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Department of Examinations - Sri Lanka

G.C.E. (A/L) Examination - 2018

67 - Science for Techonology

Marking Scheme

This document has been prepared for the use of Marking Examiners. Some changes would be made according to the views presented at the Chief Examiners' meeting.

Amendments to be included

G.C.E. (A/L) Examination - 2018
67 - Science for Technology

Distribution of Marks

Paper I **1 x 50 = 50**

Paper II

Part A - Structured Essay (All four questions should be answered.)

Question No 01 - 100

Question No 02 - 100

Question No 03 - 100

Question No 04 - 100

100 x 4 = 400

04 questions should be answered selecting minimum one question from Parts B, C and D.

Part B - Essay

Question No. 05 - 150

Question No. 06 - 150

Part C - Essay

Question No. 07 - 150

Question No. 08 - 150

Part D - Essay

Question No 09. - 150

Question No 10. - 150

150 x 4 = 600

Total Marks of Paper II = 400 + 600 = 1000

Final Marks of Paper II = 1000 ÷ 10 = 100

සියලු ම හිමිකම් ඇවිරිණි/[முழுப் பதிப்புரிமையுடையது/All Rights Reserved]

ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
இலங்கைப் பரீட்சைத் திணைக்களம் இலங்கைப் பரீட்சைத் திணைக்களம் இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka
ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
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අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2018 අගෝස්තු
கல்விப் பொதுத் தராதர் பத்திர (உயர் தர்ப் பரீட்சை, 2018 ஓகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2018

15.08.2018 / 0830 – 1030

තාක්ෂණවේදය සඳහා විද්‍යාව I தொழினுட்பவியலுக்கான விஞ்ஞானம் I **Science for Technology** I	**67 E I**	පැය දෙකයි இரண்டு மணித்தியாலம் ***Two hours***

Instructions:

- *Answer **all** the questions.*
- *Write your **Index Number** in the space provided in the answer sheet.*
- *Read the instructions given on the back of the answer sheet carefully.*
- *In each of the questions **1** to **50**, pick one of the alternatives from (1), (2), (3), (4), (5) which is **correct** or **most appropriate** and **mark your response on the answer sheet with a cross (×) in accordance with the instructions given on the back of the answer sheet.***
- *Use of calculators is not allowed.*

1. *Corynobacterium glutamicum* bacteria is used to produce
(1) antibiotics. (2) ethanol. (3) amino acids. (4) vinegar. (5) beer.

2. Consider the following microorganisms.
(A) *Streptococcus lactis*
(B) *Clostridium tetani*
(C) *Lactobacillus spp.*
Which of the above microorganism/s is/are used in curd production?
(1) (A) only. (2) (B) only. (3) (C) only.
(4) (A) and (B) only. (5) (A) and (C) only.

3. Two monosaccharides present in beetroot are
(1) glucose and sucrose. (2) glucose and galactose.
(3) galactose and fructose. (4) glucose and fructose.
(5) glucose and lactose.

4. Anerobic microbial activity of a wastewater treatment plant is used at the step of,
(1) primary treatment. (2) secondary treatment. (3) settling tank.
(4) sludge digestion. (5) disinfection and release.

5. Consider the following statements.
The reaction between vinegar and sodium hydroxide solution is an
(A) acid base reaction.
(B) exothermic reaction.
(C) endothermic reaction.
Of the above, the correct statement/s would be
(1) (A) only. (2) (B) only. (3) (C) only.
(4) (A) and (B) only. (5) (A) and (C) only.

6. Heat can be defined as the
(1) temperature of a system. (2) total amount of energy of a system.
(3) flow of energy between two systems. (4) amount of work done on a system.
(5) amount of work done by a system.

7. Activation energy for a given reaction is the
(1) average energy of reactants.
(2) average energy of reactants at 25 °C and 1 atmospheric pressure.
(3) energy difference between reactants and products.
(4) minimum amount of energy required to initiate the reaction.
(5) amount of energy released from the reaction.

8. Consider the following statements.
Vulcanized rubber
(A) has more cross links than natural rubber.
(B) can be softened using heat and remoulded to a new shape.
(C) is stronger than natural rubber.
Of the above, the correct statement/s would be
(1) (A) only. (2) (A) and (B) only. (3) (A) and (C) only.
(4) (B) and (C) only. (5) All (A), (B) and (C).

9. Use of the 4R concept is more suitable than the 3R concept for the plastic recycling process in Sri Lanka. The newly added fourth R concept to the 3R concept is
(1) Reuse. (2) Recycle. (3) Reduce. (4) Rethink. (5) Refuse.

10. All natural products are
(1) produced using water, carbon dioxide and other compounds.
(2) produced only by plants.
(3) primary metabolites only.
(4) useful for the growth of living organisms.
(5) volatile organic compounds.

11. Which of the following can be used to draw the baseline when preparing a thin layer chromatographic plate?
(1) A ball-point pen (2) A sharp object (3) A marker pen
(4) A blunt object (5) A pencil

12. An investor refused to start a caustic soda production plant saying it will not be commercially viable in Sri Lanka. What can be the main reason for the above decision of the investor?
(1) Formation of by-products
(2) High cost of electricity
(3) High production cost of pure NaCl
(4) Pure NaCl is not commercially available.
(5) No market for caustic soda in Sri Lanka

13. Production of TiO_2 nano particles is a suitable industry for Sri Lanka. This is due to the
(1) availability of Ilmenite in Pulmude.
(2) availability of Apatite in Eppawala.
(3) popularity of the production of TiO_2 nano particles in Sri Lanka.
(4) availability of the industries based on TiO_2 nano particles in Sri Lanka.
(5) availability of TiO_2 nano particle deposits in Sri Lanka.

14. Which of the following government institutions is responsible for issuing Sri Lankan Patents?
(1) Sri Lanka Inventors Commission
(2) Ministry of Science, Technology and Research
(3) National Intellectual Property Office
(4) National Science Foundation
(5) Ministry of Higher Education

15. Acid rains are produced due to dissolution of atmospheric acidic gases in atmospheric water. Which of the following statements is true about acid rains?
(1) Carbon dioxide can produce acid rains.
(2) The acidity of an acid rain depends on the amount of acidic gases dissolved.
(3) The acidity of an acid rain is independent of the strength of the acid produced.
(4) Atmospheric SO_2 does not produce acid rains.
(5) The pH value of acid rains is higher than 7.

16. Consider the following statements regarding compost fertilizers.

(A) The amount of primary nutrients in compost fertilizers is higher than that of chemical fertilizers.

(B) Compose fertilizers improve the cation exchange capacity of soil.

(C) Compost fertilizers mainly provide micronutrients to plants.

Of the above, the correct statement/s would be

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

17. The type of rays requires for the natural generation of ozone gas is,

(1) infrared rays. (2) X-rays. (3) visible light.
(4) ultra violet rays. (5) Gamma rays.

18. If 1 litre of paint is required to paint a surface area of 1000 cm^2, then the volume of paint needed (in litres) to apply on the surface of a closed right circular cone with a slant height 36 cm and base radius 14 cm is, $\left(\pi = \frac{22}{7}\right)$

(1) 1.584 (2) 2.200 (3) 616 (4) 1584 (5) 2200

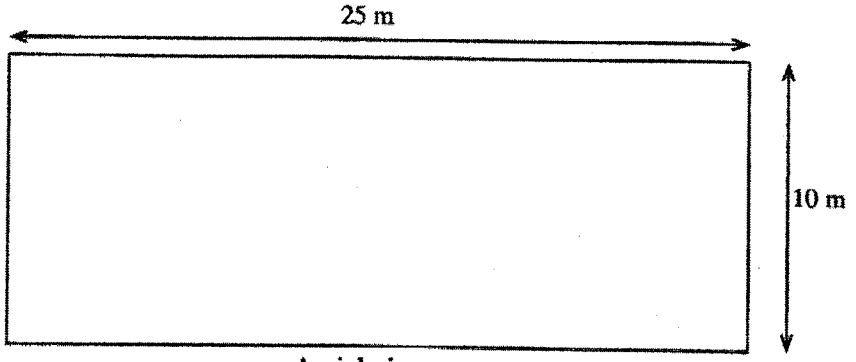
19. It is required to construct a staircase to climb 15 m vertically, when 25 m horizontal distance is travelled. How many steps are needed for this purpose when the width and the height of each step are 25 cm and 15 cm, respectively?

