාෂා විෂයයන් දෙකක් තෝරාගන්නා ශිෂ්‍යයකුට සිය තුන්වන විෂයය වශයෙන් සමාජයීය විද්‍යා/ව්‍යවහාරික සමාජ අධ්‍යයන, ආගම් හා ශිෂ්ටාචාර, සෞන්දර්ය අධ්‍යයන යන විෂය කාණ්ඩවලින් කැමති විෂයක් තෝරා ගත හැකි ය.

5.1.6 කලා විෂය ධාරාව සඳහා විෂයය කාණ්ඩ

(අ) සමාජයීය විද්‍යා/ව්‍යවහාරික සමාජ අධ්‍යයන විෂයයන්

1. ආර්ථික විද්‍යාව
2. භූගෝල විද්‍යාව
3. ඉතිහාසය(ලංකා ඉතිහාසය සමග ඉන්දීය ඉතිහාසය හෝ යුරෝපා ඉතිහාසය හෝ නූතන ලෝක ඉතිහාසය)
4. ගෘහ ආර්ථික විද්‍යාව
5. දේශපාලන විද්‍යාව
6. තර්ක ශාස්ත්‍රය හා විද්‍යාත්මක ක්‍රමය
7. ගිණුම්කරණය හෝ ව්‍යාපාර සංඛ්‍යානය
8. කෘෂි විද්‍යාව හෝ ගණිතය හෝ සංයුක්ත ගණිතය

9. තාක්ෂණවේදය විෂයයන්ගෙන් එක් විෂයක් (සිවිල් තාක්ෂණවේදය හෝ යාන්ත්‍රික තාක්ෂණවේදය හෝ විදුලිය ඉලෙක්ට්‍රොනික සහ තොරතුරු තාක්ෂණවේදය හෝ ආහාර හා තාක්ෂණවේදය හෝ කෘෂි තාක්ෂණවේදය හෝ ජෛව සම්පත් තාක්ෂණවේදය)
10. සන්නිවේදනය හා මාධ්‍ය අධ්‍යයනය
11. තොරතුරු හා සන්නිවේදන තාක්ෂණය

(ආ) ආගම් හා ශිෂ්ටාචාර විෂයයන්

1. බුද්ධ ධර්මය හෝ බෞද්ධ ශිෂ්ටාචාරය
2. ක්‍රිස්තියානි ධර්මය හෝ ක්‍රිස්තියානි ශිෂ්ටාචාරය
3. හින්දු ධර්මය හෝ හින්දු ශිෂ්ටාචාරය
4. ඉස්ලාම් හෝ ඉස්ලාම් ශිෂ්ටාචාරය
5. ග්‍රීක හා රෝම ශිෂ්ටාචාරය

(ඇ) සෞන්දර්ය අධ්‍යයන විෂයයන්

1. චිත්‍ර කලාව
2. නර්තනය (දේශීය හෝ භරත)
3. සංගීතය (පෙරදිග හෝ කර්ණාටක හෝ බටහිර)
4. නාට්‍ය හා රංග කලාව (සිංහල හෝ දෙමළ හෝ ඉංග්‍රීසි)

(ඈ) භාෂා විෂයයන්

1. සිංහල, දෙමළ, ඉංග්‍රීසි
2. අරාබි, පාලි, සංස්කෘත
3. චීන, මැලේ, ප්‍රංශ, ජර්මන්, රුසියන්, හින්දි, ජපන්

5.2. වාණිජ්‍යය විෂය ධාරාව

මෙම විෂය ධාරාව හැදෑරීමට බලාපොරොත්තු වන සිසුන් පහත සඳහන් විෂයයන් අතුරින් අවම වශයෙන් විෂයයන් දෙකක් තෝරා ගත යුතු ය.

1. ගිණුම්කරණය
2. ව්‍යාපාර අධ්‍යයනය
3. ආර්ථික විද්‍යාව

ඉතිරි විෂය පහත දැක්වෙන විෂයයන් අතුරින් තෝරා ගත යුතුය.

1. ව්‍යාපාර සංඛ්‍යානය
2. භූගෝල විද්‍යාව
3. දේශපාලන විද්‍යාව
4. ඉතිහාසය (ලංකා ඉතිහාසය සමග ඉන්දීය ඉතිහාසය හෝ යුරෝපා ඉතිහාසය හෝ නූතන ලෝක ඉතිහාසය)
5. තර්ක ශාස්ත්‍රය සහ විද්‍යාත්මක ක්‍රමය
6. ඉංග්‍රීසි
7. ජර්මන්
8. ප්‍රංශ
9. කෘෂි විද්‍යාව
10. සංයුක්ත ගණිතය හෝ ගණිතය
11. තොරතුරු හා සන්නිවේදන තාක්ෂණය

5.3. ජෛවීය විද්‍යා විෂය ධාරාව

මෙම විෂය ධාරාව හැදෑරීමට බලාපොරොත්තු වන සිසුන් ජීව විද්‍යාව සමඟ පහත සඳහන් විෂයයන් අතුරින් විෂයයන් 2ක් තෝරා ගත යුතු ය.

1. රසායන විද්‍යාව
2. භෞතික විද්‍යාව
3. කෘෂි විද්‍යාව
4. ගණිතය

5.4. භෞතීය විද්‍යා විෂයධාරාව

මෙම විෂය ධාරාව හැදෑරීමට බලාපොරොත්තු වන සිසුන් පහත සඳහන් විෂයයන් අතුරින් විෂයයන් තුනක් තෝරා ගත යුතුය.

1. සංයුක්ත ගණිතය
2. රසායන විද්‍යාව
3. භෞතික විද්‍යාව
4. උසස් ගණිතය

5.5. ජෛව පද්ධති තාක්ෂණවේදය විෂයධාරාව

මෙම විෂය ධාරාව හදාරනු ලබන සිසුන් පහත සඳහන් විෂයයන් අනිවාර්යයෙන් තෝරා ගත යුතු ය.

1. ජෛව පද්ධති තාක්ෂණවේදය
2. තාක්ෂණවේදය සඳහා විද්‍යාව

තුන් වන විෂය පහත දැක්වෙන විෂයයන් අතුරින් තෝරා ගත යුතු ය.

1. ආර්ථික විද්‍යාව
2. භූගෝල විද්‍යාව
3. ගෘහ ආර්ථික විද්‍යාව
4. ඉංග්‍රීසි
5. සන්නිවේදනය හා මාධ්‍ය අධ්‍යයනය
6. තොරතුරු හා සන්නිවේදන තාක්ෂණය
7. චිත්‍ර කලාව
8. ව්‍යාපාර අධ්‍යයනය
9. කෘෂි විද්‍යාව
10. ගිණුම්කරණය
11. ගණිතය

5.6 ඉංජිනේරු තාක්ෂණවේදය විෂය ධාරාව

මෙම විෂය ධාරාව හදාරනු ලබන සිසුන් පහත සඳහන් විෂයයන් අනිවාර්යයෙන් තෝරා ගත යුතු ය.

1. ඉංජිනේරු තාක්ෂණවේදය
2. තාක්ෂණවේදය සඳහා විද්‍යාව

තුන් වන විෂය පහත දැක්වෙන විෂයයන් අතුරින් තෝරා ගත යුතු ය.

1. ආර්ථික විද්‍යාව
2. භූගෝල විද්‍යාව
3. ගෘහ ආර්ෂික විද්‍යාව
4. ඉංග්‍රීසි
5. සන්නිවේදනය හා මාධ්‍ය අධ්‍යයනය
6. තොරතුරු හා සන්නිවේදන තාක්ෂණය
7. චිත්‍ර කලාව
8. ව්‍යාපාර අධ්‍යයනය
9. කෘෂි විද්‍යාව
10. ගිණුම්කරණය
11. ගණිතය

6.0 ඉහත සඳහන් පරිදි විෂය ධාරාවන් යටතේ අදාළ විෂය සංයෝජන තෝරා ගත යුතු ය. එහෙත් අදාළ පාසලේ ප්‍රමාණවත් ශිෂ්‍ය සංඛ්‍යාවක් සිටී නම් හා කාලසටහන ලබාදීමටත්, පහසුකම් සැපයීමටත් හැකියාව ඇති විෂයයන් සඳහා පමණක් තමන්ට කැමති විෂයයන් සහිත විෂය සංයෝජනයක් තෝරා ගැනීමේ ඉඩකඩ සිසුනට ලබා දිය හැකි ය. එසේ වුව ද විෂයයන් අතුරින් "හෝ" යනුවෙන් සඳහන් කර ඇත්නම් ඉන් එක් විෂයයක් පමණක් තෝරාගත යුතු ය. මෙසේ විෂයයන් තෝරා ගන්නා සිසුන් විශ්වවිද්‍යාල ප්‍රවේශයේ දී තෝරා ගත යුතු පාඨමාලා පිළිබඳ පුළුල් අවබෝධයක් ලබා දිය යුතු ය.

7.0 සම්මත විෂය ධාරාවලට අනුගත නොවන වෙනත්, විෂය සංකලනයන් තෝරා ගත් අවස්ථාවක දී අයදුම්කරුවන් **"නිශ්චිත විෂය ධාරාවකට අයත් නොවන"** යනුවෙන් හඳුන්වා දෙන අතර, විභාග ප්‍රතිඵල නිකුත් කිරීමේ දී "දිවයින තරාව" (Island Rank) හා "දිස්ත්‍රික් තරාව"(District Rank) නිකුත් කරනු නොලැබේ.

8.0 අ.පො.ස (උසස් පෙළ) සඳහා වන සියලුම විෂයයන් සිංහල හා දෙමළ යන මාධ්‍යයන් වලින් ඉගැන්වෙන අතර පහත සඳහන් විෂයයන් ඉංග්‍රීසි මාධ්‍යයෙන් ද ඉගැන්විය හැකි ය.

1. ජීව විද්‍යාව
2. භෞතික විද්‍යාව
3. රසායන විද්‍යාව
4. සංයුක්ත ගණිතය
5. කෘෂි විද්‍යාව
6. ගිණුම්කරණය
7. ව්‍යාපාර අධ්‍යයනය
8. ආර්ථික විද්‍යාව
9. දේශපාලන විද්‍යාව
10. භූගෝල විද්‍යාව

මීට අමතරව ඉංග්‍රීසි මාධ්‍යයෙන් වෙනත් විෂයයන් ඉගැන්වීමට අවශ්‍ය වේ නම් හා ඊට අදාළ සම්පත් ඇත්නම්, අධ්‍යාපන අමාත්‍යාංශයේ අනුමැතිය ලබා ගැනීමෙන් පසුව ඉගැන්විය හැකි ය.

9.0 විශ්වවිද්‍යාල උපාධි පාඨමාලා සඳහා විෂය සංයෝජන

9.1 විශ්වවිද්‍යාල මගින් පවත්වනු ලබන ප්‍රථම උපාධි පාඨමාලාවන්ට ඇතුළත් වීම සඳහා ශිෂ්‍යයන් විසින් අ.පො.ස. (උසස් පෙළ) දී හදාරා තිබිය යුතු විෂය සංයෝජන පහත දැක්වේ. විශ්වවිද්‍යාල ප්‍රථම උපාධි පාඨමාලා සඳහා මූලික සුදුසුකම් වශයෙන් අ.පො.ස. (උසස් පෙළ) විභාගයෙන් අදාළ ප්‍රධාන විෂයයන් තුනෙන් ම සමත් වී තිබිය යුතු අතර, සාමාන්‍ය පොදු පරීක්ෂණයේ දී අවශ්‍යවන ලකුණු ප්‍රමාණය ලබා තිබීම අත්‍යවශ්‍ය වේ. එහෙත් විශ්වවිද්‍යාලයට බඳවා ගන්නා පදනම හා ඇතුළත් කර ගත හැකි සංඛ්‍යාව අනුව මූලික සුදුසුකම් ලබාගත් අය අතුරින් තෝරා ගැනීමේ කටයුතු විශ්වවිද්‍යාල ප්‍රතිපාදන කොමිෂන් සභාව විසින් සිදු කරනු ඇත.

9.2 පහත සඳහන් කරනුයේ විශ්වවිද්‍යාල ප්‍රථම උපාධි පාඨමාලා සඳහා විශ්වවිද්‍යාල ප්‍රතිපාදන කොමිෂන් සභාව මගින් නියම කර ඇති අ.පො.ස. (උසස් පෙළ) විෂය සංයෝජන පමණි. ඊට අදාළ වැඩි විස්තර අවශ්‍යවන්නේ නම්, ඒ ඒ අධ්‍යයන වර්ෂ සඳහා විශ්වවිද්‍යාල ප්‍රතිපාදන කොමිෂන් සභාව මගින් ප්‍රකාශයට පත් කරන **"ශ්‍රී ලංකාවේ විශ්වවිද්‍යාල ප්‍රථම උපාධි පාඨමාලා සඳහා ප්‍රවේශය"** නම් අත් පොත පරිශීලනය කළ යුතු ය.

(1) කලා **(ARTS)**

කලා විෂය ධාරාව යටතේ දී ඇති කොන්දේසිවලට අනුව තෝරා ගත් විෂයයන් 03ක්

(2) කලා (ශ්‍රීපාලි මණ්ඩපය) - **(ARTS - SRIPALI CAMPUS)**

පහත සඳහන් කොන්දේසිවලට අනුව කලා විෂය ධාරාව යටතේ ලබා දී ඇති විෂයයන් 03ක්

- භාෂා විෂයයන් දෙකකට වඩා පෙනී නොසිටිය යුතු ය.
- ආගම් හා ශිෂ්ටාචාර විෂය කාණ්ඩයෙන් එක් විෂයයකට වඩා පෙනී නොසිටිය යුතු ය.
- තාක්ෂණවේදය විෂයයන් එකකට වඩා පෙනී නොසිටිය යුතු ය.
- පහත සඳහන් විෂයයන්ගෙන් එකකට වඩා පෙනී නොසිටිය යුතු ය.

(i) ගිණුම්කරණය
(ii) ව්‍යාපාර සංඛ්‍යානය
(iii) ආර්ථික විද්‍යාව

අ.පො.ස. (සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි විෂයය සඳහා අවම වශයෙන් සාමාන්‍ය (S) සාමර්ථ්‍යයක් තිබිය යුතු අතර, යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(3) කලා (සබරගමුව) - **(ARTS - SABARAGAMUWA)**

කලා, වාණිජ්‍යය යන කුමන හෝ විෂයධාරාවක් යටතේ තෝරා ගත් විෂයයන් 03ක්

(4) සන්නිවේදන අධ්‍යයනය **(COMMUNICATION STUDIES)**

සිංහල හෝ දෙමළ හෝ ඉංග්‍රීසි විෂයට අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් සහිත ව ඕනෑම විෂයයන් 03ක්

අ.පො.ස.(සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි විෂයය සඳහා අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් තිබිය යුතු ය.

(5) සාමය හා ගැටුම් නිරාකරණය **(PEACE & CONFLICT RESOLUTION)**

ඕනෑම විෂයයන් තුනක්

(6) ඉස්ලාම් අධ්‍යයනය **(ISLAMIC STUDIES)**

අවම වශයෙන් ඉස්ලාම් හෝ ඉස්ලාම් ශිෂ්ටාචාරය විෂයය සමග වෙනත් ඕනෑම විෂයයන් දෙකක්

(7) අරාබි භාෂාව **(ARABIC LANGUAGE)**

අරාබි භාෂාව සමග වෙනත් ඕනෑම විෂයයන් දෙකක්

(8) සංගීතය/නර්තනය /චිත්‍ර හා නිර්මාණ/නාට්‍ය හා රංග කලාව/දෘශ්‍ය හා තාක්ෂණික කලා/දෘශ්‍ය කලා
(MUSIC/DANCING/ART & DESIGN/DRAMA & THEATRE/VISUAL & TECHNOLOGICAL ARTS/VISUAL ARTS)

හැදෑරීමට අපේක්ෂිත පාඨමාලාවට අදාළ විෂය (සංගීතය/නර්තනය/චිත්‍ර/නාට්‍ය හා රංග කලාව) සඳහා අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් සහ අනිකුත් ඕනෑම විෂයයන් දෙකක්

මෙයට අමතරව විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(9) **කළමනාකරණය/කළමනාකරණය (රාජ්‍ය) විශේෂ/දේපල කළමනාකරණය සහ තක්සේරුකරණය/ වාණිජ්‍යය**
(MANAGEMENT/MANAGEMENT (PUBLIC)SPECIAL/ESTATE MANAGEMENT & VALUATION/COMMERCE)

ඉහත පාඨමාලා සඳහා පහත සඳහන් විෂය සංයෝජන අතුරින් එක් විෂය සංයෝජනයක්

(i) ව්‍යාපාර අධ්‍යයනය, ආර්ථික විද්‍යාව හා ගිණුම්කරණය

හෝ

(ii) අවම වශයෙන් ඉහත (i) හි සඳහන් විෂයයන් දෙකක් සහ පහත සඳහන් විෂයයන් අතුරින් තෝරාගත් එක් විෂයයක්

කෘෂි විද්‍යාව	භූගෝල විද්‍යාව	ඉංග්‍රීසි
සංයුක්ත ගණිතය හෝ ගණිතය	භෞතික විද්‍යාව	ඉතිහාසය
තර්ක ශාස්ත්‍රය සහ විද්‍යාත්මක ක්‍රමය	ව්‍යාපාර සංඛ්‍යානය	ජර්මන්
තොරතුරු සහ සන්නිවේදන තාක්ෂණය	දේශපාලන විද්‍යාව	ප්‍රංශ

(10) **කළමනාකරණ අධ්‍යයන (ත්‍රිකුණාමලය සහ වව්නියාව)** -
(MANAGEMENT STUDIES TRINCOMALEE & VAVUNIA)

ඕනෑම විෂය ධාරාවක් යටතේ, ඕනෑම විෂයයන් තුනක්

(11) ව්‍යාපාර තොරතුරු පද්ධති (විශේෂ) (BUSINESS INFORMATION SYSTEMS) (SPECIAL)

ගිණුම්කරණය ව්‍යාපාර අධ්‍යයනය ආර්ථික විද්‍යාව

ඉහත සඳහන් විෂයයන් අතුරින් අවම වශයෙන් විෂයයන් දෙකක් සමග පහත සඳහන් විෂයයන්ගෙන් එකක්

