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
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, 2024
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2024
General Certificate of Education (Adv. Level) Examination, 2024

යාන්ත්‍රික තාක්ෂණවේදය I
பொறிமுறைத் தொழினுட்பவியல் I
Mechanical Technology I

15 E I

පැය දෙකයි
இரண்டு மணித்தியாலம்
Two hours

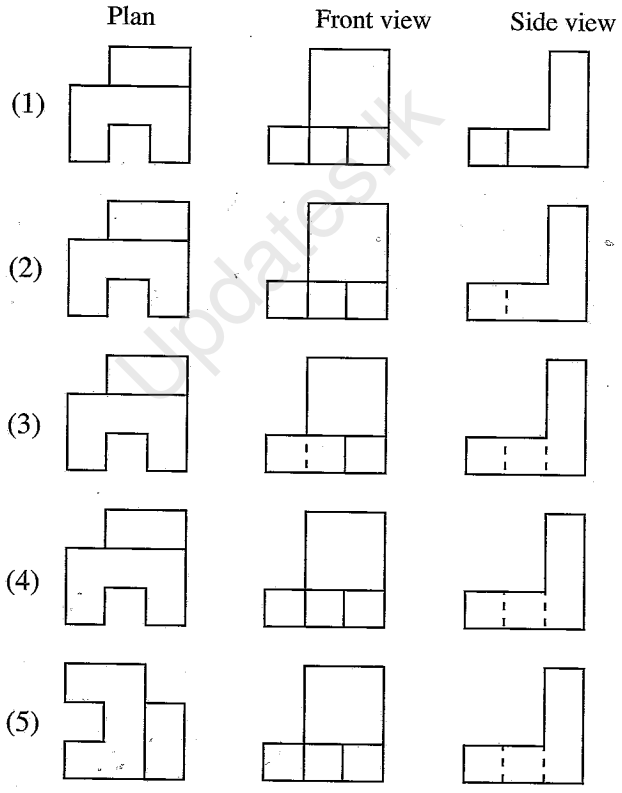
Instructions:

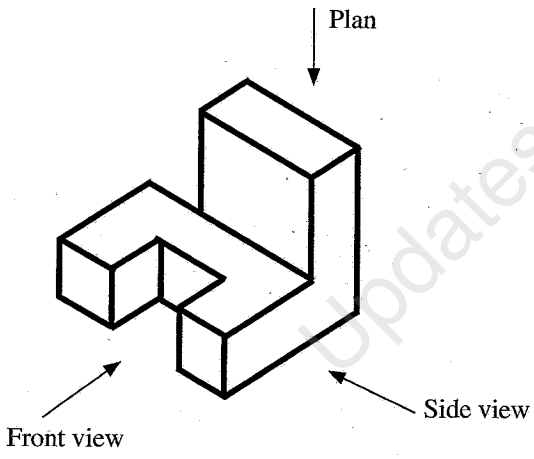
- *Answer **all** the questions.*
- *Write your **Index Number** in the space provided in the answer sheet.*
- *Instructions are given on the back of the answer sheet. Follow them carefully.*
- *In each of the questions **1** to **50**, pick one of the alternatives from (1), (2), (3), (4), (5) which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

1. Which of the following chair designs best promotes ergonomic posture for a prolonged computer user?

(1) Chair with a straight backrest and no armrests
(2) Chair with lumbar support and adjustable armrests
(3) Chair with no backrest and no armrests
(4) Chair with a reclining backrest but no seat height adjustment
(5) Chair with a hard, flat seat and fixed armrests

2. Which answer shows the correct third angle projection views of the given isometric view?





[See page two

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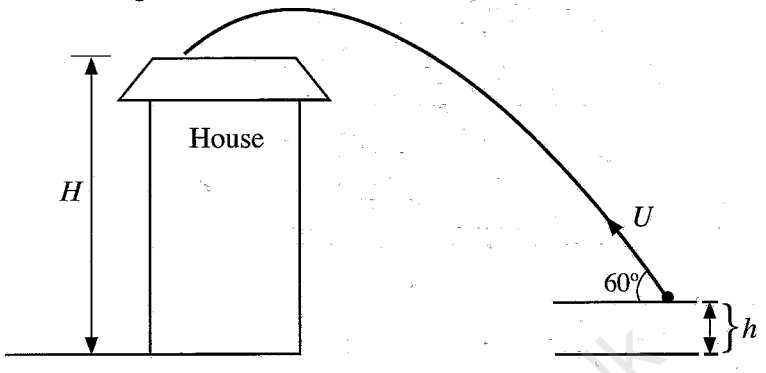
3. A person throw a ball from h height above the ground. Its initial velocity U is as shown in the figure. The ball fell onto a roof of a nearby house. The height from ground to roof is H. The time taken for the motion is t. (gravitational acceleration - g)



Which option shows the correct height (H) of the house from ground to roof?

(1) $H = 2\ h + U\ t \sin 60$

(2) $H = U\ t \cos 60$

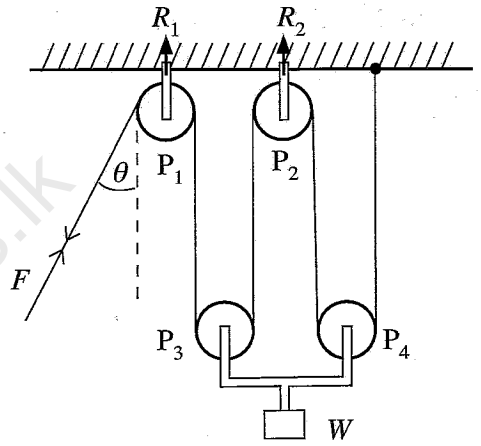
(3) $H = U\ t \sin 60 + \frac{1}{2} gt^2$

(4) $H = U\ t \cos 60 - \frac{1}{2} gt^2$

(5) $H = h + U\ t \sin 60 - \frac{1}{2} gt^2$

● Answer the question No. **4** and **5** using below figure.

A frictionless pulley system is shown in the figure. Assume the cable is non-elastic. Neglect the weight of pulleys and the cable. F is the minimum force to keep the system equilibrium.



4. The correct statement about the above pulley system is

(1) $F = \frac{W}{4}$. (2) $F = W$. (3) $7F = \frac{1}{2}W$.

(4) $F = 4W$. (5) $3F = 2W$.

5. R_1 and R_2 are reaction forces from the pulleys P_1 and P_2. R_1 and R_2 respectively are,

(1) $2F\ \text{Cos}\theta$, $2F$.

(2) $F\ \text{Cos}\theta$, F .

(3) $F + F\ \text{Cos}\theta$, $2F$.

(4) F, $2F\ \text{Cos}\theta$.

(5) $F\ \text{Sin}\theta$, $2F$.

[See page three

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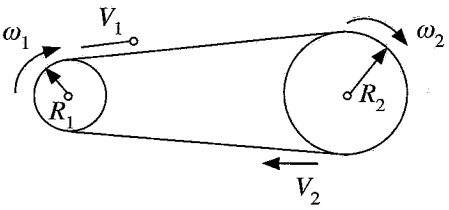
6. Which answer gives the correct unit of below physical quantities?

	luminous intensity	Solid angle	Frequency
(1)	S	C	W
(2)	cd	Sr	Hz
(3)	Sr	rad	S
(4)	cd	S	Hz
(5)	Sr	rad	cd

7.



A belt drive is given in the figure. If the belt weight is **not** considered, which statement is correct?

