

අධ්‍යයන පොදු සහතික පත්‍ර (උපක් පෙළ) විභාගය, 2021(2022) කළුවිප පොතුත් තුරාතුරුප පත්තිර (ශයෝග තුරු)ප පරිශ්‍යී, 2021(2022) General Certificate of Education (Adv. Level) Examination, 2021(2022)

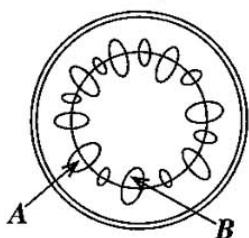
தொக்ஷன் வெள்ளை கலை விடையால் தொழில்நுட்பவியலுக்கான விஞ்ஞானம் Science for Technology

67 E I

ஆய தேவை
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 (x) in accordance with the instructions given on the back of the answer sheet.
- * Use of non-programmable calculators is allowed.



Correct labelling of A and B are respectively

(1) Cortex and Phloem. (2) Xylem and Phloem.
(3) Cambium and Phloem. (4) Phloem and Xylem.
(5) Phloem and Cambium.

4. Consider the following statements regarding plant tissues.

- A - Meristematic and permanent tissues are two main types of plant tissues.
- B - Parenchyma, collenchyma and sclerenchyma tissues are abundant meristematic tissues in plants.
- C - The cells present in meristematic tissues are continuously divided to produce new cells.

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.

5. What is the main function of kinase enzyme?

- (1) Digestion of lipids into fatty acids
- (2) Phosphorylation of protein
- (3) Digestion of enzymes to amino acids
- (4) Digestion of medicines
- (5) Metabolization of medicines into water soluble compounds

6. What is the unit of retention factor (R_f) calculated in a thin layer chromatographic experiment?
 (1) cm (2) cm^2 (3) cm^{-1} (4) cm s^{-1} (5) No units

7. What chemical is used to remove lignin from wood in the paper industry?
 (1) clay (2) chlorine
 (3) calcium carbonate (4) sodium hydroxide
 (5) sodium hypochlorite

8. When equal volumes of 1 mol dm^{-3} HCl and 1 mol dm^{-3} NaOH are mixed, which graph correctly shows the temperature variation of the mixture with time?

Temperature (1) Time (2) Time (3) Time (4) Time (5) Time

9. All chemical reactions
 (1) are exothermic.
 (2) are single step reactions.
 (3) always require a catalyst.
 (4) are endothermic and single step reactions.
 (5) reactants must collide with each other to react.

10. Phthalates are used in the process of plastic production
 (1) as a colouring agent. (2) as a stabilizing agent.
 (3) as a filling agent. (4) to increase the flexibility.
 (5) as a fire retarding material.

11. When multiple methods are available for a chemical industry, the method selected for a sustainable industry needs to
 (1) recycle waste produced.
 (2) utilize a large quantity of water.
 (3) depend only on manpower.
 (4) be based on imported raw materials.
 (5) a method that uses fossil fuels.

12. Consider the following statements regarding hydrogen produced using fossil fuels.
 A - Combustion of hydrogen gas produces poisonous gases.
 B - Hydrogen production process increases the amount of CO_2 in the environment.
 C - Combustion of hydrogen gas produces H_2O .
 Of the above, the correct statement/s would be
 (1) A only. (2) B only. (3) C only.
 (4) A and B only. (5) B and C only.

13. What is the correct statement regarding proteins?
 (1) Collagen is used to produce gelatin.
 (2) All catalysts are proteins.
 (3) All proteins are globular proteins.
 (4) 'Whey protein' is found in corn starch.
 (5) Gluten is found in eggs.

14. Caffeine in coffee is
 (1) an alkaloid. (2) an antioxidant. (3) an essential oil.
 (4) a primary metabolite. (5) a polyphenolic compound.

15. What is a process that can occur in the environment?

- Increase of the pH of ocean water due to the dissolution of CO_2 .
- Combustion of wood releases new carbon to the environment.
- CO_2 gas in the atmosphere produces acid rain.
- Ozone amount near to the earth surface can be increased due to pollution.
- Ethane released by cattle creates green house effect.

16. Consider the following statements regarding the uses of microorganisms.

A - for the production of fertilizers
 B - for the production of food supplements
 C - for the removal of poisonous organic compounds at the tertiary water purification stage

Of the above, the correct statement/s would be

- A only.
- A and B only.
- A and C only.
- B and C only.
- all A, B and C.

17. What is the correct statement regarding carbohydrates?

- Carbohydrates contain nitrogen.
- Glucose is the sweetest natural sugar.
- Amylopectin is a branched polysaccharide.
- Simple sugars can be hydrolyzed further into smaller molecules.
- Nitrocellulose is commonly used for the production of fabrics.

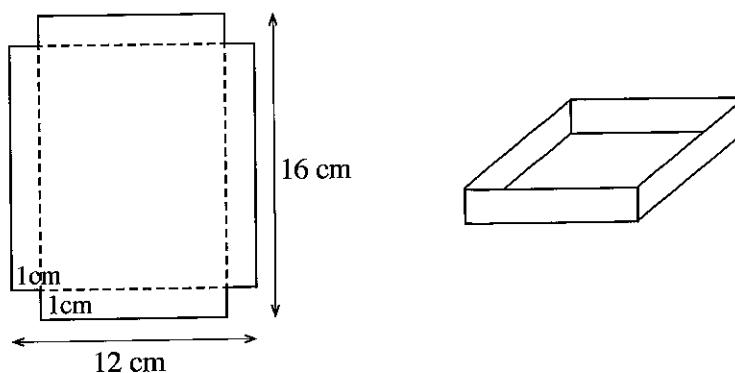
18. What is the true statement regarding enzymes?

- Enzymes are pH resistance.
- Enzymes are active even at higher temperatures.
- Enzymes can be carbohydrates or proteins.
- Most enzymatic reactions produce multiple by-products.
- Some enzymes need a cofactor to maintain their function.