තොරතුරු හා සන්නිවේදන තාක්ෂණය	තර්ක ශාස්ත්‍රය සහ විද්‍යාත්මක ක්‍රමය
සංයුක්ත ගණිතය හෝ ගණිතය	ව්‍යාපාර සංඛ්‍යානය
භෞතික විද්‍යාව	

(12) වෛද්‍ය විද්‍යාව/දන්ත ශල්‍ය විද්‍යාව/පශු වෛද්‍ය විද්‍යාව
(MEDICINE/DENTAL SURGERY/VETERINARY SCIENCE)

පහත සඳහන් විෂයයන් තුනම

ජීව විද්‍යාව　　රසායන විද්‍යාව　　භෞතික විද්‍යාව

(13) කෘෂි තාක්ෂණය සහ කළමනාකරණය
(AGRICULTURAL TECHNOLOGY & MANAGEMENT)
පහත සඳහන් විෂය සංයෝජන අතුරින් එක් විෂය සංයෝජනයක්

(i) රසායන විද්‍යාව, භෞතික විද්‍යාව සහ ජීව විද්‍යාව
(ii) රසායන විද්‍යාව, භෞතික විද්‍යාව හෝ ගණිතය, ජීව විද්‍යාව හෝ කෘෂි විද්‍යාව
(iii) රසායන විද්‍යාව, ජීව විද්‍යාව, කෘෂි විද්‍යාව හෝ ගණිතය

(14) කෘෂිකර්මය (AGRICULTURE)
ඉහත සඳහන් කෘෂි තාක්ෂණය සහ කළමනාකරණය පාඨමාලාවට අදාළ විෂය සංයෝජන (අංක 13 බලන්න)

(15) ආහාර විද්‍යාව හා පෝෂණය (FOOD SCIENCE & NUTRITION)

ඉහත සඳහන් කෘෂි තාක්ෂණය සහ කළමනාකරණය පාඨමාලාවට අදාළ විෂය සංයෝජන (අංක 13 බලන්න)

(16) ආහාර විද්‍යාව හා තාක්ෂණය (FOOD SCIENCE & TECHNOLOGY)

රසායන විද්‍යාව, භෞතික විද්‍යාව සහ ජීව විද්‍යාව යන විෂයයන් තුනම

(17) ආයුර්වේද/යුනානි/සිද්ධ වෛද්‍ය (AYURVEDA/UNANI/SIDDHA)

ජීව විද්‍යාව, රසායන විද්‍යාව සහ භෞතික විද්‍යාව යන විෂයයන් තුනම

(18) ජෛවීය විද්‍යාව (BIOLOGICAL SCIENCE)

ජීව විද්‍යාව, රසායන විද්‍යාව සහ පහත දැක්වෙන විෂයයන් අතුරින් එක් විෂයක්

කෘෂි විද්‍යාව　　ගණිතය හෝ සංයුක්ත ගණිතය
උසස් ගණිතය　　භෞතික විද්‍යාව

(19) ව්‍යවහාරික විද්‍යා (ජෛවීය විද්‍යා) (APPLIED SCIENCE - BIOLOGICAL SCIENCE)

ඉහත සඳහන් ජෛවීය විද්‍යා පාඨමාලාව සඳහා දක්වා ඇති විෂය සංයෝජන (අංක 18 බලන්න

(20) සෞඛ්‍ය ප්‍රවර්ධන (HEALTH PROMOTION)

ඉහත සඳහන් ජෛවීය විද්‍යාව පාඨමාලාව සඳහා දක්වා ඇති විෂය සංයෝජන (අංක 18 බලන්න

(21) හෙද (NURSING)

ජීව විද්‍යාව, රසායන විද්‍යාව සහ භෞතික විද්‍යාව යන විෂයයන් තුනම
අ.පොෙ.ස.(සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි විෂය සඳහා අවම වශයෙන් සාමාන්‍ය (S) සාමර්ථ්‍යයක්

(22) ඖෂධ විද්‍යාව (PHARMACY)

රසායන විද්‍යාව සඳහා අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් සහිතව භෞතික විද්‍යාව සහ ජීව විද්‍යාව යන විෂයයන් තුනම
අ.පොෙ.ස.(සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි විෂය සඳහා අවම වශයෙන් සාමාන්‍ය (S) සාමර්ථ්‍යයක්

(23) වෛද්‍ය රසායනාගාර විද්‍යා (MEDICAL LABORATORY SCIENCES)

භෞතික විද්‍යාව, රසායන විද්‍යාව සහ ජීව විද්‍යාව යන විෂයයන් තුනම

අ.පොෙ.ස. (සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි විෂය සඳහා අවම වශයෙන් සාමාන්‍ය (S) සාමර්ථ්‍යයක්

(24) විකිරණ ශිල්පය (RADIOGRAPHY)

භෞතික විද්‍යාව, රසායන විද්‍යාව සහ ජීව විද්‍යාව යන විෂයයන් තුනම

අ.පොෙ.ස. (සාමාන්‍ය පෙළ) විභාගයේදී ඉංග්‍රීසි විෂය සඳහා අවම වශයෙන් සාමාන්‍ය (S) සාමර්ථ්‍යයක්

(25) භෞත චිකිත්ස (PHYSIOTHERAPY)

භෞතික විද්‍යාව සහ රසායන විද්‍යාව සමග පහත සඳහන් විෂයයන්ගෙන් එක් විෂයයක්

ජීව විද්‍යාව සංයුක්ත ගණිතය උසස් ගණිතය ගණිතය

අ.පොෙ.ස.(සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි විෂයය සඳහා අවම වශයෙන් සාමාන්‍ය (S) සාමර්ථ්‍යයක්

(26) අණුක ජීව විද්‍යාව සහ ජීව රසායන විද්‍යාව
(MOLECULAR BIOLOGY & BIOCHEMISTRY)

භෞතික විද්‍යාව, රසායන විද්‍යාව සහ ජීව විද්‍යාව යන විෂයයන් තුනම

(27) ධීවර සහ සාගර විද්‍යාව (FISHERIES & MARINE SCIENCES)

අණුක ජීව විද්‍යාව සහ ජීව රසායන විද්‍යාව පාඨමාලාව සඳහා වූ විෂය සංයෝජනය (අංක 26 බලන්න.)

(28) පරිසර සංරක්ෂණය හා කළමණාකරණය (ENVIRONMENTAL CONSERVATION & MANAGEMENT)

ජීව විද්‍යාව හා රසායන විද්‍යාව සමග පහත සඳහන් විෂයයන්ගෙන් එක් විෂයක්
භෞතික විද්‍යාව සංයුක්ත ගණිතය
කෘෂි විද්‍යාව ගණිතය

(29) සත්ත්ව පාලනය හා මත්ස්‍ය විද්‍යාව (ANIMAL SCIENCE & FISHERIES)

පහත සඳහන් විෂය සංයෝජන අතුරින් එක් විෂය සංයෝජනයක්

i. රසායන විද්‍යාව, ජීව විද්‍යාව සහ භෞතික විද්‍යාව
ii. රසායන විද්‍යාව, ජීව විද්‍යාව සහ කෘෂි විද්‍යාව

(30) ආහාර නිෂ්පාදනය සහ තාක්ෂණ කළමනාකරණය (FOOD PRODUCTION & TECHNOLOGY MANAGEMENT)

කෘෂි තාක්ෂණය සහ කළමනාකරණය පාඨමාලාවට අදාළ විෂය සංයෝජන (අංක 13 බලන්න.)

(31) ඉංජිනේරු විද්‍යාව (ENGINEERING)

පහත දැක්වෙන විෂයයන් තුනම

රසායන විද්‍යාව සංයුක්ත ගණිතය භෞතික විද්‍යාව

(32) ඉංජිනේරු විද්‍යාව (EM) - භූ සම්පත් ඉංජිනේරු විද්‍යාව
(ENGINEERING) (EM)- (EARTH RESOURCES ENGINEERING)

ඉංජිනේරු විද්‍යාව පාඨමාලාවට අදාළ වූ විෂය සංයෝජනය (අංක 31 බලන්න)

(33) ඉංජිනේරු විද්‍යාව (TM) - පේෂකර්ම හා රෙදිපිළි තාක්ෂණය
(ENGINEERING) (TM) - (TEXTILE & CLOTHING TECHNOLOGY)

ඉංජිනේරු විද්‍යාව පාඨමාලාවට අදාළ වූ විෂය සංයෝජනය (අංක 31 බලන්න)

(34) භෞතීය විද්‍යාව (PHYSICAL SCIENCE)

සංයුක්ත ගණිතය හෝ උසස් ගණිතය සහ රසායන විද්‍යාව හෝ භෞතික විද්‍යාව ඇතුළුව පහත සඳහන් විෂයයන්ගෙන් විෂයයන් තුනක්

කෘෂි විද්‍යාව සංයුක්ත ගණිතය ජීව විද්‍යාව
උසස් ගණිතය රසායන විද්‍යාව භෞතික විද්‍යාව

(35) පරිගණක විද්‍යාව (COMPUTER SCIENCE)

සංයුක්ත ගණිතය හෝ භෞතික විද්‍යාව හෝ උසස් ගණිතය යන විෂයයන්ගෙන් එකකට අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් සහිතව පහත සඳහන් විෂයයන් අතුරින් තුනක්

සංයුක්ත ගණිතය හෝ ගණිතය උසස් ගණිතය රසායන විද්‍යාව
තොරතුරු හා සන්නිවේදන තාක්ෂණය භෞතික විද්‍යාව

(36) තොරතුරු සහ සන්නිවේදන තාක්ෂණය
(INFORMATION & COMMUNICATION TECHNOLOGY)

පහත සඳහන් විෂයයන්ගෙන් එකකට සම්මාන (C) සාමර්ථ්‍යයක් සමග ඕනෑම විෂයයන් තුනක්

උසස් ගණිතය	ජීව විද්‍යාව
ගණිතය හෝ සංයුක්ත ගණිතය	භෞතික විද්‍යාව
ගිණුම්කරණය	රසායන විද්‍යාව
ව්‍යාපාර සංඛ්‍යානය	තොරතුරු හා සන්නිවේදන තාක්ෂණය
ව්‍යාපාර අධ්‍යයනය	සිවිල් තාක්ෂණවේදය
භූගෝල විද්‍යාව	යාන්ත්‍රික තාක්ෂණවේදය
ආර්ථික විද්‍යාව	විදුලිය ඉලෙක්ට්‍රෝනික සහ තොරතුරු තාක්ෂණවේදය
තර්ක ශාස්ත්‍රය සහ විද්‍යාත්මක ක්‍රමය	සංගීතය (පෙරදිග හෝ කර්ණාටක හෝ බටහිර)
	සංස්කෘත

අ.පො.ස (සාමාන්‍ය පෙළ) විභාගයේ දී ගණිතය හා ඉංග්‍රීසි විෂයයන් සඳහා අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක්

මෙයට අමතර ව, විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(37) ව්‍යවහාරික විද්‍යා (භෞතීය විද්‍යා)
(APPLIED SCIENCES/PHYSICAL SCIENCE)

සංයුක්ත ගණිතය හෝ උසස් ගණිතය සහ රසායන විද්‍යාව හෝ භෞතික විද්‍යාව ඇතුළුව පහත සඳහන් විෂයයන්ගෙන් එක් විෂයක්

කෘෂි විද්‍යාව	සංයුක්ත ගණිතය	උසස් ගණිතය
තොරතුරු හා සන්නිවේදන තාක්ෂණය	ජීව විද්‍යාව	භෞතික විද්‍යාව
රසායන විද්‍යාව		

(38) ප්‍රවාහන හා සැපයුම් කළමනාකරණය
(TRANSPORT & LOGISTIC MANAGEMENT)

භෞතික විද්‍යාව, රසායන විද්‍යාව හා සංයුක්ත ගණිතය යන විෂයයන් තුනම

(39) කර්මාන්ත සංඛ්‍යානය හා ගණිතමය මූල්‍ය
(INDUSTRIAL STATISTICS & MATHEMATICAL FINANCE)

සංයුක්ත ගණිතය සමග පහත සඳහන් විෂයයන් අතුරින් විෂයයන් දෙකක්

උසස් ගණිතය	භෞතික විද්‍යාව	රසායන විද්‍යාව

(40) සංඛ්‍යානය සහ සංකාර්ය පර්යේෂණ
(STATISTICS & OPERATIONS RESEARCH)

සංයුක්ත ගණිතය සමග පහත දැක්වෙන විෂයයන්ගෙන් ඕනෑම විෂයයන් දෙකක්

ජීව විද්‍යාව	භෞතික විද්‍යාව	උසස් ගණිතය
රසායන විද්‍යාව	කෘෂි විද්‍යාව	ගණිතය
තොරතුරු හා සන්නිවේදන තාක්ෂණය		

(41) ආගනණය සහ තොරතුරු පද්ධති (COMPUTING & INFORMATION SYSTEMS)

සංයුක්ත ගණිතය, භෞතික විද්‍යාව, උසස් ගණිතය යන විෂයයන්ගෙන් එකක් සඳහා අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් සහ පහත සඳහන් විෂයයන් අතුරින් විෂයයන් දෙකක්

සංයුක්ත ගණිතය
භෞතික විද්‍යාව
රසායන විද්‍යාව
උසස් ගණිතය
තොරතුරු හා සන්නිවේදන තාක්ෂණය

අ.පො.ස.(සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි භාෂාව සඳහා අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක්

(42) තොරතුරු තාක්ෂණය (INFORMATION TECHNOLOGY- IT)

පහත සඳහන් විෂයයන්ගෙන් අවම වශයෙන් එක් විෂයයක් සඳහා සම්මාන (C) සාමර්ථ්‍යයක් සහිතව අනිකුත් ඕනෑම විෂයයන් දෙකක්

උසස් ගණිතය ගණිතය සංයුක්ත ගණිතය භෞතික විද්‍යාව

(43) කළමනාකරණය හා තොරතුරු තාක්ෂණය (MANAGEMENT & INFORMATION TECHNOLOGY - MIT)

අ.පො.ස. (උසස් පෙළ) විභාගයේ දී උසස් ගණිතය, සංයුක්ත ගණිතය, ගණිතය සහ භෞතික විද්‍යාව යන විෂයයන්ගෙන් එක් විෂයයක් සඳහා සම්මාන (C) සාමර්ථ්‍යයක් සහිතව

(i) ජෛවීය විද්‍යා විෂය ධාරාවෙන් හෝ භෞතීය විද්‍යා විෂය ධාරාවෙන් විෂයයන් තුනකින් සමත් වීම

හෝ

(ii) ජෛවීය විද්‍යා විෂය ධාරාවෙන් හෝ භෞතීය විද්‍යා විෂය ධාරාවෙන් විෂයයන් දෙකක් සහ තොරතුරු සහ සන්නිවේදන තාක්ෂණය විෂය සමත් වීම

මෙයට අමතරව විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(44) ප්‍රමාණ සමීක්ෂණය (QUANTITY SURVEYING)

සංයුක්ත ගණිතය, උසස් ගණිතය යන විෂයයන් අතුරෙන් අවම වශයෙන් එක් විෂයයක්

සහ

පහත දැක්වෙන විෂයයන් අතුරෙන් එක් විෂයයක් හෝ විෂයයන් දෙකක්

ගිණුම්කරණය
ව්‍යාපාර සංඛ්‍යානය
තොරතුරු හා සන්නිවේදන තාක්ෂණය
ආර්ථික විද්‍යාව
ව්‍යාපාර අධ්‍යයනය
භෞතික විද්‍යාව
රසායන විද්‍යාව

මෙයට අමතරව අ.පො.ස. (සාමාන්‍ය පෙළ) විභාගයේ දී, ගණිතය හා ඉංග්‍රීසි විෂයයන්ට අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක්ද විද්‍යාව විෂයයට අවම වශයෙන් සාමාන්‍ය (S) සාමර්ථ්‍යයක් ද ලබා තිබිය යුතු ය.

(45) මැනුම් විද්‍යාව (SURVEYING SCIENCE)

භෞතික විද්‍යාව, සංයුත්ක ගණිතය සමග වෙනත් ඕනෑම විෂයක්

(46) නගර හා ග්‍රාම නිර්මාණය (TOWN & COUNTRY PLANNING)

(i) පහත සඳහන් විෂයයන් අතුරින් අවම වශයෙන් විෂයයන් දෙකක්

ගිණුම්කරණය	රසායන විද්‍යාව	උසස් ගණිතය
කෘෂි විද්‍යාව	සංයුක්ත ගණිතය	තර්ක ශාස්ත්‍රය සහ විද්‍යාත්මක ක්‍රමය
ජීව විද්‍යාව	ආර්ථික විද්‍යාව	දේශපාලන විද්‍යාව
ව්‍යාපාර අධ්‍යයනය	ගණිතය	භෞතික විද්‍යාව
ව්‍යාපාර සංඛ්‍යානය	භූගෝල විද්‍යාව	තොරතුරු හා සන්නිවේදන තාක්ෂණය

(ii) තෙවන විෂය පහත සඳහන් විෂයයන්ගෙන් එක් විෂයයක්

අරාබි	ක්‍රිස්තියානි ශිෂ්ටාචාරය	මැලේ
බුද්ධ ධර්මය	ගෘහ ආර්ථික විද්‍යාව	පාලි
බෞද්ධ ශිෂ්ටාචාරය	හින්දි	රුසියන්
ක්‍රිස්තු ධර්මය	හින්දු ධර්මය	සංස්කෘත
චීන	හින්දු ශිෂ්ටාචාරය	සිංහල
ඉංග්‍රීසි	ඉතිහාසය	දෙමළ
ප්‍රංශ	ඉස්ලාම්	ග්‍රීක හා රෝම ශිෂ්ටාචාරය
ජර්මන්	ඉස්ලාම් ශිෂ්ටාචාරය	ජපන්
චිත්‍ර කලාව		

මෙයට අමතරව, අ.පොෙ.ස.(සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි හා ගණිතය යන විෂයයන්ට අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක්

මෙම පාඨමාලාව සඳහා සුදුසුකම් ලැබීම පිණිස 2017/2018 අධ්‍යයන වර්ෂයේ සිට අයදුම්කරුවන් විසින් ඉහත (i) කාණ්ඩය යටතේ ඇති විෂයයන්ගෙන් විෂයයන් තුනක් සමත් විය යුතුය.