(1) 10 (2) 20 (3) 40 (4) 100 (5) 200

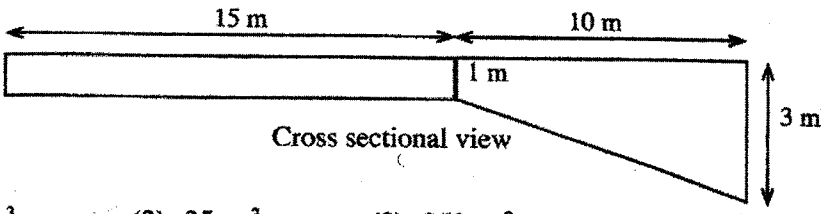
20. Consider a line segment AB, which connects points $A \equiv (1, 2)$ and $B \equiv (5, 4)$. The line which is perpendicular to AB and goes through the mid-point of AB cuts the Y-axis at the point of

(1) (9, 0) (2) (0, 9) (3) (4.5, 0) (4) (0, 4.5) (5) (0, 1.5)

21. Aerial and cross sectional views of a swimming pool are given below. The volume of water required to fill the pool is,



Aerial view



Cross sectional view

(1) 15 m^3. (2) 35 m^3. (3) 250 m^3. (4) 350 m^3. (5) 550 m^3.

22. The class limits of a grouped frequency distribution is given in the table and its mean is found to be 9. However, it was observed later that the grouped frequency distribution was constructed by incorrectly recording 16 instead of 8. Hence, it was corrected and the mean was recalculated and found to be 7. How many data points are there in the grouped frequency distribution?

Class limit
1 -5
6 - 10
11 - 15
16 - 20

(1) 3 (2) 4
(3) 5 (4) 8
(5) Insufficient information to calculate.

23. Consider the following data set.

$-1, -2, -2, 0, -5, 5, 3, 5, 6, 121, -4, 125$

The most suitable measure/s of central tendency for the data set is/are,

(1) mean. (2) median. (3) mode.
(4) mean and median. (5) median and mode.

24. A company wishes to design a water tank of a given volume. The proposed two shapes are a cylindrical tank with a radius of 3 units and a spherical tank with a radius of 3 units. The production cost per unit surface area for each shape is Rs. 10/-. If $\pi = 3$, the production costs for cylindrical and spherical shaped tanks respectively in rupees are,

(1) 1260 and 1080. (2) 1080 and 1260. (3) 1260 and 565.
(4) 1080 and 565. (5) 1260 and 377.

25. The perimeter of the triangle whose vertices are (2, 2), (10, 8) and (10, 17) in linear units is,

(1) 36 (2) $\sqrt{389}$ (3) $\sqrt{470}$ (4) 389 (5) 470

26. Consider the two lines given by $2x + 3y + 1 = 0$ and $4x + 6y + 1 = 0$. These two lines

(1) have the same intercept. (2) are perpendicular.
(3) coincide. (4) are passing through the origin.
(5) are parallel.

27. The point resides on the both lines $x - 2y = 1$ and $2x - y = 1$ is,

(1) (1, 0) (2) (0, 1) (3) $\left(\frac{1}{3}, -\frac{1}{3}\right)$ (4) $\left(-\frac{1}{3}, \frac{1}{3}\right)$ (5) (0, 0)

28. Which of the following is **not** an important factor to consider when purchasing a computer?

(1) Hard disk capacity (2) Random Access Memory (RAM)
(3) Processor type and speed (4) Printer type
(5) Number of USB ports

29. Consider the following statements about the memory of a computer.

(A) Memory of a computer consists of RAM, ROM and Cache memory.
(B) Cache memory and RAM are non-volatile memory devices.
(C) PROM stands for Programmable Read Only Memory.

Of the above, the correct statement/s is/are

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

30. In Graphical User Interface (GUI) designing, **WIMP** is abbreviated for the components

(1) Windows, Interactions, Mails, Pointer.
(2) Windows, Icons, Menu, Pointer.
(3) Web, Icons, Mails, Programmes.
(4) Web, Interactions, Menu, Programmes.
(5) Web, Icons, Mails, Pointer.

31. Which one of the following commands should be used to write the equation

$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ in a word processor?

(1) Subscript (2) Italics (3) Superscript (4) Strikethrough (5) Text effects

32. In a typical word processing software F1 key is used to

(1) open a new file. (2) get help.
(3) open 'find and replace' dialog box. (4) check spelling.
(5) save as a new file.

● The question numbers **33** and **34** are based on the following spreadsheet segment. It shows the marks and the corresponding grades obtained by four students for the subject of 'Science for Technology' at the year-end examination of a school.

	A	B	C
1	**Name**	**Marks**	**Grade**
2	**Student 1**	**68**	**B**
3	**Student 2**	**80**	**A**
4	**Student 3**	**75**	**A**
5	**Student 4**	**65**	**B**
6	**Average**	**72**	

33. The formula that should be included in B6 cell to obtain the average mark of the students is,
(1) =MEAN(B2:B5) (2) =AVERAGE(B2:B5)
(3) =AVERAGE(B2+B3+B4+B5) (4) =COUNT(B2+B3+B4+B5)
(5) =AVG(B2:B5)

34. The function that should be used to obtain the grade in column **C** is,
(1) SUM (2) COUNT (3) IF (4) MAX (5) MIN

35. Which of the following is **not** a view in PowerPoint?
(1) Presentation view (2) Slide sorter view
(3) Slide show view (4) Reading view
(5) Normal view

36. A web address belongs to Sri Lanka is
(1) www.gov.cn (2) www.ausregistry.com.au
(3) www.ox.ac.uk (4) www.nic.sl
(5) www.mohe.gov.lk

37. The most appropriate password for an email account is,
(1) Sachiperera (2) drged#23@BLo (3) Password123
(4) Birthday0910 (5) MataraColombo

38. Object *A* rotates at an angular velocity of 10 rad s^{-1} and its moment of inertia about the rotating axis is 3 kg m^2. Another object *B* of mass 12 kg is executing a linear motion with the same kinetic energy as that of the object *A*. The moving speed of the object *B* is,
(1) 1 m s^{-1} (2) 2 m s^{-1} (3) 3 m s^{-1} (4) 4 m s^{-1} (5) 5 m s^{-1}

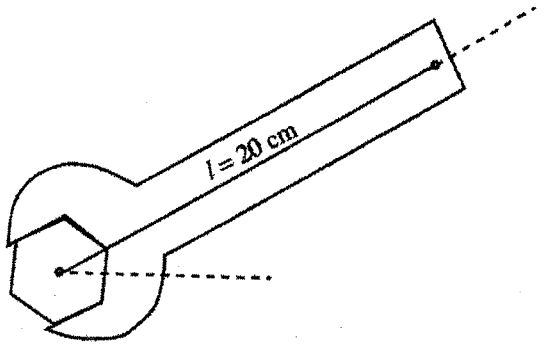
39. Two liquids in two identical calorimeters are at the same temperature. When heat is supplied to them for a same period of time at a constant rate, the final temperature of both liquids becomes equal. Select the correct statement out of the following.
(1) Densities of two liquids are equal.
(2) Masses of two liquids are equal.
(3) Volumes of two liquids are equal.
(4) Heat capacities of two liquids are equal.
(5) Specific heat capacities of two liquids are equal.

40. Under which given situation the maximum heat is dissipated from a circuit having a resistant wire and a cell with negligible internal resistance?
(1) Connecting the wire to the terminals of the cell.
(2) Connecting half of the wire to the terminals of the cell.
(3) Connecting one third of the wire to the terminals of the cell.
(4) Cutting the wire into two equal pieces and connecting them in parallel to the terminals of the cell.
(5) Cutting the wire into three equal pieces and connecting them in parallel to the terminals of the cell

41. A water-pump pumps out 1200 kg mass of water per minute from a tube well of 30 m depth. If water is released with a velocity of 3 m s^{-1}, how much work is done, when the pump runs for an hour? Consider the gravitational acceleration as 10 m s^{-2}

(1) 1.69 J (2) 6.09 kJ (3) 3.24×10^2 kJ (4) 2.16×10^4 kJ (5) 2.19×10^4 kJ

42. A 20 N m torque is needed to untight a tightened nut. A wrench of length 20 cm is used for this purpose as shown in the figure. What is the minimum force should be applied onto the handle of the wrench to untight the nut?



(1) 1 N (2) 5 N (3) 20 N (4) 100 N (5) 200 N

43. Consider the following statements about a transformer.

(A) Use to vary the magnitude of alternating voltage

(B) Step up transformers are used in direct current power supplies.

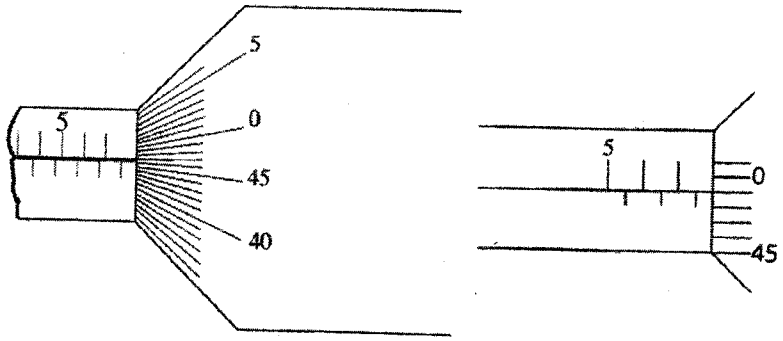
(C) In step down transformers, the number of turns in the secondary coil is greater than the number of turns in the primary coil.