(1) $V_1 = V_2$, $\frac{R_1}{R_2} = \frac{\omega_2}{\omega_1}$

(2) $V_1 > V_2$, $\frac{R_1}{R_2} = \frac{\omega_1}{\omega_2}$

(3) $V_1 = V_2$, $R_1 R_2 = \omega_1 \omega_2$

(4) $V_1 < V_2$, $\frac{1}{R_1 R_2} = \omega_1 \omega_2$

(5) $V_1 < V_2$, $R_1 \omega_2 = R_2 \omega_1$

8. Select the correct statement relevant to the building regulations of Sri Lanka.

(1) There is no minimum site area requirement for the construction of a house in a land.

(2) In general, the maximum plot coverage by a house in a land is 33.3%.

(3) The minimum rear open space distance that should be provided for a single storey house is 3m.

(4) Construction boundary wall shall only be permitted along the building line of a land.

(5) The minimum height of bed rooms and living rooms shall be maintained as 2.7 m unless those are mechanically ventilated.

9. What is **not** an attribute of a successful entrepreneur?

(1) Flexibility (2) Self awareness (3) Dedication
(4) Leadership (5) Risk free approach

10. Consider the following statements.

A - Sulphuric acid is primarily used to make phosphoric acid in industrial applications.
B - Sodium hydroxide is one of the top five most common industrial chemicals.
C - Ammonia is only artificially produced and not found naturally in the environment.
D - Ethylene is commonly used in the food industry for quick-cooling processes.

Out of the above, what are true regarding chemicals used in industries?

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

[*See page four*

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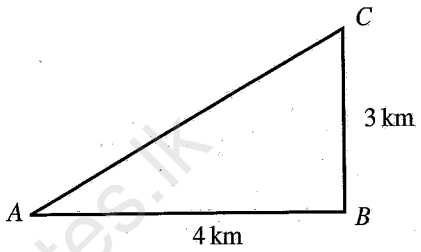
11. A father has divided his land with an extent of 5 hectares and 100 m^2 among his two sons. The elder got an extent of 2 hectares and 50 m^2. What is the extent of land given to the younger son in acres and perches?

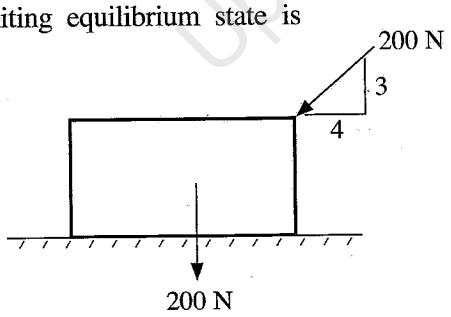
(1) 6 acres and 10 perches. (2) 7 acres and 68 perches.
(3) 8 acres and 65 perches. (4) 9 acres and 72 perches.
(5) 10 acres and 13 perches.

12. The figure shows right triangle *ABC*. Calculate the length of *AC* in miles.

(1) 2.9 miles (2) 3 miles (3) 3.1 miles
(4) 3.2 miles (5) 3.3 miles



13. A uniform crate has a weight of 200 N (approximately equal to 20 kg) and it is pushed with a force of 200 N (refer figure). Coefficient of static friction between the crate and ground is 0.25. The friction force at the limiting equilibrium state is



(1) 20 N. (2) 24 N. (3) 80 N. (4) 95 N. (5) 160 N.

14. A concrete mix of 1:3:6 (20 mm) is recommended to concreting in

(1) slabs. (2) beams. (3) columns.
(4) foundations. (5) lean concrete work.

15. Consider the following statements regarding trusses.

A - Trusses are used in building roofs and bridges.
B - Steel and timber are used in truss construction.
C - When the truss span is larger, truss height also higher.
D - Bottom chord of a truss is subjected to tensile forces.

Which of the above statements are true?

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

[*See page five*

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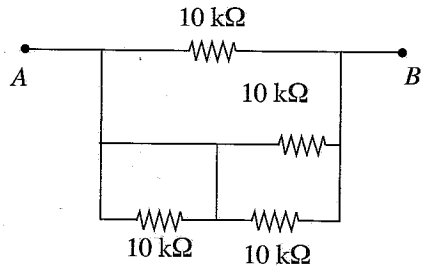
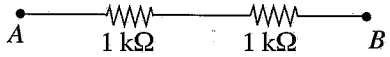
16. A group of students is observing about a resistor bank with highest resistance between A and B. Select the suitable resistor network.

(1)



(2)



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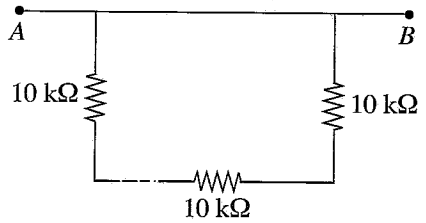

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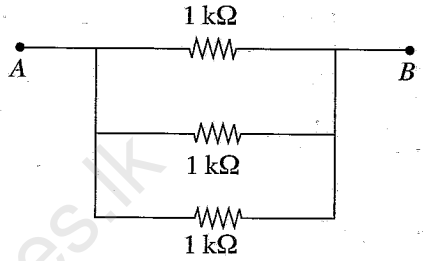

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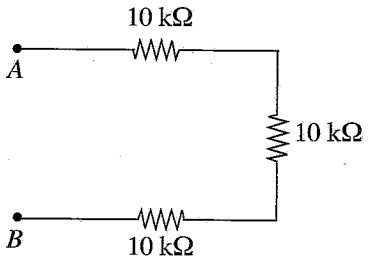


17. A resistor of 10 Ω is connected to a DC source. Its power dissipation is 250 W. What is the voltage of the source?

(1) 5 V (2) 25 V (3) 50 V (4) 100 V (5) 500 V

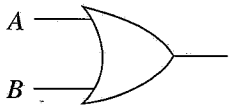
18. What is the item which is **not** included in a domestic electrical installation?

(1) bulb (2) socket outlet (3) switch
(4) two way switch (5) oscilloscope

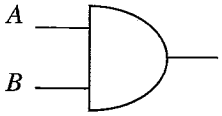
19. Select the logic gate for the following truth table.

Inputs		Outputs
A	B	
0	1	1
1	0	1
1	1	1
0	0	0

(1)



(2)



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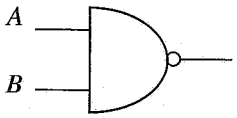

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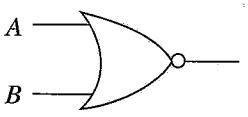

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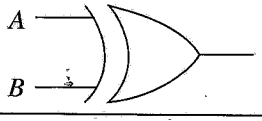

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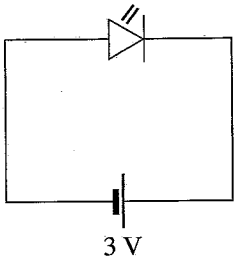
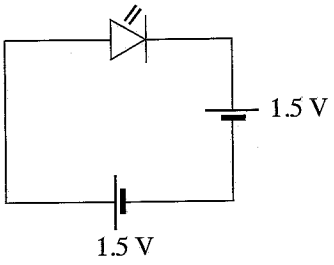
20. From the following circuits which one demonstrates the LED is on?