එසේම 2017/2018 අධ්‍යයන වර්ෂයේ සිට අයදුම්කරුවන් විසින් අ.පොෙ.ස. (සාමාන්‍ය පෙළ) විභාගයේ ඉංග්‍රීසි විෂයට අවම වශයෙන් (B) සාමර්ථ්‍යයක් හා ගණිතය විෂයට සම්මාන (C) සාමර්ථ්‍යයක් ලබා තිබිය යුතු ය.

(47) වාස්තු විද්‍යාව (ARCHITECTURE)

(i) පහත දැක්වෙන විෂයයන් අතුරින් අවම වශයෙන් එක් විෂයයක්

චිත්‍ර කලාව	භූගෝල විද්‍යාව	ජීව විද්‍යාව
උසස් ගණිතය	රසායන විද්‍යාව	භෞතික විද්‍යාව
සංයුක්ත ගණිතය		

සහ

(ii) පහත දැක්වෙන විෂයයන් අතුරින් තවත් එක් විෂයයක් හෝ විෂයයන් දෙකක්

ගිණුම්කරණය	හින්දි	අරාබි
හින්දු ශිෂ්ටාචාරය	බෞද්ධ ශිෂ්ටාචාරය	ඉතිහාසය
ව්‍යාපාර සංඛ්‍යානය	ගෘහ ආර්ථික විද්‍යාව	ව්‍යාපාර අධ්‍යයනය
ඉස්ලාම් ශිෂ්ටාචාරය	චීන	ජපන්

ක්‍රිස්තියානි ශිෂ්ටාචාරය	තර්ක ශාස්ත්‍රය සහ විද්‍යාත්මක ක්‍රමය	ආර්ථික විද්‍යාව
දේශපාලන විද්‍යාව	ගණිතය	පාලි
ඉංග්‍රීසි	සංස්කෘත	ප්‍රංශ
සිංහල	තොරතුරු හා සන්නිවේදන තාක්ෂණය	ජර්මන්
ග්‍රීක හා රෝම ශිෂ්ටාචාරය	කෘෂි විද්‍යාව	දෙමළ

සන්නිවේදනය හා මාධ්‍ය අධ්‍යයනය

මෙයට අමතරව පහත සඳහන් අවශ්‍යතාවයන් ද සපුරාලිය යුතු ය.

(අ) අ.පොෙ.ස.(සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි විෂයයට අවම වශයෙන් සාමාන්‍ය (S) සාමර්ථ්‍යයක්

(ආ) අ.පොෙ.ස.(සාමාන්‍ය පෙළ) විභාගයේ දී ගණිතය විෂයට අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් හෝ අ.පොෙ.ස.(උසස් පෙළ) විභාගයේ දී ගණිතය විෂයට අවම වශයෙන් සාමාන්‍ය (S) සාමර්ථ්‍යයක්

මෙයට අමතරව, විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(48) **නිර්මාණවේදය** (DESIGN)

අ.පොෙ.ස. (උසස් පෙළ) විභාගයේදී ඕනෑම විෂයයන් තුනක්.
මෙයට අමතරව පහත සඳහන් අවශ්‍යතාවයන් ද සපුරාලිය යුතු ය.

(අ) අ.පොෙ.ස.(සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි විෂයට අවම වශයෙන් සාමාන්‍ය (S) සාමර්ථ්‍යයක්
(ආ) අ.පොෙ.ස.(සාමාන්‍ය පෙළ) විභාගයේ දී ගණිතය විෂයට අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් හෝ අ.පොෙ.ස. (උසස් පෙළ) විභාගයේ දී ගණිතය විෂයට අවම වශයෙන් සාමාන්‍ය (S) සාමර්ථ්‍යයක් ලබා තිබිය යුතු ය.

තව ද , 2017/2018 අධ්‍යයන වර්ෂයේ සිට මෙම පාඨමාලාවට සුදුසුකම් ලැබීම පිණිස අයදුම්කරුවන් විසින් අ.පොෙ.ස. (සාමාන්‍ය පෙළ) ඉංග්‍රීසි විෂයයට සාමාන්‍ය (S) සාමර්ථ්‍යයක් හා ගණිතය හා විද්‍යාව විෂයයන් සඳහා සම්මාන (C) සාමර්ථ්‍යක් ලබා තිබිය යුතු ය.

මෙයට අමතරව, විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතුයි.

(49) **විලාසිතා නිර්මාණ සහ නිපැයුම් ප්‍රවර්ධනය** (FASHION DESIGN & PRODUCT DEVELOPMENT)

අ.පොෙ.ස. (උසස් පෙළ) විභාගයේදී ඕනෑම විෂයයන් තුනක්.

අ.පොෙ.ස. (සාමාන්‍ය පෙළ) විභාගයේ දී ගණිතය, ඉංග්‍රීසි, විද්‍යාව යන විෂයයන්ට අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් ලබා තිබිය යුතුය.

මෙයට අමතර ව, විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(50) නීතිය (LAW)

(i) පහත දැක්වෙන විෂයයන්ගෙන් තෝරා ගත් විෂයයන් තුනක්

භූගෝල විද්‍යාව	දේශපාලන විද්‍යාව	කෘෂි විද්‍යාව
ව්‍යාපාර සංඛ්‍යානය	ජීව විද්‍යාව	උසස් ගණිතය
සන්නිවේදනය හා මාධ්‍ය අධ්‍යයනය	ඉතිහාසය	ව්‍යාපාර අධ්‍යයනය
තර්ක ශාස්ත්‍රය සහ විද්‍යාත්මක ක්‍රමය	රසායන විද්‍යාව	ආර්ථික විද්‍යාව
ගණිතය හෝ සංයුක්ත ගණිතය	භෞතික විද්‍යාව	ගිණුම්කරණය
තොරතුරු හා සන්නිවේදන තාක්ෂණය		

හෝ

ඉහත සඳහන් විෂයයන්ගෙන් එකක් හෝ දෙකක් හෝ සමග පහත දැක්වෙන විෂයයන්ගෙන් ඉතිරි විෂයය හෝ විෂයයන්

බුද්ධ ධර්මය හෝ බෞද්ධ ශිෂ්ටාචාරය	හින්දු ධර්මය හෝ හින්දු ශිෂ්ටාචාරය
ක්‍රිස්තියානි ධර්මය හෝ ක්‍රිස්තියානි ශිෂ්ටාචාරය	ඉස්ලාම් හෝ ඉස්ලාම් ශිෂ්ටාචාරය
ජපන්	චීන
පාලි	ඉංග්‍රීසි
සංස්කෘත	ප්‍රංශ
සිංහල	ජර්මන්
දෙමළ	අරාබි
ග්‍රීක හා රෝම ශිෂ්ටාචාරය	

අ.පො.ස. (සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි විෂය සඳහා අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් හෝ අ.පො.ස. (උසස් පෙළ) විභාගයේ දී ඉංග්‍රීසි විෂය සඳහා සාමාන්‍ය (S) සාමර්ථ්‍යයක්

(51) **පහසුකම් කළමනාකරණය** (FACILITIES MANAGEMENT)

සංයුක්ත ගණිතය හෝ ගිණුම්කරණය සමග පහත සඳහන් විෂයයන්ගෙන් ඕනෑම විෂයයන් දෙකක්

ව්‍යාපාර සංඛ්‍යානය	භෞතික විද්‍යාව	ව්‍යාපාර අධ්‍යයනය
උසස් ගණිතය	රසායන විද්‍යාව	ආර්ථික විද්‍යාව
තොරතුරු හා සන්නිවේදන තාක්ෂණය		

මෙයට අමතරව අ.පො.ස. (සාමාන්‍ය පෙළ) විභාගයේ දී, ඉංග්‍රීසි හා ගණිතය විෂයයන්ට අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් හා විද්‍යාව විෂයයට අවම වශයෙන් සාමාන්‍ය (S) සාමර්ථ්‍යයක්

(52) **පරිගණනය සහ කළමනාකරණය** (COMPUTATION & MANAGEMENT)

ආර්ථික විද්‍යාව හෝ සංයුක්ත ගණිතය ඇතුළුව ඕනෑම විෂයයන් තුනක්

මෙයට අමතරව අ.පො.ස. (සාමාන්‍ය පෙළ) විභාගයේ දී ගණිතය විෂයට අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක්

(53) **කළමනාකරණය සහ තොරතුරු තාක්ෂණය (අග්නිදිග විශ්වවිද්‍යාලය)** -
MANAGEMENT & INFORMATION TECHNOLOGY (SOUTH EASTERN UNIVERSITY)

ඕනෑම විෂයයන් තුනක්

(54) විද්‍යාව හා තාක්ෂණය (SCIENCE & TECHNOLOGY)

ජෛවීය විද්‍යා සහ භෞතීය විද්‍යා පාඨමාලා සඳහා අවශ්‍ය සුදුසුකම් අදාළ වේ. (අංක 18 සහ 34 බලන්න)

(55) පරිගණක විද්‍යාව හා තාක්ෂණය (COMPUTER SCIENCE & TECHNOLOGY)

මෙම පාඨමාලාව සඳහා ද ජෛවීය විද්‍යා, භෞතීය විද්‍යා සහ ව්‍යවහාරික විද්‍යා (භෞතීය විද්‍යා) පාඨමාලා සඳහා අවශ්‍ය විෂයයන් තුනක් (අංක 18, 34 සහ 37 බලන්න)

මෙයට අමතර ව විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(56) ව්‍යවසායකත්වය සහ කළමනාකරණය (ENTREPRENEURSHIP & MANAGEMENT)

ඕනෑම විෂයයන් තුනක්

මෙයට අමතරව විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(57) සත්ත්ව පාලන විද්‍යාව (ANIMAL SCIENCE)

ජෛවීය විද්‍යා පාඨමාලාව සඳහා අවශ්‍ය සුදුසුකම් අදාළ වේ. (අංක 18 බලන්න.)

(58) අපනයන කෘෂිකර්මය (EXPORT AGRICULTURE)

ජෛවීය විද්‍යා පාඨමාලාව සඳහා අවශ්‍ය සුදුසුකම් අදාළ වේ. (අංක 18 බලන්න)

(59) තේ තාක්ෂණය සහ අගය එකතු කිරීම (TEA TECHNOLOGY & VALUE ADDITION)

පහත සඳහන් විෂය සංයෝජනයකින් එක් විෂය සංයෝජනයක්

(i) ජීව විද්‍යාව, රසායන විද්‍යාව, භෞතික විද්‍යාව හෝ කෘෂි විද්‍යාව
(ii) සංයුක්ත ගණිතය, රසායන විද්‍යාව, භෞතික විද්‍යාව

(60) කාර්මික තොරතුරු තාක්ෂණය (INDUSTRIAL INFORMATION TECHNOLOGY)

ඕනෑම විෂයයන් තුනක්

මෙයට අමතර ව විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(61) බණිජ සම්පත් සහ තාක්ෂණය (MINERAL RESOURCES & TECHNOLOGY)

පහත සඳහන් එක් විෂය සංයෝජනයක්

(i) ජීව විද්‍යාව, රසායන විද්‍යාව, භෞතික විද්‍යාව
(ii) සංයුක්ත ගණිතය, රසායන විද්‍යාව, භෞතික විද්‍යාව

(62) ජලජ සම්පත් තාක්ෂණය (AQUATIC RESOURCES TECHNOLOGY)

ජෛවීය විද්‍යා පාඨමාලාවට අදාළ වන විෂයය සංයෝජනය අදාළ වේ. (අංක 18 බලන්න)

(63) තාල සහ ක්ෂීර තාක්ෂණය හා අගය වැඩි කිරීම (PALM & LATEX TECHNOLOGY & VALUE ADDITION)

පහත සඳහන් එක් විෂය සංයෝජනයකින් විෂයයන් තුනක්

(i) ජීව විද්‍යාව, රසායන විද්‍යාව, භෞතික විද්‍යාව හෝ කෘෂි විද්‍යාව
(ii) සංයුක්ත ගණිතය, රසායන විද්‍යාව සහ භෞතික විද්‍යාව

(64) ආගන්තුක සත්කාර සංචාරක ව්‍යාපාර සහ සිද්ධි පිළිබඳ කළමනාකරණය (HOSPITALITY TOURISUM & EVENTS MANAGEMENT)

ඕනෑම විෂයයන් තුනක්

මෙයට අමතර ව විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(65) ශාරීරික අධ්‍යාපනය (PHYSICAL EDUCATION)

ඕනෑම විෂයයන් තුනක්

මෙයට අමතර ව විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(66) ක්‍රීඩා විද්‍යාව සහ කළමනාකරණය (SPORTS SCIENCE & MANAGEMENT)

ඕනෑම විෂයයන් තුනක්

මෙයට අමතර ව විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(67) කථන හා ශ්‍රවණ චිකිත්සාව (SPEECH & HEARING THERAPHY)

ජෛවීය විද්‍යාව හෝ භෞතීය විද්‍යාව හෝ කලා විෂය ධාරාවන් යටතේ ඕනෑම විෂයයන් තුනක්

(68) කෘෂි සම්පත් කළමනාකරණය හා තාක්ෂණය (AGRICULTURAL RESOURCE MANAGEMENT & TECHNOLOGY)

කෘෂි තාක්ෂණය හා කළමනාකරණය පාඨමාලාවට අදාළ විෂය සංයෝජන (අංක 13 බලන්න)

(69) කෘෂි ව්‍යාපාර කළමනාකරණය (AGRI BUSINESS MANAGEMENT)

ජීව විද්‍යාව, රසායන විද්‍යාව සමග පහත සඳහන් විෂයයන්ගෙන් එක් විෂයයක්

භෞතික විද්‍යාව කෘෂි විද්‍යාව
ආහාර හා තාක්ෂණවේදය හෝ ජෛව සම්පත් තාක්ෂණවේදය හෝ කෘෂි තාක්ෂණවේදය

(70) හරිත තාක්ෂණය (GREEN TECHNOLOGY)

ජීව විද්‍යාව, රසායන විද්‍යාව සමග පහත සඳහන් විෂයයන්ගෙන් එක් විෂයයක්

භෞතික විද්‍යාව කෘෂි විද්‍යාව
ආහාර හා තාක්ෂණවේදය හෝ ජෛව සම්පත් තාක්ෂණවේදය හෝ කෘෂි තාක්ෂණවේදය

අ.පොෂ. (සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි විෂයයට අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් ලබා තිබිය යුතු ය.

(71) භූමි නිර්මාණවේදය (LANDSCAPE ARCHITECTURE)

(i) පහත සඳහන් විෂයයන් අතුරින් අවම වශයෙන් එක් විෂයක්.

චිත්‍ර කලාව	භූගෝල විද්‍යාව	ජීව විද්‍යාව
උසස් ගණිතය	රසායන විද්‍යාව	භෞතික විද්‍යාව
සංයුක්ත ගණිතය	කෘෂි විද්‍යාව	

(ii) පහත සඳහන් විෂයයන් අතුරින් තවත් එක් විෂයයක් හෝ විෂයයන් දෙකක්

ගිණුම්කරණය	හින්දි	අරාබි
බෞද්ධ ශිෂ්ටාචාරය	ඉතිහාසය	ඉංග්‍රීසි
ව්‍යාපාර සංඛ්‍යානය	ගෘහ ආර්ථික විද්‍යාව	ජපන්
ඉස්ලාම් ශිෂ්ටාචාරය	ආර්ථික විද්‍යාව	චීන
ග්‍රීක හා රෝම ශිෂ්ටාචාරය	තර්ක ශාස්ත්‍රය හා විද්‍යාත්මක ක්‍රමය	පාලි
දේශපාලන විද්‍යාව	ගණිතය	ප්‍රංශ
හින්දු ශිෂ්ටාචාරය	සංස්කෘත	දෙමළ
සිංහල	ක්‍රිස්තියානි ශිෂ්ටාචාරය	ජර්මන්
සන්නිවේදනය හා මාධ්‍ය අධ්‍යයනය	ව්‍යාපාර අධ්‍යයනය	
තොරතුරු හා සන්නිවේදන තාක්ෂණය		

(අ) අ.පොෂ. (සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි විෂයට අවම වශයෙන් සාමාන්‍ය (S) සාමර්ථ්‍යයක්
(ආ) අ.පොෂ. (සාමාන්‍ය පෙළ) විභාගයේ දී ගණිතය විෂයට අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් හෝ අ.පොෂ. (උසස් පෙළ) විභාගයේ දී ගණිතය විෂයට අවම වශයෙන් සාමාන්‍ය (S) සාමර්ථ්‍යයක්

මෙයට අමතර ව විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(72) තොරතුරු තාක්ෂණය හා කළමනාකරණය (INFORMATION TECHNOLOGY & MANAGEMENT)

පහත සඳහන් විෂයයන්ගෙන් අවම වශයෙන් එකකට සම්මාන (C) සාමර්ථ්‍යයක් සහිත ව ඕනෑම විෂයයන් තුනක්

උසස් ගණිතය	ගණිතය	ආර්ථික විද්‍යාව
සංයුක්ත ගණිතය	ගිණුම්කරණය	භූගෝල විද්‍යාව
භෞතික විද්‍යාව	ව්‍යාපාර සංඛ්‍යානය	තර්ක ශාස්ත්‍රය සහ විද්‍යාත්මක ක්‍රමය

අ.පොෂ.(සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි විෂයයට හා ගණිතය විෂයයට අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් ලබා තිබිය යුතු ය.