Of the above, the true statement/s is/are

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

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

44. A micrometer screw gauge is having a thimble with 50 divisions and a pitch of 0.5 mm. The reading of it as shown in the figure is,



(1) 7.01 mm (2) 7.49 mm (3) 7.51 mm (4) 7.99 mm (5) 8.00 mm

45. When a car is started, its starter motor draws 50 A of current from the battery of 12 V for 1.2 s. How much electrical energy does the battery supply if its internal resistance is negligible?

(1) 5 J (2) 60 J (3) 500 J (4) 600 J (5) 720 J

46. Which of the following statements on thermal radiation is correct?

(1) A good absorber of thermal radiation is not a good emitter.

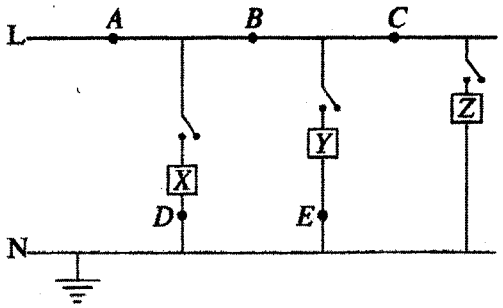
(2) Silver plated glass walls in thermos flask minimize the radiation loss.

(3) Thermal radiation does not belong to electromagnetic waves.

(4) Black clothes are recommended for the warm sunny places, as they do not absorb more heat radiation.

(5) Heat transfers from one place to another only by radiation.

47. A part of a domestic electrical circuit is shown in the figure. *X*, *Y* and *Z* are three electrical apparatus in it. Which is the best position to fix a circuit breaker in order to protect the circuit in the event of short-circuit at any apparatus?

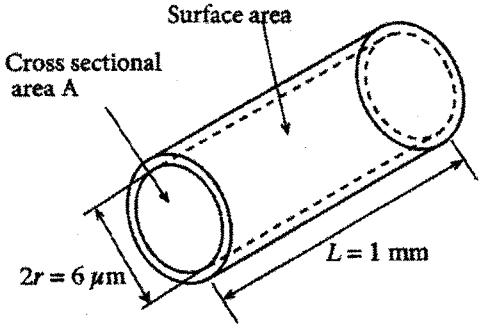


(1) *A* (2) *B* (3) *C* (4) *D* (5) *E*

48. Which of the following statements on stretched wire is correct?

(1) The product of tension and extension gives elastic potential energy stored in it.
(2) Even if the wire is stretched beyond its elastic limit, it will return to the initial length upon removal of the stress.
(3) Tension of the wire is proportional to its extension within the proportional limit.
(4) Stress is equal to the product of the force applied and the cross-sectional area of the wire.
(5) The wire can be stretched only after its elastic limit.

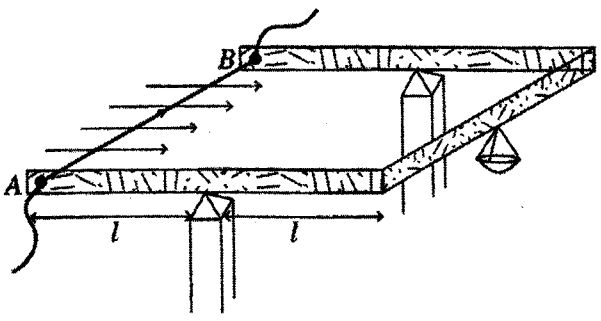
49. The blood flowing rate from the heart of a person at rest is 6 litres per minute and this volume passes through the capillaries at an average speed of 1 mm s^{-1}. A schematic of one capillary is given below. Assume that blood is an incompressible fluid having laminar flow.



If π = 3, the number of capillaries in the body is,

(1) 7.3×10^6 (2) 9.3×10^8 (3) 3.7×10^9 (4) 5.6×10^{10} (5) 2.2×10^{11}

50. In a part of a current balance, a conducting wire is connected between *A* and *B* points of the plastic frame and the system is balanced on the horizontal plane as shown in the figure. The length of the wire is 10 cm and a uniform horizontal magnetic field with 2×10^{-3} T flux density is applied across the wire. If an electric current of 10 A flows in the wire from *A* to *B*, what is the mass required to keep on the pan in order to balance the system on the same horizontal plane? Consider the gravitational acceleration as 10 m s^{-2}.



(1) 0.02 g (2) 0.20 g (3) 2.00 g (4) 0.20 kg (5) 2.00 kg

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ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
ජාතික ඇගයීම් හා පරීක්ෂණ සේවාව

இலங்கைப் பரீட்சைத் திணைக்களம்
தேசிய மதிப்பீட்டிற்கும் பரீட்சித்தலுக்குமான சேவை

රහසයි
அந்தரங்கமானது

අ.පො.ස.(උ.පෙළ) විභාගය - 2018
க.பொ.த (உயர் தர)ப் பரீட்சை - 2018

විෂය අංකය / பாட இலக்கம் 67 විෂය / பாடம் Science for Technology

ලකුණු දීමේ පටිපාටිය/புள்ளி வழங்கும் திட்டம் - I පත්‍රය/பத்திரம் I

ප්‍රශ්න අංකය / வினா இல.	පිළිතුරු අංකය / விடை இல.	ප්‍රශ්න අංකය / வினா இல.	පිළිතුරු අංකය / விடை இல.	ප්‍රශ්න අංකය / வினா இல.	පිළිතුරු අංකය / விடை இல.	ප්‍රශ්න අංකය / வினா இல.	පිළිතුරු අංකය / விடை இல.	ප්‍රශ්න අංකය / வினா இல.	පිළිතුරු අංකය / விடை இல.
01.	3	11.	5	21.	4	31.	1	41.	5
02.	5	12.	2	22.	3	32.	2	42.	4
03.	4	13.	1	23.	2	33.	2	43.	1
04.	4	14.	3	24.	1	34.	3	44.	4
05.	4	15.	2	25.	1	35.	1	45.	5
06.	3	16.	4	26.	5	36.	5	46.	2
07.	4	17.	4	27.	3	37.	2	47.	1
08.	3	18.	2	28.	4	38.	5	48.	3
09.	4	19.	4	29.	5	39.	4	49.	3
10.	1	20.	2	30.	2	40	5	50	2

විශේෂ උපදෙස් / விசேட அறிவுறுத்தல் — එක් පිළිතුරකට ඒකකය / ஒரு சரியான விடைக்கு ලකුණු / புள்ளி 01 බැගින් / புள்ள வீதம் 50

මුළු ලකුණු / மொத்தப் புள்ளிகள் 1×50 = 50

G.C.E. (A/L) Examination - 2018
67 - Science for Technology- II
Marking Scheme

Part A - Structured Essay

Part A – Structured Essay

Answer all questions on this paper itself.

1. Microorganisms are found in almost everywhere on the earth. Few of those microorganisms are listed in the box below. Answer the following questions, using the microorganisms given in the box.

(A) *Acetobacter*	(B) *Clostridium*	(C) *Lactobacillus*
(D) *Saccharomyces*	(E) *Penicillium*	(F) *Methanococcus*

(a) (i) What is the group, that the above **D** and **E** microorganisms belong to?

Fungi *(10 marks)*

(ii) What is the major component of the cell wall of both microorganisms, **D** and **E**?

Chitin *(05 marks)*

(iii) Which antibiotic can be produced by using the microorganism **E**?

Penicillin *(05 marks)*

(iv) Name the microorganism that can be used in more than one industry.

Saccharomyces OR "D" /*Lactobacillus* OR *"C"* *(10 marks)*

(v) Name the microorganism that is involved in biogas production.

Methanococcus OR "F" *(05 marks)*

(vi) Which microorganism grows only under the compulsory anaerobic condition?

Clostridium OR "B" *(05 marks)*

(vii) What is the shape of a *Lactobacillus* cell?

Bacillus/ rod/ cylindrical *(10 marks)*

(Total marks 50)

(b) Industrial vinegar production is done by the microbial fermentation. The two main steps in the vinegar production can be given as follows:

Step 1 Step 2

Raw material (X) ⟶ Intermediate product (Y) ⟶ Vinegar

(i) What is the most widely used raw material in the vinegar production in Sri Lanka?

Coconut inflorescence sap /sap *(05 marks)*

(ii) Name the disachcharide in 'X'.

Sucrose *(05 marks)*

(iii) What is the experiment used for the identification of 'X'?

Testing with benedict reagent in the presence of diluted HCl (acidic medium/H^+).

(05 + 05 marks)

(iv) Out of step 1 and step 2, which step is based on the microbial fermentation?