(1)



(2)



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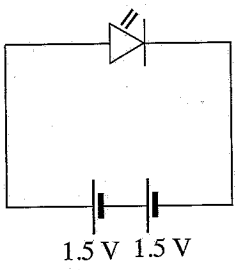
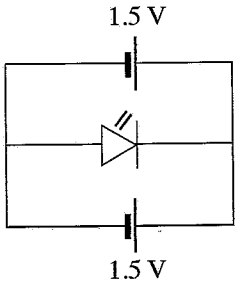


(4)



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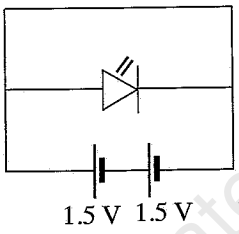
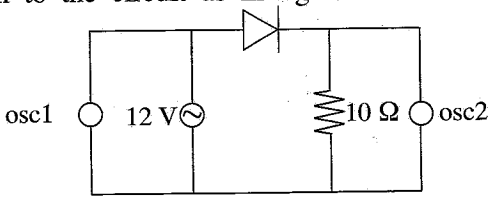


21. What are the SI units used for electrical power and energy respectively?

(1) W , J (2) V , A (3) W , A

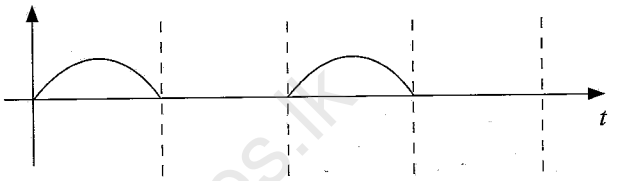
(4) kg m s^{-1} , N m s^{-2} (5) V , m s^{-1}

- Considering following rectifier circuit and answer the questions **22** and **23**. Two oscilloscopes (osc1 and osc2) are connected in to the circuit as in figure.



22. What is the correct waveform of the first oscilloscope osc1?

(1)



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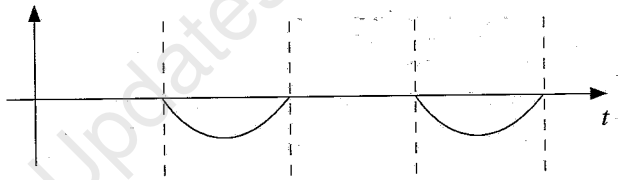

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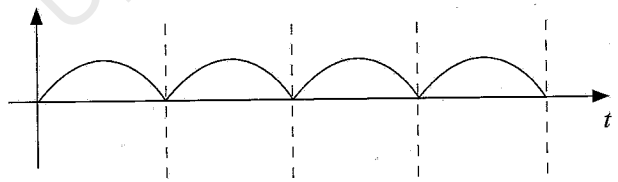

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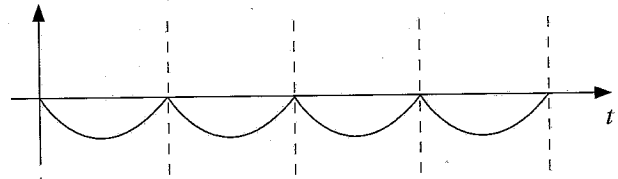

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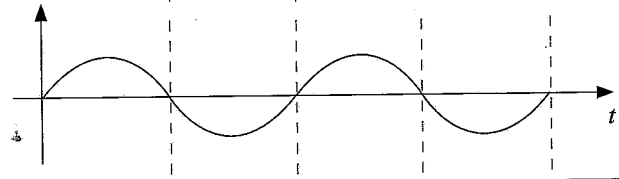

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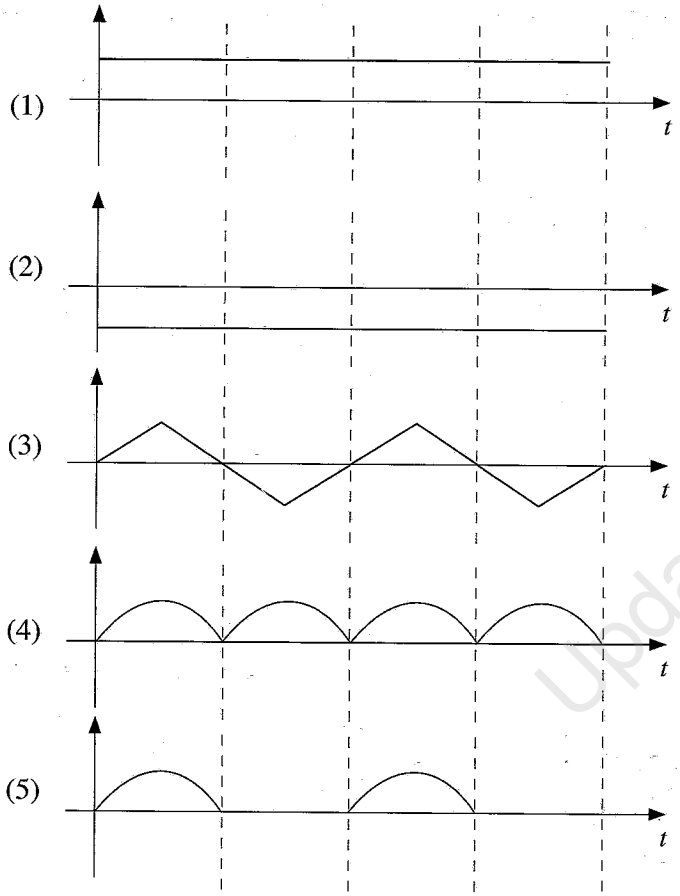
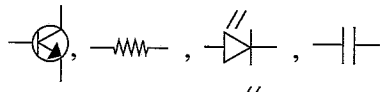
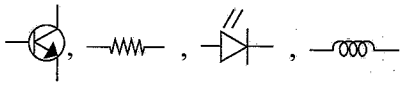
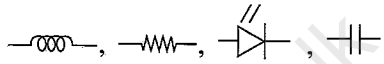
23. What is the correct waveform of the second oscilloscope osc2?

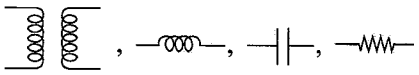


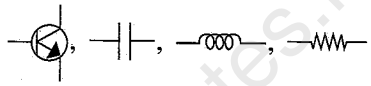
24. Student group is working on identifying transistor, resistor, light emitting diode and capacitor in a circuit. What is the answer with the correct item symbols in order?

(1) 

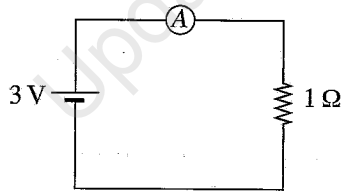
(2) 

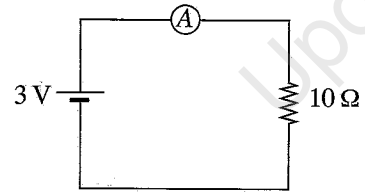
(3) 

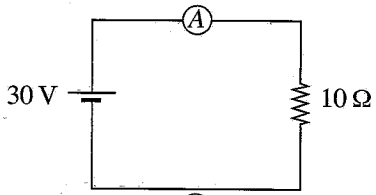
(4) 

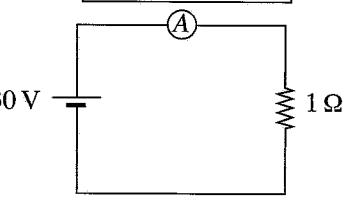
(5) 

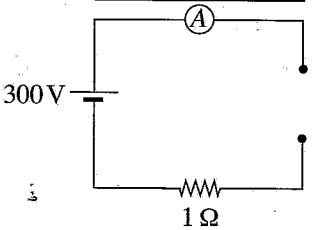
25. Out of the following figures, which shows the correct highest ammeter reading?