(73) සංචාරක සහ ආගන්තුක සත්කාර කළමනාකරණය (TOURISM & HOSPITALITY MANAGEMENT)

පහත සඳහන් විෂය සංයෝජන අතුරින් එක් විෂයය සංයෝජනයක්

(i) වාණිජ්‍යය, ජෛවීය විද්‍යාව සහ භෞතීය විද්‍යා විෂයය ධාරා යටතේ අනුමත විෂයයන් තුනක්

(ii) පහත දැක්වෙන විෂයයන් අතුරින් අවම වශයෙන් එක් විෂයක්
ආර්ථික විද්‍යාව, භූගෝල විද්‍යාව, ව්‍යාපාර සංඛ්‍යානය

සහ

කලා විෂය ධාරාව යටතේ ඇති අනිකුත් විෂයයන් දෙකක්

(74) තොරතුරු පද්ධති (INFORMATION SYSTEMS)

පහත සඳහන් විෂයයන්ගෙන් අවම වශයෙන් විෂයයන් දෙකකට සම්මාන (C) සාමාර්ථ්‍යයක් සහිතව ඕනෑම විෂයයන් තුනක්

උසස් ගණිතය	ගණිතය හෝ සංයුක්ත ගණිතය
භෞතික විද්‍යාව	රසායන විද්‍යාව
ගිණුම්කරණය	ව්‍යාපාර සංඛ්‍යානය
ආර්ථික විද්‍යාව	ව්‍යාපාර අධ්‍යයනය
ජීව විද්‍යාව	දේශපාලන විද්‍යාව
තර්ක ශාස්ත්‍රය සහ විද්‍යාත්මක ක්‍රමය	භූගෝල විද්‍යාව
සිවිල් තාක්ෂණවේදය	යාන්ත්‍රික තාක්ෂණවේදය
විදුලිය ඉලෙක්ට්‍රොනික සහ තොරතුරු තාක්ෂණවේදය	
තොරතුරු හා සන්නිවේදන තාක්ෂණය	

අ.පොෂ. (සාමාන්‍ය පෙළ) විභාගයේ දී ඉංග්‍රීසි විෂයට හා ගණිතය විෂයයට සම්මාන (C) සාමර්ථ්‍යයක් මෙයට අමතර ව විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(75) මෘදුකාංග ඉංජිනේරු විද්‍යාව (SOFTWARE ENGINEERING)

සංයුක්ත ගණිතය , භෞතික විද්‍යාව යන විෂයයන් සමග පහත දක්වා ඇති විෂයයන්ගෙන් එකක්

රසායන විද්‍යාව උසස් ගණිතය තොරතුරු හා සන්නිවේදන තාක්ෂණය

(76) පරිවර්තන අධ්‍යයන (TRANSLATION STUDIES)

ඕනෑම විෂයයන් තුනක්
මෙයට අමතර ව විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(77) සිනමා හා රූපවාහිනී අධ්‍යයන (CINEMA & TELEVISION STUDIES)

ඕනෑම විෂයයන් තුනක්

මෙයට අමතර ව විශ්වවිද්‍යාලය මගින් පවත්වනු ලබන යෝග්‍යතා පරීක්ෂණයෙන් ද සමත් විය යුතු ය.

(78) ව්‍යාපෘති කළමනාකරණය (PROJECT MANAGEMENT)

ඕනෑම විෂයයන් තුනක්

(79) ඉංජිනේරු තාක්ෂණවේදය (ENGINEERING TECHNOLOGY)

ඉංජිනේරු තාක්ෂණවේදය, තාක්ෂණවේදය සඳහා විද්‍යාව, යන විෂයයන් දෙක සමග පහත සඳහන් විෂයයන්ගෙන් එක් විෂයක්

ආර්ථික විද්‍යාව
ගෘහ ආර්ථික විද්‍යාව
සන්නිවේදනය හා මාධ්‍ය අධ්‍යයනය
චිත්‍ර කලාව
කෘෂි විද්‍යාව
ගණිතය
භූගෝල විද්‍යාව
ඉංග්‍රීසි
තොරතුරු හා සන්නිවේදන තාක්ෂණය
ව්‍යාපාර අධ්‍යයනය
ගිණුම්කරණය

(80) ජෛව පද්ධති තාක්ෂණවේදය (BIOSYSTEMS TECHNOLOGY)

ජෛව පද්ධති තාක්ෂණවේදය, තාක්ෂණවේදය සඳහා විද්‍යාව, යන විෂයයන් සමග පහත සඳහන් විෂයයන්ගෙන් එක් විෂයක්

ආර්ථික විද්‍යාව
ගෘහ ආර්ථික විද්‍යාව
සන්නිවේදනය හා මාධ්‍ය අධ්‍යයනය
චිත්‍ර කලාව
කෘෂි විද්‍යාව
ගණිතය
භූගෝල විද්‍යාව
ඉංග්‍රීසි
තොරතුරු හා සන්නිවේදන තාක්ෂණය
ව්‍යාපාර අධ්‍යයනය
ගිණුම්කරණය

(81) තොරතුරු සන්නිවේදන තාක්ෂණය (INFORMATION COMMUNICATION TECHNOLOGY)

තොරතුරු හා සන්නිවේදන තාක්ෂණය සමග තාක්ෂණවේදය සඳහා විද්‍යාව සහ ඉංජිනේරු තාක්ෂණවේදය හෝ ජෛව පද්ධති තාක්ෂණවේදය යන විෂයයන්

(82) ඉංග්‍රීසි දෙවන භාෂාවක් ලෙස ඉගැන්වීම අධ්‍යයන පාඨමාලාව (TEACHING ENGLISH AS A SECOND LANGUAGE) (TESL)

ඉංග්‍රීසි විෂයය ඇතුළුව වෙනත් ඕනෑම විෂයයන් දෙකක්

(83) ආහාර ව්‍යාපාර කළමනාකරණය (FOOD BUSINESS MANAGEMENT)

පහත සඳහන් විෂයයන් අතුරින් විෂයයන් තුනක්

රසායන විද්‍යාව	ජීව විද්‍යාව
භෞතික විද්‍යාව	සංයුක්ත ගණිතය
කෘෂි විද්‍යාව	ව්‍යාපාර අධ්‍යයනය
ආර්ථික විද්‍යාව	ගණකාධිකරණය

මෙයට අමතරව අ.පොෙ.ස. (සාමාන්‍ය පෙළ) විභාගයේ දී විද්‍යාව, ගණිතය සහ ඉංග්‍රීසි යන විෂයයන්ට අවම වශයෙන් සම්මාන (C) සාමර්ථ්‍යයක් ලබා තිබිය යුතු ය.

(84) **සාගර සහ මිරිදිය විද්‍යාව** (MARINE AND FRESHWATER SCIENCE)

පහත විෂය සංයෝජන අතුරින් එක් විෂය සංයෝජනයක්

(i) රසායන විද්‍යාව, භෞතික විද්‍යාව සහ ජීව විද්‍යාව
(ii) රසායන විද්‍යාව, භෞතික විද්‍යාව සහ සංයුක්ත ගණිතය

(85) **භෞතීය විද්‍යා - තොරතුරු සහ සන්නිවේදන තාක්ෂණය** (PHYSICAL SCIENCE - ICT)
සංයුක්ත ගණිතය, භෞතික විද්‍යාව සහ තොරතුරු සහ සන්නිවේදන තාක්ෂණය යන විෂයයන්

10.0 මෙම චක්‍රලේඛයේ නියමයන්ට අනුව, කටයුතු සිදු කළ යුතු අතර සිසුන් දැනුවත් කිරීමට ද පියවරගනු ඇතැයි අපේක්ෂා කරමි. විශ්වවිද්‍යාල පාඨමාලා සඳහා වන විෂයය සංයෝජනයන්ට අමතර ව පාඨමාලා මාධ්‍යය හා විශ්වවිද්‍යාලය තෝරා ගැනීමේ දී අවශ්‍ය වෙනත් සුදුසුකම් හා අනෙකුත් තොරතුරු සඳහා විශ්වවිද්‍යාල ප්‍රතිපාදන කොමිෂන් සභාව විසින් වාර්ෂිකව නිකුත් කරනු ලබන "**ශ්‍රී ලංකාවේ විශ්ව විද්‍යාල ප්‍රථම උපාධි පාඨමාලා සඳහා ප්‍රවේශය**" නම් ග්‍රන්ථය පරිශීලනය කළ යුතු ය.

ඉදිරියේ දී යෝජිත අධ්‍යාපන ප්‍රතිසංස්කරණවලට අනුව මෙම චක්‍රලේඛයේ වගන්ති ද සංශෝධනය විය හැකිය.

ඩබ්ලිව්. එම්. බන්දුසේන,
ලේකම්,
අධ්‍යාපන අමාත්‍යාංශය.

පිටපත් :-

1. ජාතික අධ්‍යාපන කොමිෂන් සභාවේ සභාපති
2. ජාතික අධ්‍යාපන ආයතනයේ අධ්‍යක්ෂ ජනරාල්
3. විශ්වවිද්‍යාල ප්‍රතිපාදන කොමිෂන් සභාවේ සභාපති
4. විගණකාධිපති
5. විභාග කොමසාරිස් ජනරාල්
6. අධ්‍යාපන ප්‍රකාශන කොමසාරිස් ජනරාල්
7. අධ්‍යාපන අමාත්‍යාංශයේ මාණ්ඩලික නිලධාරීන්
8. රජයේ හා රජයේ අනුමත පෞද්ගලික පාසල්වල ප්‍රධානීන්

சுற்றறிக்கை இலக்கம் : 2016/13

எனது இலக்கம்:- ஈடீ/01/12/02/06/02–(I)
பாடசாலை செயற்பாடுகள் கிளை,
கல்வி அமைச்சு,
"இசுறுபாய",
பத்தரமுல்லை,
2016.04.26.

மாகாண பிரதம செயலாளர்கள்,
மாகாணக் கல்விச் செயலாளர்கள்,
மாகாணக் கல்விப் பணிப்பாளர்கள்,
வலயக் கல்விப் பணிப்பாளர்கள்,
கல்விக் கோட்டங்களுக்குப் பொறுப்பான பிரதி/ உதவி கல்விப் பணிப்பாளர்கள்,
அரசாங்க மற்றும் அரச அங்கீகாரம் பெற்ற தனியார் பாடசாலைகளின் அதிபர்கள்.

க.பொ.த. (உயர் தர) பாடச் சேர்மானங்களும் பல்கலைக்கழகப் பிரவேசம் தொடர்பான பாடச் சேர்மானங்களும்

க.பொ.த. (உயர் தர) பாடச் சேர்மானங்களும் பல்கலைக்கழகப் பிரவேசம் தொடர்பான பாடச் சேர்மானங்களும் எனும் தலைப்பில் இதற்கு முன்னர் வெளியிடப்பட்டுள்ள 2009.05.18 ஆந் திகதிய 2009/16 ஆம் இலக்க சுற்றறிக்கை மற்றும் 2010.04.21ஆந் திகதிய 2009/16 (I) சுற்றறிக்கையின் திருத்தமும் இதற்கு ஏற்புடையதாகும் வகையில் வெளியிடப்பட்டுள்ள 2013.06.11ஆந் திகதிய சுற்றறிக்கைக் கடிதத்தினதும் சகல ஏற்புடைமைகளையும் விஞ்சியதாக 2016 இலும் அதன் பின்பும் 12 ஆம் தரத்திற்கு அனுமதி பெறும் மாணவர்களுக்கு இச்சுற்று நிருப அறிவுறுத்தல்கள் அமுலில் இருக்கும்.

2.0 க.பொ.த. (சாதாரண தரம்) சித்தியெய்தும் மாணவர்கள் க.பொ.த. (உயர் தர) வகுப்பில் தாம் பயில்வதற்கு எதிர்பார்க்கும் பாடத்துறையைத் தெரிவு செய்கையில், பாடங்கள் மற்றும் பாடச்சேர்மானங்கள் தொடர்பில் காணப்படும் சரியான தெளிவின்மை காரணமாக, சிக்கலான ஒரு நிலைமைக்கு முகம் கொடுக்கின்றார்கள். மேலும், பல்கலைக்கழகங்களில் தற்போது நடைமுறையில் உள்ள இளமாணிப் பட்டக் கற்கைநெறிகளுக்குத் தேவையான பாடச்சேர்மானங்கள் குறித்து மாணவர்களிடையே காணப்படும் தெளிவின்மை காரணமாகவும் பல்கலைக்கழக அனுமதியின்போது பல்வேறு சிரமங்களுக்கு முகம் கொடுக்கின்றார்கள். எனவே, இச்சிக்கல்களைத் தீர்ப்பதற்காகவும் மாணவர்களுக்கான ஒரு வழிகாட்டியாகவும் இந்த சுற்றறிக்கை வெளியிடப்படுகின்றது. ஆகவே, இந்த சுற்றிக்கையில் குறிப்பிடப்படும் க.பொ.த. (உயர் தர) பாடச்சேர்மானங்களும் பல்கலைக்கழக இளமாணிப் பட்டக் கற்கைநெறிக்கான பாடச்சேர்மானங்களும் குறித்து 12ஆம் தரத்திற்கு அனுமதிக்கப்படும் சகல மாணவர்களையும் அறிவுறுத்துவது அதிபர்களின் பொறுப்பாகும்.

3.0 க.பொ.த (உயர் தர) வகுப்புக்களில் மூன்று பிரதான பாடங்கள் கற்பிக்கப்படுவதுடன், ஒரு பாடத்துக்கென ஒரு வாரத்தில் 10 பாடவேளைகள் ஒதுக்கப்படும். இதற்கமைய, குறிப்பிட்ட விதப்புரை செய்யப்பட்ட 03 பிரதான பாடங்களுக்கும் 30 பாடவேளைகள் ஒதுக்கப்படும். எஞ்சிய 10 பாடவேளைகளில் 06 பாடவேளைகள் பொது ஆங்கிலப் பாடத்துக்காக ஒதுக்கப்பட வேண்டியதுடன், பொது தகவல் தொழில்நுட்பம் (GIT) பாடத்துக்காக 12ஆம் தரத்தில் மாத்திரம் 02 பாடவேளைகளை ஒதுக்குதல் வேண்டும். 12ஆம் தரத்தில் எஞ்சிய 02 பாடவேளைகளையும் 13ஆம் தரத்தில் எஞ்சிய 04 பாடவேளைகளையும் பாடசாலை முகாமைத்துவக் குழுவின் விருப்பத்தின் பிரகாரம் மாணவர்களது கல்வி வளர்ச்சிக்குத் துணைபுரியும் வகையில் பயன்படுத்துதல் வேண்டும்.

4.0 விதிக்கப்பட்டுள்ள அடிப்படைத் தகைமைகளைப் பூர்த்தி செய்துள்ள மாணவர்கள் 13ஆம் தரத்தின் இறுதியில் பிரதான 03 பாடங்களுடன் பொதுப் பரீட்சை மற்றும் பொது ஆங்கில பாடப் பரீட்சைக்குத் தோற்றுதல் வேண்டும். பொது ஆங்கில பாடத்தில் பெறப்படும் புள்ளியோ அல்லது சித்தியோ பல்கலைக்கழக அனுமதியின்போது கவனத்திற் கொள்ளப்பட மாட்டாது. ஆனால் குறித்த பாடத்தில் பெறப்படும் பெறுபேறு க.பொ.த (உயர் தர)ப் பரீட்சை பெறுபேற்றுச் சான்றிதழில் குறிப்பிடப்படும்.

5.0 க.பொ.த.(உயர் தர) பாடத்துறைகளுக்கான பாடச்சேர்மானங்கள்

பாடசாலைகளில் தற்போது க.பொ.த. (உயர் தர) வகுப்புகளுக்காக மூன்று பிரிவுகளின் கீழ் (கலை/ வணிகவியல், விஞ்ஞானம், தொழில்நுட்பவியல்) ஆறு (6) பாடத்துறைகள் நடைமுறைப்படுத்தப்படுகின்றன.

5.1 கலைப் பாடத்துறை

மாணவர்கள் கலைப் பாடத்துறையின் கீழ் கல்வி பயில்வதற்காக கீழே காட்டப்பட்டுள்ள நிபந்தனைகளுக்கு இசைவாகப் பாடச்சேர்மானங்களைத் தெரிவுசெய்தல் வேண்டும்.

5.1.1 கீழே காட்டப்பட்டுள்ள சமூக விஞ்ஞானம்/ பிரயோக சமூகக் கற்கைகள் பாடத் தொகுதியிலிருந்து (5.1.6 அ) குறைந்தது ஒரு பாடத்தையேனும் தெரிவு செய்தல் வேண்டும். (மொழிப் பாடங்கள் 02இனை அல்லது மொழிப் பாடங்கள் மூன்றினையும் தெரிவு செய்யும் மாணவர்களுக்கு இது ஏற்புடையதாகாது) மாணவரது விருப்பத்தின் பிரகாரம், இத் தொகுதியிலிருந்து இரண்டு பாடங்களையோ அல்லது மூன்று பாடங்களையுமோ தெரிவு செய்ய முடியும்.

5.1.2 கீழே காட்டப்பட்டுள்ள சமயங்களுக்கும் நாகரீகங்களுக்குமான பாடங்களிலிருந்து (5.1.6 ஆ) யாதேனும் சமயமொன்றைத் தெரிவு செய்வதாயின், அதனுடன் தொடர்புடைய நாகரீக பாடத்தை தெரிவு செய்ய முடியாது.

5.1.3 கீழே காட்டப்பட்டுள்ள அழகியற் கல்விப் பாடங்களிலிருந்து (5.1.6 இ) ஒரு பாடத்தை அல்லது இரண்டு பாடங்களைத் தெரிவு செய்ய முடியும்.

5.1.4 கீழே காட்டப்பட்டுள்ள மொழிகள் பாடத் தொகுதியிலிருந்து (5.1.6 ஈ) எந்தவொரு மொழிப் பாடத்தையும் அல்லது பாடங்கள் இரண்டினையும் தெரிவு செய்ய முடியும். ஆனால், மூன்று பாடங்களையும் மொழிப் பாடங்களிலிருந்து தெரிவு செய்வதாயின், அது பின்வரும் விதத்தில் மாத்திரம் அமைதல் வேண்டும்.

- 5.1.6 (ஈ) (1) இல் குறிப்பிடப்படும் 03 பாடங்களும்
- 5.1.6 (ஈ) இல் (1) மற்றும் (2) ஆகிய இரண்டு உபதொகுதிகளிலிருந்தும் மாத்திரம் தெரிவுசெய்யப்படும் மூன்று பாடங்கள்

5.1.5 மொழிப் பாடங்கள் இரண்டினைத் தெரிவு செய்யும் ஒரு மாணவன் தனது மூன்றாவது பாடமாக சமூக விஞ்ஞானம்/ பிரயோக சமூகக் கற்கைகள், சமயங்கள் மற்றும் நாகரீகம், அழகியற் கல்வி ஆகிய பாடத் தொகுதிகளிலிருந்து தாம் விரும்பிய ஒரு பாடத்தைத் தெரிவு செய்து கொள்ள முடியும்.