Step1 *(05 marks)*

(v) What is the step in the vinegar production process that *Acetobacter* is involved?

Step 2 *(05 marks)*

(vi) If the production process is terminated at step 1, what is the product that can be obtained?

Ethanol/ C_2H_5OH/ CH_3CH_2OH/ Ethyl alcohol / toddy *(10 marks)*

(vii) Write the chemical name of vinegar.

Acetic acid/ Ethanoic acid *(10 marks)*

(No marks for formula).

(Total marks 50)

2. Calorific value (amount of heat produced on complete burning of 1 g of fuel) of wood is less than LP gas. Technologically advanced Gliricidia wood pellets have a greater calorific value compared to typical wood based fuel. Gliricidia (*Gliricidia sepium*) is commonly used in wood pellet production industries in Sri Lanka.

Chemical reaction of the combustion of the Gliricidia pellets can be given as follows.

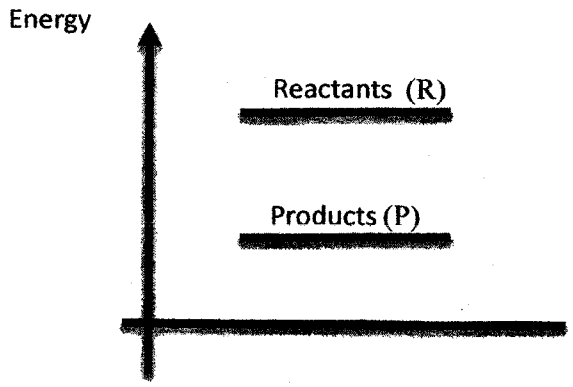
Reactants (R) Products (P)

Gliricidia pellets + $O_2(g)$ ⟶ $CO_2(g)$ + $H_2O(l)$ + Ash

(a) (i) Is the combustion of wood fuel an endothermic or exothermic?

Exothermic *(10 marks)*

(ii) For the above combustion, mark the energy positions of the reactants (R) and the products (P) on the relevant energy levels in the given diagram below.



(If the student considered the reaction, all reactants and products should be written).

(If both correct, 10 marks)

(iii) State two environmental advantages of using Gliricidia wood pellets over LP gas to produce energy.

Gliricidia is a renewable energy source

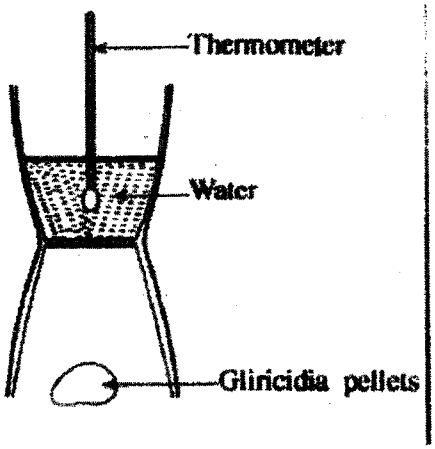
Gliricidia do not add additional CO_2 to the environment / No contribution to change CO_2 percentage in the atmosphere

Use of Gliricidia can save the other fuels with higher energy density such as LP gas.

(Any two answers, 10 × 2 = 20 marks)

(Total marks 40)

(b) A sketch of the experimental setup to determine the calorific values of Gliricidia wood and Gliricidia wood pellets is given in the figure. A mass of 500 g of water is used for the experiment. The specific heat capacity of water is 4.2 J °C^{-1} g^{-1}. The water at the initial temperature of 32 °C has warmed upto final temperature of 62 °C when a mass of 15 g of Gliricidia pellets combusted for the experiment.



(i) Calculate the amount of heat absorbed by water.

$\Delta E = mc\Delta\vartheta$ / $mc\vartheta$ or $ms\Delta\vartheta$ / $ms\vartheta$ *(05 marks)*

= 500 g × 4.2 J °C^{-1} g^{-1} × 30 °C *(05 marks)*

= 63000 J or 63 kJ *(04 + 01 marks)*

(ii) The time taken for the combustion of 15 g of Gliricidia wood pellets is 20 minutes. Calculate the rate of combustion in g min^{-1}.

Rate = - (weight difference)/time difference OR $-(\Delta m/\Delta t)$ *(05 marks)*

= - (- 15 g)/20 min *(05 marks)*

= 0.75 g min^{-1} *(05 marks)*

(iii) Calculate the calorific value of Gliricidia wood pellets used for the experiment.

Calorific value = 63000 J / 15 g or 63 kJ / 15 g *(10 marks)*

= 4200 J/g or 4.2 kJ/g *(04 +01 marks)*

(iv) Standard calorific value reported in literature is greater than the calorific value of Gliricidia wood pellets obtained from this experiment. State one possible reason for this observation.

Loss of heat to the environment (partial combustion) OR

Heat gained by the vessel OR

Gliricidia wood pellets are not dried.

(15 marks)

(Total marks 60)

3. (a) You have been asked to design and perform an experiment in the laboratory to determine the specific latent heat of fusion of ice using the method of mixtures. A thermally insulated copper calorimeter with water and a stirrer with a mesh, small ice pieces, blotting papers, a triple beam balance, a thermometer and a Bunsen burner are provided.

(i) State one advantage of using a thermally insulated calorimeter.

Heat loss (to the surroundings) can be neglected.

Heat loss (to the surroundings) is minimized or prevented.

No heat exchange with the surrounding.

(Any reason 05 marks)

(ii) What are the three measurements obtained before adding ice to the calorimeter?

X_1: Mass of empty calorimeter (+ stirrer)

X_2: Mass of water and calorimeter (+ stirrer)

X_3: (Initial) Temperature of water

(05 x 3 = 15 marks)

(Irrespective of the order)

(iii) State two precautionary steps that you should follow when ice is added into the calorimeter.

Use small ice pieces
Add one ice piece at a time
Before adding ice pieces wipe out water on them (dry the ice pieces)
Avoid splashing of water
Use a stirrer with a mesh to stop floating ice on water.

Any two (05 x 2 = 10 marks)

(iv) What are the two measurements obtained after finishing the process of adding ice

X_4: Minimum temperature of the mixture
X_5: Final mass of the mixture

(05 x 2 = 10 marks)

(v) If L is the specific latent heat of fusion of ice, C_W is the specific heat capacity of water and C is the specific heat capacity of copper,

(1) write an expression for the heat gained in terms of the measurements you obtained when melting ice.

Heat received when melting ice $= (X_5 - X_2)L + (X_5 - X_2)C_W(X_4 - 0)$

(05 marks)

(2) write an expression for the heat emitted by water and the calorimeter in terms of the measurements you obtained.

Heat released from water and calorimeter $= (X_2 - X_1)C_W(X_3 - X_4) + X_1C(X_3 - X_4)$

(05 marks)

(3) write an equation to determine the specific latent heat of fusion of ice using the above expressions.

$$(X_2 - X_1)C_W(X_3 - X_4) + X_1C(X_3 - X_4) = (X_5 - X_2)L + (X_5 - X_2)C_WX_4$$

(10 marks)

(Only to equalize above (1) and (2) expressions, award 05 marks)

(vi) Write a reason for not using powdered ice instead of small ice pieces in this experiment.

Powdered ice becomes liquid water easily and involve in heat exchange.
During the transfer of the powdered ice to the calorimeter, amount of heat lost from the powder is high because of its high surface area.
Temperature of the powdered ice will be higher than 0 °C when it is transferred to the calorimeter because of higher melting rate (due to large surface area).
Water stays around powdered ice. They cannot blot.

(Any reason 05 marks)

(Total marks 65)

(b) (i) Explain why ice is transported as large pieces.

Smaller specific surface area reduces the melting rate OR
To control melting of ice.

(05 marks)

(ii) **Fishes are stored in synthetic polymer boxes with ice pieces for preservation. What is the scientific reason to use synthetic polymer boxes?**

Reduce heat conductivity / Boxes are heat insulators / boxes are lagged

(05 marks)

(iii) **In transportation, ice pieces are embedded in wooden flakes. Give the scientific reason for this.**

Wooden flakes act as an insulator / act as an lagging material.

(05 marks)

(iv) **What is the biological reason for preserving fishes at low temperature?**

Population/density of microorganisms controls/reduces OR
The growth rate of the microorganism population reduces.

(05 marks)

(v) **There are 10 kg of fish in a heat insulated box at 30 °C temperature. Calculate the mass of ice that is needed to decrease the temperature of fish to 15 °C.**

The specific latent heat of fusion of ice is $3.33 \times 10^5\,J\,kg^{-1}$ and the specific heat capacity of water is $4200\,J\,°C^{-1}\,kg^{-1}$. Assume that the average specific heat capacity of the body materials of fish is $2640\,J\,°C^{-1}\,kg^{-1}$.

