

සියලු ම හිමිකම් ඇවිරිණි / முழுப் பதிப்புரிமைபுடையது / All Rights Reserved

ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
இலங்கைப் பரீட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka
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අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2017 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2017 ஓகஸ்ட்
General Certificate of Education (Adv. Level) Examination, August 2017

තාක්ෂණවේදය සඳහා විද්‍යාව
தொழினுட்பவியலுக்கான விஞ்ஞானம்
Science for Technology

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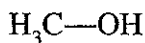
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පැය දෙකයි
இரண்டு மணித்தியாலம்
Two hours

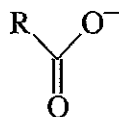
Instructions:

- * 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 (x) in accordance with the instructions given on the back of the answer sheet.
- * Use of calculators is not allowed.

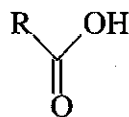
1. Which of the following statements is correct regarding the fungi?
 - (1) Most of the fungi are autotrophs.
 - (2) Yeast is an example for unicellular fungi.
 - (3) Cell walls of fungi are made of cellulose.
 - (4) Starch is the main stored food in fungi.
 - (5) Fungi reproduce only asexually.
2. The name of the bacteria used to obtain a gene to produce 'golden rice' is
 - (1) *Agrobacterium tumefaciens*
 - (2) *Bacillus thuringiensis*
 - (3) *Escherichia coli*
 - (4) *Corynebacterium glutamicum*
 - (5) *Erwinia uredovora*
3. Consider the following statements regarding vinegar production.
 - (A) Conversion of ethanol into acetic acid is the first step of the vinegar production.
 - (B) *Acetobacter* or *Gluconobacter* can be used to convert ethanol into acetic acid.
 - (C) Conversion of ethanol into acetic acid in this process is an oxidation 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) (B) and (C) only.
4. Lactose belongs to which group of carbohydrates?
 - (1) Monosaccharide
 - (2) Disaccharide
 - (3) Starch
 - (4) Polysaccharide
 - (5) Oligosaccharide
5. Consider the following statements regarding synthetic polymers.
 - (A) Each polymer is only built with a single type of monomers.
 - (B) All polymers are unbranched chains.
 - (C) Molecular weights of polymers are higher than that of simple molecules.
 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. Polymeric materials in paint are acting as
 - (1) pigments.
 - (2) filling agents.
 - (3) wetting agents.
 - (4) binding agents.
 - (5) solvents.
7. A possible structure of a soap molecule is



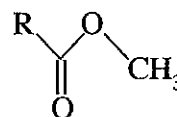
(1)



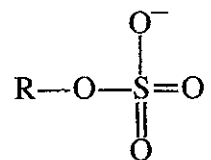
(2)



(3)



(4)



(5)

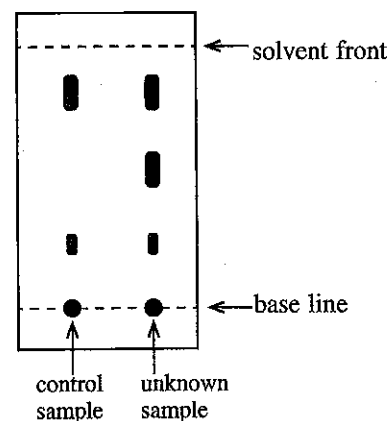
8. What is the true statement regarding biodiesel?
- (1) When it is burnt CO_2 is not released to the environment.
 - (2) It can only be produced using fresh plant oils.
 - (3) Methanol is a raw material for its production.
 - (4) NaOH is the most suitable catalyst for its production.
 - (5) It is a non-regenerative energy source.
9. Apatite can be used to produce fertilizers. A reason for making apatite to react with sulphuric acid is to
- (1) reduce the hydrophobic nature of the final product.
 - (2) break into small pieces.
 - (3) add a filling agent.
 - (4) reduce the toxic nature of apatite.
 - (5) improve the water solubility.
10. What is the most suitable method to get scientific, health and technical information relevant to a raw chemical material?
- (1) Talking to a chemical supplier
 - (2) Using Material Safety Data Sheet
 - (3) Searching through the internet
 - (4) Talking to the manufacture
 - (5) Referring to relevant patents

11. Consider the following gasses

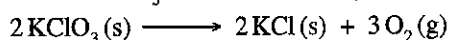
(A) CH_4 (B) O_2 (C) Ar (D) NH_3 (E) H_2O

Of the above gasses, which can absorb infra-red radiation?

- (1) (A), (B) and (C) only
 - (2) (A), (C) and (D) only
 - (3) (A), (D) and (E) only
 - (4) (B), (C) and (D) only
 - (5) (C), (D) and (E) only
12. Biochemical Oxygen Demand (BOD) is the amount of oxygen
- (1) dissolved in a given water sample containing microorganisms.
 - (2) produced by aquatic organisms in a water sample at the day time.
 - (3) consumed by aquatic organisms in a water sample at the night time.
 - (4) consumed by aquatic organisms in a water sample in 24 hours.
 - (5) consumed by microorganisms to oxidize organic compounds in a water sample.
13. A diagram of the developed thin layer chromatographic plate used to study an unknown sample using a control sample is shown here. Which of the following statements is true?
- (1) The unknown sample contains less than two compounds.
 - (2) The unknown sample contains two compounds.
 - (3) The unknown sample may contain compounds present in the control sample.
 - (4) The unknown sample only contains compounds present in the control sample.
 - (5) The control sample is prepared using a pure compound.

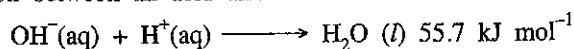


14. Decomposition of KClO_3 can be shown by the following reaction.



A heated sample of KClO_3 has produced 5 moles of oxygen in the first 5 minutes and another 3 moles of oxygen in the next 5 minutes. What is the average decomposition rate of KClO_3 in that 10 minutes?

- (1) $0.20 \text{ mol min}^{-1}$
 - (2) $0.33 \text{ mol min}^{-1}$
 - (3) $0.50 \text{ mol min}^{-1}$
 - (4) $0.53 \text{ mol min}^{-1}$
 - (5) $0.80 \text{ mol min}^{-1}$
15. The reaction between an acid and a base can be shown as follows.