5.1.6 கலைப் பாடத்துறைக்கான பாடத்தொகுதிகள்

(அ) சமூக விஞ்ஞானம்/ பிரயோக சமூக கற்கைப் பாடங்கள்

1. பொருளியல்
2. புவியியல்
3. வரலாறு (இலங்கை வரலாற்றுடன் இந்திய வரலாறு அல்லது ஐரோப்பிய வரலாறு அல்லது நவீன உலக வரலாறு)
4. மனைப் பொருளியல்
5. அரசியல் விஞ்ஞானம்
6. அளவையியலும் விஞ்ஞான முறையும்
7. கணக்கீடு அல்லது வணிகப் புள்ளிவிபரவியல்
8. விவசாய விஞ்ஞானம் அல்லது கணிதம் அல்லது இணைந்த கணிதம்
9. தொழிட்பவியல் பாடங்களிலிருந்து ஒரு பாடம் (குடிசார் தொழில் நுட்பவியல் அல்லது பொறிமுறைத் தொழில்நுட்பவியல் அல்லது மின், இலத்திரனியல் மற்றும் தகவல் தொழில்நுட்பவியல் அல்லது உணவுத் தொழில்நுட்பவியல் அல்லது விவசாயத் தொழில்நுட்பவியல் அல்லது உயிர் வளத் தொழில்நுட்பவியல்)
10. தொடர்பாடலும் ஊடகக் கற்கையும்
11. தகவல், தொடர்பாடல் தொழில்நுட்பம்

(ஆ) சமயங்களும் நாகரீகங்களுக்குமான பாடங்கள்

1. பௌத்த சமயம் அல்லது பௌத்த நாகரீகம்
2. கிறிஸ்தவ சமயம் அல்லது கிறிஸ்தவ நாகரீகம்
3. இந்து சமயம் அல்லது இந்து நாகரீகம்
4. இஸ்லாம் அல்லது இஸ்லாமிய நாகரீகம்
5. கிரேக்க மற்றும் உரோம நாகரீகம்

(இ) அழகியற் கல்விப் பாடங்கள்

1. சித்திரம்
2. நடனம் (தேசிய அல்லது பரதம்)
3. சங்கீதம் (கீழைத்தேய அல்லது கர்நாடக அல்லது மேலைத்தேய)
4. நாடகமும் அரங்கியலும் (சிங்களம் அல்லது தமிழ் அல்லது ஆங்கிலம்)

(ஈ) மொழிப் பாடங்கள்

1. சிங்களம், தமிழ், ஆங்கிலம்
2. அரபு, பாளி, சமஸ்கிருதம்
3. சீனம், மலாய், பிரெஞ்சு, ஜேர்மன், ரஷியன், ஹிந்தி, ஜப்பான்

5.2 வணிகவியல் பாடத்துறை

இப்பாடத்துறையில் கற்பதற்கு எதிர்பார்க்கும் மாணவர்கள் கீழே குறிப்பிடப்படும் பாடங்களுள் குறைந்தது இரண்டு பாடங்களைத் தெரிவு செய்தல் வேண்டும்.

1. கணக்கீடு
2. வணிகக் கல்வி
3. பொருளியல்

எஞ்சிய பாடத்தை கீழே குறிப்பிடப்படும் பாடங்களிலிருந்து தெரிவு செய்தல் வேண்டும்.

1. வணிகப் புள்ளிவிபரவியல்
2. புவியியல்
3. அரசியல் விஞ்ஞானம்
4. வரலாறு (இலங்கையின் வரலாற்றுடன் இந்திய வரலாறு அல்லது ஐரோப்பிய வரலாறு அல்லது நவீன உலக வரலாறு)
5. அளவையியலும் விஞ்ஞான முறையும்
6. ஆங்கிலம்
7. ஜேர்மன்
8. பிரெஞ்சு
9. விவசாய விஞ்ஞானம்
10. இணைந்த கணிதம் அல்லது கணிதம்
11. தகவல், தொடர்பாடல் தொழில்நுட்பம்

5.3 உயிரியல் விஞ்ஞானப் பாடத்துறை

இந்தப் பாடத்துறையினைக் கற்பதற்கு எதிர்பார்க்கும் மாணவர்கள் உயிரியல் பாடத்துடன் கீழே குறிப்பிடப்படும் பாடங்களிலிருந்து இரண்டு பாடங்களைத் தெரிவு செய்தல் வேண்டும்.

1. இரசாயனவியல்
2. பௌதீகவியல்
3. விவசாய விஞ்ஞானம்
4. கணிதம்

5.4 பௌதீக விஞ்ஞான பாடத்துறை

இந்தப் பாடத்துறையில் கற்பதற்கு எதிர்பார்க்கும் மாணவர்கள் கீழே குறிப்பிடப்படும் பாடங்களிலிருந்து மூன்று பாடங்களைத் தெரிவு செய்தல் வேண்டும்

1. இணைந்த கணிதம்
2. இரசாயனவியல்
3. பௌதிகவியல்
4. உயர் கணிதம்

5.5 உயிர் முறைமைகள் தொழில்நுட்ப பாடத்துறை

இந்தப் பாடத்துறையில் கற்கும் மாணவர்கள் கீழே குறிப்பிடப்படும் பாடங்களைக் கட்டாயமாகத் தெரிவு செய்தல் வேண்டும்.

1. உயிர் முறைமைகள் தொழில்நுட்பவியல்
2. தொழில்நுட்பவியலுக்கான விஞ்ஞானம்

மூன்றாவது பாடத்தை பின்வரும் பாடங்களிலிருந்து தெரிவு செய்தல் வேண்டும்.

1. பொருளியல்
2. புவியியல்
3. மனைப் பொருளியல்
4. ஆங்கிலம்
5. தொடர்பாடலும் ஊடகக் கற்கையும்
6. தகவல், தொடர்பாடல் தொழில்நுட்பம்
7. சித்திரம்
8. வணிகக் கல்வி
9. விவசாய விஞ்ஞானம்
10. கணக்கீடு
11. கணிதம்

5.6 பொறியியல் தொழில்நுட்ப பாடத்துறை

இந்தப் பாடத்துறையில் கற்கும் மாணவர்கள் கீழே குறிப்பிடப்படும் பாடங்களைத் தெரிவு செய்வது கட்டாயமானதாகும்.

1. பொறியியற் தொழில்நுட்பவியல்
2. தொழில்நுட்பவியலுக்கான விஞ்ஞானம்

மூன்றாவது பாடத்தை பின்வரும் பாடங்களிலிருந்து தெரிவு செய்தல் வேண்டும்.

1. பொருளியல்
2. புவியியல்
3. மனைப் பொருளியல்
4. ஆங்கிலம்
5. தொடர்பாடலும் ஊடகக் கற்கையும்
6. தகவல், தொடர்பாடல் தொழில்நுட்பம்
7. சித்திரம்
8. வணிகக் கல்வி
9. விவசாய விஞ்ஞானம்
10. கணக்கீடு
11. கணிதம்

6.0 மேற்குறிப்பிடப்படும் விதத்தில் பாடத்துறைகளின் கீழ் குறிப்பிட்ட பாடச்சேர்மானங்களைத் தெரிவு செய்தல் வேண்டும். ஆனால் குறிப்பிட்ட பாடசாலையில் போதிய எண்ணிக்கையிலான மாணவர்கள் காணப்படும் பட்சத்திலும் நேர சூசியை வழங்குவதற்கும் வசதிகளை ஏற்படுத்துவதற்கும் இயலுமான பாடங்களுக்கு மாத்திரம் தமக்கு விருப்பமான பாடங்களைக் கொண்ட பாடச்சேர்மானத்தைத் தெரிவுசெய்வதற்கான வாய்ப்பினை மாணவர்களுக்கு வழங்க முடியும். ஆயினும், பாடங்களுக்கு இடையில் "அல்லது" எனக் குறிப்பிடப்பட்டிருப்பின் அதிலிருந்து ஒரு பாடத்தை மாத்திரம் தெரிவு செய்தல் வேண்டும். இவ்வாறு பாடங்களைத் தெரிவு செய்யும் மாணவர்களுக்குப் பல்கலைக்கழக அனுமதியின்போது தெரிவு செய்ய வேண்டிய பாடநெறிகள் குறித்துப் பரந்த அறிவினைப் பெற்றுக் கொடுத்தல் வேண்டும்.

7.0 ஏற்றுக்கொள்ளப்பட்ட பாடத்துறைகளுடன் இணைந்தொழுகாத ஏனைய பாடச்சேர்மானங்களைத் தெரிவு செய்யும் பட்சத்தில், விண்ணப்பதாரிகள் "குறித்த பாடத்துறை ஒன்றில் அடங்காத" என அறிமுகப் படுத்தப்படுவதுடன், பரீட்சைப் பெறுபேறுகளை வெளியிடுகையில் "நாடளாவிய தரம்" (Island Rank) மற்றும் "மாவட்டத் தரம்" (District Rank) வெளியிடப்பட மாட்டாது.

8.0 க.பொ.த. (உயர் தர) த்திற்கான சகல பாடங்களும் சிங்களம் மற்றும் தமிழ் மொழிமூலங்களில் கற்பிக்கப்படுவதுடன், கீழே காட்டப்பட்டுள்ள பாடங்களை ஆங்கில மொழியிலும் கற்பிக்க முடியும்.

1. உயிரியல்
2. பௌதீகவியல்
3. இரசாயனவியல்
4. இணைந்த கணிதம்
5. விவசாய விஞ்ஞானம்
6. கணக்கீடு
7. வணிகக் கல்வி
8. பொருளியல்
9. அரசியல் விஞ்ஞானம்
10. புவியியல்

இதற்கு மேலதிகமாக ஆங்கில மொழியில் வேறு பாடங்களைக் கற்பிப்பதற்கு தேவையாயின், மற்றும் இதற்கான வளங்கள் காணப்படுமாயின், கல்வி அமைச்சின் அங்கீகாரத்தைப் பெற்றுக்கொண்டதன் பின்னர் கற்பிக்க முடியும்.

9.0 பல்கலைக்கழகப் பட்டப் பாடநெறிகளுக்கான பாடச்சேர்மானங்கள்

9.1 பல்கலைக்கழகங்களினால் நடாத்தப்படும் இளமாணிப் பட்டப் பாடநெறிகளுக்கு அனுமதிப்பதற்காக மாணவர்கள் க.பொ.த. (உயர் தரம்) இல் பயில வேண்டிய பாடச்சேர்மானங்கள் கீழே காட்டப்பட்டுள்ளன. பல்கலைக்கழக இளமாணிப் பட்டப் பாடநெறிக்கு தெரிவு செய்யப்படுவதற்கான அடிப்படைத் தகைமையாக க.பொ.த. (உயர் தர)ப் பரீட்சையில் குறிப்பிட்ட பிரதான மூன்று பாடங்களிலும் சித்தியடைந்திருத்தல் வேண்டுமென்பதுடன், பொதுப் பரீட்சையில் தேவையான புள்ளி மட்டத்தைப் பெற்றிருத்தலும் கட்டாயமானதாகும். ஆனாலும், பல்கலைக்கழகங்களுக்கு அனுமதிக்கப்படும் அடிப்படை மற்றும் தெரிவுசெய்யப்படக் கூடிய எண்ணிக்கைக்கு ஏற்ப, அடிப்படைத் தகைமைகளைப் பூர்த்தி செய்தவர்கள் மத்தியிலிருந்து தெரிவு செய்யும் நடவடிக்கைகளை பல்கலைக்கழக மானியங்கள் ஆணைக்குழு மேற்கொள்ளும்.

9.2 பல்கலைக்கழக இளமாணிப் பட்டப் பாடநெறிகளுக்காக பல்கலைக்கழக மானியங்கள் ஆணைக்குழுவினால் விதப்புரை செய்யப்பட்டுள்ள க.பொ.த. (உயர் தர) பாடச்சேர்மானங்கள் மாத்திரம் கீழே காட்டப்பட்டுள்ளன. இது தொடர்பில் மேலதிக தகவல்கள் தேவைப்படுமாயின், குறிப்பிட்ட கல்வியாண்டுக்காக பல்கலைக்கழக மானியங்கள் ஆணைக்குழுவினால் வெளியிடப்படும் "இலங்கைப் பல்கலைக்கழக இளமாணிப் பட்டப் பாடநெறிகளுக்கான அனுமதி" எனும் கையேட்டினைப் பரிசீலனை செய்தல் வேண்டும்.

(1) கலை (ARTS)

கலைப் பாடத்துறையின் கீழ் வழங்கப்பட்டுள்ள நிபந்தனைகளுக்கு அமைவாகத் தெரிவு செய்யப்பட்ட 03 பாடங்கள்

(2) கலை (ஸ்ரீபாளி வளாகம்) (ARTS – SRIPALI CAMPUS)

கீழே குறிப்பிடப்படும் நிபந்தனைகளுக்கு அமைவாகக் கலைப் பாடத்துறையின் கீழ் தரப்பட்டுள்ள 03 பாடங்கள்

- மொழிப்பாடங்கள் இரண்டிற்கு அதிகமாகத் தோற்றாதிருத்தல் வேண்டும்
- சமயங்களும் நாகரீகங்களும் தொகுதியிலிருந்து ஒரு பாடத்திற்கு அதிகமாகத் தோற்றாதிருத்தல் வேண்டும்
- ஒன்றுக்கு மேற்பட்ட தொழில்நுட்பவியல் பாடங்களுக்குத் தோற்றாதிருத்தல் வேண்டும்
- பின்வரும் பாடங்களில் ஒன்றுக்கு அதிகமாகத் தோற்றாதிருத்தல் வேண்டும்
  - கணக்கியல்
  - வணிகப் புள்ளிவிபரவியல்
  - பொருளியல்

க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் ஆங்கிலத்தில் குறைந்தது சாதாரண சித்தி (S) பெற வேண்டுமென்பதுடன், தகுதிகாண் பரீட்சையிலும் சித்தியடைதல் வேண்டும்.

(3) கலை (சப்ரகமுவ) - (ARTS - SABARAGAMUWA)

கலை, வணிகம் ஆகிய ஏதேனும் பாடத்துறைகளின் கீழ் தெரிவு செய்யப்பட்ட 03 பாடங்கள்

(4) தொடர்பாடல் கற்கைகள் (COMMUNICATION STUDIES)

சிங்களம் அல்லது தமிழ் அல்லது ஆங்கிலப் பாடத்திற்கு குறைந்தது திறமைச் சித்தி (C) உடன் ஏதேனும் 03 பாடங்கள்
க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் ஆங்கில பாடத்தில் குறைந்தது திறமைச் சித்தியைக் (C) கொண்டிருத்தல் வேண்டும்

(5) சமாதானமும் முரண்பாடு தீர்த்தலும் (PEACE & CONFLICT RESOLUTION)

யாதேனும் மூன்று பாடங்கள்

(6) இஸ்லாமிய கற்கைகள் (ISLAMIC STUDIES)

இஸ்லாம் அல்லது இஸ்லாமிய நாகரீக பாடத்துடன் வேறு ஏதேனும் இரண்டு பாடங்கள்

(7) அரபு மொழி (ARABIC LANGUAGE)

அரபு மொழியுடன் வேறு ஏதேனும் இரண்டு பாடங்கள்

(8) சங்கீதம்/ நடனம்/ சித்திரம் மற்றும் வடிவமைப்பு/ நாடகமும் அரங்கியலும்/ கட்புலமும் தொழில்நுட்பவியல் கலையும்/ கட்புலக் கலை (MUSIC/ DANCING/ ART & DESIGN/ DRAMA & THEATRE/ VISUAL & TECHNOLOGICAL ARTS/ VISUAL ARTS)

கற்பதற்கு எதிர்பார்க்கும் பாடநெறி தொடர்பிலான பாடத்துக்கு (சங்கீதம்/ நடனம்/ சித்திரம்/ நாடகமும் அரங்கியலும்) குறைந்தது திறமைச் சித்தியுடன் (C) ஏனைய யாதேனும் இரண்டு பாடங்கள்.
இதற்கு மேலதிகமாக பல்கலைக்கழகத்தினால் நடத்தப்படும் தகுதிகாண் பரீட்சையிலும் சித்தியெய்துதல் வேண்டும்.

(9) முகாமைத்துவம்/முகாமைத்துவம் (பொது) சிறப்பு/சொத்து முகாமைத்துவமும் மதிப்பீடும்/ வணிகவியல் (MANAGEMENT / MANAGEMENT (PUBLIC) SPECIAL/ ESTATE MANAGEMENT & VALUATION / COMMERCE)

மேற்குறிப்பிட்ட பாடநெறிகளுக்காக பின்வரும் பாடச்சேர்மானங்களில் ஒரு பாடச்சேர்மானம்

(i) வணிகக் கல்வி, பொருளியல் மற்றும் கணக்கீடு அல்லது
(ii) மேலே (i) இல் குறிப்பிடப்படும் பாடங்களில் இரண்டு பாடங்களும் பின்வரும் பாடங்களிலிருந்து தெரிவு செய்யப்பட்ட ஒரு பாடமும்

விவசாய விஞ்ஞானம்	புவியியல்
ஆங்கிலம்	இணைந்த கணிதம் அல்லது கணிதம்
பௌதிகவியல்	வரலாறு
அளவையியலும் விஞ்ஞான முறையும்	வணிகப் புள்ளிவிபரவியல்
ஜேர்மன்	தகவல் தொடர்பாடல் தொழில்நுட்பம்
அரசியல் விஞ்ஞானம்	பிரெஞ்சு

(10) முகாமைத்துவக் கற்கைகள் (திருகோணமலை மற்றும் வவுனியா) - MANAGEMENT STUDIES (TRINCOMALEE & VAVUNIA)

எந்தவொரு பாடத்துறையின் கீழும் ஏதேனும் 03 பாடங்கள்

(11) வியாபாரத் தகவல் முறைமைகள் (சிறப்பு) BUSINESS INFORMATION SYSTEMS) (SPECIAL)

கணக்கியல் வணிகக் கல்வி பொருளியல்

மேலே குறிப்பிடப்பட்ட பாடங்களில் குறைந்தது 02 பாடங்களுடன் பின்வரும் பாடங்களில் ஒரு பாடம்

தகவல், தொடர்பாடல் தொழில்நுட்பம்
அளவையியலும் விஞ்ஞான முறையும்
இணைந்த கணிதம் அல்லது கணிதம்
வணிகப் புள்ளிவிபரவியல்
பௌதிகவியல்

(12) மருத்துவம்/ பல் அறுவைச் சிகிச்சை/ விலங்கு மருத்துவ விஞ்ஞானம் (MEDICINE/ DENTAL SURGERY/ VETERINARY SCIENCE)

பின்வரும் மூன்று பாடங்களும்

உயிரியல் இரசாயனவியல் பௌதிகவியல்

(13) விவசாயத் தொழில்நுட்பமும் முகாமைத்துவமும் (AGRICULTURAL TECHNOLOGY & MANAGEMENT)

பின்வரும் பாடச்சேர்மானங்களில் ஒரு பாடச் சேர்மானம்

(i) இரசாயனவியல், பௌதிகவியல் மற்றும் உபிரியல்

(ii) இரசாயனவியல், பௌதிகவியல் அல்லது கணிதம், உயிரியல் அல்லது விவசாய விஞ்ஞானம்

(iii) இரசாயனவியல், உயிரியல், விவசாய விஞ்ஞானம் அல்லது கணிதம்

(14) விவசாயம் (AGRICULTURE)

மேற்குறிப்பிடப்பட்ட விவசாயத் தொழில்நுட்பமும் முகாமைத்துவமும் பாடநெறிக்கான பாடச்சேர்மானங்கள் (இலக்கம் 13ஐப் பார்க்கவும்)

(15) உணவு விஞ்ஞானமும் போசாக்கும் (FOOD SCIENCE & NUTRITION)

மேற்குறிப்பிடப்பட்ட விவசாயத் தொழில்நுட்பமும் முகாமைத்துவமும் பாடநெறிக்கான பாடச்சேர்மானம் (இலக்கம் 13ஐப் பார்க்கவும்)

(16) உணவு விஞ்ஞானமும் தொழில்நுட்பமும் (FOOD SCIENCE & TECHNOLOGY)

இரசாயனவியல், பௌதிகவியல் மற்றும் உயிரியல் ஆகிய மூன்று பாடங்களும்.

