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இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2025
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2025
General Certificate of Education (Adv. Level) Examination, 2025

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 in 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. What is the SI unit used for electrical power?
   (1) A (2) V (3) J (4) W (5) Nm

2. The item which is needed in domestic electrical installations is,
   (1) ammeter. (2) voltmeter. (3) socket outlet. (4) multimeter. (5) oscilloscope.

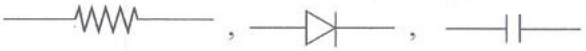
3. Select the answer with correct symbols for resistor, capacitor and diode in order.

   (1) 

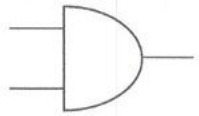
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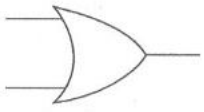
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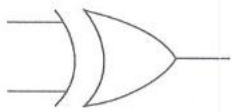
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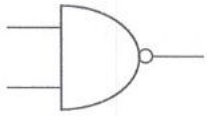
   (5) 

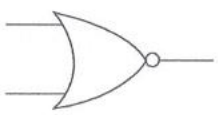
4. Out of the below circuits, which logic gate's output is high only when both inputs are logic '1'?

   (1) 

   (2) 

   (3) 

   (4) 

   (5) 

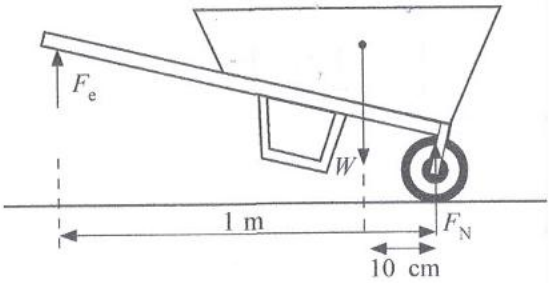
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● Answer the question **5** and **6** using below figure.

A wheelbarrow used to transport sand in a construction site is shown in the figure. The combined weight (W) of the wheelbarrow and sand is 40 kg. The combined weight has a perpendicular distance of 10 cm and the force generated from hand (F_e) has a perpendicular distance of 1 m from the axis of the wheel as shown in the figure. Consider acceleration of gravity as 10 m s^{-2}.



5. What is the upward force (F_e) that should be applied by the operator to lift the load?
(1) 40 N (2) 80 N (3) 100 N (4) 200 N (5) 400 N

6. Force exerted by the wheel (F_N) on the ground is,
(1) 40 N. (2) 200 N. (3) 360 N. (4) 400 N. (5) 440 N.

7. Consider the following statements.
A - Coarse aggregate is not used in cement blocks.
B - Hollow blocks are lighter than solid blocks.
C - Fine aggregate should be carefully selected for making cement blocks.
D - Cement to sand ratio 1:15 can be recommended.
Which of the above statements are true regarding solid and hollow cement blocks?
(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.

8. Consider the following statements about deceleration.
A - Its SI unit is m s^{-2}.
B - It is a scalar quantity.
C - It can be calculated by rate of change of velocity.
D - It has the same units as acceleration.
Out of the above, which statements are correct related to deceleration?
(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

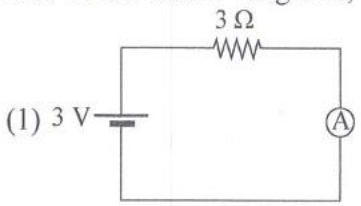
9. A student has calculated the length and the width of his land as 72 m × 23 m, respectively. His grandfather wants to know the extent in Perches. The correct extent of the land is,
(1) 65.47 Perch. (2) 66.24 Perch. (3) 74.23 Perch.
(4) 86.76 Perch. (5) 112.65 Perch.

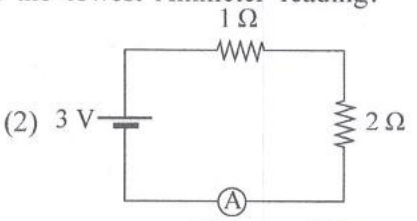
10. A surveyor has measured the distance between point *A* and *B* using the Gunter's chain as 2 chains and 75 links. However, a technician wants to find the distance in meters. The correct value for this distance is,
(1) 49.71 m. (2) 55.32 m. (3) 62.51 m. (4) 72.15 m. (5) 74.97 m.