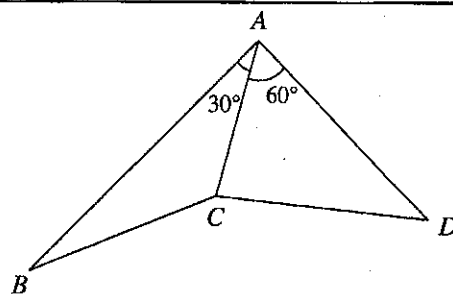
The amount of heat generated when 100.00 ml of HCl acid reacted with an excess amount of NaOH is 5.57 kJ. The concentration of the HCl solution is

- (1) 0.2 mol dm^{-3}
- (2) 0.8 mol dm^{-3}
- (3) 1.0 mol dm^{-3}
- (4) 1.5 mol dm^{-3}
- (5) 2.5 mol dm^{-3}

23. If the areas of the triangles ABC and ACD in the figure are equal, the ratio $AB:AD$ is

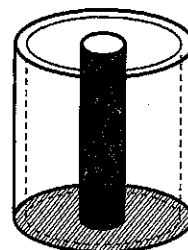
(Consider $\sin 30^\circ = \frac{1}{2}$ and $\sin 60^\circ = \frac{\sqrt{3}}{2}$.)

- (1) $1:\sqrt{3}$ (2) $\sqrt{3}:1$ (3) $1:3$
(4) $2:1$ (5) $3:1$



24. A cylindrical chemical reactor with an internal radius of r_1 (meters) is constructed to start an industry based on a natural product. A solid cylindrical bar with a radius of r_2 (meters) has been fixed to the reactor vertically as shown in the diagram. What is the height (meters) of the mixture in the reactor when $\pi \text{ m}^3$ of the mixture is poured into the reactor?

- (1) $\frac{\pi}{r_2^2}$ (2) $\frac{1}{(r_1^2 - r_2^2)}$ (3) $\frac{\pi}{r_1^2}$
(4) $\frac{1}{(r_1^2 + r_2^2)}$ (5) $\frac{\pi}{(r_1^2 + r_2^2)}$



25.

Value	1	4	6	8
Frequency	1	a	3	2

If the mean of the above ungrouped frequency distribution is 5, the value of a is

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

26. A grouped frequency distribution of the data set 4, 2, 9, 7, 8, 14, 12, 11, 19, 17, 23 is given in the table below.

Class	Class boundaries	Frequency	Class mark
1	1 - 5	2	3
2	6 - 10	3	8
3	11 - 15	3	13
4	16 - 20	2	18
5	21 - 25	1	23

It was found that the mean of the grouped frequency distribution is different from the true mean of the data set. Data in which class does make this difference?

- (1) Class 1 (2) Class 2 (3) Class 3 (4) Class 4 (5) Class 5

27. If a child rolled a tyre with radius 0.5 m at a speed of 6 ms^{-1} for 11 seconds, the number of rotations it has made is (Consider $\pi = \frac{22}{7}$.)

- (1) 3.5 (2) 10.5 (3) 15 (4) 21 (5) 42

28. In a computer system, which of the followings is an optical storage device?

- (1) Hard disk (2) ROM (3) RAM (4) CD ROM (5) USB

29. Consider the following devices of a computer system.

(A) Keyboard (B) CRT Monitor (C) DVD drive (D) Pen drive

Which of the above devices are both input and output devices?

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

30. A collection of web pages related to each other is called a

- (1) network (2) URL (3) Google (4) Website (5) Internet

31. The programming language commonly used to create web pages is

- (1) English (2) HTTP (3) HTML (4) FTP (5) URL

32. Which of the followings is a main function of an operating system of a computer?

- (1) Protecting computer from viruses
(2) Providing a web browser
(3) Managing its RAM
(4) Providing at least one word processing software
(5) Providing at least one internet connection

33. In word processing, Portrait or Landscape indicates the page

- (1) orientation (2) size (3) layout (4) margins (5) font type

34. Which of the following facilities in word processing applications can be used to find words with similar meaning for a given word?
 (1) Dictionary (2) Thesaurus (3) Find (4) References (5) Format Painter

35. Consider the below statements about email applications.

- (A) It is guaranteed that all email sent are always delivered to the recipients.
 (B) Once an email is received it can be forwarded to the other email users.
 (C) When composing an email it is essential to fill in the Subject box.

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.

- Questions 36 and 37 are based on the following spread sheet segment. It is constructed to calculate the
 (i) variation of current in a circuit with the potential difference and resistance.
 (ii) energy generated in the circuit within 5 seconds.

	A	B	C	D
1	Potential Difference (Volts)	Resistance (Ohms)	Current (Amperes)	Energy generated in 5 seconds (Joules)
2	3	3.0		
3	3	2.5		
4	3	2.0		
5	3	1.5		
6	3	1.0		
7	3	0.5		
8	4	3.0		
9	4	2.5		
10	4	2.0		
11	4	1.5		
12	4	1.0		
13	4	0.5		