$m_f s_f(30°C - 15°C) = m_i L + m_i s_w(15°C - 0°C)$ OR

$10 \times 2640 \times 15 = m_i(333 \times 10^3 + [4200 \times 15])$

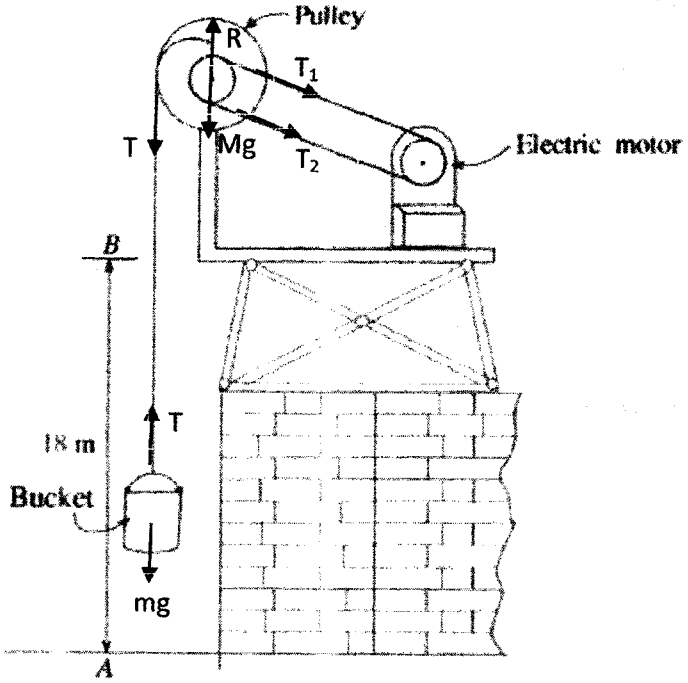
(Left side + Right side = 05 + 05 marks)

$m_i = 1\ kg$

(04 + 01 marks)

(Total marks 35)

4. The given diagram shows a setup used to lift a mixture of concrete at a building construction site. A light cable has been wound around the pulley. One end of the cable has been attached to the pulley and the other end to the bucket. When the pulley is rotated by the electric motor, the bucket is lifted by winding the cable around the pulley. Consider the gravitational acceleration as 10 $m\,s^{-2}$ and the ground as the level of zero potential.



(a) (i) The bucket with concrete mixture is performing ..... motion.

Linear /vertical *(05 marks)*

(ii) Pulley is performing ..... motion.

Rotational *(05 marks)*

(iii) Mark the forces acting on the bucket in the diagram.

(For marking T, 05 marks)

(For marking 1000 N /W /mg/100 g, 05 marks)

(iv) Mark the forces acting on the pulley in the diagram, if the pulley with the axle is rotated around a smooth axis.

(For marking T, 05 marks)

(For marking unequal T_1 and T_2, 10 marks)

(Total marks 35)

(b) (i) Calculate the tension of the cable when it is lifting at an acceleration of 2 $m\,s^{-2}$ and if the mass of the bucket with the concrete mixture is 100 kg.

$T - 1000 = 100 \times 2$

$T = 1200$ N *(04 + 01 marks)*

(ii) What is the angular acceleration of the pulley if the radius of it is 25 cm?

$a = R\alpha$

$\alpha = \frac{a}{R} = \frac{2}{0.25} =$ *(05 marks)*

$8\ rad\ s^{-2}$ *(04 + 01 marks)*

(iii) What is the effective torque acting on the pulley if the moment of inertia of the pulley with the axle is 25 kg m^2?

$\tau = I\alpha = 25 \times 8 =$

$200\ N\ m$ *(04 + 01 marks)*

(Total marks 20)

(c) The bucket with the concrete mixture is lifted at 18 m height at 6 seconds and stopped.

(i) What is the potential energy gained by the bucket with the mixture?

Potential energy = $100 \times 10 \times 18$

$= 18$ kJ *(04 + 01 marks)*

(ii) What is the output power of the motor?

Output power = $\frac{100 \times 10 \times 18}{6}$ *(05 marks)*

$= 3$ kJ *(04 + 01 marks)*

(iii) What is the efficiency of the setup if the input power of the motor is 5 kW?

$Efficiency\ of\ the\ setup = \frac{3}{5} \times 100\%$ *(05 marks)*

$= 60\ \%$ *(04 + 01 marks)*

(Total marks 25)

(d) Will the change of radius of the pulley affect the efficiency of the setup?

No *(02 marks)*

Justify your answer scientifically.

Power transmission belt is connected to the axle. So there is the same speed of rotation of the pulley.

(08 marks)

(e) If the rotating axle of the pulley in the setup is rough, is the efficiency of the setup decreasing or increasing or not changing?

Decrease. *(02 marks)*

Briefly write the scientific reason for your answer.

Energy loss due to <u>frictional torque.</u> *(08 marks)*

(Total marks 20)

Part B - Essay

5. The floor plan of an equilateral hexagonal shaped old fort is shown in figure 01. The centre of the fort is O and the side length is 60 m. The main entrance of the fort is at the AB wall and shape of it is depicted in figure 02. There are 6 similar towers in A, B, C, D, E and F corners and the shape of a tower is shown in figure 03 (Consider $\pi = 3.14$, $\sqrt{26} = 5.01$ and $\sqrt{3} = 1.73$ in calculations).

	30°	45°	60°
sin	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$
cos	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$
tan	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$

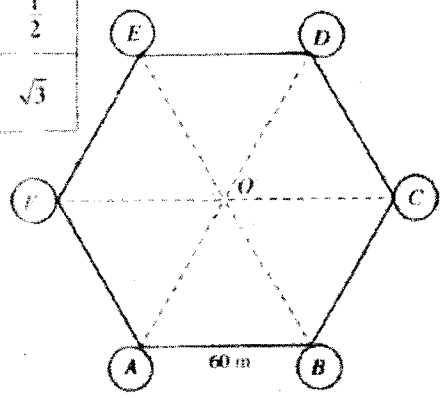


Figure 01



Figure 02

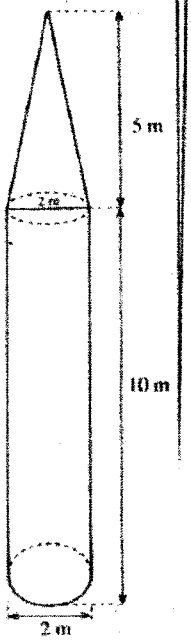


Figure 03

(a) Using the data in the given figures, calculate the following.
(i) Length of FO
(ii) Area of the base of a tower
(iii) Floor area of section $ABCF$
(iv) Area of the inner floor of the fort

(i) Consider AFO triangle.

According to the given data, $F\hat{O}A = F\hat{A}O = 60^0$ *(05 marks)*

Therefore, AFO is an equilateral triangle. *(05 marks)*

Therefore, length of FO = 60 m

(04 + 01 marks)

(ii) Radius of the tower base $= \frac{2}{2} = 1\ m$ *(05 marks)*

Area of the tower base $= \pi \times 1^2$ *(05 marks)*

$= 3.14\ m^2$ *(04 + 01 marks)*

(iii) OCB is also an equilateral triangle. So the length of OC also is 60 m *(05 marks)*

Therefore, length of FC $= 60\ m + 60\ m$

$= 120\ m.$ *(05 marks)*

Considering AEF triangle, height of trapezium ABCF $= 60 \cos 30^0 = 60 \times \frac{\sqrt{3}}{2}$

(05 marks)

$= 30 \times 1.73 = 51.9\ m$

(05 marks)

Area of trapezium ABCF $= \frac{1}{2}(60 + 120) \times 51.9$ (05 marks)

$= 4671\ m^2$ *(04 + 01 marks)*

Alternative method

Consider AFO equilateral triangle .The side length of it is $60\ m$.

Hence the height of AFO equilateral triangle $= 60\cos 30^0 = 60 \times \frac{\sqrt{3}}{2}$ *(05 marks)*

$= 30 \times 1.73 = 51.9\ m$ *(05 marks)*

Therefore the area of AFO equilateral triangle $= \frac{1}{2} \times 60 \times 51.9$ *(05 marks)*

$= 1557\ m^2$ *(05 marks)*

Area of trapezium ABCF = 3× area of AFO triangle *(05 marks)*

$= 3 \times 1557 = 4671\ m^2$ *(04 + 01 marks)*

(iv) According to the figure, Area of trapezium FCDE $= 4671\ m^2$ *(05 marks)*

Inner floor area of the fort $= 4671 + 4671$ *(05 marks)*

$= 9342\ m^2$ *(04 + 01 marks)*

(Total marks 75)

(b) The door at the main entrance is made of 0.3 m thick wood. The shape of the upper part of the door is semi-circular as shown in figure 02.

(i) Calculate the area of the front surface of the door.

(ii) The mass of a cubic metre of wood used to make the door is 100 kg. Calculate the mass of the door.