(1) 

(2) 

(3) 

(4) 

(5) 

[*See page eight*

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26. Consider the following statements that are related to the placement of different equipment and items in a pantry.

A - When placing the refrigerator, there should be a suitable gap between the wall or pantry cupboard for air circulation.

B - A plug point can be placed near to the sink.

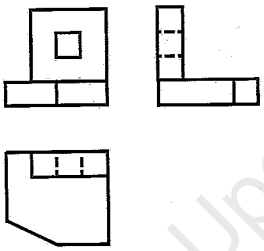
C - Gas cooker/burner can be placed near a window.

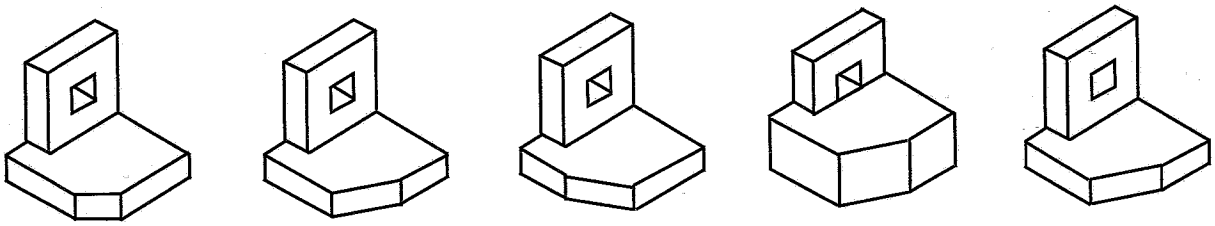
D - Electrical equipment should not be placed near to the sink.

Which of the above statements are correct?

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

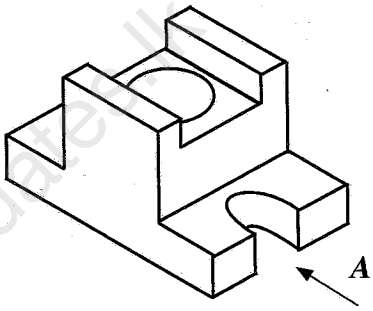
27. Which shows the correct isometric view of the orthogonal projections shown in the figure below?

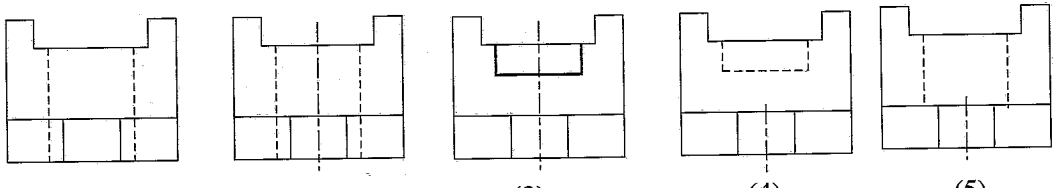




(1) (2) (3) (4) (5)

28. What is the correct orthogonal projection view of the below component when viewed from direction ***A***?





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

29. A car of mass 1500 kg is moving at a speed of 30 $m\,s^{-1}$. If the car comes to rest over a distance of 50 meters, what is the magnitude of the average force acting on the car?

(1) 13 500 N (2) 18 000 N (3) 22 500 N (4) 25 500 N (5) 27 000 N

[*See page nine*

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30. Consider the following statements.

A - Provides stability and control during drive
B - Absorbs shocks from road unevenness
C - Increases fuel efficiency
D - Maintains proper tyre contact with the road

Which of the above statements best describe the primary functions of a vehicle suspension system?

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

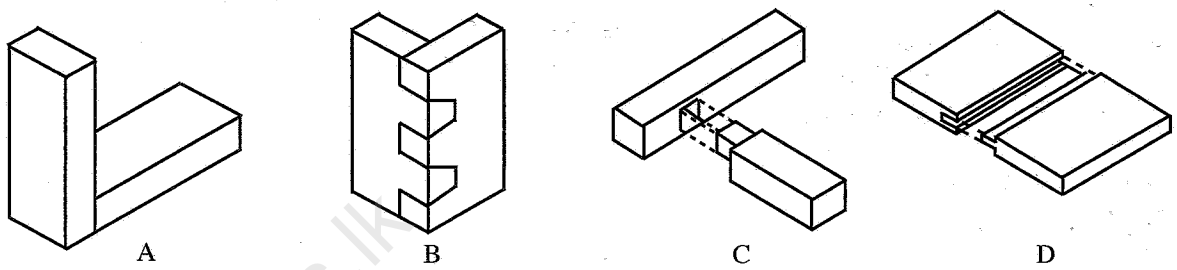
31. Which of the following is a key principle of designing ergonomic tools?

(1) Tools should always be lightweight and portable.
(2) Tools should be designed for the dominant hand only.
(3) Tools should minimize awkward postures and repetitive motions.
(4) Tools should require strong grip for efficiency.
(5) Tools should have short handles for increased precision.

32. Which ergonomic intervention is best suited for reducing the risk of repetitive strain injury for assembly line workers of a factory?

(1) Providing anti-fatigue mats
(2) Increasing worker productivity quotas
(3) Installing air conditioners
(4) Offering free gymnasium memberships
(5) Introducing job rotation

33. Which answer states the correct order of the names of the following wood joints?



(1) Lap joint, Corner joint, Tongue and Grove joint, Slot joint
(2) Butt joint, Dovetail joint, Mortise and Tennon joint, Tongue and Grove joint
(3) Mortise and Tennon joint, Butt joint, Dovetail joint, Tongue and Grove joint
(4) Butt joint, Dovetail joint, Tongue and Grove joint, Mortise and Tennon joint
(5) Lap joint, Dovetail joint, Mortise and Tennon joint, Tongue and Grove joint

[*See page ten*

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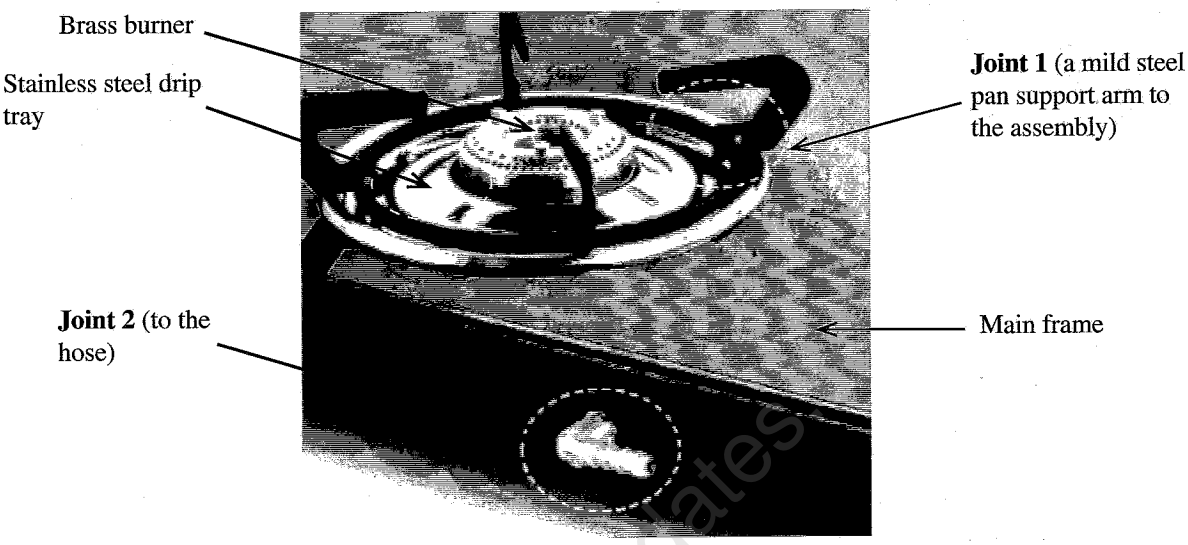
● Figure shows a domestic gas cooker model commonly used in Sri Lanka. Referring to the figure answer **34, 35** and **36**.