36. What should be the formulae entered in cells C2 and D2 respectively, to obtain the intended results?
 (1) A2/B2 and (A2*A2*5)/B2 (2) A2/B2 and (A2*A2*5)/A2
 (3) B2/A2 and (A2*A2*5)/A2 (4) A2/B2 and (A2*A2)/C2
 (5) B2/A2 and (A2*5)/B2
37. The most suitable type of graph that can be used to indicate the variation of current with resistance for a given voltage is
 (1) Pie chart (2) Histogram (3) Scatter diagram
 (4) Line diagram (XY diagram) (5) Bar chart
38. If the error due to measuring a side length of a cube is 3%, the error in calculating its volume is
 (1) 3% (2) 4% (3) 6% (4) 9% (5) 27%
39. The length of a uniform copper wire of $2\ \Omega$ resistance is 20m. If the resistivity of the material of the wire is $1.7 \times 10^{-8}\ \Omega\text{m}$, its cross sectional area is
 (1) $1.7 \times 10^{-4}\text{m}^2$ (2) $2.0 \times 10^{-4}\text{m}^2$ (3) $3.4 \times 10^{-6}\text{m}^2$ (4) $17 \times 10^{-8}\text{m}^2$ (5) $34 \times 10^{-8}\text{m}^2$
40. Two springs, X and Y having spring constants $710\ \text{N m}^{-1}$ and $2840\ \text{N m}^{-1}$, respectively are separately stretched by two forces with the same magnitude. The potential energy ratio of X and Y is
 (1) 1 : 2 (2) 1 : 3 (3) 1 : 4 (4) 3 : 1 (5) 4 : 1
41. A fan with effective area of A moves air of density ρ at a speed of v . The required power for this movement is
 (1) $\frac{1}{2} \rho A v^3$ (2) $\frac{1}{2} \rho A v$ (3) $\rho A v$ (4) $\rho A v^2$ (5) $\rho A v^3$
42. The human heart discharges 74ml of blood at a beat against a pressure of 0.1 mHg. If the pulse frequency is 72 beats per minute, the density of mercury is $13600\ \text{kg m}^{-3}$ and the acceleration of gravity is $10\ \text{N kg}^{-1}$, the power of the heart is
 (1) 0.01 W (2) 0.02 W (3) 1.00 W (4) 1.20 W (5) 72.5 W
43. An electric lamp indicated with 230 V, 60 W is connected to an electrical supply of 230 V, 50 Hz. Consider the following statements.
 (A) The maximum potential difference applied to the lamp is 460 V.
 (B) When the lamp is glowing at the indicated power, its resistance is $960\ \Omega$.
 (C) The current flowing through the lamp becomes zero hundred times in every second.
 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.

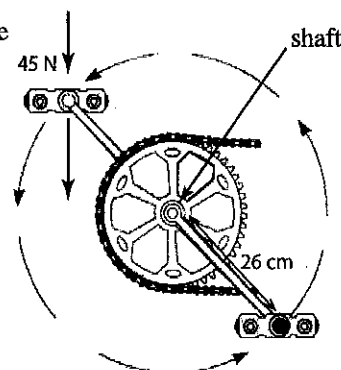
44. A man pushes a 180 N lawn mower at a constant velocity as shown in the figure. The frictional force on the lawn mower is 90 N. The force that the person must exert on the handle, which makes an angle of 45° with the ground, and the normal force acting on the lawn mower by the ground are respectively ($\cos 45^\circ = \sin 45^\circ = \frac{1}{\sqrt{2}}$)

- (1) 45 N and 180 N
- (2) $90\sqrt{2}$ N and 180 N
- (3) 90 N and $180\sqrt{2}$ N
- (4) 90 N and 270 N
- (5) $90\sqrt{2}$ N and 270 N



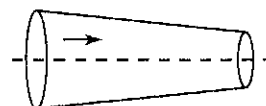
45. A uniform force of 45 N is applied to a bicycle pedal as in the figure. If the length of the pedal arm is 26 cm, the torque applied to the shaft is

- (1) 0.58 N m
- (2) 1.73 N m
- (3) 11.7 N m
- (4) 829 N m
- (5) 1170 N m



46. A non-viscous fluid with density d has a streamline flow in a tube with a variable cross section as shown in the diagram. The axis of the tube is aligned horizontally. If the fluid pressure is P at a point where the flow velocity is v , what would be the pressure at a point where the flow velocity is $5v$?

- (1) $P - 2dv^2$
- (2) $P + 2dv^2$
- (3) $P + 4dv^2$
- (4) $P - 4dv^2$
- (5) $P - 12dv^2$

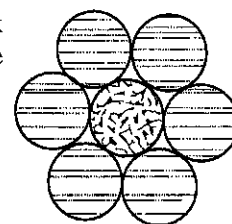


47. A very high voltage is used to distribute the electricity throughout the country. The reason for this is

- (1) to avoid the possible damage by human to the transmission lines.
- (2) due the requirement of a high voltage to push electrons to longer distances.
- (3) to allow the flow of a larger current.
- (4) to transmit electric power more efficiently.
- (5) due to the production of a high voltage by electrical generators.

48. A high voltage electric cable consists of a steel conductor with resistance R_s and six conducting wires around it, each with resistance R_a as shown in the figure. If all the wires are insulated separately, what is the resistance of the cable?

- (1) $R_s + 6R_a$
- (2) $\frac{1}{R_s} + \frac{1}{6R_a}$
- (3) $\frac{1}{R_s} + \frac{1}{R_a}$
- (4) $\frac{R_s R_a}{R_a + 6R_s}$
- (5) $\frac{R_s R_a}{R_s + 6R_a}$



49. If the specific heat capacity of water at room temperature is $4.2 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$ which of the following statements is true?

- (1) When an amount of 4.2 J heat energy is supplied to 1 g of water, its temperature is increased by 1°C .
- (2) When an amount of 4.2 J heat energy is supplied to 1 kg of water, its temperature is increased by 1°C .
- (3) When an amount of 1.0 J heat energy is supplied to 1 kg of water, its temperature is increased by 1°C .
- (4) When an amount of $4.2 \times 10^3 \text{ J}$ heat energy is supplied to 1 kg of water, its temperature is increased by 100°C .
- (5) When an amount of $4.2 \times 10^3 \text{ J}$ heat energy is supplied to 1 kg of water, its temperature is increased by 273°C .

50. According to the Fleming's right hand rule, when the fore finger, thumb and middle finger of the right hand are formed in right angles to each other, they indicate respectively

- (1) motion, magnetic field and induced current.
- (2) magnetic field, motion and induced current.
- (3) motion, induced current and magnetic field.
- (4) induced current, motion and magnetic field.
- (5) magnetic field, induced current and motion.

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ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
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Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka
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අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2017 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2017 ஓகஸ்ட்
General Certificate of Education (Adv. Level) Examination, August 2017

නාක්ෂණවේදය සඳහා විද්‍යාව II
தொழில்நுட்பவியலுக்கான விஞ்ஞானம் II
Science for Technology II

67 E II

පැය තුනයි
மூன்று மணித்தியாலம்
Three hours

Index No. :

Instructions :

- * This question paper consists of 12 pages.
- * This question paper comprises of four Parts A, B, C and D. The time allotted for all parts is three hours.
- * Use of calculators is not allowed.