19. What distance has a bicycle ridden, if its wheel of radius 20 cm has turned 2500 rounds when it is ridden? (Consider $\pi = 3$)

- 350 m
- 1200 m
- 3000 m
- 3500 m
- 4000 m

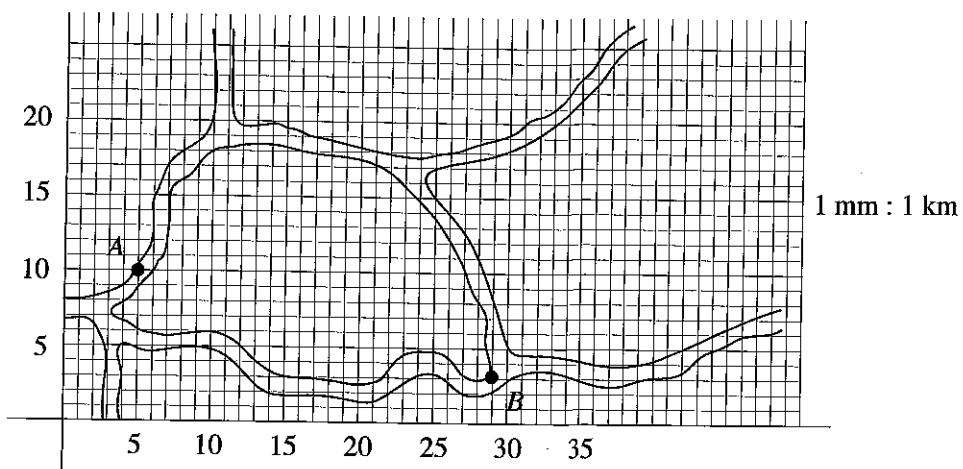
20. An open-top box is made by removing four squares of side length 1 cm out of each corner of a rectangular piece of cardboard of length 16 cm and width 12 cm and by folding the tabs along the creases shown.



The volume of the box is

- 96 cm^3
- 140 cm^3
- 165 cm^3
- 192 cm^3
- 280 cm^3

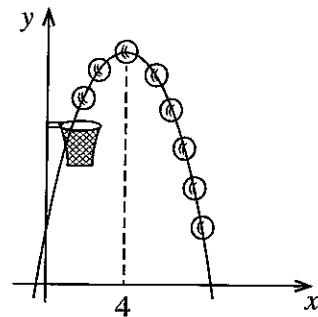
21. Use the grid coordinates to find the direct distance between the two marked locations A and B in the following Google map. Consider, a small square here is $1 \text{ mm} \times 1 \text{ mm}$.



(1) 23 km (2) 24 km (3) 25 km (4) 26 km (5) 27 km

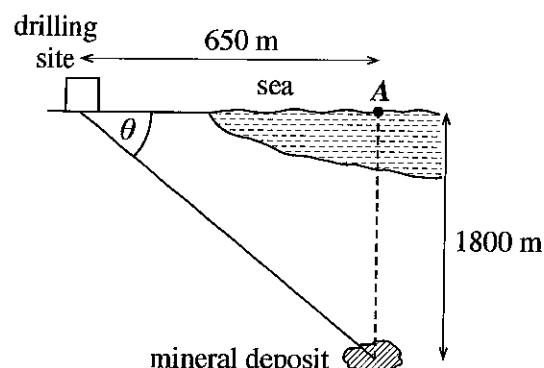
22. The path of the basketball shown in the picture can be modelled by the equation $y = -0.5x^2 + 4x + 2$. If the ball reached the maximum height at $x = 4$ units, this height is

(1) 8 units
 (2) 10 units
 (3) 16 units
 (4) 20 units
 (5) 26 units

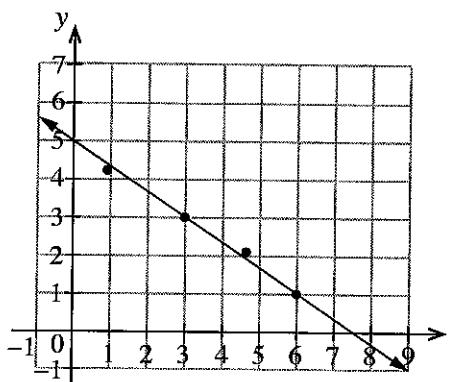


23. In Pesalai, a mineral deposit is detected at a location 1800 m below the point A in the sea. The nearest drilling site is located 650 m away from A as shown in the diagram. In what angle θ , must the straight drilling path take place to reach the mineral deposit.

(1) $\tan^{-1}\left(\frac{1800}{650}\right)$ (2) $\tan^{-1}\left(\frac{650}{1800}\right)$
 (3) $\sin^{-1}\left(\frac{1800}{650}\right)$ (4) $\cos^{-1}\left(\frac{1800}{650}\right)$
 (5) $\cos^{-1}\left(\frac{650}{1800}\right)$

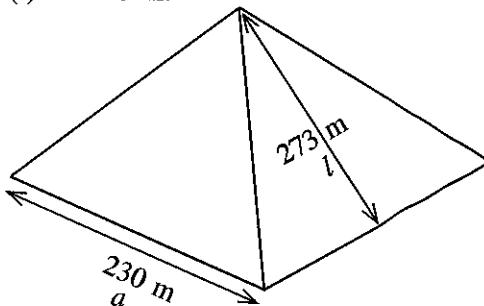


24. Data gathered in an experiment is plotted to identify the relationship between the two variables x and y . Which equation best describes the relationship between the variables?



(1) $y = \frac{2}{3}x + 5$
 (2) $y = -\frac{2}{3}x + 5$
 (3) $y = -\frac{2}{3}x + 7.5$
 (4) $y = 1.5x + 5$
 (5) $y = -1.5x + 5$

- Questions 25 and 26 are based on the pyramid of Giza in Egypt (shown in the figure) which is one of the Seven Wonders of the World. The pyramid has a square base of side length (a) 230 m and a slant height (l) of 273 m.