34. What is the most appropriate joining/assembly methods for '**Joint 1**' and '**Joint 2**' respectively?
(1) Welding, press fitting
(2) Welding, hose clip
(3) Riveting, hose clip
(4) Screwing, hose clip
(5) Nut and bolt, hose clip

35. Which answer shows the appropriate order of the manufacturing processes in making the drip tray if made in small quantities?
(1) Bending, Drilling, Cutting
(2) Cutting, Bending, Drilling
(3) Cutting, Drilling, Bending
(4) Bending, Cutting, Drilling
(5) Drilling, Cutting, Bending

36. Which answer shows the appropriate order of manufacturing processes in making the Brass Burner?
(1) Casting, Turning, Drilling, Grinding
(2) Turning, Casting, Drilling, Grinding
(3) Grinding, Turning, Casting, Drilling
(4) Casting, Drilling, Turning, Grinding
(5) Casting, Grinding, Drilling, Turning

37. In a gear box, gear *A* has 50 teeth and is driven by an input shaft rotating at 1800 rpm. Gear *B* is mounted on the same shaft as gear *A* and has 20 teeth. Gear *B* meshes with gear *C*, which has 100 teeth. If gear *C* is driving a final output gear (gear *D*) with 50 teeth, what is the speed of the output shaft attached to gear *D*?
(1) 360 rpm (2) 450 rpm (3) 720 rpm (4) 900 rpm (5) 1800 rpm

38. An object of 5 kg is moving with a velocity of 10 $m\,s^{-1}$. What is the kinetic energy of object?
(1) 50 J (2) 100 J (3) 200 J (4) 250 J (5) 500 J

39. A block of mass 10 kg is moving on a horizontal surface with an initial velocity of 5 $m\,s^{-1}$. If the coefficient of kinetic friction between the block and the surface is 0.2, what is the frictional force acting on the block? (Take $g = 9.8\ m\,s^{-2}$)
(1) 9.8 N (2) 19.6 N (3) 39.2 N (4) 49.0 N (5) 98.0 N

[*See page eleven*

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40. Which of the following statements is **incorrect** when compairing two stroke Otto engines with four stroke Otto engine?

(1) Low power to weight ratio
(2) High emission level
(3) Less energy fluctuation at the crank shaft
(4) High thermal efficiency
(5) Higher power output for a given cylinder capacity

41. Consider the following statements about a spark ignition engine operating at partial load.

A - Low effective compression ratio
B - High effective compression ratio
C - Low efficiency
D - High efficiency

Out of the above, which statements are correct?

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

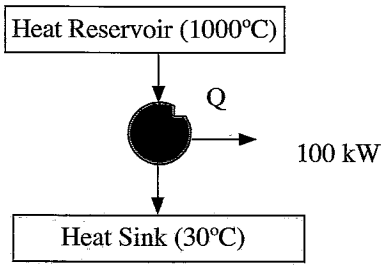
42. The primary role of the venturi (a convergent-divergent nozzle) inside the carburetor is

(1) decrease the air velocity.
(2) increase pressure drop at air suction side.
(3) increase the compression ratio.
(4) decrease the volumetric efficiency.
(5) evaporating gasoline by reducing the air pressure.

43. The calorific value of a fuel used in internal combustion engines helps to determine

(1) the mechanical work output of the engine.
(2) the Octane or Cetane number of the fuel.
(3) the compression ratio of the engine.
(4) the self-ignition temperature of the fuel.
(5) the capacity of the engine.

44.



An ideal thermal power cycle (Carnot) operates between a heat reservoir and a heat sink, as shown in the figure above. If the required mechanical power (P) is 100 kW, the minimum heat flow (Q) required, in kW, is

(1) -104 kW. (2) 0.97 kW. (3) 100 kW. (4) 104 kW. (5) 132 kW.

[*See page twelve*

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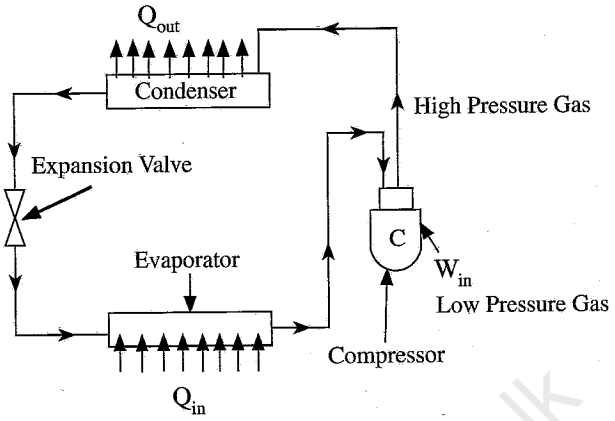
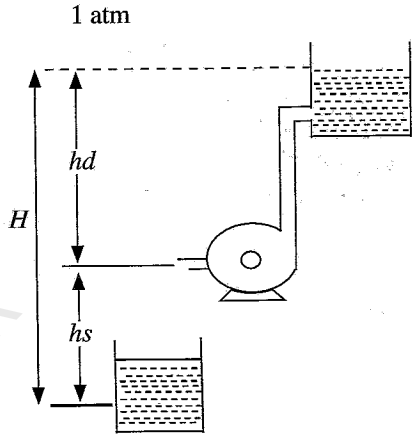
● Answer the questions **45** and **46** using the figure below.



45. A vapour compression chiller, as schematically shown above, meets a cooling demand (Q_{in}) of 500 kW while consuming 200 kW of electricity (W_{in}). The total heat rejected by the condenser (W_{out}) is
(1) 2.5 kW. (2) 200 kW. (3) 300 kW. (4) 500 kW. (5) 700 kW.

46. If the coefficient of performance (COP) of the above chiller is 3, what is the electricity demand when it handles a cooling load (Q_{in}) of 300 kW?
(1) 3 kW (2) 100 kW (3) 303 kW (4) 400 kW (5) 900 kW

● Answer the question **47** using the following diagram.



47. If the atmospheric pressure is 10 m in a water barometer, what is the maximum possible depth of the well, indicated as '*hs*,' in above figure when a centrifugal pump is connected to a high capacity motor?
(1) *H* m (2) *H*-10 m (3) 10 m (4) *H*/10 m (5) 3*H*/2 m

48. Consider the following statements.
A - The workpiece rotates while the cutting tool moves linearly
B - Used to create cylindrical shapes
C - High material removal rates when compared to milling
D - Typically perform on non-metallic materials only
Which of the above are characteristics of turning operations in machining?
(1) *A* and *B* only. (2) *A* and *C* only. (3) *A*, *B* and *C* only.
(4) *A*, *B* and *D* only. (5) *A*, *B*, *C* and *D* all.

[*See page thirteen*

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49. Which factor is must be crucially considered in reducing musculoskeletal disorders in a manufacturing workstation?