Part A - Structured Essay (07 pages)

- * 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 (05 pages)

- * 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	Q. No.	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
C	7	
	8	
D	9	
	10	
Total		
Percentage		

Final Marks

In Numbers	
In Words	

Code Numbers

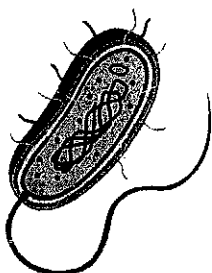
Marking Examiner 1	
Marking Examiner 2	
Checked by	
Supervised by	

Part A – Structured Essay

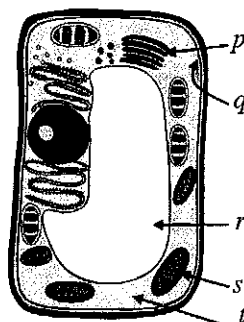
Answer all questions on this paper itself.

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1. The following figures A and B show two types of living cells.



A



B

(a) (i) Identify A and B.

A:

B:

(ii) State **two** similarities and **two** differences between A and B mentioned above.

Similarities :

(1)

(2)

Differences :

(1)

(2)

(iii) Name the parts labelled in the figure B.

p:

q:

r:

s:

t:

(iv) State how viruses are different from the cells identified above.

.....
.....(v) Name **two** main shapes of viruses.

(1) (2)

(b) Questions below are based on industrial beer production.

(i) Name widely used cereal grain in beer production.

.....

(ii) Malting is an important step in the beer production. How 'malt' is prepared in this process?

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

(iii) What is the main chemical conversion taking place in the cereal grains during the 'malt' production?

.....

(iv) How can you test the progress of the above part (b)(iii) chemical conversion in a laboratory?

.....

(v) Name an enzyme which can catalyse the above part (b)(iii) chemical conversion.

.....

Do not
write
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column(vi) Write **two** factors that could affect the activity of an enzyme.

(1) (2)

(vii) What is the function of 'hop' in beer production?

.....

(viii) Name the main fungus that is used in beer fermentation.

.....

(c) Proteins are important type of biomolecule in living organisms.

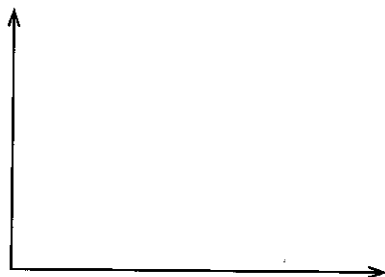
(i) Name a reagent that can be used to identify proteins.

.....

(ii) Name **two** main shapes of three dimensional (3D) structures of proteins.

(1) (2)

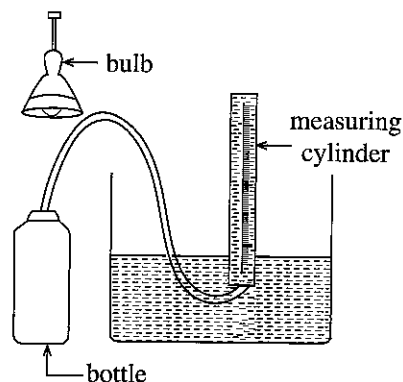
(iii) Enzymes catalyse biological reactions. Draw the relevant energy curves for an enzymatic reaction in the absence and in the presence of an enzyme.



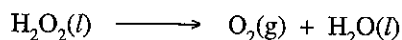
Q.1

100

2. A bio-plastic production company has developed a new dark colour bio-degradable material to produce bio-plastic bottles to store light sensitive compounds. The setup shown in the figure was used to test the effectiveness of this new material. Bottles were filled with an aqueous hydrogen peroxide solution and exposed to an electric bulb which emits light similar to the sun light. The amount of oxygen released was collected within a period of one hour.



Unbalanced chemical equation for the decomposition of hydrogen peroxide is shown below.

(a) (i) State **two** factors that can affect the rate of the decomposition of hydrogen peroxide.

(1) (2)

(ii) Write the balanced chemical equation for the decomposition of the hydrogen peroxide.

.....

(b) The test solution is prepared prior to the experiment by mixing 150 ml of water at 50 °C with 100 ml of 10 mol dm⁻³ H₂O₂ solution at 20 °C. (Assume that the heat capacity of both these solutions are 4.2 J °C⁻¹ g⁻¹ and the densities of these solutions are 1 g ml⁻¹.)

(i) Calculate the temperature of the test solution produced by mixing water and hydrogen peroxide solution.

.....

.....

(ii) On the basis of matter and energy exchange, name the type of system for which biodegradable bottle filled with the test solution belongs.

.....

- (c) Three different types of prototype bottles, developed using three different materials, were tested using the method described. Results of these experiments done for a period of one hour are given in the table below.

Bottle type	Temperature of the test solution at the end of the experimental period	Air volume reading (ml)	
		Initial	Final
Prototype A	30 °C	4	12
Prototype B	31 °C	3	9
Prototype C	36 °C	5	13

- (i) Calculate the oxygen volume released from each experiment conducted using three prototype bottles.
-
-
- (ii) Calculate the amount of heat loss to the surroundings from the prototype bottle A during the experimental period.
-
-
- (iii) Calculate the average rate of oxygen gas production in ml/min by giving relevant steps.
-
-
- (iv) Give a reason for the observed higher final temperature in the experiment conducted with the prototype bottle C.
-
-
- (v) Based on these results, which prototype bottle is the best to store light sensitive compounds.
-

Q.2

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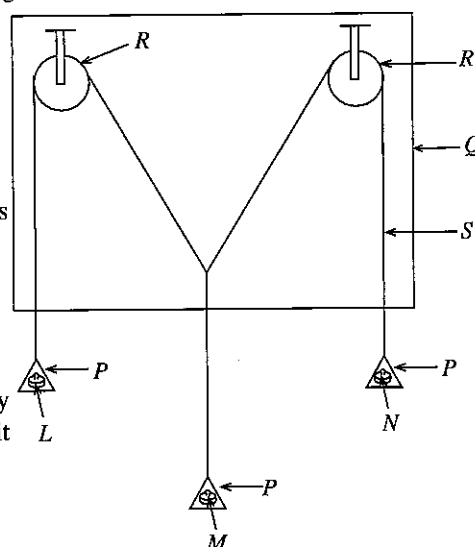
3. Figure shows a setup used to verify the principle of parallelogram of forces.