25. The vertical height (h) of the pyramid, to the nearest metre (m) is
 (1) 147. (2) 225. (3) 248. (4) 296. (5) 357.

26. What formula can be used to calculate the volume (V) of the pyramid?
 (1) $V = \left(\frac{a}{2}\right)^2 h$ (2) $V = \frac{1}{3}a^2 h$ (3) $V = \frac{1}{3}ahl$ (4) $V = \frac{1}{3}\left(\frac{a}{2}\right)^2 h$ (5) $V = \frac{1}{3}a^2 hl$

27. A fair die numbered from 1 to 6 is tossed four times. The variable X is the number of times of the value 6 of the die turns up. The mean and the median of the all possible values of X are respectively
 (1) 2.0 and 2.0. (2) 2.0 and 2.5. (3) 2.5 and 2.5. (4) 2.5 and 3.5. (5) 3.5 and 3.5.

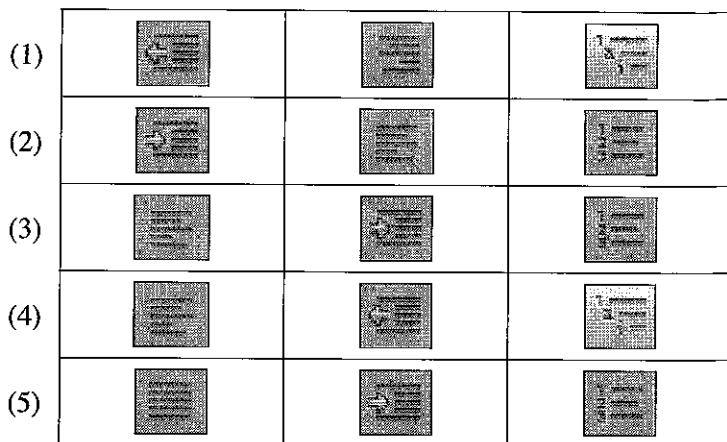
28. $\sum_{i=1}^{10} (2x_i + 5)$ is equal to
 (1) $2\sum_{i=1}^{10} x_i + 5$ (2) $2\sum_{i=1}^{10} x_i + 50$
 (3) $20\sum_{i=1}^{10} x_i + 5$ (4) $20\sum_{i=1}^{10} x_i + 50$
 (5) $20\sum_{i=1}^{10} x_i + 10$

29. Consider the following statements.
 A - Control Unit, Arithmetic and Logic Unit and Memory Registers are the main components of the Central Processing Unit.
 B - MS-DOS is an example of a single-user and multi tasking operating system.
 C - The capacity of the RAM (Random Access Memory) is an important factor that impacts the efficiency of a computer.
 Of the above, the correct statement/s would be
 (1) A only. (2) B only. (3) C only.
 (4) A and C only. (5) B and C only.

30. What is the first step of the booting process of a computer?
 (1) User Test (2) Reliability Test
 (3) Integrity Test (4) Correct Functioning Test
 (5) Power-On Self Test

31. What tool can be used to insert the author's name at the bottom of every page of a word document?
 (1) Header (2) Footer (3) WordArt
 (4) Bookmark (5) Comment

32. What is the correct order of icons used in a typical word processing software to indicate left align, increase indent and numbering.



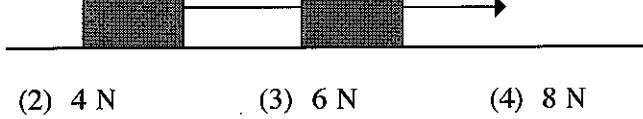
40. Which one of the following is **not** a vector quantity?
 (1) Torque (2) Linear acceleration
 (3) Angular acceleration (4) Angular velocity
 (5) Angular frequency

41. The angular velocity of a car engine is increased from 800 rpm to 3200 rpm in 15 s at a constant rate. What is its angular acceleration of the engine?
 (1) 160 rpm/min (2) 4000 rpm/min (3) 9600 rpm/min
 (4) 16000 rpm/min (5) 36000 rpm/min

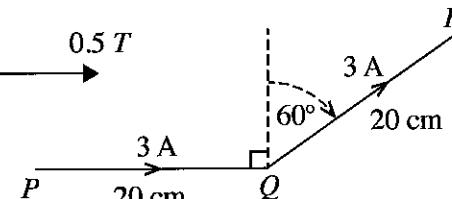
42. What is the electricity cost for 30 days of a 1.5 kW air conditioner, if it operates for 2 hours per day? (Assume the cost of 1 kWh is 10 rupees)
 (1) Rs. 450 (2) Rs. 600 (3) Rs. 900 (4) Rs. 1200 (5) Rs. 1800

43. A battery (Electro motive force E , internal resistance r) is connected to an external load R as shown in the diagram. The battery delivers a current I through the circuit. Consider the following equations about the voltage (V_R) across the load R .
 (A) $V_R = IR$
 (B) $V_R = E - Ir$
 (C) $V_R = E + Ir$

Of the above, the correct would be
 (1) (A) only. (2) (B) only. (3) (C) only.
 (4) (A) and (B) only. (5) all (A), (B) and (C).

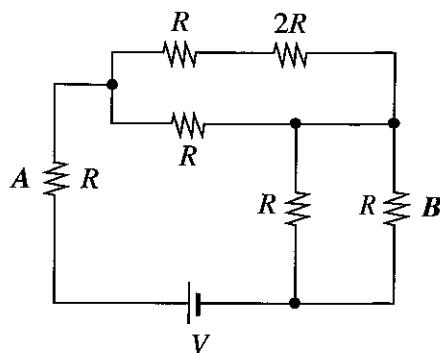
44. Consider two blocks of masses 4 kg and 2 kg placed on a frictionless horizontal surface connected with a light inextensible string as shown in the figure. If the mass 2 kg is pulled horizontally with a force of 12 N, what is the tension on the string?