(1) Adjustable work surface height
(2) Proper lighting and ventilation
(3) Use of noise-canceling equipment
(4) Implementation of regular breaks
(5) Introduction of air-purification systems

50. Which of the following is an advantage of the forging process?

(1) High dimensional accuracy without the need for machining
(2) Improved grain structure and strength of the material
(3) Reduced material wastage due to precision moulds
(4) Ability to produce complex internal cavities
(5) Lower energy consumption compared to casting processes

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

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இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2024
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2024
General Certificate of Education (Adv. Level) Examination, 2024

යාන්ත්‍රික තාක්ෂණවේදය II பொறிமுறைத் தொழினுட்பவியல் II **Mechanical Technology II**	**15 E II**

පැය තුනයි மூன்று மணித்தியாலம் ***Three hours***	අමතර කියවීම් කාලය - මිනිත්තු 10 යි மேலதிக 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. : .....

Important :

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

Part A - Structured Essay (08 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.*

Part B and C - Essay (04 pages)

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

For Examiner's Use Only

Part	Q. No.	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
C	8	
	9	
	10	
Total		

Total

In Numbers	
In Words	

Code Numbers

Marking Examiner 1	
Marking Examiner 2	
Checked by	
Supervised by	

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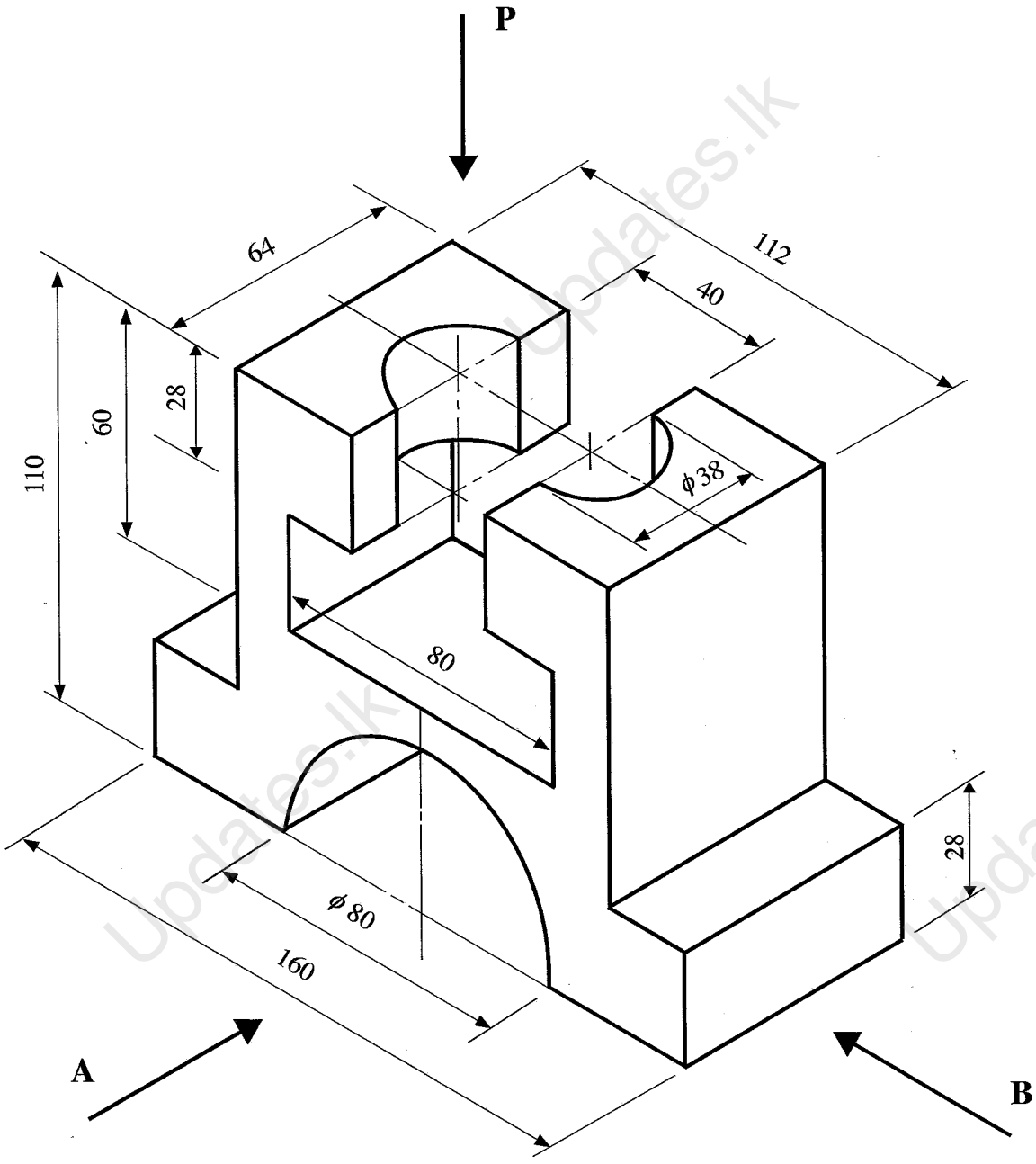
PART A – Structured Essay

*Answer **all** questions on this **paper itself**.*

*(Each question carries **10** marks)*

1. Draw the third-angle orthogonal projection views of the isometric view given in the figure using an appropriate scale. Indicate all relevant dimensions. Use the graph papers given on pages 3 and 4. All dimensions are in millimetres. The figure is not drawn in to scale.