(17) ஆயுர்வேதம்/ யுனானி/ சித்த மருத்துவம் (AYURVEDA/ UNANI/ SIDDHA)

உயிரியல், இரசாயனவியல் மற்றும் பௌதிகவியல் ஆகிய மூன்று பாடங்களும்

(18) உயிரியல் விஞ்ஞானம் (BIOLOGICAL SCIENCE)

உயிரியல், இரசாயனவியல் மற்றும் பின்வரும் பாடங்களில் ஒரு பாடம்

விவசாய விஞ்ஞானம்	கணிதம் அல்லது இணைந்த கணிதம்
உயர் கணிதம்	பௌதிகவியல்

(19) பிரயோக விஞ்ஞானங்கள் (உயிரியல் விஞ்ஞானம்) (APPLIED SCIENCE – BIOLOGICAL SCIENCE)

மேற்குறிப்பிடப்பட்டுள்ள உயிரியல் விஞ்ஞான பாடநெறிக்காகத் தரப்பட்டுள்ள சேர்மானம் (இலக்கம் 18ஐப் பார்க்கவும்)

(20) சுகாதார விருத்தி (HEALTH PROMOTION)

மேற்குறிப்பிடப்பட்டுள்ள உயிரியல் விஞ்ஞான பாடநெறிக்காகத் தரப்பட்டுள்ள பாடச் சேர்மானம் (இலக்கம் 18ஐப் பார்க்கவும்)

(21) தாதியியல் (NURSING)

உயிரியல், இரசாயனவியல் மற்றும் பௌதிகவியல் ஆகிய மூன்று பாடங்களும்

க.பொ.த. (சா.தர)ப் பரீட்சையில் ஆங்கிலப் பாடத்தில் குறைந்தது சாதாரண சித்தியைப் (S) பெற்றிருத்தல்

(22) மருந்தகவியல் (PHARMACY)

இரசாயனவியலில் குறைந்தது திறமைச் சித்தியுடன் (C) பௌதிகவியல் மற்றும் உயிரியல் ஆகிய மூன்று பாடங்களும்

க.பொ.த. (சா.தர)ப் பரீட்சையில் ஆங்கிலப் பாடத்தில், குறைந்தது சாதாரண சித்தியைப் (S) பெற்றிருத்தல்

(23) மருத்துவ ஆய்வுகூட விஞ்ஞானங்கள் (MEDICAL LABORATORY SCIENCES)

பௌதிகவியல், இரசாயன்வியல் மற்றும் உயிரியல் ஆகிய மூன்று பாடங்களும்

க.பொ.த. (சா.தர)ப் பரீட்சையில் ஆங்கிலப் பாடத்தில், குறைந்தது சாதாரண சித்தியைப் (S) பெற்றிருத்தல்

(24) ஊடுகதிர்ப்படவியல் (RADIOGRAPHY)

பௌதிகவியல், இரசாயனவியல் மற்றும் உயிரியல் ஆகிய மூன்று பாடங்களும்

க.பொ.த. (சா.தர)ப் பரீட்சையில் ஆங்கிலப் பாடத்தில், குறைந்தது சாதாரண சித்தியைப் (S) பெற்றிருத்தல்

(25) இயன் மருத்துவம் (PHYSIOTHERAPY)

பௌதிகவியல் மற்றும் இரசாயனவியலுடன் பின்வரும் பாடங்களில் ஒரு பாடம்

உயிரியல் இணைந்த கணிதம் உயர் கணிதம் கணிதம்

க.பொ.த. (சா.தர)ப் பரீட்சையில் ஆங்கிலப் பாடத்தில், குறைந்தது சாதாரண சித்தியைப் (S) பெற்றிருத்தல்.

(26) மூலக்கூற்று உயிரியலும் உயிரிரசாயனவியலும் (MOLECULAR BIOLOGY & BIOCHEMISTRY)

பௌதிகவியல், இரசாயனவியல் மற்றும் உயிரியல் ஆகிய மூன்று பாடங்களும்

(27) மீன்பிடித்தலும் கடல்சார் விஞ்ஞானங்களும் (FISHERIES & MARINE SCIENCES)

மூலக்கூற்று உயிரியலும் உயிரிரசாயனவியலும் பாடநெறிக்கான பாடச்சேர்மானம் (இலக்கம் 26ஐப் பார்க்கவும்)

(28) சூழல் பேணலும் முகாமைத்துவமும் (ENVIRONMENTAL CONSERVATION & MANAGEMENT)

உயிரியல் மற்றும் இரசாயனவியலுடன் பின்வரும் பாடங்களில் ஒரு பாடம்

பௌதிகவியல்	இணைந்த கணிதம்
விவசாய விஞ்ஞானம்	கணிதம்

(29) விலங்கு விஞ்ஞானமும் மீன்பிடித்தலும் (ANIMAL SCIENCE & FISHERIES)

பின்வரும் பாடச்சேர்மானங்களில் ஒரு பாடச்சேர்மானம்

(i) இரசாயனவியல், உயிரியல் மற்றும் பௌதிகவியல்
(ii) இரசாயனவியல், உயிரியல் மற்றும் விவசாய விஞ்ஞானம்

(30) உணவு உற்பத்தியும் தொழில்நுட்ப முகாமைத்துவமும் (FOOD PRODUCTION & TECHNOLOGY MANAGEMENT)

விவசாயத் தொழில்நுட்பமும் முகாமைத்துவமும் பாடநெறிக்கான பாடச்சேர்மானம் (இலக்கம் 13ஐப் பார்க்கவும்)

(31) பொறியியல் (ENGINEERING)

பின்வரும் மூன்று பாடங்களும்-

இரசாயனவியல் இணைந்த கணிதம் பௌதிகவியல்

(32) பொறியியல் (EM) - நில வளங்கள் பொறியியல் (ENGINEERING) (EM) - (EARTH RESOURCES ENGINEERING)

பொறியியல் பாடநெறிக்கான பாடச்சேர்க்கை (இலக்கம் 31ஐப் பார்க்கவும்)

(33) பொறியியல் (TM) - புடைவை மற்றும் துணி தொழில்நுட்பம்
(ENGINEERING) (TM) - (TEXTILE & CLOTHING TECHNOLOGY)

பொறியியல் பாடநெறிக்கான பாடச்சேர்மானம் (இலக்கம் 31ஐப் பார்க்கவும்)

(34) பௌதிக விஞ்ஞானம் (PHYSICAL SCIENCE)

இணைந்த கணிதம் அல்லது உயர் கணிதம் மற்றும் இரசாயனவியல் அல்லது பௌதிகவியலை உள்ளடக்கியதாக பின்வரும் பாடங்களில் மூன்று பாடங்கள்

விவசாய விஞ்ஞானம்	இணைந்த கணிதம்	உயிரியல்
உயர் கணிதம்	இரசாயனவியல்	பௌதிகவியல்

(35) கணினி விஞ்ஞானம் (COMPUTER SCIENCE)

இணைந்த கணிதம் அல்லது பௌதிகவியல் அல்லது உயர் கணிதம் ஆகிய பாடங்களில் ஒன்றுக்கு குறைந்தபட்சம் திறமைச் சித்தியுடன் (C) பின்வரும் பாடங்களில் மூன்று பாடங்கள்

இணைந்த கணிதம் அல்லது கணிதம்	உயர் கணிதம்	இரசாயனவியல்
தகவலும் தொடர்பாடல் தொழில்நுட்பமும்	பௌதிகவியல்	

(36) தகவல் தொடர்பாடல் தொழில்நுட்பம்
(INFORMATION & COMMUNICATION TECHNOLOGY)

பின்வரும் பாடங்களில் ஒரு பாடத்தில் திறமைச் சித்தியுடன் (C) ஏதேனும் மூன்று பாடங்கள்

உயர் கணிதம்	உயிரியல்
கணிதம் அல்லது இணைந்த கணிதம்	பௌதிகவியல்
கணக்கீடு	இரசாயனவியல்
வணிகப் புள்ளிவிபரவியல்	தகவல், தொடர்பாடல் தொழில்நுட்பம்
வணிகக் கல்வி	குடிசார் தொழில்நுட்பவியல்
புவியியல்	பொறிமுறை தொழில்நுட்பவியல்
பொருளியல்	
இலத்திரனியல் மற்றும் தகவல் தொழில்நுட்பவியல்	
அளவையியலும் விஞ்ஞான முறையும்	
சங்கீதம் (கீழைத்தேய/ கர்நாடக/ மேலைத்தேய)	
சமஸ்கிருதம்	

க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் கணிதம் மற்றும் ஆங்கில பாடங்களுக்கு ஆகக் குறைந்தது திறமைச் சித்தியைக் (C) கொண்டிருத்தல் வேண்டும்.

இதற்கு மேலதிகமாக, பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையில் சித்தியடைதல் வேண்டும்.

(37) பிரயோக விஞ்ஞானங்கள் (பௌதிக விஞ்ஞானம்) (APPLIED SCIENCES/ PHYSICAL SCIENCE)

இணைந்த கணிதம் அல்லது உயர் கணிதம் மற்றும் இரசாயனவியல் அல்லது பௌதிகவியல் பாடங்களுடன் பின்வரும் பாடங்களில் ஒரு பாடம்

விவசாய விஞ்ஞானம்
உயர் கணிதம்
உயிரியில்
இரசாயனவியல்
இணைந்த கணிதம்
தகவல், தொடர்பாடல் தொழில்நுட்பம்
பௌதிகவியல்

(38) போக்குவரத்தும் தேவைகள் விநியோக ஒழுங்கமைப்பு முகாமைத்துவமும் (TRANSPORT & LOGISTICS MANAGEMENT)

பௌதிகவியல், இரசாயனவியல் மற்றும் இணைந்த கணிதம் ஆகிய மூன்று பாடங்களும்

(39) கைத்தொழில் புள்ளிவிபரவியலும் கணிதவியல் நிதியும் (INDUSTRIAL STATISTICS & MATHEMATICAL FINANCE)

இணைந்த கணிதத்துடன் பின்வரும் பாடங்களில் இரண்டு பாடங்கள்

உயர் கணிதம் பௌதிகவியல் இரசாயனவியல்

40) புள்ளிவிபரவியலும் செயற்பாட்டு ஆராய்ச்சியும் (STATISTICS & OPERATIONS RESEARCH)

இணைந்த கணிதத்துடன் பின்வரும் பாடங்களில் ஏதேனும் இரண்டு பாடங்கள்

உயிரியல்
உயர் கணிதம்
விவசாய விஞ்ஞானம்
தகவல், தொடர்பாடல் தொழில்நுட்பம்
பௌதிகவியல்
இரசாயனவியல்
கணிதம்

(41) கணக்கிடலும் தகவல் முறைமைகளும் (COMPUTING & INFORMATION SYSTEMS)

இணைந்த கணிதம், பௌதிகவியல், உயர் கணிதம் ஆகிய பாடங்களில் ஒன்றில் குறைந்தது திறமைச் சித்தியும் (C) பின்வரும் பாடங்களுள் இரண்டு பாடங்களும்

இணைந்த கணிதம்
பௌதிகவியல்
இரசாயனவியல்
உயர் கணிதம்
தகவல் தொடர்பாடல் தொழில்நுட்பம்

க.பொ.த. (சா.தர)ப் பரீட்சையில் ஆங்கிலப் பாடத்தில் குறைந்தது திறமைச் சித்தியைப் (C) பெற்றிருத்தல்

(42) தகவல் தொழில்நுட்பம் (INFORMATION TECHNOLOGY- IT)

பின்வரும் பாடங்களில் குறைந்தது ஒரு பாடத்துக்கு திறமைச் சித்தியும் (C) வேறு ஏதேனும் இரண்டு பாடங்களும்

உயர் கணிதம் கணிதம் இணைந்த கணிதம் பௌதிகவியல்

(43) முகாமைத்துவம் மற்றும் தகவல் தொழில்நுட்பம் (MANAGEMENT & INFORMATION TECHNOLOGY – MIT)

உயர் கணிதம், இணைந்த கணிதம், கணிதம் மற்றும் பௌதிகவியல் ஆகிய பாடங்களில் ஒரு பாடத்துக்கான திறமைச் சித்தியுடன் (C)

(i) உயிரியல் விஞ்ஞானப் பாடத்துறையிலிருந்து அல்லது பௌதிக விஞ்ஞானப் பாடத்துறையிலிருந்து மூன்று பாடங்களில் சித்திபெற்றிருத்தல்.

அல்லது

(ii) உயிரியல் பாடத்துறையிலிருந்து அல்லது பௌதிக விஞ்ஞானப் பாடத்துறையிலிருந்து இரண்டு பாடங்களிலும் தகவல், தொடர்பாடல் தொழில்நுட்பம் பாடத்திலும் சித்தியடைந்திருத்தல்.

இதற்கு மேலதிகமாக பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையிலும் சித்தியடைந்திருத்தல் வேண்டும்.

(44) கணிய அளவையியல் (QUANTITY SURVEYING)

இணைந்த கணிதம், உயர் கணிதம் ஆகிய பாடங்களில் குறைந்தது ஒரு பாடத்திலும் பின்வரும் பாடங்களில் ஒரு பாடத்தில் அல்லது இரண்டு பாடங்களில் சித்தியடைந்திருத்தல் வேண்டும்.

கணக்கீடு	பொருளியல்	பௌதிகவியல்
வணிகப் புள்ளிவிபரவியல்	வணிகக் கல்வி	இரசாயனவியல்
தகவல், தொடர்பாடல் தொழில்நுட்பம்		

இதற்கு மேலதிகமாக க.பொ.த. (சா.தர)ப் பரீட்சையில் ஆங்கில மற்றும் கணித பாடங்களில் குறைந்தது திறமைச் சித்தியைப் (C) பெற்றிருத்தல் வேண்டுமென்பதுடன் விஞ்ஞான பாடத்தில் குறைந்தது சாதாரண சித்தியையும் (S) பெற்றிருத்தல் வேண்டும்.

(45) அளவையியல் விஞ்ஞானம் (SURVEYING SCIENCE)

பௌதிகவியல், இணைந்த கணிதம் உடன் வேறு ஏதேனும் ஒரு பாடம்

(46) பட்டினமும் நாடும் திட்டமிடல் (TOWN & COUNTRY PLANNING)

(i) பின்வரும் பாடங்களில் குறைந்தது இரண்டு பாடங்கள்

கணக்கீடு	இரசாயனவியல்
உயர் கணிதம்	விவசாய விஞ்ஞானம்
இணைந்த கணிதம்	அளவையியலும் விஞ்ஞான முறையும்
உயிரியல்	பொருளியல்
அரசியல் விஞ்ஞானம்	வணிகக் கல்வி
கணிதம்	பௌதிகவியல்
வணிகப் புள்ளிவிபரவியல்	புவியியல்
தகவல், தொடர்பாடல் தொழில்நுட்பம்	

(ii) மூன்றாவது பாடம் பின்வரும் பாடங்களுள் ஒன்றாக அமைதல் வேண்டும்.

அரபு	கிறிஸ்தவ நாகரீகம்
மலாய்	பௌத்த சமயம்
மனைப் பொருளியல்	பாளி
பௌத்த நாகரீகம்	ஹிந்தி
ரஷ்யன்	கிறிஸ்தவ சமயம்
இந்து சமயம்	சமஸ்கிருதம்
சீனம்	இந்து நாகரீகம்
சிங்களம்	ஆங்கிலம்
வரலாறு	தமிழ்
பிரெஞ்சு	இஸ்லாம்
கிரேக்க மற்றும் உரோம நாகரீகம்	ஜேர்மன்
இஸ்லாமிய நாகரீகம்	ஜப்பான்
சித்திரம்	

இதற்கு மேலதிகமாக, க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் ஆங்கிலம் மற்றும் கணிதம் ஆகிய பாடங்களில் குறைந்தது திறமைச் சித்தியைப் (C) பெற்றிருத்தல் வேண்டும்.

மேற்குறிப்பிட்ட பாடநெறிக்குத் தகைமை பெறும் பொருட்டு விண்ணப்பதாரிகள் 2017/2018 கல்வியாண்டு முதல் மேலே (i) தொகுதியின் கீழ் உள்ள பாடங்களிலிருந்து மூன்று பாடங்களில் சித்தியடைந்திருத்தல் வேண்டும்.

அவ்வாறே, விண்ணப்பதாரிகள் 2017/2018 கல்வியாண்டு முதல் க.பொ.த (சாதாரண தர)ப் பரீட்சையில் ஆங்கில பாடத்தில் குறைந்தது (B) சித்தியையும் கணித பாடத்தில் திறமைச் சித்தியையும் (C) பெற்றிருத்தல் வேண்டும்.