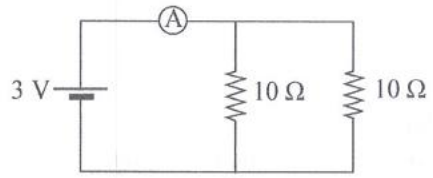
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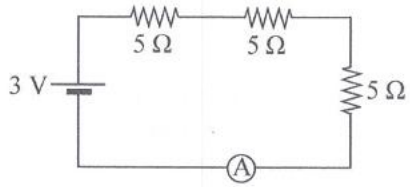
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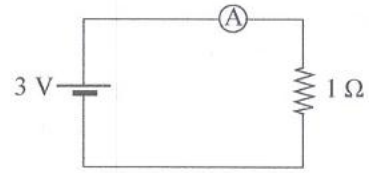
11. Out of the below diagrams, which is the circuit with the lowest Ammeter reading?

(1) 

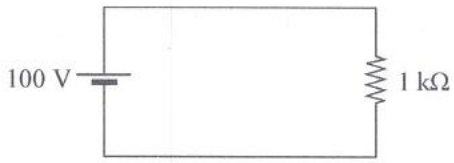
(2) 

(3) 

(4) 

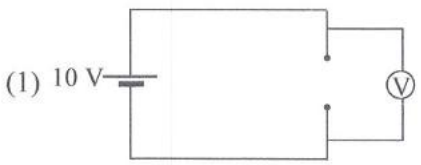
(5) 

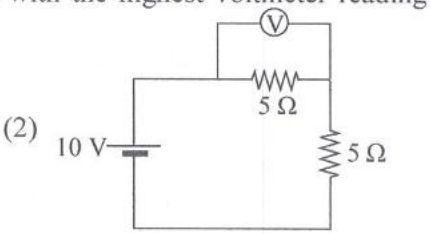
12. A student has tested the below circuit. What is the power dissipation across the resistor?

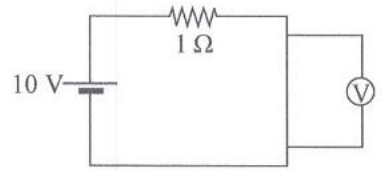


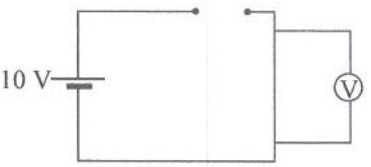
(1) 1 W
(2) 10 W
(3) 100 W
(4) 200 W
(5) 500 W

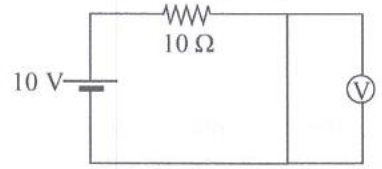
13. Out of the below circuit diagrams, which is the circuit with the highest voltmeter reading?

(1) 

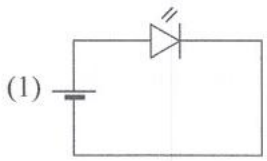
(2) 

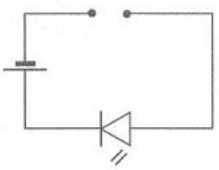
(3) 

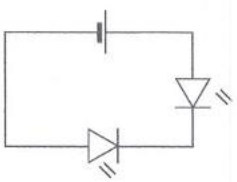
(4) 

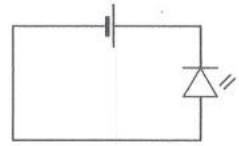
(5) 

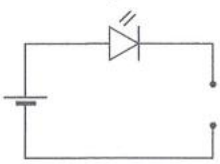
14. Select the circuit in which the LED is ON.