(i) Area of the rectangular part of the door $= 2 \times 5 = 10\ m^2$ *(05 marks)*

Radius of the semi-circular part of the door $= \frac{2}{2} = 1\ m$ *(05 marks)*

Area of the semi-circular part $= \frac{1}{2} \times \pi \times 1^2 = \frac{\pi}{2}\ m^2$ *(05 marks)*

$= 1.57\ m^2$ *(05 marks)*

Front surface area of the door $= 10 + 1.57 = 11.57\ m^2$ *(04 + 01 marks)*

(ii) Thickness of the door $= 0.3\ m$

Volume of the wood of the door $= 11.57 \times 0.3 = 3.471\ m^3$ *(05 marks)*

$\therefore$ Mass of the door $= 3.471 \times 100 = 347.1\ kg$ *(04 + 01 marks)*

(Total marks 35)

(c) If the tower given in figure 03 consists of a cylindrical part and a right circular cone, calculate the surface area of a tower. (excluding the base).

Radius of the tower $= \frac{2}{2} = 1\ m$

Surface area of the cylindrical shaped part of the tower $= 2 \times \pi \times 1 \times 10 = 20\pi\ m^2$ *(05 marks)*

$= 62.8\ m^2$ *(05 marks)*

Surface area of the conical shaped part of the tower $= \pi \times 1 \times 5.01 = 5.01\pi\ m^2$ *(05 marks)*

$= 15.73\ m^2$ *(05 marks)*

Surface area of the tower $= 62.8 + 15.73 = 78.53\ m^2$ *(04 + 01 marks)*

(Total marks 25)

(d) Obtain the tangent value of the angle of elevation to the top of the tower located at the position F as seen by a child at the position O whose eye level is 1 m above the ground.

Height of the tower from the eye level $= 5 + 10 - 1 = 14\ m$ *(05 marks)*

Distance from O to centre of the tower = OA + radius of the cylindrical part of the tower

$= 60 + 1 = 61\ m$ *(05 marks)*

If θ is the angle of elevation to the top of the tower ,$\tan\theta = \frac{14}{61} = 0.229$ *or* 0.23 *(05 marks)*

(Total marks 15)

6. (a) Amount of carbon monoxide emission is measured at the vehicle emission test. Amounts of carbon monoxide obtained by testing 50 petrol cars are given in the following grouped frequency distribution.

Table 1: Grouped frequency distribution for petrol cars

Class limits	Number of vehicles (frequency)	Class boundary	Class mark	Cumulative frequency	Percentage cumulative frequency
0.1–1.0	02				
1.1–2.0	03				
2.1–3.0	10				
3.1–4.0	20				
4.1–5.0	08				
5.1–6.0	05				
6.1–7.0	02				

(i) Complete class boundary, class mark, cumulative frequency and percentage cumulative frequency columns in the Table 1 above.

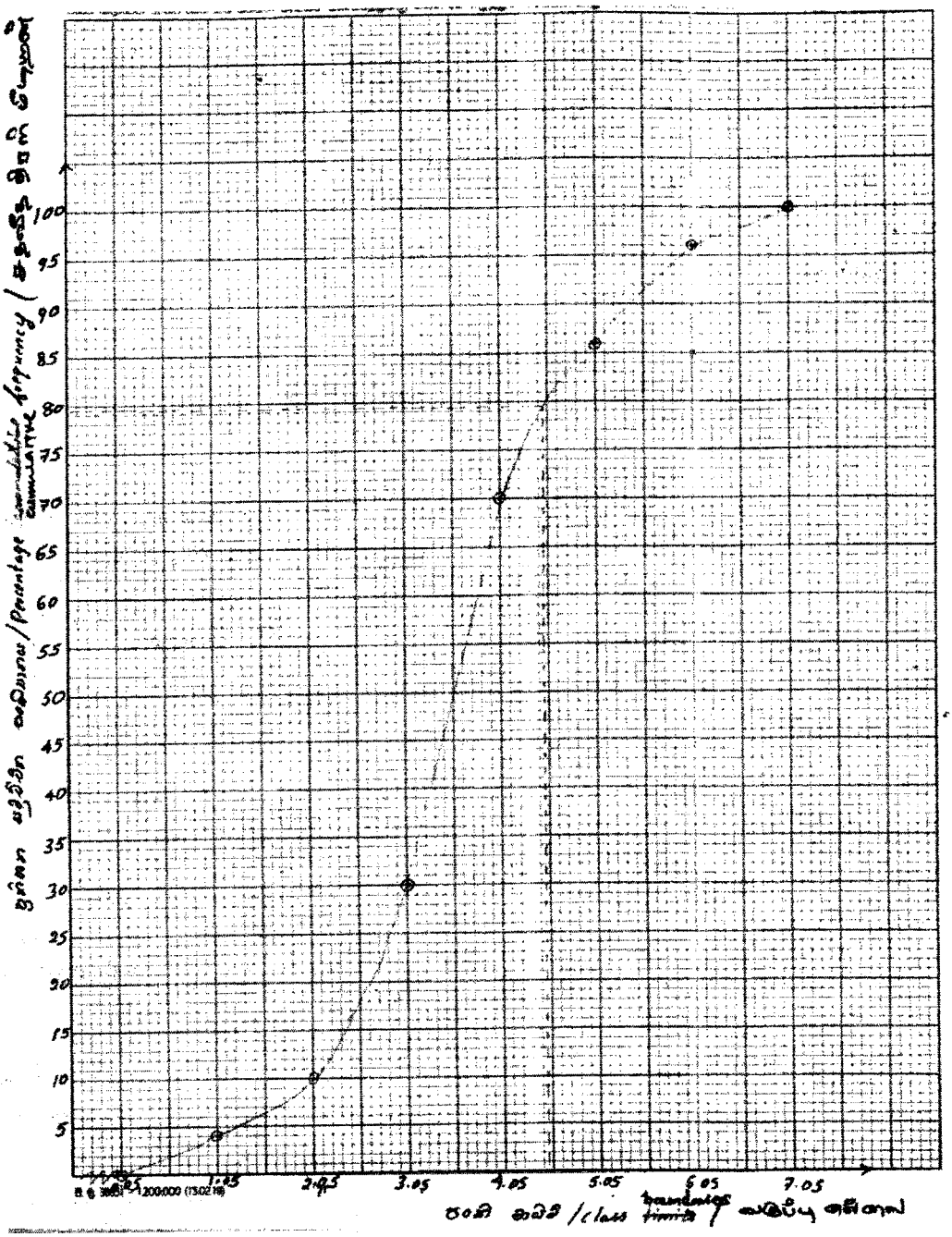
Class limit	Number of vehicles	Class boundary	Class mark	Cumulative frequency	Percentage cumulative frequency
0.1 – 1.0	02	0.05-1.05	0.55	02	04
1.1 – 2.0	03	1.05-2.05	1.55	05	10
2.1 – 3.0	10	2.05-3.05	2.55	15	30
3.1 - 4.0	20	3.05-4.05	3.55	35	70
4.1 - 5.0	08	4.05-5.05	4.55	43	86
5.1 - 6.0	05	5.05-6.05	5.55	48	96
6.1 - 7.0	02	6.05-7.05	6.55	50	100
		(10 marks)	***(10 marks)***	***(10 marks)***	***(10 marks)***

(ii) Using the grouped frequency distribution, calculate the mean of the amount of carbon monoxide emitted by petrol cars.

$$\text{Mean} = \frac{2\times0.55+3\times1.55+10\times2.55+20\times3.55+8\times4.55+5\times5.55+2\times6.55}{50}$$ *(05 marks)*

$= 3.59$ *(05 marks)*

(iii) Draw the percentage cumulative frequency curve for the above distribution on the graph paper provided.



(Labelled axes with rational scale, 04 x 2 = 08 marks
Marking 7 points, 02 x 7 = 14 marks
Shape of the graph including point (0.05, 0) = 03 marks)

(iv) According to the current law, the petrol cars with carbon monoxide emission greater than 4.5 are considered as not roadworthy. Find the percentage of unroadworthy petrol cars, using the percentage cumulative frequency curve.

Percentage of petrol cars with carbon monoxide emission less than 4.5%79.5 = *(05 marks)*

Therefore, the percentage of petrol cars with carbon monoxide emission less than 4.5 =

79.5 – 100 *(05 marks)*

%20.5 = (%21.5 - %19.5) *(05 marks)*

(Total marks 90)

(b) Amount of carbon monoxide obtained for 20 trishaws are tabulated as follows.

Table 2: Ungrouped frequency distribution for trishaws.

Amount of Carbon monoxide	Number of vehicles
3.5	02
4.1	02
4.8	01
5.2	01
5.7	03
6.0	05
6.3	01
6.5	02
7.4	03

(i) Calculate the range of the middle 50% of the amounts of carbon monoxide emitted by trishaws.