(47) கட்டடக் கலை (ARCHITECTURE)

(i) பின்வரும் பாடங்களிலிருந்து குறைந்தது ஒரு பாடம்

சித்திரம்	புவியியல்	உயிரியல்
உயர் கணிதம்	இரசாயனவியல்	பௌதிகவியல்
இணைந்த கணிதம்		

மற்றும்

(ii) பின்வரும் பாடங்களில் மேலும் ஒரு பாடம் அல்லது இரண்டு பாடங்கள்

கணக்கீடு	ஹிந்தி	அரபு
இந்து நாகரீகம்	பௌத்த நாகரீகம்	வரலாறு
வணிகப் புள்ளிவிபரவியல்	மனைப் பொருளியல்	வணிகக்கல்வி
இஸ்லாமிய நாகரீகம்	சீனம்	ஜப்பான்
கிறிஸ்தவ நாகரீகம்		
அளவையியலும் விஞ்ஞான முறையும்		பொருளியல்
அரசியல் விஞ்ஞானம்	கணிதம்	பாளி
ஆங்கிலம்	சமஸ்கிருதம்	பிரெஞ்சு
சிங்களம்	தகவல், தொடர்பாடல்	தொழில்நுட்பம்
ஜேர்மன்	கிரேக்க மற்றும் உரோம நாகரீகம்	
விவசாய விஞ்ஞானம்	தமிழ்	
தொடர்பாடலும் ஊடகக்கற்கையும்		

இவற்றுக்கு மேலதிகமாக, பின்வரும் தேவைப்பாடுகளையும் பூர்த்தி செய்தல் வேண்டும்.

க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் ஆங்கிலப் பாடத்துக்கு குறைந்தது சாதாரண சித்தி (S).

க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் கணித பாடத்துக்கு குறைந்தது திறமைச் சித்தி (C).

அல்லது

க.பொ.த. (உயர் தர)ப் பரீட்சையில் கணித பாடத்துக்கு குறைந்தது சாதாரண சித்தி (S) பெறுதல் வேண்டும்.

இவற்றுக்கு மேலதிகமாக, பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையிலும் சித்தியடைதல் வேண்டும்.

(48) வடிவமைப்பு (DESIGN)

யாதேனும் மூன்று பாடங்கள்

இவற்றுக்கு மேலதிகமாக, பின்வரும் தேவைப்பாடுகளையும் பூர்த்தி செய்தல் வேண்டும்.

க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் ஆங்கில பாடத்துக்கு குறைந்தது சாதாரண சித்தி (S).
க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் கணித பாடத்துக்கு குறைந்தது திறமைச் சித்தி (C).

அல்லது

க.பொ.த. (உயர் தர)ப் பரீட்சையில் கணித பாடத்துக்கு குறைந்தது சாதாரண சித்தி (S).

மேலும், 2017/2018 கல்வியாண்டு முதல் இந்த கற்கைநெறிக்கு தகைமை பெறும் பொருட்டு விண்ணப்பதாரிகள் க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் ஆங்கில பாடத்தில் சாதாரண சித்தியையும் (S) கணிதம் மற்றும் விஞ்ஞானம் ஆகிய பாடங்களில் திறமைச் சித்தியையும் (C) பெறுதல் வேண்டும்.

இவற்றுக்கு மேலதிகமாக, பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையிலும் சித்தியடைதல் வேண்டும்.

(49) நவநாகரீக வடிவமைப்பும் உற்பத்தி அபிவிருத்தியும் (FASHION DESIGN & PRODUCT DEVELOPMENT)

ஏதேனும் மூன்று பாடங்கள்

க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் கணிதம், ஆங்கிலம், விஞ்ஞானம் ஆகிய பாடங்களுக்கு குறைந்தது திறமைச் சித்தி (C) பெறுதல் வேண்டும்.

இவற்றுக்கு மேலதிகமாக, பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையிலும் சித்தியடைதல் வேண்டும்.

(50) சட்டம் (LAW)

(i) பின்வரும் பாடங்களிலிருந்து தெரிவு செய்யப்பட் மூன்று பாடங்கள்.

புவியியல்	அரசியல் விஞ்ஞானம்
விவசாய விஞ்ஞானம்	வணிகப் புள்ளிவிபரவியல்
உயிரியல்	உயர் கணிதம்
தொடர்பாடலும் ஊடகக் கற்கையும்	வரலாறு
வணிகக் கல்வி	அளவையியலும் விஞ்ஞான முறையும்
இரசாயனவியல்	பொருளியல்
கணிதம் அல்லது இணைந்த கணிதம்	கணக்கீடு
பௌதிகவியல்	தகவல், தொடர்பாடல் தொழில்நுட்பம்

அல்லது

மேற்குறிப்பிடப்பட்டுள்ள பாடங்களில் ஒன்று அல்லது இரண்டுடன் பின்வரும் பாடங்களில் எஞ்சிய பாடம் அல்லது பாடங்கள்.

பௌத்த சமயம் அல்லது பௌத்த நாகரீகம்	ஆங்கிலம்
இந்து சமயம் அல்லது இந்து நாகரீம்	பிரெஞ்சு
கிறிஸ்தவ சமயம் அல்லது கிறிஸ்தவ நாகரீகம்	சிங்களம்
இஸ்லாம் அல்லது இஸ்லாமிய நாகரீகம்	ஜேர்மன்
ஜப்பான்	தமிழ்
சீனம்	அரபு
பாளி	
கிரேக்க மற்றும் உரோம நாகரீகம்	

க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் ஆங்கில பாடத்துக்கு குறைந்தது திறமைச் சித்தி (C).

அல்லது

க.பொ.த. (உயர் தர)ப் பரீட்சையில் ஆங்கில பாடத்துக்கு குறைந்தது சாதாரண சித்தி (S).

(51) வசதிகள் முகாமைத்துவம் (FACILITIES MANAGEMENT)

இணைந்த கணிதம் அல்லது கணக்கீட்டுப் பாடத்துடன் பின்வரும் பாடங்களில் ஏதேனும் இரண்டு பாடங்கள்

வணிகப் புள்ளிவிபரவியல்	பௌதிகவியல்
வணிகக் கல்வி	உயர் கணிதம்
இரசாயனவியல்	பொருளியல்
தகவல், தொடர்பாடல் தொழில்நுட்பம்	

இவற்றுக்கு மேலதிகமாக க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் ஆங்கிலம் மற்றும் கணித பாடங்களில் குறைந்தது திறமைச் சித்தியும் (C) விஞ்ஞான பாடத்துக்கு குறைந்தது சாதாரண சித்தியும் (S) பெறுதல் வேண்டும்.

(52) கணக்கிடலும் முகாமைத்துவமும் (COMPUTATION & MANAGEMENT)

பொருளியல் அல்லது இணைந்த கணிதம் உள்ளிட்ட ஏதாவது மூன்று பாடங்கள்

இவற்றுக்கு மேலதிகமாக, க.பொ.த (சாதாரண தர)ப் பரீட்சையில் கணித பாடத்துக்கு குறைந்தது திறமைச் சித்தி (C) பெறுதல் வேண்டும்.

(53) முகாமைத்துவமும் தகவல் தொழில்நுட்பமும் (தென் கிழக்குப் பல்கலைக்கழகம்)
MANAGEMENT & INFORMATION TECHNOLOGY (SOUTH EASTERN UNIVERSITY)

ஏதேனும் மூன்று பாடங்கள்

(54) விஞ்ஞானமும் தொழில்நுட்பமும் (SCIENCE & TECHNOLOGY)

உயிரியல் விஞ்ஞானம் மற்றும் பௌதிக விஞ்ஞான பாடநெறிகளுக்குத் தேவையான தகைமைகள் ஏற்புடையதாகும். (இலக்கம் 18 மற்றும் 34ஐப் பார்க்கவும்)

(55) கணனி விஞ்ஞானமும் தொழில்நுட்பமும் (COMPUTER SCIENCE & TECHNOLOGY)

இந்தப் பாடநெறிக்கும் உயிரியல், பௌதிக விஞ்ஞானம் மற்றும் பிரயோக விஞ்ஞானங்கள் (பௌதிக விஞ்ஞானம்) பாடநெறிகளுக்குத் தேவையான மூன்று பாடங்கள் (இலக்கம் 18, 34 மற்றும் 37ஐப் பார்க்கவும்)

இதற்கு மேலதிகமாக, பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையில் சித்தியடைதல் வேண்டும்.

(56) தொழில்முயற்சியும் முகாமைத்துவமும் (ENTREPRENEURSHIP & MANAGEMENT)

ஏதேனும் மூன்று பாடங்கள்

இதற்கு மேலதிகமாக, பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையில் சித்தியடைதல் வேண்டும்.

(57) விலங்கு விஞ்ஞானம் (ANIMAL SCIENCE)

உயிரியல் விஞ்ஞானம் பாடநெறிக்கான தகைமைகள் ஏற்புடையதாகும். (இலக்கம் 18ஐப் பார்க்கவும்)

(58) ஏற்றுமதி விவசாயம் (EXPORT AGRICULTURE)

உயிரியல் விஞ்ஞானம் பாடநெறிக்கான தகைமைகள் ஏற்புடையதாகும். (இலக்கம் 18ஐப் பார்க்கவும்)

(59) தேயிலைத் தொழில்நுட்பமும் பெறுமதி சேர்ப்பும் (TEA TECHNOLOGY & VALUE ADDITION)

பின்வரும் பாடச் சேர்மானங்களில் ஒரு பாடச்சேர்மானம்

(i) உயிரியல், இரசாயனவியல், பௌதிகவியல் அல்லது விவசாய விஞ்ஞானம்
(ii) இணைந்த கணிதம், இரசாயனவியல், பௌதிகவியல்

(60) கைத்தொழில் தகவல் தொழில்நுட்பம் (INDUSTRIAL INFORMATION TECHNOLOGY)

ஏதேனும் மூன்று பாடங்கள்

இதற்கு மேலதிகமாக, பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையில் சித்தியடைதல் வேண்டும்.

(61) கனிப்பொருள் வளங்களும் தொழில்நுட்பமும் (MINERAL RESOURCES & TECHNOLOGY)

பின்வரும் பாடச்சேர்மானங்களில் ஒன்று

(i) உயிரியல், இரசாயனவியல், பௌதிகவியல்
(ii) இணைந்த கணிதம், இரசாயனவியல், பௌதிகவியல்

(62) நீர்வாழ் வளங்கள் தொழில்நுட்பம் (AQUATIC RESOURCES TECHNOLOGY)

உயிரியல் விஞ்ஞானப் பாடநெறிக்கான பாடச்சேர்மானங்கள் ஏற்புடையதாகும். (இலக்கம் 18ஐப் பார்க்கவும்)

(63) பனை இனத்தாவரம் மற்றும் இறப்பர் பால் தொழில்நுட்பமும் பெறுமதி சேர்ப்பும் (PALM & LATEX TECHNOLOGY & VALUE ADDITION)

பின்வரும் ஒரு பாடச்சேர்மானத்திலிருந்து மூன்று பாடங்கள்

(i) உயிரியல், இரசாயனவியல், பௌதிகவியல் அல்லது விவசாய விஞ்ஞானம்
(ii) இணைந்த கணிதம், இரசாயனவியல் மற்றும் பௌதிகவியல்

(64) விருந்தோம்பல், சுற்றுலா மற்றும் நிகழ்ச்சிகள் முகாமைத்துவம் (HOSPITALITY TOURISUM & EVENTS MANAGEMENT)

ஏதேனும் மூன்று பாடங்கள்

இதற்கு மேலதிகமாக, பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையில் சித்தியடைதல் வேண்டும்.

(65) உடற் கல்வி (PHYSICAL EDUCATION)

ஏதேனும் மூன்று பாடங்கள்

இதற்கு மேலதிகமாக, பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையில் சித்தியடைதல் வேண்டும்.

(66) விளையாட்டு விஞ்ஞானமும் முகாமைத்துவமும் (SPORTS SCIENCE & MANAGEMENT)

ஏதேனும் மூன்று பாடங்கள்

இதற்கு மேலதிகமாக, பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையில் சித்தியடைதல் வேண்டும்.

(67) பேச்சும் செவிமடுத்தல் விஞ்ஞானமும் (SPEECH & HEARING THERAPHY)

உயிரியல்விஞ்ஞானம் அல்லது பௌதிகவிஞ்ஞானம் அல்லது கலைப் பாடத்துறையின் கீழான ஏதேனும் மூன்று பாடங்கள்

(68) விவசாய வள முகாமைத்துவமும் தொழில்நுட்பமும் (AGRICULTURAL RESOURCE MANAGEMENT & TECHNOLOGY)

விவசாயத் தொழில்நுட்பமும் முகாமைத்துவமும் பாடநெறிக்கான பாடச் சேர்மானம் (இலக்கம் 13ஐப் பார்க்கவும்)

(69) விவசாய வியாபார முகாமைத்துவம் (AGRI BUSINESS MANAGEMENT)

உயிரியல் மற்றும் இரசாயனவியல் ஆகியவற்றுடன் பின்வரும் பாடங்களில் ஒரு பாடம்

பௌதிகவியல் விவசாய விஞ்ஞானம்

உணவுத் தொழில்நுட்பவியல் அல்லது உயிர்வளத் தொழில்நுட்பவியல் அல்லது விவசாயத் தொழில்நுட்பவியல்

(70) பசுமைத் தொழில்நுட்பம் (GREEN TECHNOLOGY)

உயிரியல், மற்றும் இரசாயனவியல் ஆகியவற்றுடன் பின்வரும் பாடங்களில் ஒரு பாடம்

பௌதிகவியல் விவசாய விஞ்ஞானம்
உணவுத் தொழில்நுட்பவியல் அல்லது உயிர்வளத் தொழில்நுட்பவியல் அல்லது விவசாயத் தொழில்நுட்பவியல்

க.பொ.த (சாதாரண தர)ப் பரீட்சையில் ஆங்கிலப் பாடத்துக்கு குறைந்தது திறமைச் சித்தி (C) பெறுதல் வேண்டும்.

(71) நிலத்தோற்றக் கட்டடக்கலை (LANDSCAPE ARCHITECTURE)

(i) பின்வரும் பாடங்களில் குறைந்தது ஒரு பாடம்

சித்திரம்	புவியியல்	உயிரியல்
உயர் கணிதம்	இரசாயனவியல்	பௌதிகவியல்
இணைந்த கணிதம்	விவசாய விஞ்ஞானம்	

(ii) பின்வரும் பாடங்களில் மேலும் ஒன்று அல்லது இரண்டு பாடங்கள்

கணக்கீடு	ஹிந்தி
அரபு	பௌத்த நாகரீகம்
வரலாறு	ஆங்கிலம்
வணிகப் புள்ளிவிபரவியல்	மனைப் பொருளியல்
ஜப்பான்	இஸ்லாமிய நாகரீகம்
பொருளியல்	சீனம்
கிரேக்க மற்றும் உரோம நாகரீகம்	
அளவையியலும் விஞ்ஞான முறையும்	
பாளி	அரசியல் விஞ்ஞானம்
கணிதம்	பிரெஞ்சு
இந்து நாகரீகம்	சமஸ்கிருதம்
தமிழ்	சிங்களம்
கிறிஸ்தவ நாகரீகம்	ஜேர்மன்
தொடர்பாடலும் ஊடகக் கற்கையும்	வணிகக் கல்வி
தகவல் தொடர்பாடல் தொழில்நுட்பம்	

க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் ஆங்கில பாடத்துக்கு குறைந்தது சாதாரண சித்தி (S).

க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் கணித பாடத்தில் குறைந்தது திறமைச் சித்தி (C) ஐ அல்லது க.பொ.த. (உயர் தர)ப் பரீட்சையில் கணித பாடத்துக்கு குறைந்தது சாதாரண சித்தி(S).

இதற்கு மேலதிகமாக, பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையில் சித்தியடைதல் வேண்டும்.

(72) தகவல் தொழில்நுட்பமும் முகாமைத்துவமும் (INFORMATION TECHNOLOGY & MANAGEMENT)

பின்வரும் பாடங்களில் குறைந்தது ஒரு பாடத்தில் திறமைச் சித்தியுடன் (C) ஏதேனும் மூன்று பாடங்கள்

உயர் கணிதம்	வணிகப் புள்ளிவிபரவியல்
இணைந்த கணிதம்	பொருளியல்
புவியியல்	பௌதிகவியல்
கணிதம்	அளவையியலும் விஞ்ஞான முறையும்
கணக்கீடு	

க.பொ.த (சாதாரண தர)ப் பரீட்சையில் ஆங்கிலம் மற்றும் கணித பாடங்களில் குறைந்தது திறமைச் சித்தி (C).

(73) சுற்றுலாவும் விருந்தோம்பல் முகாமைத்துவமும் (TOURISM & HOSPITALITY MANAGEMENT)

பின்வரும் பாடச்சேர்மானத்திலிருந்து ஒரு பாடச்சேர்மானம்

(i) வணிகவியல், உயிரியல் விஞ்ஞானம் மற்றும் பௌதீக விஞ்ஞானம் பாடத்துறைகளின் கீழ் அனுமதிக்கப்பட்ட மூன்று பாடங்கள்

(ii) பின்வரும் பாடங்களிலிருந்து குறைந்தது ஒரு பாடம்

பொருளியல், புவியியல், வியாபாரப் புள்ளிவிபரவியல் மற்றும் கலைப் பாடத்துறையின் கீழ் ஏனைய இரண்டு பாடங்கள்

(74) தகவல் முறைமைகள் (INFORMATION SYSTEMS)

பின்வரும் பாடங்களில் குறைந்தது இரண்டு பாடங்களுக்கு திறமைச் சித்தி (C) சகிதம் ஏதேனும் மூன்று பாடங்கள்

உயர் கணிதம்	கணிதம் அல்லது இணைந்த கணிதம்
பௌதிகவியல்	இரசாயனவியல்
கணக்கீடு	வியாபாரப் புள்ளிவிபரவியல்
பொருளியல்	வணிகக் கல்வி
உயிரியல்	அரசியல் விஞ்ஞானம்
அளவையியலும் விஞ்ஞான முறையும்	புவியியல்
குடிசார் தொழில்நுட்பவியல்	பொறிமுறைத் தொழில்நுட்பவியல்

மின், இலத்திரனியல் மற்றும் தகவல்தொழில்நுட்பவியல்
தகவல் தொடர்பாடல் தொழில்நுட்பம்

க.பொ.த (சாதாரண தர)ப் பரீட்சையில் ஆங்கிலம் மற்றும் கணித பாடங்களில் குறைந்தது திறமைச் சித்தி (C) பெறுதல் வேண்டும்.