(a) Front elevation looking from **A**

(b) End elevation looking from **B**

(c) The plan view of **P**

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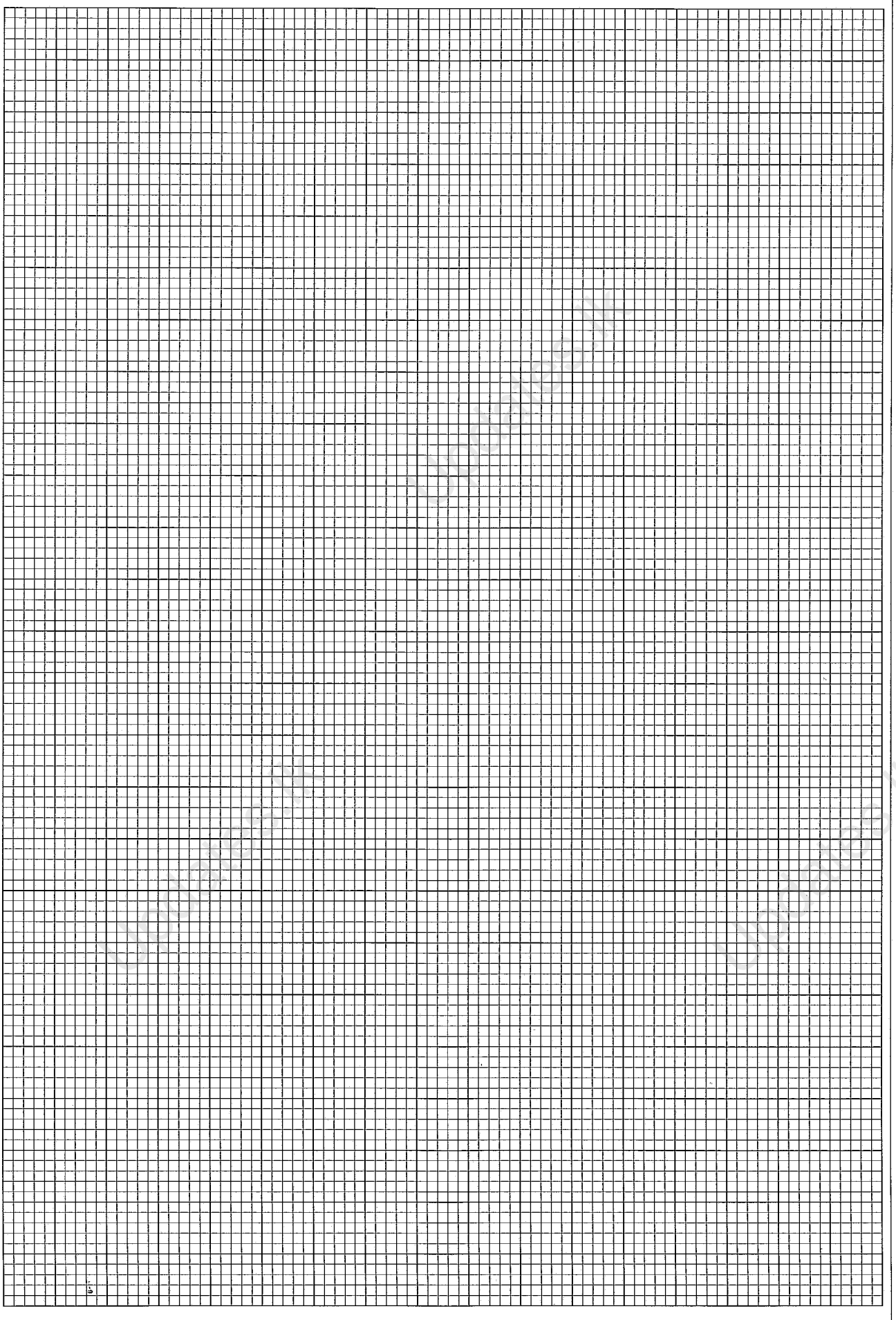

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2. There is a proposal to convert electronics laboratory of *ABC* school to a smart learning environment. Assume that you are appointed as the relevant technical officer for this project.

(a) (i) Forty laptop computers are to be purchased. Write suitable specification for the laptops.

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(ii) List **three** software for a laptop.

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(b) The school is planning to provide internet access to each laptop. List **two** suitable methods for this purpose.

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(c) There is a plan to describe the laboratory work by a teacher using examples, connections and operations through modern tools.

(i) State **one** hardware item for this purpose.

.....

(ii) Suggest **one** approach for interactively editing laboratory reports with the student groups.

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(d) Facilities will be available to conduct interactive sessions by external experts in realtime remotely. The experts will conduct sessions from their places and students will be in smart learning environment.

(i) State **two** hardware items required for facilitating this.

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(ii) State **one** possible software tool for above (d) (i).

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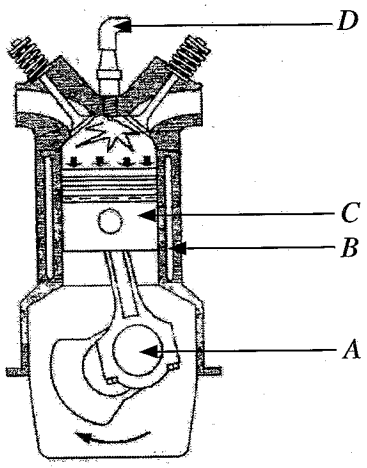
3. Figure shows the diagram of a four stroke Otto engine.



(a) Identify parts *A*, *B*, *C* and *D* given in the figure and write the appropriate letter along with the name.

(i) Cylinder - .....

(ii) Piston - .....

(iii) Crankshaft - .....

(iv) Spark plug - .....

(b) State the function of the each part given.

(i) Cylinder - .....

(ii) Piston - .....

(iii) Crankshaft - .....

(iv) Spark plug - .....

(c) State **three** advantages and disadvantages of four stroke Otto engines compaired to two stroke spark ignition engines.

	Advantages	Disadvantages
(i)	.....	.....
	.....	.....
(ii)	.....	.....
	.....	.....
(iii)	.....	.....
	.....	.....

(d) If the stroke length (L) = 5 cm, cylinder cross section is (A) = 10 cm^2 and clearance volume (V_4) = 5 cm^3, calculate, the followings.

(i) the swept volume of the engine

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(ii) compression ratio of the engine

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(iii) Air volume flow rate in the suction manifold at 3000 RPM (neglect the clearance volume)

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4. A furniture manufacturing company is planning to develop a new line of chairs for office environments. The goal is to design a chair that is both comfortable and supportive for a wide range of users, considering the diversity in body sizes, weights, and work habits of employees. The chair will be used by workers seating in variety of postures, who typically spend long hours seated.

(a) Identify **three** Ergonomic factors that should be considered when designing the chair.

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(b) State **two** reasons for the importance of considering above factors in (a).

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(c) List **four** key body measurements that should be considered when designing the chair to ensure that the chair is adaptable to users with diverse body size.

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(d) Briefly explain **two** factors that should be considered when selecting materials for the seat of the chair.

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[see page nine

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ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2024
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2024
General Certificate of Education (Adv. Level) Examination, 2024

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பொறிமுறைத் தொழினுட்பவியல்	II
Mechanical Technology	**II**

15 E II

Essay

* *Select* ***two*** *questions from each of the* ***Parts*** **B** *and* **C** *and answer* ***four*** *questions only.*
(Each question carries ***15*** *marks.)*

Part B

5. Use of advanced technologies such as robotics has become popular in the modern agriculture. Drones are used to distribute pesticides, weddicides and fertilizer and also monitoring plant health and variety of other tasks.

(a) State **two** other modern technologies that are used presently in agriculture.

(b) Briefly explain **three** advantages of using modern technologies in agriculture.

(c) Explain **two** barriers to use such advanced technologies in the Sri Lankan context.

(d) Propose **two** suggestions to overcome above barriers mentioned in (c).

6. Sri Lanka has been experiencing many severe floods in the recent history that have caused significant damages to infrastructures, communities and the economy. These floods are influenced by both natural and human-made factors, highlighting the country's vulnerability to extreme weather events.

(a) State **two** natural and **two** human activities that contributed to the recent floods in Sri Lanka.

(b) Explain the social, economic and environmental impacts occurred due to recent floods in Sri Lanka.

(c) Describe **two** measures implemented by the relevant authorities in response to those floods with effectiveness of these measures and highlighting challenges faced in their implementation.

(d) Propose a long-term strategy to mitigate the impact of future floods in Sri Lanka and explain its potential benefits.

7. The available energy sources and their effective use are critical in achieving sustainable development.

(a) List **five** energy sources that are currently used in Sri Lanka.

(b) Briefly describe pros and cons of **three** energy sources from above (a).

(c) Critically evaluate how we could use energy sources by considering **two** examples. Use relevant sketches of machines and setups related to operation. Clearly label the components.