Inter quartile Range

Q1 – Middle value of the 5th and 6th data points (5.25th Data Point) *(05 marks)*

5.2 4.8 4.1 4.1 3.5 3.5

Q1= 4.9=0.25*(4.8 – 5.2) + 4.8 *(05 marks)*

Q3–Middle value of the 15th and 16th data points (15.75th Data Point) *(05 marks)*

6.3 6.5 6.5 7.4 7.4 7.4

Q3=) + 6.36. -56. = 0.75*(36.45 *(05 marks)*

Inter quartile Range = 6.45 – 4.9 *(05 marks)*

= 1.55.

Therefore the range of the middle 50% of the data1. = 55 *(05 marks)*

(ii) Complete the following table using the data given in the Table 2.

Table 3 : Grouped frequency distribution for trishaws

Class limit	Number of vehicles
3.1 – 4.0	
4.1 – 5.0	
5.1 – 6.0	
6.1 – 7.0	
7.1 – 8.0	

Class limit	Number of vehicles
3.1-4.0	02
4.1- 5.0	03
5.1-6.0	09
6.1-7.0	03
7.1-8.0	03

(05 marks)

(iii) Using the grouped frequency distributions given in Table 1 and Table 3, determine which type of vehicle has the higher dispersion in amounts of carbon monoxide. Justify your answer.

The maximum range for petrol cars6.9 = 0.1 – 7.0 = *(05 marks)*

The maximum range for trishaws4.9=3.1-8.0 = *(05 marks)*

Therefore, the dispersion is higher for petrol cars. *(05 marks)*

Alternative method

The minimum range for petrol cars5.1 = 1.0 – 6.1 = *(05 marks)*

The minimum range for trishaws3.1= 4.0- 7.1 = *(05 marks)*

Therefore, the dispersion is higher for petrol cars. *(05 marks)*

(iv) Obtain a single grouped frequency distribution for two types of vehicles using Table 1 and Table 3. (It is enough to show the 'class limit' and the 'number of vehicles' in the new distribution).

Class limit	Number of vehicles
0.1 – 1.0	02
1.1 – 2.0	03
2.1 – 3.0	10
3.1 - 4.0	22 (20 + 2)
4.1 - 5.0	11 (8+3)
5.1 - 6.0	14 (5+9)
6.1 - 7.0	05 (2+3)
7.1 – 8.0	03

(05 x 2 = 10 marks)

(Total marks 60)

Part C - Essay

7. Based on current investigations, it has been reported that a larger amount of plastic dumped into the ocean has been collected on the Pacific Ocean surface. It has been estimated that the amount of plastic floating on the ocean surface is approximately 80,000 metric tons. The region with this plastic garbage collected is known as the 'Great Pacific Garbage Patch'.

(a) (i) Is plastic a synthetic polymer or a natural polymer?

Synthetic *(10 marks)*

(ii) State one major advantage of plastics.

Easy to manufacture / low cost / can be used to many purposes/ easily recycle/ light/low weight

(Any one, 10 marks)

(iii) State one major disadvantage of plastics.

Non-biodegradable /exist longer time in the environment. *(10 marks)*

(iv) State two actions that can be taken to minimize the environmental impact of plastics.

Recycle / reuse / reduce the use / use biodegradable alternatives

(Any two, 10 x 2= 20 marks)

(v) State one possible effect on human due to burning of plastics.

Production of poly aromatic compounds (dioxins) / production of toxic compounds (gases) / increasing the risk of cancers.

(Any one, 10 marks)

(vi) What is the impact of the 'Great Pacific Garbage Patch' on the fish population in Pacific Ocean?

Reduce the population density (lower the number) OR Toxic and reduced. *(Any one, 10 marks)*

(Total marks 70)

(b) Drinking water is a limited natural renewable resource. National Water Supply and Drainage Board distributes water suitable to drink after processing.

(i) Water cycle is a natural cycle. Describe it.

Explain the way to show how water exchanged among the various parts/ phases of the nature.

(10 marks)

(ii) What are the two cations responsible for the permanent hardness of water?

Ca^{2+} and Mg^{2+} / Ca ions and Mg ions / Ca and Mg *(Any answer, 10 marks)*

(iii) Name a chemical that is used by the National Water Supply and Drainage Board to remove mud particles during the water purification process.

Alum (Aluminum sulfate) OR Poly electrolyte *(10 marks)*

(iv) Water distributed by the National Water Supply and Drainage Board must not be used to wash vehicles and watering plants. Briefly explain the reason for this.

Drinking water is a limited resource OR Government spent money on production of drinking water.

(Any answer, 10 marks)

(Total marks 40)

(c) An activity performed by a student using the waste plastic bottles is described below.

A used plastic bottle filled with water was tightly closed with a lid and dipped in the cistern of the toilet by the student. This reduced the volume of water required to fill the cistern by 1 litre. Due to this, the amount of water required to flush the toilet once can be reduced by 1 litre.

(i) What is the amount of water that can be saved in a school, which uses the toilet 1000 times per day, for 30 days?

1L × 1000 × 30

= 30,000 L *(09 + 01 marks)*

(ii) If one unit of water is 1000 litre, what is the number of units that can be saved by this method for 30 days?

30,000 (L) / 1000 (L)

= 30 units *(10 marks)*

(iii) Use of liquid soap to wash hands after using toilet is a common practice. State one environmental issue that can occur as a result of the release of waste water containing liquid soap.

Release of dissolved organic compounds to the environment OR
Addition of organic (non-biodegradable) compounds to the environment OR
Water pollution OR
Soil pollution OR
Increase the salinity of soil

(Any answer, 10 marks)

(iv) Suggest a method to reuse waste water containing hand washed liquid soap within the toilet to encourage the water management.

Collect and use the water with soap to flush/clean the toilet *(10 marks)*

(Total marks, 40)

8. Resources required to start an industry can be divided into five groups according to the 5M concept.
(a) Two essential resource groups listed by this concept are Methods and Materials.
(i) According to the 5M concept, what are the other **three** resource groups required to start an industry?

Money, Man)Power(, Machines *(05 x 3 = 15 marks)*

(ii) State **two** factors that must be considered when selecting raw materials.

Easy to obtain (easy to access), available in large scale, high purity, long term affordable
(Any two, 05 x 2 = 10 marks)

(iii) In the modern 5M concept. Methods and Materials are considered as one group and Marketing is included as a new group. Explain the importance of this group.
The produced goods must be sell in the market to make the industry commercially viable. Marketing provide the required publicity to sell the product.

(15 marks)

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= x 3 05)15 marks)

(Total marks 40)

(b) The organic solvent in expired enamel paints can be recovered using distillation and can be used again for paint production.
(i) What is the function of organic solvent present in enamel paint?

To control/reduce the viscosity *(10 marks)*

(ii) What is the solvent used in emulsion paint?

Water *(10 marks)*

(iii) Why is the use of emulsion paint is more environmental friendly compared to the enamel paint?

Do not release organic vapor to the environment *(10 marks)*

(iv) State two advantages that a producer can gain by using organic solvent recovered from expired paint for the production of enamel paints in Sri Lanka.

Reduce the cost to process the waste / Reduce the impact on the environment / Cost for the raw materials is less/ Time spent to import raw material is reduced. *(Any two 05 x 2 = 10 marks)*

(v) What is the main property of the solvent that must be considered when selecting a solvent for the production of a paint that dries quickly?

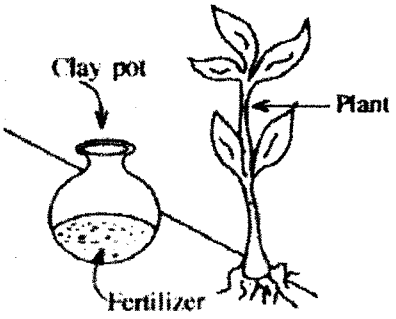
Low boiling point OR Evaporate quickly *(10 marks)*

(vi) State two physio-chemical changes that take place during the drying process of enamel paint after application.

Evaporation / drying of solvent,
polymeric materials closely packed on the surface (produce cross links)
Forming dry paint film *(Any two 05 x 2 = 10 marks)*

(Total marks 60)

(c) A method suggested by a student to apply super phosphate fertilizer to a cultivation located on a steep mountain region with higher precipitation is shown in the diagram. Water is poured into clay pots with fertilizer buried in the ground parallel to the cultivation. Water with fertilizer is slowly dripped into the soil through the walls of clay pots.



(i) State one economical and environmental disadvantage each of using larger amounts of fertilizers to obtain greater yields.

Economical disadvantage: Higher cost for fertilizers or Higher production cost

Environmental disadvantage : Release nutrients to the environment (Eutrophication) or describe any reason for Eutrophication.

(05 x 2 =10 marks)

(ii) Name the city in which the largest appetite deposit consisting phosphate in Sri Lanka.