 (1) 2 N (2) 4 N (3) 6 N (4) 8 N (5) 10 N

45. A piece of copper is cooled in a refrigerator and then put in a thermally insulated jug with water at the room temperature. What information is **not** required to calculate the specific heat capacity of copper?
 (1) Mass of the water
 (2) Mass of the copper
 (3) Specific heat capacity of water
 (4) Temperature of cooled copper piece
 (5) Time taken for the system to reach room temperature

46. A metal wire PQR of 40 cm long is placed in a magnetic field of 0.5 T parallel to PQ segment as shown in the diagram. What is the net force exerted on the wire segment, when current through the wire is 3 A?

 (1) 0.15 N (2) 0.60 N (3) 15 N (4) 45 N (5) 60 N

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

47. Six resistors and a battery are connected in a circuit as shown in the diagram. How many times of the power dissipation of resistor A , as power dissipation of resistor B ?

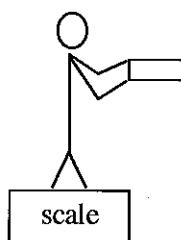


(1) 1 (2) 2 (3) 3 (4) 4 (5) 5

48. The potential energy stored in a light spring is E when stretched by 1 m. What is the potential energy of the spring when the same spring is stretched by 2 m?

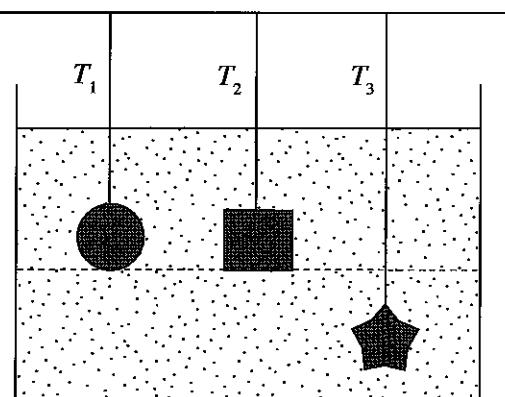
(1) $\frac{E}{2}$ (2) E (3) $2E$ (4) $3E$ (5) $4E$

49. A man of mass 70 kg is standing in a stable position on a weighing scale while horizontally holding a uniform pole of length of 2 m and mass of 5 kg as shown below. What is the reading of the scale?



(1) 73 kg
(2) 74 kg
(3) 75 kg
(4) 77 kg
(5) 80 kg

50. Three solid blocks each with equal volumes and masses are immersed in a water tank using three light ropes with negligible volumes as shown in the given diagram. What is the correct relationship among the tensions T_1 , T_2 and T_3 of these three ropes?



(1) $T_1 = T_2 = T_3$ (2) $T_1 = T_2 > T_3$ (3) $T_1 = T_2 < T_3$ (4) $T_1 < T_2 < T_3$ (5) $T_1 > T_2 > T_3$

* * *

අධ්‍යාපන පොදු සහතික පත්‍ර (උසක් පෙළ) විභාගය, 2021(2022)
කළුවිප පොතුත් තුරාතුරුප පත්තිර (ශ්‍යාරු තරු)ප පර්තිසේ, 2021(2022)
General Certificate of Education (Adv. Level) Examination, 2021(2022)

தொகை-ஈவெல்லை கலை விடை	II
தொழினுட்பவியலுக்கான விஞ்ஞானம்	II
Science for Technology	II

67 E II

பூர்வ நிலை
மூன்று மணித்தியாலம்
Three hours

அமுனர் கியலிடி காலை	- தினித்து 10 மி
மேலதிகி வாசிப்பு நேரம்	- 10 நிமிடங்கள்
Additional Reading Time	10 minutes

Use additional reading time to go through the question paper, select the questions you will answer and decide which of them you will prioritise.

Index No.:

Instructions :

- * This question paper consists of 14 pages.
- * This question paper comprises of four Parts A, B, C and D. The time allotted for all parts is three hours.
- * Use of non-programmable calculators is allowed.

Part A - Structured Essay

(Pages 2 - 8)

- * *Answer all the questions on this paper itself.*
- * *Write your answers in the space provided for each question. Note that the space provided is sufficient for your answers and that extensive answers are not expected.*

Parts B, C and D - Essay

(Pages 9 - 14)

- * Select minimum of **one** question from each of the parts **B**, **C** and **D** and answer **four** questions only. Use the papers supplied for this purpose. At the end of the time allotted for this paper, tie **all parts** together so that **Part A** is on the top of **Parts B, C and D** before handing over to the supervisor.
- * You are permitted to remove only **Parts B, C and D** of the question paper from the examination hall.

For Examiners' Use Only

Part	Question Nos.	Marks Awarded
A	1	
	2	
	3	
	4	
B	5	
	6	
C	7	
	8	
D	9	
	10	
Total	In Numbers	
	In Words	

Code Numbers

Marking Examiner 1	
Marking Examiner 2	
Checked by	
Supervised by	

Do not
write
in this
column**Part A – Structured Essay***Answer all questions on this paper itself.*

1. (A) Primary and secondary are two main types of natural forests. **A** and **B** are schematic diagrams of these two types of forests.



Diagram A

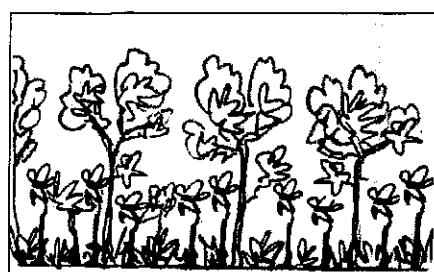


Diagram B

(i) Identify diagrams **A** and **B**, and write the forest type in the given box below.

Diagram A	
Diagram B	

(ii) Write **two** examples for primary forests in Sri Lanka.