P - Light scale pans
Q - Vertical drawing board with a white paper pinned on
R - Smooth small pulleys
S - Light string
L, M and *N* - Weights

- (a) What are the other apparatus required to carry out this experiment accurately?
-
-

- (b) What do you check by displacing the system slightly from its initial equilibrium position and see whether it returns to the same equilibrium position?
-
-
-

- (c) What is the reason for using light strings in this experiment?
-



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- (d) The following initial steps are completed in the verification of the principle of parallelogram of forces.

- (i) Marking the position of each string on the paper.
- (ii) Removing the paper from the board.
- (iii) Drawing the lines proportional to the weights L and N from the point of intersection of the two inclined portions of the string.

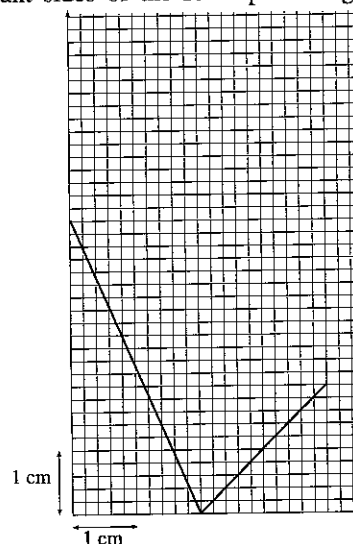
Write down the remaining steps.

- (iv)
- (v)
- (vi)
- (vii)

- (e) This setup was used to find the weight M of a stone. The relevant sides of the force parallelogram drawn in the experiment are given in the diagram.

Find the weight M of the stone. ($1 \text{ cm} = 0.27 \text{ N}$)

.....



- (f) The experiment is repeated while the stone is fully immersed in a water beaker. Calculate the relative density of the stone if the relevant diagonal is 3 cm.

.....

- (g) If the relevant diagonal of the properly drawn force parallelogram was not vertical, state a reason for it.

.....

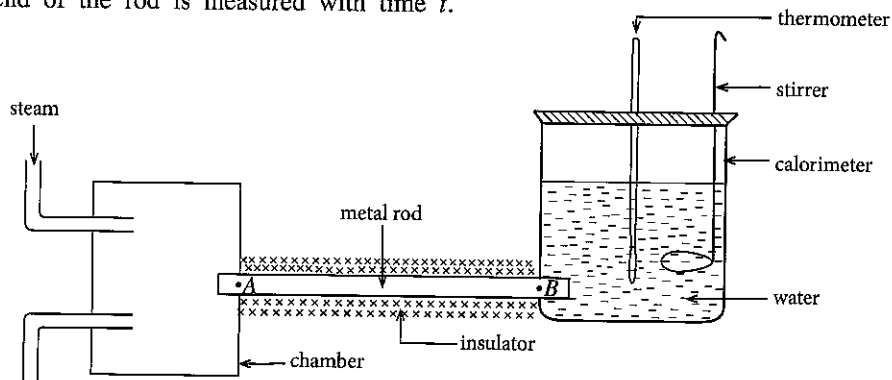
- (h) If the scale pans are **not** light, what step could be taken to carry out the experiment correctly?

.....

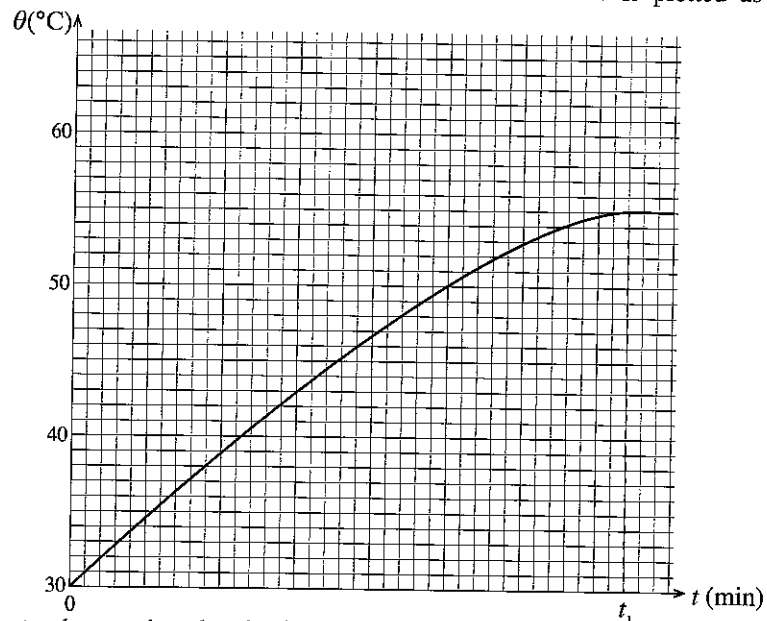
Q.3

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4. The apparatus shown in the diagram can be used to determine the thermal conductivity of a metal rod with a uniform cross-section. One end of the insulated rod is heated by passing 100°C steam through the chamber. The temperature θ of the water in the calorimeter, which is connected to the other end of the rod is measured with time t .



- (a) What are the forms of transmission of heat energy from one place to another?
-
-
- (b) State an advantage of using steam.
-
-
- (c) The variation of temperature of water in the calorimeter with time is plotted as shown below.



- (i) According to the graph, what is the temperature of water at the steady state?
-
- (ii) What is the reason for the temperature of water reaches a steady value?
-
-
- (iii) The variation of the temperature (θ) from time $t=0$ to $t=t_1$ is **not** linear. State **two** main reasons for this.
- (1)
-
- (2)
-

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- (d) It has been found from another cooling experiment that the rate of heat dissipation R from the calorimeter and its contents at temperature θ could be given by the equation,

$$R = 0.16 (\theta - \theta_r)$$

where θ_r is the room temperature.

- (i) If the room temperature is 30°C , calculate R at the steady temperature.

.....

.....

.....

- (ii) Write an expression for the rate of heat conduction through the rod.

.....

.....

- (iii) If the length of the rod from A to B is 0.6 m and its cross sectional area is $1.4 \times 10^{-4}\text{ m}^2$, determine the thermal conductivity of the metal.