Eppawala *(10 marks)*

(iii) What is the disadvantage of addition of super phosphate fertilizer to a cultivation located on a steep mountain region having a high precipitation?

Fertilizer can be washed away with the rain water. *(10 marks)*

(iv) How can the disadvantage stated in part (iii) be minimized by the method proposed by the student?

Fertilizer is trapped inside the clay pot OR fertilizer released slowly to the soil.

(Any reason, 10 marks)

(v) State a possible disadvantage of the method proposed by the student.

Fertilizer is concentrated at a single location OR Fertilizer is not spread around the plant root system.

(10 marks)

(Total marks 50)

Part D - Essay

9. A stadium in Sri Lanka is fitted with 4 lighting poles at 4 corners to provide uniform lighting to the playground in the night. Each pole has 60 numbers of 2 kW Halide lamps. Spectator stands and other areas have 500 numbers of 100 W CFL lamps and 150 numbers of 200 W industrial fans.

(a) When all the lamps and fans are switched ON for 6 hours for a night match, calculate the electrical consumption of the following in kWh.

(i) by all the fans in the stadium

200 W x 150 x 6 hrs *(05 marks)*

= 180 kW h *[05 Marks]*

(ii) by all the CFL lamps in the stadium

100 W x 500 x 6 hrs *(05 marks)*

= 300 kW h *[05 Marks]*

(iii) by all the halide lamps in the stadium

2 kW x 240 x 6 hrs *(05 marks)*

= 2,880 kWh *[05 Marks]*

(Total marks 30)

(b) Every month, ten night matches are played in the stadium under floodlight. If the price for one unit of electric power is Rs. 45, calculate the amount of the monthly electricity bill for the stadium.

Total electrical power consumption per match is

= 180 kWh + 300 kWh + 2,880 kWh = 3,360 kWh *(05 marks)*

= 3,360 units *[05 Marks]*

Total electrical power consumption for a month is,

= 3,360 x 10 = 33,600 units *[05 Marks]*

The monthly electric bill will be,

= 33,600 units x Rs. 45.00 *[05 Marks]*

= Rs. 1,512,000/- *[04 + 01 Marks]*

(Total marks 25)

(c) (i) Name **three** sources, which are mainly used to produce electricity in Sri Lanka.

Under the government 'Soorya Bala Sangramaya' project, it is suggested to install solar panels on the roofs of the spectator stands. A solar panel of 1 kW with the surface area of 8 m^2 can generate 120 kWh electrical energy in a month.

Petrolium/diesel /burnt oil/fossil fuel, Hydro power (water), coal *(05 x 3 = 15 marks)*

(ii) Write **two** advantages and **two** disadvantages of using solar panels.

Eco friendly / economical in the long run / energy source is freely available/ renewable energy/ reduces electricity bill/ low maintenance cost *(Any two 05 x 2 = 10 marks)*

(iii) Calculate the minimum number of solar panels required to be installed at the stadium to meet its monthly electrical consumption requirement.

Minimum number of solar panels required = 33,600 kWh / 120 kWh *(05 marks)*

= 280 panels *[05 marks]*

(iv) Assuming that all the solar panels are to be fixed only within the roof area of the stadium, calculate the minimum roof area needed to hold the required number of solar panels obtained in part (c)(iii) above.

Roof area: 280 x 8 m^2 *(05 marks)*

= 2240 m^2 *[04 +01*

Marks]

(v) If the cost of installing 1 kW solar panel with required components to connect to the national grid is Rs. 300 000,

(1) what is the total cost for installing the minimum number of solar panels to meet the monthly requirement of the stadium?

Rs. 300,000 x 280 panels *[10 Marks]*

= Rs. 84,000,000/- *[04 + 01*

Marks]

(2) how long would it take in years to recover the investment on the installation of solar panels?

Rs. 84,000,000 / Rs. 1,512,000 *[10 Marks]*

≈ 55 or 56 months) ≈ 4⅔ years(*[05 Marks]*

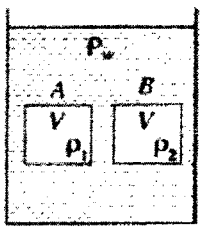
(Total marks 75)

(d) Net-Metering plan allows consumers to generate electricity through solar panels and set off the power generated against the power consumed from the national grid. Consumer pays only for the 'net' number of units (difference between import and export electrical energy) every month. What is the main advantage of using the net-metering arrangement at the stadium?

The excess electric power generated during the day time is readily exported to the national grid.

)2 0marks)

10. (a) Two cubes *A* and *B* each having volume *V*, are made of materials of densities ρ_1 and ρ_2, respectively. These two cubes are kept closer to the middle of a tall vessel filled with water as shown in the figure and gently released them.



Consider that the density of water is ρ_w and $\rho_1 > \rho_w$ and $\rho_2 < \rho_w$. g is the gravitational acceleration.

(i) Write expressions for the weights of *A* and *B* using the given terms.

Weight of A = $V \rho_1 g$

Weight of B = $V \rho_2 g$

(05 x 2 = 10 marks)

(ii) Write an expression for the upthrust acting on *A* and *B*.

U = $V \rho_w g$ *(05 marks)*

(iii) Once *A* and *B* are released, what would be the directions of motion of them? Justify your answer by considering the expressions obtained in (a)(i) and (a)(ii).

Since $\rho_1 > \rho_w$, weight of A U < *(10 marks)*

So cube A vertically moves downward. *(05 marks)*

Since $\rho_2 < \rho_w$, weight of B < U *(10 marks)*

So cube B vertically moves upward. *(05 marks)*

(Total marks 45)

(b) When a hydrometer floats in water, 25 cm of its stem is dipped in water. When it floats in another liquid, 20 cm of its stem is dipped in the liquid. Find the relative density of the liquid.

$1 \times \rho_w \times 25 = d \times \rho_w \times 20$ *(10 marks)*

d = 1.25 *(05 marks)*

(Total marks 15)

(c) For what purpose the following apparatus are used?

(1) Lactometer

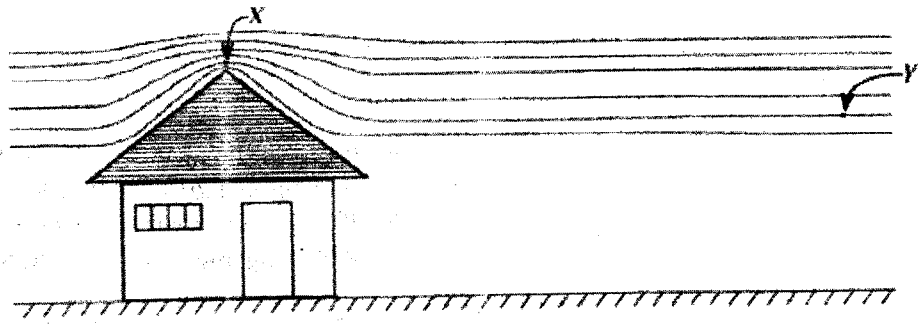
(2) Metrolac

(1) Lactometer :To compare /to obtain the densities of milk *(10 marks)*

(2) Metrolac :To compare/measure the densities of latex *(10 marks)*

(Total marks 20)

(d) The figure shows the shape of a roof and the airflow over it during a cyclone.



Points X and Y are on a same streamline of the wind flow and they are far apart enough to neglect the difference in their heights.

(i) At which point the wind flow has higher velocity?

Point X *(05 marks)*

(ii) At which point the wind flow has higher pressure?

Point Y *(05 marks)*

(iii) If v_1 and v_2 are the velocities and P_1 and P_2 are the pressures of the wind flow at X and Y respectively, write the Bernoulli equation. Let ρ be the density of air.

$$P_1 + \frac{1}{2}\rho v_1^2 = P_2 + \frac{1}{2}\rho v_2^2$$ *(10 marks)*

(iv) If the effective area of the roof is 200 m^2, the velocity of wind flow at point X is 360 km h^{-1} and the density of air is 1.3 kg m^{-3}, calculate the force acting on the roof due to the wind flow (Consider the velocity of wind inside the house as zero).

Consider the pressure in the house is P'

Bernoulli equation for X : $P_1 + \frac{1}{2} \times 1.3 \times 100^2$ *(10 marks)*

The pressure difference between inside and outside of the roof = $P' - P_1 = \frac{1}{2} \times 1.3 \times 100^2$ *(10 marks)*

$Force = (P' - P_1)A = \frac{1}{2} \times 1.3 \times 100^2 \times 200 = 1.3 \times 10^6\ N$ *(10 marks)*

(v) A student says that the roof of a house is safe if the windows and doors are opened during a rapid wind flow. Do you agree with this statement? Explain your answer.

Yes *(05 marks)*

The pressure in the house is reduced when air flows through it. It reduces the pressure difference between inside and outside of the roof. Therefore, the additional force applying upward also reduces. So the roof is protective. *(15 marks)*

(Total marks 70)

* * *