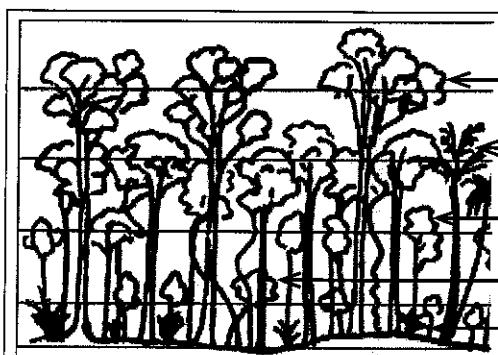
(1)

(2)

(iii) Write **two** main structural differences between primary and secondary forests.

	Primary	Secondary
(1)
(2)

(B) The diagram below represents the stratification of a tropical rain forest. Name each layer labelled as **P**, **Q**, **R**, **S** and **T** in this tropical rain forest.



P :

Q :

R :

S :

T :

(C) Forests exposed to destruction can be regrown artificially using suitable plants.

(i) Name **two** plants suitable for artificial regrowing of the forests.

(1)

(2)

(ii) Write **two** reasons for selecting such plants for artificial regrowing of the forests.

(1)

(2)

(D) Tissue culture can be used to propagate an endangered plant in a forest to secure its existence.

(i) Name **two** explants that can be used in tissue culture.

(1)

(2)

(ii) Write **five** major components that must contain in a tissue culture growth media.

(1)

(2)

(3)

(4)

(5)

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Q.1

100

2. Compost fertilizer can improve the quality of soil and increase the retainability of nutrients in soil. A group of students conducted an experiment to determine the amount of nutrients removed with water when urea is added with the compost fertilizer. The experiment setup and the collected data is provided in the table below.

Day	Amount of ammonium ions released	
	Experimental setup (Compost + Urea)	Control setup (Sand + Urea)
01	0.3 g	1.0 g
02	0.4 g	0.7 g
03	0.3 g	0.6 g
04	0.3 g	0.3 g
05	0.3 g	0.2 g
06	0.2 g	0.2 g
07	0.2 g	0.0 g
08	0.1 g	0.0 g
09	0.1 g	0.0 g
10	0.1 g	0.0 g

(A) 5.0 g of urea is mixed with the 100.0 g of compost fertilizer and packed in a column. A layer of sand added on top of the compost-urea mixture as shown in the figure. A control setup was arranged by using sand-urea mixture as shown in the figure. Each day a 50 g of water was added, and measured the amount of nutrient in the leachate.

(i) What is the nutrient provided by urea?

.....

(ii) Why should plant nutrients be soluble in water?

.....

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(B) When a urea sample of 5.0 g was dissolved in 100.0 g of water, the temperature of the mixture dropped by 2°C .

(i) Calculate the amount of energy absorbed by the water due to the dissolution of urea. (Specific heat capacity of water = $4.2 \text{ J g}^{-1} \text{ }^{\circ}\text{C}^{-1}$).

.....
.....
.....
.....

(ii) Calculate the dissolution reaction heat of urea in water.

(Molar mass of urea = 60 g mol^{-1})

.....
.....
.....
.....

(C) When 5.0 g of urea is dissolved in water, about 3 g of NH_4^+ ions is produced.

(i) Calculate the amount of NH_4^+ ions retained in the compost fertilizer after ten days.

.....
.....
.....
.....

(ii) What is the reason for adding a layer of sand on top of the mixture in the column?

.....

(iii) Calculate the average rate of release of NH_4^+ ions within the ten days.

.....
.....
.....

(iv) Write one economical and one environmental advantage of mixing urea with compost fertilizer when adding to the soil.

Economical :

Q.2

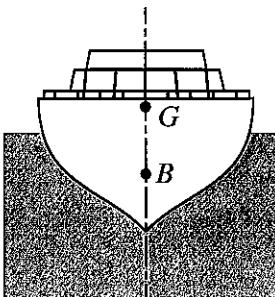
Environmental :

(v) Why is it not recommended to add fertilizers to a crop on a heavy rainy day?

.....

100

3. (A) As shown in the below diagram ship of mass 8000×10^3 kg floats in the sea and remains stable. The centre of gravity and the centre of buoyancy of the ship are indicated by G and B respectively.



Stable vertical floatation of the ship

(i) What is the magnitude of each of the following forces?
(Consider gravitational acceleration as 10 N kg^{-1})

(a) Weight of the ship

.....

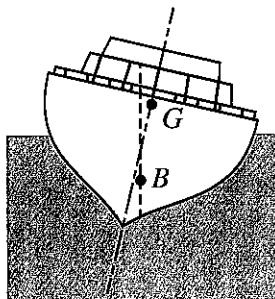
(b) Upthrust on the ship

.....

(ii) How must the lines of action of weight and upthrust be positioned for the stable vertical floatation of the ship?

.....

(iii) Under a stormy condition the ship comes to a titled position from the previous stable vertical floatation as shown in the diagram below.



(a) If the horizontal distance between G and B is 50 cm, calculate the moment of the couple of forces acting on the ship.

.....

.....

(b) Is the direction of the above moment clockwise or anticlockwise?

.....

.....

(c) Would the ship come back to its stable vertical floatation?

.....

.....

(d) Give reasons for the answer you gave for the above part (iii)(c).

.....

.....

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(B) The labels of four boxes containing, each of starch, glucose, sucrose and protein, in a cargo ship were faded due to soaking in sea water. In order to identify the biomolecule in each box, the boxes were labelled as A, B, C, D and two tests were conducted on the materials in boxes A, B and D. Details of those tests are given in the table below.

Box	Test	Result
A	Benedict Test	Turn to brick red
B	Iodine Test	Turn to blue/purple
D	Iodine Test	No colour change

(i) Based on the test results, identify the biomolecule in boxes A, B and D.

	Box	Type of biomolecule
(1)	A
(2)	B
(3)	D

(ii) Name a reagent that can be used to identify proteins.

.....

(iii) Write the observation, when a protein sample is mixed with the reagent named in above part (ii).

.....

(iv) Which group of carbohydrates does sucrose belong to?

.....

(v) Write the **two** monosaccharides produced when sucrose is hydrolyzed.