.....

.....

.....

- (e) Briefly explain the reason for **not** insulating the calorimeter during this experiment.

.....

.....

.....

- (f) Why this method is **not** suitable to find the heat conductivity of a rubber rod?

.....

.....

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Q.4

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* *

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 கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2017 ஆகஸ்ட்
 General Certificate of Education (Adv. Level) Examination, August 2017

තාක්ෂණවේදය සඳහා විද්‍යාව II
 தொழினுட்பவியலுக்கான விஞ்ஞானம் II
 Science for Technology II

67 E II

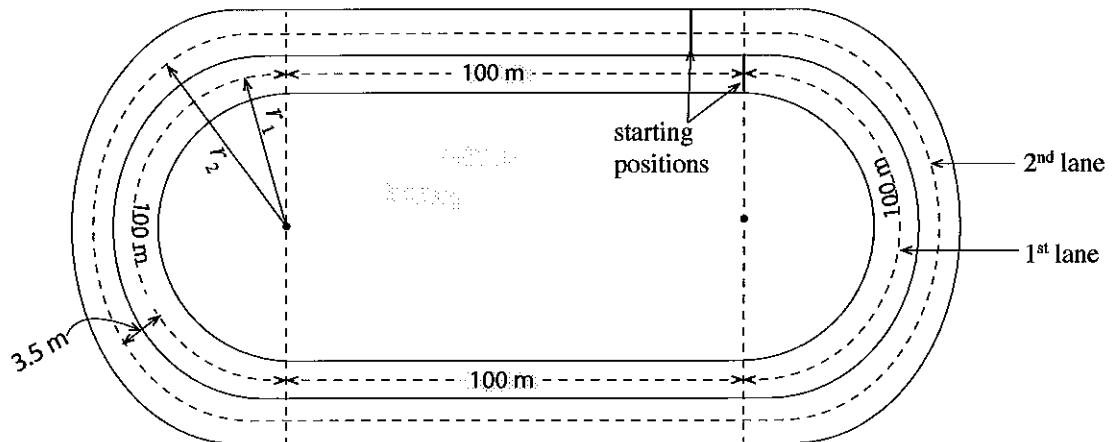
Essay

Instructions:

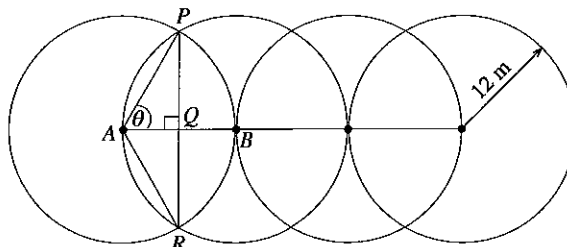
- * Select minimum of **one** question each from **parts B, C and D** and answer **four** questions only.
- * Each question carries **15** marks.
- * Graph sheet for question number **6** in **part B** is provided with the questions paper.

Part B - Essay

5. A design of a 400m race track with 3.5m gap between two dashed lines of any two consecutive lanes in a playground is given in the diagram. The diagram is not drawn to the scale. All athletes should run 400m distance on the dashed line in the middle of their respective lanes.



- (a) Write down the radii r_1 and r_2 of the semi-circular sections of the lanes shown in the diagram in terms of π .
- (b) What should be the gap between the starting positions of the first and the second lanes?
- (c) As shown in the following diagram, four circles with radii 12 m were drawn on the above playground for a drill such that the centres of the circles are fallen onto a horizontal line. The distance between two centres of consecutive circles is 12 m.



	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	$\sqrt{3}$

- (i) Find the length of PQ .
- (ii) Find the angle θ in radian.
- (iii) Find the area of the triangle APR .
- (iv) Find the area of the sector $APBR$, in terms of π .
- (v) Find the area enclosed by the arc PBR and the chord PR , in terms of π .
- (vi) Calculate the area of the compound diagram enclosed by these circles, in terms of π .

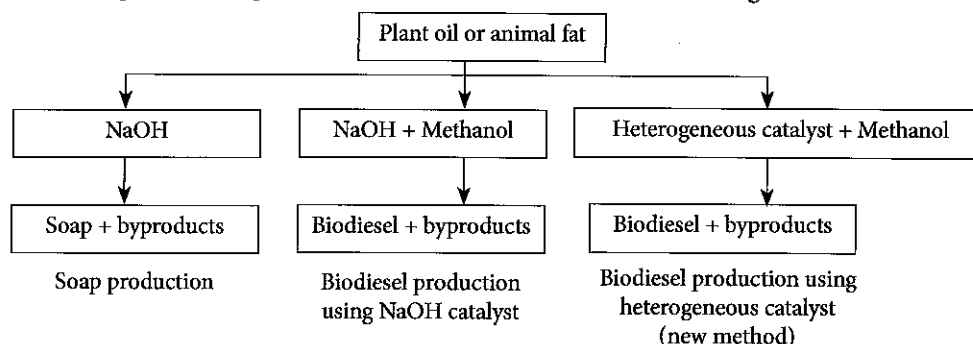
6. (a) The grouped frequency distribution of the weights in grams of 75 combs of bananas of the same type is given below.

Class limits	Frequency	Class boundary	Class mark	Cumulative frequency
730–770	10			
780–820	30			
830–870	20			
880–920	11			
930–970	03			
980–1020	01			

- (i) Complete the above table.
- Answer the following questions using the above completed grouped frequency distribution.
- (ii) Calculate the mean weight of a comb of banana.
- (iii) Calculate the production cost of this banana lot if the production cost of 1kg of banana is Rs. 100.
- (iv) Find the possible maximum and the minimum values of the range of the raw data set.
- (v) Draw a cumulative frequency curve on the graph sheet provided.
- (vi) Using the graph drawn in above part (v), find the maximum weight of 20% of the least weight combs of bananas and the minimum weight of 20% of the most weight combs of bananas.
- (b) (i) Calculate the selling price of one kilogram of banana in order to get 50% profit, if 20% of the total weight of the banana lot is damaged during the transportation.
- (ii) The damage due to transportation can be minimized to 4% using wooden boxes. If one kilogram of banana was sold at the same selling price you obtained in part (b)(i), calculate the profit percentage when using wooden boxes.