(1) 

(2) 

(3) 

(4) 

(5) 

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15. Consider the below steps.
A - Switching off the main switch of the power supply.
B - Usage of foam spray fire extinguisher to control fire.
C - Usage of Carbon dioxide fire extinguisher to control fire.
Out of the above steps, what are the step/steps that should be taken to control the fire erupted at an office in a construction site?
(1) *B* only. (2) *C* only. (3) *A* and *B* only.
(4) *A* and *C* only. (5) *A*, *B* and *C* all.

16. Consider the following statements.
A - Gypsum is used for manufacturing Plaster of Paris.
B - Portland cement is a compounds that contains of calcium, silica, alumina and iron oxide.
C - Bitumen is petroleum by-product used for road surfacing.
D - Fly ash can be used as a pozzolanic material in cement concrete.
Which of the above statements are true about commonly used construction materials?
(1) *A* and *B* only. (2) *B* and *D* only. (3) *A*, *B* and *C* only.
(4) *A*, *C* and *D* only. (5) *A*, *B*, *C* and *D* all.

17. Consider the following statements.
A - Coefficient of static friction is higher than coefficient of dynamic friction.
B - Friction is not always beneficial to human life.
C - When the weight of an object increases, frictional force is increased.
Which of the above statement/s is/are true regarding friction?
(1) *A* only. (2) *A* and *B* only. (3) *A* and *C* only.
(4) *B* and *C* only. (5) *A*, *B* and *C* only.

18. What is the choice that states the four-strokes of a petrol engine in order?
(1) Intake→Compression→Expansion→Cooling
(2) Intake→Expansion→Compression→Exhaust
(3) Compression→Expansion→Exhaust→Cooling
(4) Intake→Compression→Power→Exhaust
(5) Intake→Power→Expansion→Exhaust

19. The main function of a gearbox of an automobile is to,
(1) increase the speed of the engine.
(2) maintain constant torque at all speeds.
(3) vary torque and speed according to driving requirements.
(4) convert linear motion to rotary motion.
(5) reduce fuel consumption of the vehicle.

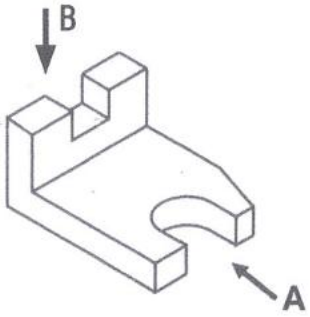
20. When a block rests on a horizontal surface and a gradually increasing horizontal force is applied, which of the following statements correctly describes the nature of friction before the block starts to move?
(1) The frictional force remains constant irrespective of the applied force.
(2) The frictional force decreases as the applied force increases.
(3) The frictional force increases with the applied force up to a certain maximum value.
(4) The frictional force acts in the direction of the applied force.
(5) The frictional force becomes zero just before the block moves.

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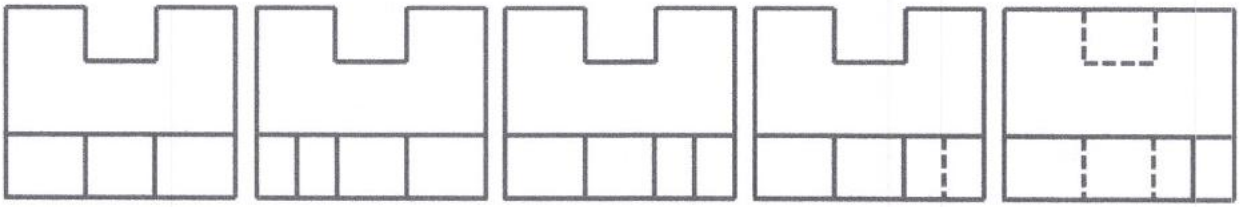
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- Answer question No. **21** and **22** referring to the isometric view of the machine component shown in the figure.