(1)

(2)

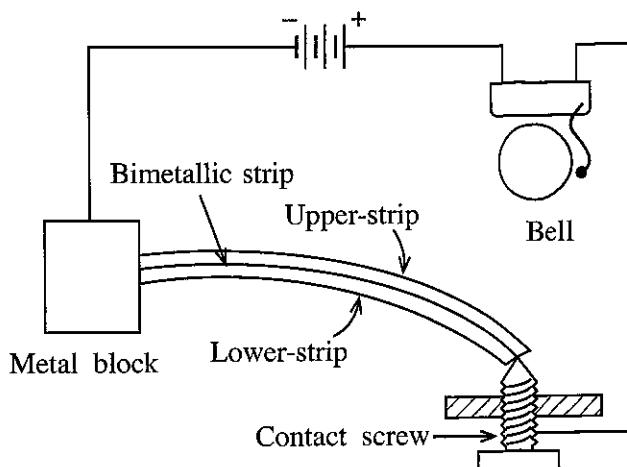
Q.3

(vi) Which biomolecule stores energy in animals?

.....

100

4. (A) The diagram shows the circuit of an electric bell that is used to alarm the increasing temperature inside the boiler room in a factory.

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The bimetallic strip in this, is made of two thin metal strips X and Y with coefficients of linear thermal expansions α_x and α_y , respectively. The initial length of each of the strips at room temperature is l_0 . If the temperature in the boiler room rises by $\Delta\theta$ from the room temperature,

(i) Write the new lengths l_x and l_y , of the metal strips X and Y in terms of $\Delta\theta$?

$$l_x = \dots$$

$$l_y = \dots$$

(ii) (a) If $\alpha_x > \alpha_y$, which metal from X and Y would you select as the upper-strip in the bimetallic strip?

.....

(b) Explain the reason for your choice.

.....
.....
.....

(iii) (a) Suppose the contact screw of the above setup is adjusted to ring the alarm bell at the temperature 45°C . If the alarm bell needs to be operated at a lower temperature than 45°C , should the contact screw be moved upward or downward?

.....

(b) Giving reasons explain your answer.

.....
.....
.....

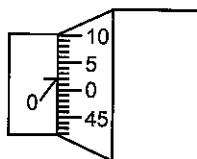
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(B) The circular scale of a micrometer screw gauge is divided into 50 equal parts. When the circular scale is rotated one full turn, the spindle shifts by 0.5 mm on the linear scale.

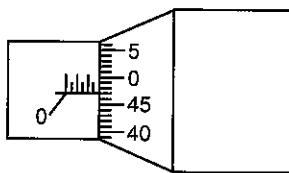
(i) What is the least count of the micrometer screw gauge?

.....

(ii) According to the following diagram what is the zero error of the instrument?



(iii) The reading of a measurement obtained with the above micrometer screw gauge is shown below.



(a) What is the reading shown in the diagram?

.....

.....

.....

(b) What is the correct measurement, if the instrument has a zero error as indicated in part (ii)?

Q.4

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* *

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தொகுத்தனவீட்டு சுட்டு விட்டுவிட	II
தொழினுட்பவியலுக்கான விஞ்ஞானம்	II
Science for Technology	II

Essay

67

E

III

Instructions:

INSTRUCTIONS:

- * Select minimum of **one** question each from parts **B**, **C** and **D** and answer four questions only.
- * Each question carries **150** marks.
- * Graph sheet required for question number **5** in part **B** is provided with the question paper.
- * Use of non-programmable calculators is allowed.

Part B - Essay

5. **Table 1** shows the distribution of the monthly cost of internet data for children's education of randomly selected 150 families during the Covid pandemic period.

Table 1: Grouped frequency distribution of 150 families for the monthly cost of internet data.

Cost of internet data (Rs.)	Number of families (f)
51 – 200	33
201 – 350	27
351 – 500	24
501 – 650	18
651 – 800	21
801 – 950	12
951 – 1100	9
1101 – 1250	6
Total	150

(a) (i) Copy **Table 2** given below to the answer booklet and complete the columns of class boundary, class mark, more than cumulative frequency and more than percentage cumulative frequency.

Table 2: Grouped frequency distribution for the monthly cost of internet data

Class interval	Number of families (frequency)	Class boundary	Class mark	More than cumulative frequency ($F <$)	More than percentage cumulative frequency
51 – 200	33				
201 – 350	27				
351 – 500	24				
501 – 650	18				
651 – 800	21				
801 – 950	12				
951 – 1100	9				
1101 – 1250	6				

(ii) In this study, find the average of monthly costs of internet data of the families.

(b) Calculate the maximum value that can be taken for the range of the above grouped frequency distribution.

(c) Draw the **more than percentage cumulative frequency curve** for the above distribution in **Table 2** on the graph paper provided with this question paper.

(d) Based on above (c), the more than percentage cumulative frequency curve you have drawn,

- find the median of monthly costs of internet data of the families.
- calculate the inter quartile range of the distribution.
- calculate the number of families who spent Rs. 750 or more for internet data per month.

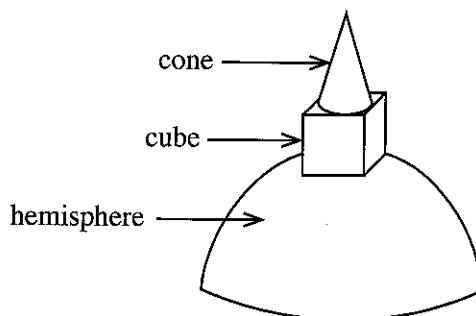
(e) **Table 3** below shows the frequency distribution of the number of school-going children for the above sample of 150 families.

Table 3: Frequency distribution of number of school going children in the sample.

Number of school going children per family	Number of families
1	47
2	56
3	32
4	12
5	3
Total	150

Calculate the expected monthly cost of internet data for a family with 6 school-going children.