Part C - Essay

7. Processes used to produce soap and bio-diesel are shown in the following flow chart.



- (a) Biodiesel can be used as a fuel either directly or mixing with petroleum diesel.
- (i) State **one** reason why the use of biodiesel is environmental friendly.
- (ii) Based on the given flow chart, what is/are the raw material/s used for the production of biodiesel?
- (iii) Name a byproduct of the biodiesel production method that uses NaOH as the catalyst.
- (b) A Sri Lankan team of inventors proposed a new production method (shown in the flow chart) based on a heterogeneous catalyst. They have observed that the new method produces a higher yield than the methods based on homogenous catalyst.
- (i) State **two** changes that a catalyst can be done on a chemical reaction.
- (ii) What can be the reason for obtaining a greater yield in the proposed new production method based on a heterogeneous catalyst over the conventional methods?
- (iii) State **one** structural difference between soap and biodiesel molecules.
- (c) Inventors plan to utilize the 3R concept to minimize the environmental impact. They redesigned the biodiesel production process to make it more environmental friendly.
- (i) 3R concept is based on three main objectives. 'Reduce' is one of those objectives, what are the other **two** objectives.
- (ii) Explain how the use of heterogeneous catalyst can reduce the amount of raw materials used for the manufacturing process.
- (iii) If you are a member of the inventor team, based on the 3R concept, suggest a method to minimize the environmental impact of the biodiesel production process.

8. In a technology research project, a group of university students has designed an extraction process to collect flavonoids from tea leaves. The developed extraction process is shown in the figure. Extracted flavonoids are used to develop a new type of shampoo with natural antioxidants. They are planning to acquire a Sri Lankan patent soon for this new shampoo. The steps in the flavonoid extraction are shown in the following chart.

Step 01 – Mixture (tea leaves + ethanol)



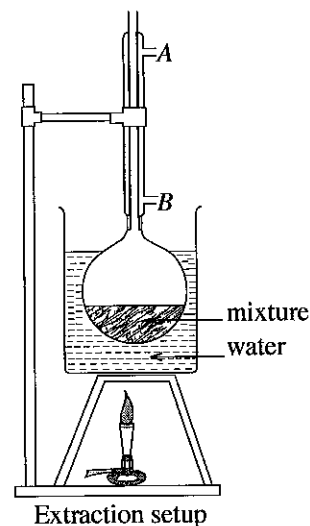
Step 02 – Extraction under reflux conditions



Step 03 – Evaporation of ethanol



Step 04 – Collection of crude extract

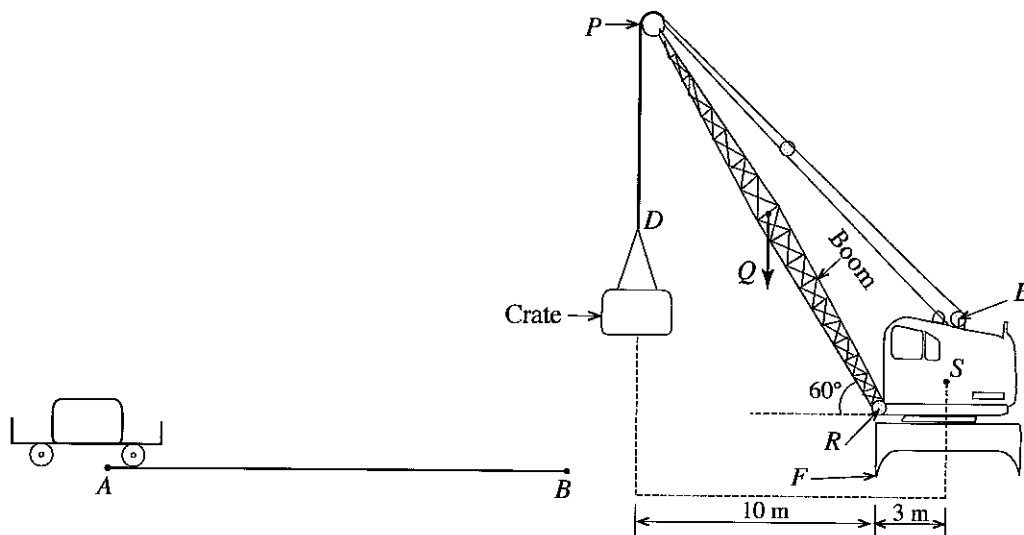


- (a) The collected crude extract is mixed with the basic shampoo mixture to add the antioxidant properties. Other ingredients are not yet revealed.
- What is a 'crude extract'?
 - Name a simple experimental method that can be used to determine the number of compounds present in the crude extract.
 - What are 'antioxidants'?
 - Explain the importance of acquiring a patent for the new product.
- (b) The setup for the extraction process is shown in the figure. In the extraction setup, two openings in the condenser are shown as A and B.
- Explain the reason for using a condenser in the extraction setup.
 - What is the reason for heating the mixture in a water bath?
 - Which of the two openings of the condenser is suitable to inject the water?
 - Explain the reason for your answer given in the above part (b)(iii).
- (c) Cleaner production concept can be used to minimize the waste generated in an industrial process. Ethanol vapour released at **Step 03** and tea dust can be considered as waste in this process.
- State **two** environmental issues that may occur if a chlorinated organic solvent is used in this extraction process.
 - According to cleaner production concept, describe briefly how to recycle/reuse the wastes generated in the process.

Part D - Essay

9. A house uses 10 filament bulbs rated 230V, 60W, an electric iron rated 230V, 1kW and an electric cooker rated 230V, 2kW. A fuse can be used to protect electrical appliances from the damages due to flow of excessive currents. Fuses with relevant ratings protect both the electric iron and the electric cooker. Everyday all the bulbs, the electric iron and the electric cooker are used for 4 hours, 30 minutes and 2 hours, respectively. The amount of electrical energy consumption is measured by kilowatt-hour (kWh).
- Calculate the electric energy consumption in kWh of this house for a month of 30 days.
 - If the cost for one unit of electric power is Rs. 8.00, calculate the electricity bill of this house for a month of 30 days.
 - Calculate the maximum electric currents flow through the fuses connected to the electric cooker and the electric iron.
 - If the relevant fuses of the electric cooker and the electric iron have mistakenly got interchanged, how will it affect the normal function of the appliances?
 - The manufacturer says that using light emitting diode (LED) bulbs are advantageous than filament bulbs.
 - Write **two** advantages of using LED bulbs.
 - If the efficiencies of filament bulb and LED bulb are 20% and 96% respectively, what would be the power of LED bulb used instead of filament bulb to get the same output power?
 - Calculate the monthly (30 days) electricity bill after replacing all filament bulbs of this house with LED bulbs mentioned above (c)(ii).