[see page ten

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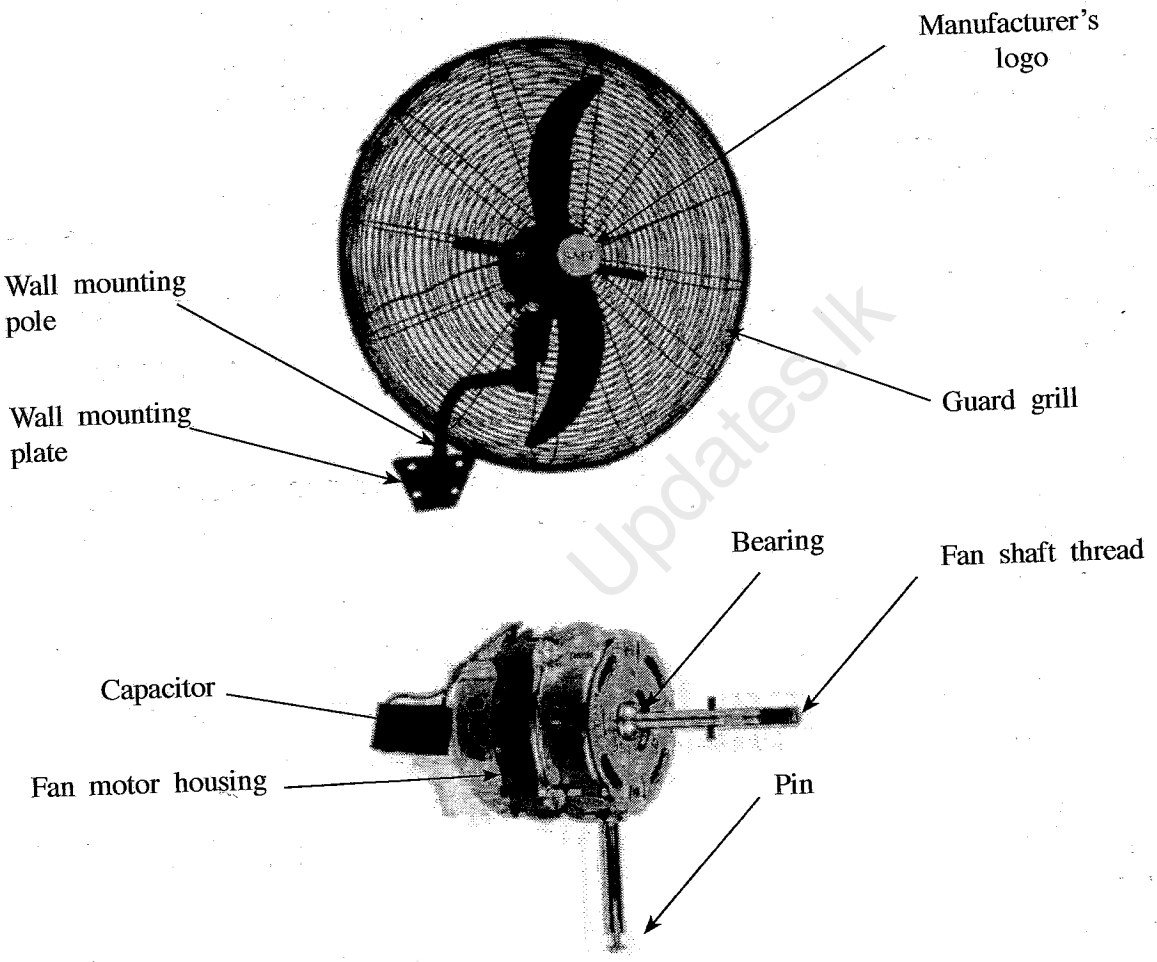
Part C

8.



(a) List potential materials to be used to make the following components.
  (i) Guard grill
  (ii) Wall mounting plate
  (iii) Manufacturer's logo

(b) Explain briefly the external thread making process of the fan shaft.

(c) List **four** manufacturing processes involved in manufacturing the fan motor housing.

(d) Briefly explain the purposes of using the 'Capacitor' and the 'Pin'.

(e) List possible joining methods to the following joints in the fan.
  (i) Wall mounting plate to wall mounting pole
  (ii) Front guard grill to the back guard grill
  (iii) Fan blade to the fan shaft

[see page eleven

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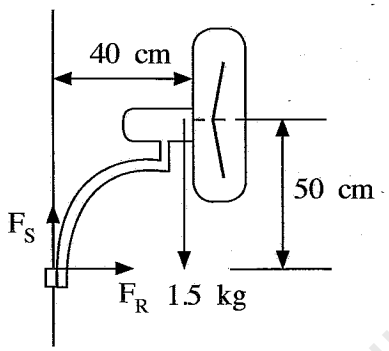
(f) The fan is mounted to the wall with anchor bolts. The mass of the fan can be taken as 1.5 kg. The centre of gravity is 40 cm away (horizontally) from the wall and 50 cm away (vertically) from the mounting point.



(i) Calculate the force marked as F_S (vertical force acting on the fan mounting plate) in Newtons.

(ii) Calculate the force marked as F_R (horizontal force acting on the fan mounting plate) in Newtons.

9.

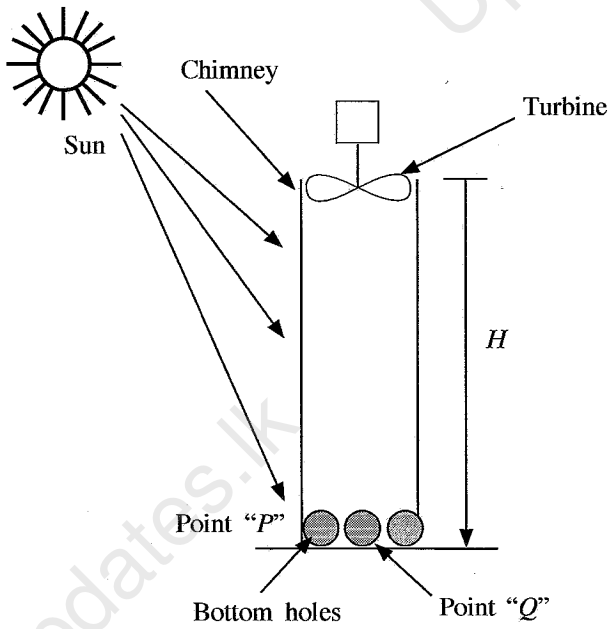


Figure illustrates a solar energy harnessing system designed to generate electricity. Solar irradiance falls onto a vertical cylinder painted in black. This black surface heats the air inside the cylinder, raising it to a uniform temperature. The heated air moves upward with a steady velocity, turning the turbine located at the top of the cylinder. This turbine is connected to a generator, which produces electricity. Points "*P*" and "*Q*" indicate positions outside and inside of the chimney, respectively.

(i) State **two** important properties expected from the black surface of the cylinder.

(ii) Draw the graph of the pressure variation along the chimney height if the chimney and the air inside the chimney have uniform temperatures.

(iii) If the air density inside and outside of the chimney are ρ_{in} and ρ_{out} respectively, considering information given in the figure, calculate the pressure difference inside and outside the chimney at the bottom, (gravitational acceleration is g).

(iv) If the cross-section area of the chimney is "*A*" calculate the net upward thrust on the turbine.

[see page twelve

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10. A vehicle ignition system is a fundamental part of internal combustion engines, responsible for creating the high-voltage spark needed to ignite the air-fuel mixture within the engine's combustion chamber. This spark is crucial for starting the engine and ensuring efficient engine operation. Answer the following questions to explore both conventional and modern ignition systems.

(a) Briefly describe the function of **four** main components in a traditional (conventional) ignition system.

(b) Explain how a modern electronic ignition system operates highlighting the role of electronic control components and sensors.

(c) Explain how an electronic ignition system enhances overall engine performance. Consider factors like fuel efficiency, reliability and power output in your answer.

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