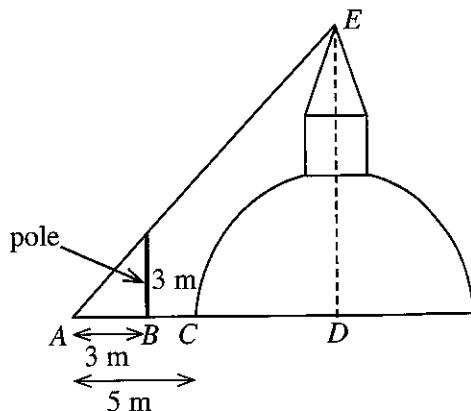
6. The amount of paint needed to paint a religious construction Stupa needs to be estimated. As shown in the figure, assume that the Stupa consists of a hemisphere, a cube and a cone whose base coincides with the width of the cube. (consider $\pi = 3$.)



(a) The vertical height of the Stupa needs to be determined. By tracing a rope around the base of the hemisphere, the circumference of the base is measured to be 36 m.

(i) Show that the radius of the base of the hemisphere section is 6 m.

In order to work out the angle of elevation of the tip of the Stupa, a point A is chosen 5 m away from the Stupa as shown in the following diagram. A pole of height 3 m had to be positioned at point B which is 3 m away from A , so that the angles of elevation of the pole and the tip of the Stupa were the same.



- (ii) Calculate the angle of elevation of the tip of the Stupa from A .
- (iii) D is the centre of the hemisphere. What is the distance from A to D ?
- (iv) Giving steps or reasons, calculate the height DE of the Stupa.

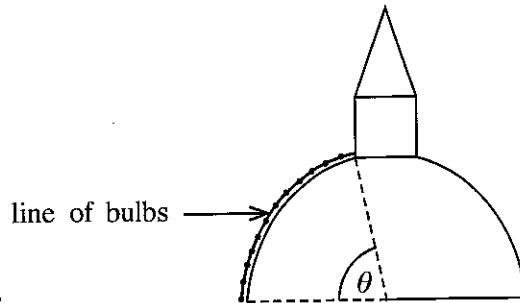
(b) It was found that the ratio between the height of the cone and the height of the cube is $3:2$.

- (i) Find the heights of the cone and the cube.
- (ii) What is the radius of the cone?
- (iii) Calculate the slant height of the cone to the nearest first decimal place.

(c) Calculate each of the following surface area.

- (i) the curved surface of the hemisphere of the Stupa.
- (ii) the curved surface of the cone of the Stupa.
- (iii) the four vertical sides around the cube.

(d) For decoration of the stupa, lines of bulbs are to be hung around as shown in the diagram. The θ angle is estimated to be 80° .



Part C - Essay

7. (a) Chemical fertilizers are used in agriculture to provide nutrients to plants. The use of organic and biofertilizers can avoid some of the disadvantages of using chemical fertilizers.

- (i) Name the three primary nutrients required for the plant growth.
- (ii) State **two** main **disadvantages** of overusing chemical fertilizers in agriculture.
- (iii) Super phosphate is a chemical fertilizer. Write one natural raw material and one synthetic raw material used to produce super phosphate.
- (iv) Why is it essential to have a high water solubility for fertilizers?

(b) Minerals can also be added to improve the quality of organic fertilizers.

- Write **two disadvantages** of using organic fertilizers over chemical fertilizers.
- A student mixes urea and apatite with compost fertilizer to produce a hybrid fertilizer.
 - Explain **two** advantages of mixing above chemicals with compost.
 - Write **two** methods that can be used to increase water solubility of apatite.
- Explain why organic fertilizers can be considered as a sustainable approach to agriculture.
- "An advantage of organic fertilizers is causing less environmental issues compared to chemical fertilizers" Explain.

(c) Cleaner production concept minimizes the effect on the environment and can be used to improve the efficiency of an industrial process.

- Write the **three** main objectives of cleaner production concept.
- Explain how cleaner production concept can be used in organic fertilizer production process to improve the productivity.

8. (a) A waste recycling center sorts daily collected biodegradable and non-biodegradable waste into five categories A, B, C, D and E as shown below.

- Ebonite and vulcanized rubber
- Food and plant waste
- Metal cans and glass bottles with chlorinated organic solvents
- Rechargeable batteries and other items with heavy metals
- Paper and cardboard

- What is meant by non-biodegradable waste?
- Which categories contain non-biodegradable waste?
- Why is it essential to recycle non-biodegradable waste?
- What is the main environmental benefit of recycling paper and cardboard?

(b) Devulcanization can be used to convert vulcanized rubber to non-vulcanized rubber.

- What properties can be added to rubber by vulcanization?
- What is the main difference between ebonite and vulcanized rubber?
- Which bond in vulcanized rubber is required to be broken in the process of devulcanization?

(c) Glass bottles can be reused to fill distilled organic solvents.

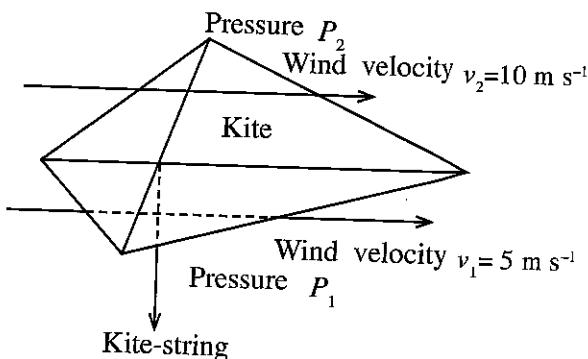
- Write **two** environmental issues that may arise due to release of organic solvents to the environment.
- Why is it essential to distill organic solvents before reuse?
- Explain how the release of rechargeable batteries to the environment produces adverse effects.
- Write **two** methods widely used to remove heavy metals in water.

Part D - Essay

9. In the usual notation, the Bernoulli principle for any two points lying on the same streamline but at different heights h_1 and h_2 can be expressed as $P_1 + \rho gh_1 + \frac{1}{2} \rho v_1^2 = P_2 + \rho gh_2 + \frac{1}{2} \rho v_2^2$.