இதற்கு மேலதிகமாக, பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையில் சித்தியடைதல் வேண்டும்.

(75) மென்பொருள் பொறியியல் (SOFTWARE ENGINEERING)

இணைந்த கணிதம், பௌதிகவியல் ஆகிய பாடங்களுடன் பின்வரும் பாடங்களில் ஒன்று

இரசாயனவியல் உயர் கணிதம்
தகவல், தொடர்பாடல் தொழில்நுட்பம்

(76) மொழிபெயர்ப்புக் கற்கைகள் (TRANSLATION STUDIES)

ஏதேனும் மூன்று பாடங்கள்

இதற்கு மேலதிகமாக, பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையில் சித்தியடைதல் வேண்டும்.

(77) திரைப்படம், தொலைக்காட்சி கற்கைகள் (CINEMA & TELEVISION STUDIES)

ஏதேனும் மூன்று பாடங்கள்

இதற்கு மேலதிகமாக, பல்கலைக்கழகத்தினால் நடாத்தப்படும் தகுதிகாண் பரீட்சையில் சித்தியடைதல் வேண்டும்.

(78) செயற்திட்ட முகாமைத்துவம் (PROJECT MANAGEMENT)

ஏதேனும் மூன்று பாடங்கள்

(79) பொறியியல் தொழில்நுட்பம் (ENGINEERING TECHNOLOGY)

பொறியியல் தொழில்நுட்பவியல், தொழில்நுட்பவியலுக்கான விஞ்ஞானம் ஆகிய இரண்டு பாடங்களுடன் பின்வரும் பாடங்களில் ஒரு பாடம்

பொருளியல்	புவியியல்
மனைப் பொருளியல்	ஆங்கிலம்
தொடர்பாடலும் ஊடகக் கற்கையும்	தகவல், தொடர்பாடல் தொழில்நுட்பம்
சித்திரம்	வணிகக் கல்வி
விவசாய விஞ்ஞானம்	கணக்கீடு
கணிதம்	

(80) உயிர் முறைமைகள் தொழில்நுட்பவியல் (BIOSYSTEMS TECHNOLOGY)

உயிர் முறைமைகள் தொழில்நுட்பவியல், தொழில்நுட்பவியலுக்கான விஞ்ஞானம் ஆகியவற்றுடன் பின்வரும் பாடங்களில் ஒரு பாடம்

பொருளியல்	புவியியல்
மனைப் பொருளியல்	ஆங்கிலம்
தொடர்பாடலும் ஊடகக் கற்கையும்	தகவல், தொடர்பாடல் தொழில்நுட்பம்
சித்திரம்	வணிகக் கல்வி
விவசாய விஞ்ஞானம்	கணக்கீடு
கணிதம்	

(81) தகவல் தொடர்பாடல் தொழில்நுட்பம் (INFORMATION COMMUNICATION TECHNOLOGY)

தகவல், தொடர்பாடல் தொழில்நுட்பப் பாடத்துடன் தொழில்நுட்பவியலுக்கான விஞ்ஞானம் மற்றும் பொறியியற் தொழில்நுட்பவியல் அல்லது உயிர் முறைமைகள் தொழில்நுட்பவியல் ஆகிய பாடங்கள்

(82) ஆங்கிலத்தை இரண்டாவது மொழியாகக் கற்பிப்பதற்கான கற்கைப் பாடநெறி (TEACHING ENGLISH AS A SECOND LANGUAGE) (TESL)

ஆங்கிலப் பாடம் உள்ளிட்ட வேறு ஏதேனும் இரண்டு பாடங்கள்

(83) உணவு வணிக முகாமைத்துவம் (FOOD BUSINESS MANAGEMENT)

பின்வரும் பாடங்களில் மூன்று பாடங்கள்

இரசாயனவியல்	உயிரியல்
பௌதிகவியல்	இணைந்த கணிதம்
விவசாய விஞ்ஞானம்	வணிகக் கல்வி
பொருளியல்	கணக்கீடு

க.பொ.த. (சாதாரண தர)ப் பரீட்சையில் விஞ்ஞானம், கணிதம் மற்றும் ஆங்கிலம் ஆகிய பாடங்களில் குறைந்தது திறமைச் சித்தி (C).

(84) கடல்சார் மற்றும் நன்னீரியல் விஞ்ஞானம்
(MARINE AND FRESH WATER SCIENCE)

பின்வரும் பாடச்சேர்மானங்களிலிருந்து ஒரு பாடச்சேர்மானம்

I. இரசாயனவியல், பௌதிகவியல் மற்றும் உயிரியல்
II. இரசாயனவியல், பௌதிகவியல் மற்றும் இணைந்த கணிதம்

(85) பௌதீக விஞ்ஞானம் - தகவல் மற்றும் தொடர்பாடல் தொழில்நுட்பம்
(PHYSICAL SCIENCE – ICT)

இணைந்த கணிதம், பௌதிகவியல் மற்றும் தகவல், தொடர்பாடல் தொழில்நுட்பம் ஆகிய பாடங்கள்

10.0 இந்த சுற்றறிக்கையின் அறிவுறுத்தல்களுக்கு அமைய செயற்பாடுகளை மேற்கொள்ள வேண்டும் என்பதுடன், இது தொடர்பில் மாணவர்களை அறிவுறுத்துவதற்கான நடவடிக்கைகளை மேற்கொள்வீர்கள் எனவும் எதிர்பார்க்கின்றேன். பல்கலைக்கழகப் பாடநெறிகளுக்கான பாடச்சேர்மானங்களுக்கு மேலதிகமாக பாடநெறிக்கான மொழிமூலம் மற்றும் பல்கலைக்கழகங்களைத் தெரிவு செய்கையில் வேண்டப்படும் ஏனைய தகைமைகள் மற்றும் ஏனைய தகவல்களுக்காக பல்கலைக்கழக மானியங்கள் ஆணைக்குழுவினால் வருடந்தோறும் வெளியிடப்படுகின்ற **"இலங்கைப் பல்கலைக்கழக இளமாணிப் பட்டக் கற்கைநெறிகளுக்கான அனுமதி"** எனும் கையேட்டினைப் பயன்படுத்த வேண்டும்.

எதிர்காலத்தில் பிரேரணை செய்யப்பட்டுள்ள கல்வி மறுசீரமைப்புகளின் பிரகாரம் இந்தச் சுற்றறிக்கையின் பிரிவுகளும் திருத்தங்களுக்கு உட்படலாம்.

இச்சுற்றுநிருபத்தின் சிங்கள உரைக்கும் தமிழ் உரைக்குமிடையே ஒவ்வாமை ஏற்படும்பட்சத்தில் சிங்கள உரையே மேலோங்கி நிற்றல் வேண்டும்.

டபிள்யு.எம்.பந்துசேன
செயலாளர்
கல்வி அமைச்சு

பிரதிகள் :-

1. தேசிய கல்வி ஆணைக்குழுவின் தலைவர்
2. தேசிய கல்வி நிறுவனத்தின் பணிப்பளார் நாயகம்
3. பல்கலைக்கழக மானியங்கள் ஆணைக்குழுவின் தலைவர்
4. கணக்காய்வாளர் தலைமை அதிபதி
5. பரீட்சை ஆணையாளர் நாயகம்
6. கல்வி வெளியீட்டு ஆணையாளர் நாயகம்
7. கல்வி அமைச்சின் பதவிநிலை உத்தியோகத்தர்கள்
8. அரச மற்றும் அரச அங்கீகாரம் பெற்ற தனியார் பாடசாலைகளின் அதிபர்கள்

Annex 02

දුරකථන/தொலைபேசி இல./Telephone Nos.

අමාත්‍යතුමා / அமைச்சர் / Minister } 2784832, 2784807, 2785617

ලේකම් / செயலாளர் / Secretary } 2784812

කාර්යාලය / அலுவலகம் / Office } 2785141-50, Fax: 2784846

ඊ මේල්/<-மெயில்/E-mail : isurupava@moe.gov.lk

எமது இல.

ඔබේ අංකය / உமது இல. / Your No. } .....

අධ්‍යාපන අමාත්‍යාංශය
கல்விஅமைச்சு
Ministry of Education

'ඉසුරුපාය' ශ්‍රී ජයවර්ධනපුර, කෝට්ටේ, බත්තරමුල්ල.
'இசுருபாயா' ஸ்ரீ ஜயவர்தனபுரகோட்டை பத்தரமுல்ல
"Isurupaya", SriJayawardhanapura Kotte Battaramulla.
පාසල් කටයුතු ශාඛාව

මගේ අංකය / My No. } ED/01/12/12/05/08

දිනය / திகதி / Date } 2017.06.01

Circular No. - 23/2017

Chief Provincial Secretary

Provincial Education Secretary

Provincial Education Directors

Zonal Education Directors

Divisional Deputy/assistant Education Directors

Principals/heads of Pirivena/Heads of Private Schools approved by Government,

Implementation of School Based Assessment Program for Grades 6 - 13 from 2017 and onwards

With the view of empowering teaching learning process more effectively on par with contemporary trends and innovations of education the school based assessments shall be implemented in schools in a novel approach from 2017. The programme shall be planned, organized and implemented by schools while the direction and supervision shall be done by the National Institute of Education, the Department of Examination and Provincial Departments of Education under the guidance of the Minister of Education.

2.0 Therefore, provisions in this circular shall apply above all circulars issued by the Minister of Education. National Institute of Education and Department of Examinations. In implementing School Based. Assessments from 10.06.2017. As such, the instructions given herein should be followed and implemented form G. C. E. (O/L) and (A/L) examinations in 2017.

3.0 In addition to the basic instructions given in the guidelines attached to the circular, further instructions shall be issued for grade 6 - 9 by the National institute of Education and grade 10 - 13 be the Department of Examinations in due course.

4.0 Said program should be implemented for all subjects taught in all grades form grade 6 to grade 13.

It is mandatory to implement one assessment for each subject in one school term for all subject from grade 6 - 13. However since this assessment progam aims in identifying students' learning capacity and providing them the feedback necessary to achieve expected competency levels, teachers may implement more assessment as required.

5.0 Number of Assessment stages related for certification.

5.1 School Based Program for Grades 6 - 9. (For reporting in the year end progress report.)

Subject	**Number of assessment stages related to a Term for deciding mastery level**			
	Grade 6	**Grade 7**	**Grade 8**	**Grade 9**
Religion (Buddhism/Shivanary/ Catholicism/Christianity/Islam	1	1	1	1
Sinhala/Tamil Language	1	1	1	1
English	1	1	1	1
Mathematics	1	1	1	1
Science	1	1	1	1
History	1	1	1	1
Geography	1	1	1	1
Life skills and Citizenship Education	1	1	1	1
Aesthetic Subjects	1	1	1	1
Practical and Technical Skills	1	1	1	1
Health and Physical Education	1	1	1	1
Sinhala/Tamil as a second language	1	1	1	1

5.2 For the certification of Ordinary Level Examination

The marks of five assessment stages which include first, second and third terms in Grade 10 and first and second terms in Grade 11 will be considered to decide mastery levels.

The below table shows the number of assessment stages that should be done within a term for each subject and the number of assessment stages obtained from Grades 10 and 11 for deciding mastery level of Ordinary Level Examination.

Subject	**Number of assessment Stages related to a term For deciding mastery Level of Ordinary Level Examination**	**Total number of assessment stages obtained from Grades 10 and 11 for deciding the mastery level of Ordinary Level Examination**
Religion	1	5
First language and Literature	1	5
English language	1	5
Mathematics	1	5
Science	1	5
History	1	5
Group Subject 1	1	5
Group Subject 2	1	5
Group Subject 3	1	5

5.3 Certification of Advanced Level Examination

The marks of five assessment stages which include first, second and third terms in Grade 12 and first and second terms in Grade 13 and also the marks of the team project will be considered to decide the mastery levels.

The below table shows the number of assessment stages that should be done within a term for each subject and the number of assessment stages should be obtained from Grades 12 and 13 for deciding mastery level Advanced Level Examination.

Subject	**Number of assessment Stages related within a term For deciding mastery Level of Advanced level Of Advanced level Examination**	**Number of assessment stages obtain from Grade 12 and 13 for deciding master level of Advanced Level Exaination**
All subjects	1	5
Team Project	—	—

Further instructions for implementing this program will be issued by the National Institute of Education and the Department of Examination and steps to implement this program successfully according to the instructions given.

6.0 Considering the School Bases assessment competency levels to get the admission to Advanced Level class under the General Qualifications

When a student has not obtained one the three credit passes required to enroll into G. C. E. (A/L) classes at G. G. E. (O/L) written examination as per section 2.1 and 2.3 of the circular No. 2018/12,, if the student has obtained a simple pass for the said subject at the written examination also obtained a credit or higher competency under School Based Assessment program it will be considered as equal to a credit pas. However, this is not applicable to Medium Language and Mathematics. A candidate, who has appeared for the second time at G. C. L. (O/L) and could not fulfill the requirement of a credit pass, any use the competency levels of the previous year as applicable.

7.0 Monitoring

Monitoring of this program must be done both internally an externally.

7.1 Internal Monitoring

7.1.1. Monitoring at school level

Through a board comprised of Principal, Deputy Principal (Education Development) and Sectional Heads.

7.2 External Monitoring

7.2.1. Monitoring at Zonal/Divisional level

Through a board comprised of Zonal Education Director, Zonal Subject Deputy/ Assistant Education Director and in - service Advisers

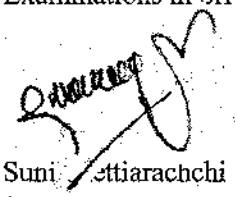
7.2.2. Monitoring at Provincial level

Through a board comprised of Provincial Education Director, Subject Deputy/ Assistant Education Director in Provincial Education Department and In - service Advisers

7.2.3. Monitoring at National level

Through a committee appointed under the leading of relevant Additional Secretory in the Ministry of Education and the supervision of Subject Directors.

Monitoring at national level is done by the Ministry of Education, Department of Examinations in Sri Lanka and the National Institute of Education.



Suni Pettiarachchi
Secratory
Ministry of Education

Copies :

1. Chairman - National Education Commission
2. All the additional Secretaries - Ministry of Education
3. Commissioner General of Examinations - Department of Examinations
4. Director General - National Institute of Education
5. Commissioner General of Educational Publications Department
6. Chief Commissioner - Teacher Education Administration and Colleges of Education Branch

ඇමුණුම **03**

දූරකථන අං./தொலைபேசி இல./Telephone Nos.

අමාත්‍යතුමා / அமைச்சர் / Minister: 2784832, 2784807, **2785617**

ලේකම් / செயலாளர் / Secretary: 2784812

කාර්යාලය / அலுவலகம் / Office: 2785141-50, **Fax**: 2784846

ඊමේල්/ඉ-මෙයිල්/E-mail : isurupaya@moe.gov.lk

ඔබගේ අංකය / உமது இல. / Your No: .....

අධ්‍යාපන අමාත්‍යාංශය
கல்வி அமைச்சு
Ministry of Education
'ඉසුරුපාය' ශ්‍රී ජයවර්ධනපුර, කෝට්ටේ,
බත්තරමුල්ලල
'இசுருபாயா' ஸ்ரீ ஜயவர்தனபுர கோட்டை
பத்தரமுல்ல
"Isurupaya", Sri Jayawardhanapura
Kotte
Battaramulla.
පාසල් කටයුතු ශාඛාව

මගේ අංකය / எமது இல. / My No.: ED/01/12/12/05/08/i

දිනය / திகதி / Date: 2017.10. 31

පළාත් අධ්‍යාපන අධ්‍යක්ෂ,
..... පළාත් අධ්‍යාපන දෙපාර්තමේන්තුව,
.....

අ.පො.ස(උ.පෙළ) විභාගයට ප්‍රථම වතාව සඳහා බාහිර අපේක්ෂකයෙකු ලෙස පෙනී සිටීමට බලාපොරොත්තු වන වයස අවුරුදු 21ට අඩු අයදුම්කරුවන් ව්‍යාපෘති හා ඇගයීම් සඳහා ලියාපදිංචි වීම

අ.පො.ස(උ.පෙළ) විභාගයට ප්‍රථම වතාව සඳහා බාහිර අපේක්ෂකයෙකු ලෙස පෙනී සිටීමට බලාපොරොත්තු වන වයස අවුරුදු 21ට අඩු අයදුම්කරුවන් ව්‍යාපෘති හා ඇගයීම් සඳහා ලියාපදිංචි වීමේ වැඩසටහන 2016 වර්ෂය දක්වා පළාත් අධ්‍යාපන දෙපාර්තමේන්තු හරහා ක්‍රියාත්මක කර ඇත.

පාසල පදනම් කරගත් නව තක්සේරුකරණ වැඩපිළිවෙළ යටතේ එම බාහිර අයදුම්කරුවන් ලියාපදිංචි කිරීමේ වැඩසටහන තවදුරටත් ක්‍රියාක්මක නොවන බව කාරුණිකව දන්වමි.

ඒ අනුව උක්ත කාරණය පිළිබඳව අදාළ පාර්ශවයන් දැනුවත් කිරීමට කටයුතු කරන ලෙස ද වැඩිදුරටත් දන්වමි.

එස්.යූ. විජේරත්න,
අතිරේක ලේකම් (ප්‍රතිපත්ති සැලසුම් හා කාර්යසාධන සමාලෝචන),
වැ.බ. අතිරේක ලේකම් (අධ්‍යාපන ගුණාත්මක සංවර්ධන),
අධ්‍යාපන ලේකම් වෙනුවට.

Please see the next page for the translation

Provincial Director of Education,
……..…. Provincial Department of Education
……...……

Registration for Projects and Assessments of candidates below 21 years of age who hope to sit the G.C.E (A.L) Examination for the first time as a private candidate

The Programme of Registering for Projects and Assessments of candidates below 21 years of age who sit the G.C.E (A.L) Examination for the first time as a private candidate was done through Provincial Departments of Education upto 2016.

This is to inform that the above mentioned Registration Programme will not take place any further under the new School Based Assessment Programme.

Accordingly, please make the relevant parties aware of this decision taken.

S. U. Wijerathna,
Additional Secratary (Policy Planning and Performance Review)
Acting Additional Secratary (Education Quality Department)
For Secratary to the MOE