10. (a) Write the equation, which can be obtained from Newton's second law of motion and define each term.
- (b) A crate with a mass of 400 kg is kept on a trolley with the mass of 100 kg located at the position A, in a warehouse. The trolley with the crate, which was initially at rest, is pushed using a uniform horizontal force to the location B, and then allowed to move freely closer to the lorry used for the transportation. Then only the crate will be loaded onto the lorry using a crane.



Consider the gravitational acceleration as 10 N kg^{-1} , and $\cos 60^\circ = \sin 30^\circ = \frac{1}{2}$.

- Calculate the momentum at locations A and B if the velocity of the crate is 2 m s^{-1} at B. (Assume that the energy loss during the movement between the positions A and B is zero.)
 - If the time taken to move the crate from A to B is 20 s, calculate the horizontal force.
 - If the distance between A and B is 20 m, calculate the work done in the above process.
- (c) The crane with mass 20000 kg is used to lift the crate as shown in the figure. The mass of the boom PR of the crane is 2000 kg. S and Q are the respective points where the masses of the crane and the boom are exerted. Q is the mid-point of PR. A vertical cable section marked as PD is holding the crate, and it is going through a smooth pulley connected at P. The other end of the cable is wrapped around a cylinder connected with a motor. The crate can be lifted by rotating the cylinder.
- What is the work done in lifting the crate to a height of 3 m?
 - Calculate the length of the crane boom.
 - The radius of the crane cylinder, used to wrap the cable, is 50 cm. What torque must be applied on the cylinder to lift the crate?
 - What is the tension of the vertical cable section (PD) carrying the crate?
 - The crane will be toppled about the axis F, when the mass of the crate exceeds a certain limit. Calculate this limit.

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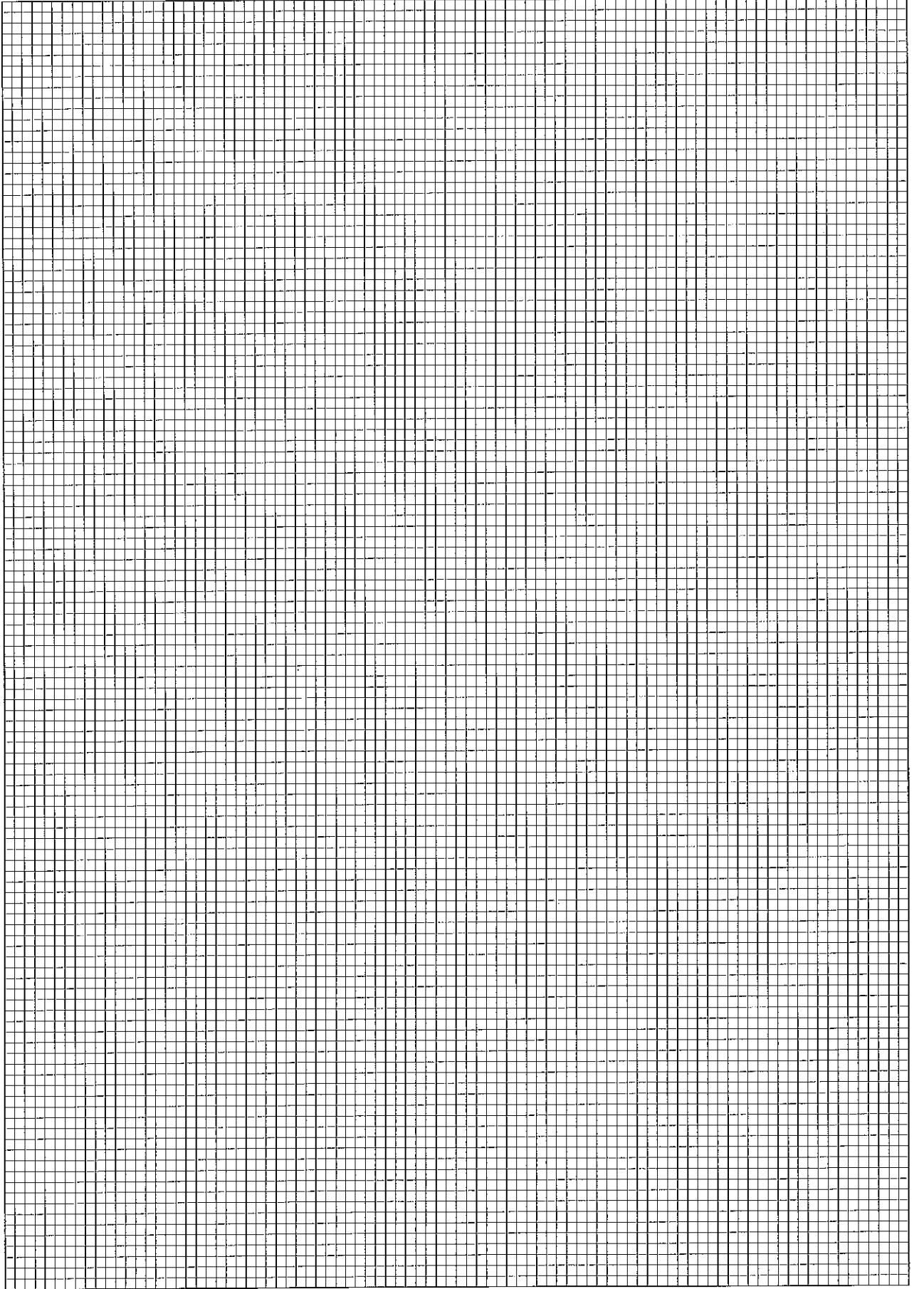
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