(a) Show that, for two points lying on the same horizontal streamline, the above equation reduces to $P_1 + \frac{1}{2} \rho v_1^2 = P_2 + \frac{1}{2} \rho v_2^2$.

(b) A kite flown by a student floats horizontally in the sky as shown in the following diagram. The air velocities at two points just below and just above the kite are $v_1 = 5 \text{ m s}^{-1}$ and $v_2 = 10 \text{ m s}^{-1}$ respectively. The pressure at the above two points are P_1 and P_2 respectively. Assuming the mass and the thickness of the kite are negligible, calculate the following.

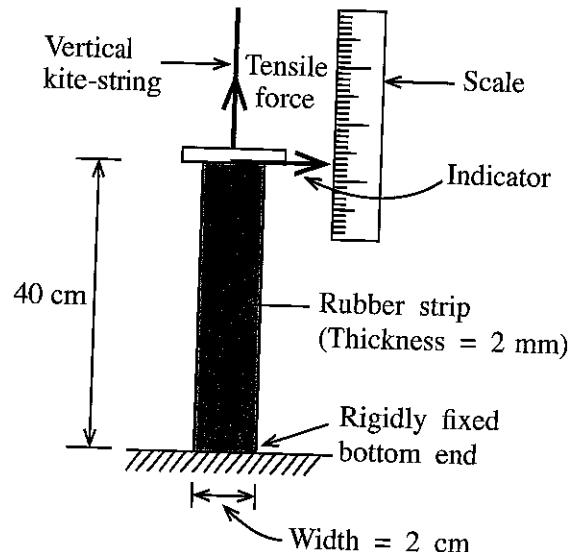


(i) Using the answer in part (a), write an expression for the pressure difference $(P_1 - P_2)$.

(ii) If the density of air $\rho = 1.2 \text{ kg m}^{-3}$, calculate the pressure difference $(P_1 - P_2)$.

(iii) If the surface area of the kite is 0.5 m^2 , calculate the tensile force required on the string to keep the kite stationary.

(c) The figure shows a setup used for measuring the tensile force of the kite string which is vertical. Here, a rubber strip (length = 40 cm, width = 2 cm and thickness = 2 mm) is attached firmly to the kite-string at the top and to the ground at the bottom. An indicator running on a vertical linear scale is attached to the upper end of the rubber strip.



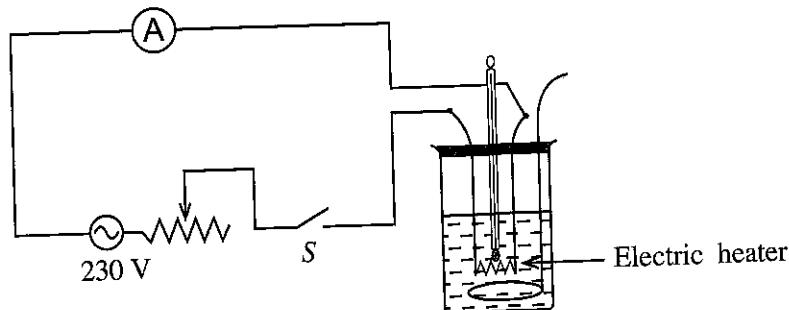
(i) What is the use of the indicator and the scale of the setup?

(ii) Calculate the cross-sectional area of the rubber strip normal to the tensile force.

(iii) If the extension of the rubber strip due to the tensile force in the kite-string is found to be 2 cm, calculate the tensile force. Young's modulus of the material of the rubber strip is $2 \times 10^7 \text{ N m}^{-2}$.

(iv) It is not recommended to connect the kite-string to the rubber strip through a hole pierced at the upper end of the rubber strip. Explain the reason for this.

10. (a) A typical electric heating setup is shown in the following diagram. When the heater is connected to a 230 V electric supply and the switch S is on, a current of 10 A flows through the circuit. Resistance of the connecting wires is negligible.

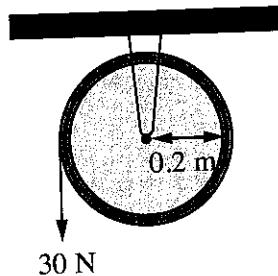


- Calculate the resistance of the heating coil.
- Calculate the heat energy, in joules, produced by the heater in 1 minute.
- This setup is used to heat 5 kg of milk. Assuming that the heat capacity of the vessel is negligible and the initial temperature of the milk is 30 °C, calculate the temperature of the milk after 7 minutes. The specific heat capacity of milk is $3900 \text{ J kg}^{-1} \text{ K}^{-1}$.
- If the resistance of the connecting wires is 0.02Ω , calculate the rate of energy loss, in watts, in the connecting wires.

(b) A light string wrapped around a pulley is pulled with a constant vertical force of 30 N as shown in the diagram. The moment of inertia of the pulley around the axis of rotation is $2 \times 10^{-2} \text{ kg m}^2$. Radius of the pulley is 0.2 m. Assume the pulley starts from rest and the string does not slip.

Equations related to rotational motion are listed below.

$$\tau = I\alpha, \quad \tau = Fr, \quad E = \frac{1}{2}I\omega^2, \quad I = mr^2, \quad \theta = \omega t, \quad \omega = \omega_0 + at, \quad \theta = \omega_0 t + \frac{1}{2}at^2, \quad \omega^2 = \omega_0^2 + 2\alpha\theta$$



- Calculate the torque applied on the pulley.
- Write an equation to show the relationship among torque, angular acceleration and moment of inertia.
- Calculate the angular acceleration of the pulley.
- When the pulley has rotated 25 turns, calculate the following:
 - Angular displacement
 - Angular velocity
 - Kinetic energy of the pulley (Consider $\pi = 3$)
- By giving reasons or showing steps, calculate the work done by the 30 N force in rotating the pulley through 25 turns.

தொழில்நுட்பவியலுக்கான வினாக்களும்
Science for Technology

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II
II

67

II

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Question No. } 5 (c)