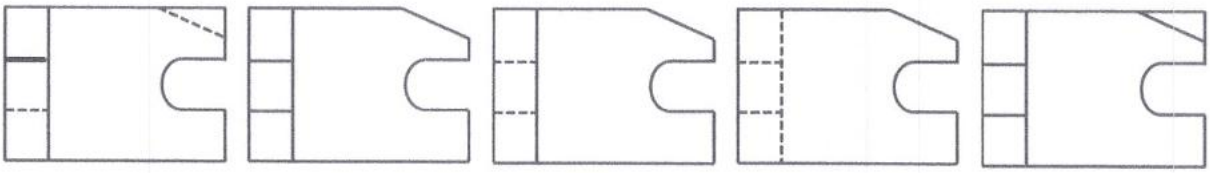


21. What is the correct orthogonal projection when viewed from the direction of arrow **A**?



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

22. What is the correct orthogonal projection when viewed from the arrow **B**?

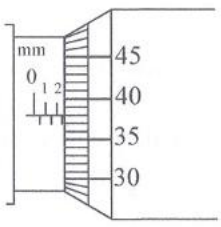


(1) (2) (3) (4) (5)

23. When designing a chair to be used in a computer laboratory, which of the following anthropometric measures is most critical for determining the seat height?

(1) Shoulder height
(2) Elbow rest height
(3) Thigh clearance
(4) Popliteal height
(5) Eye height

24. The figure shows a micrometer screw gauge measurement of a machine component.



What is the reading?

(1) 2.38 mm (2) 2.88 mm (3) 3.38 mm (4) 3.88 mm (5) 5.38 mm

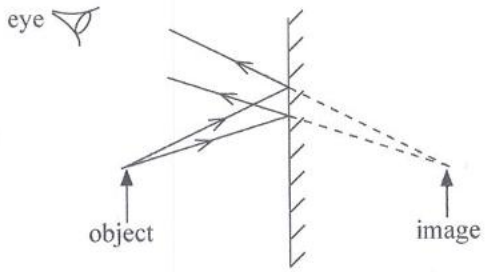
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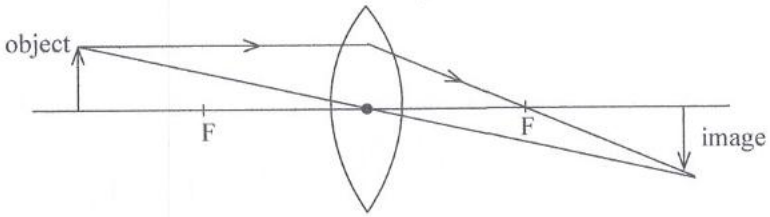
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25. A group of students is studying on behaviour of light rays. According to their observations, following line diagrams are shown below. Which of the below diagrams is **incorrect**?

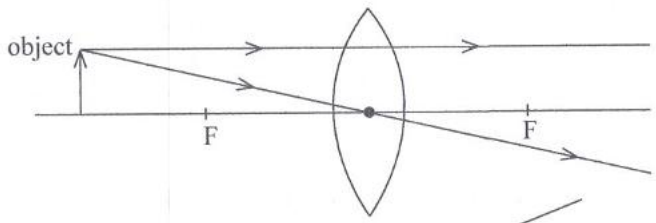
(1)



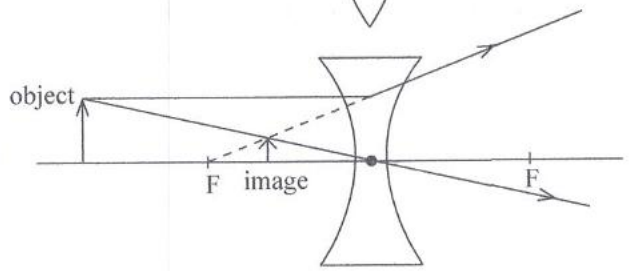
(2)



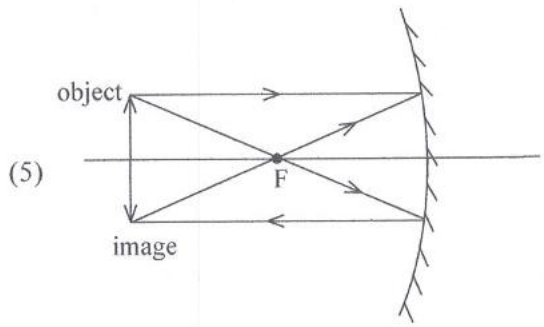
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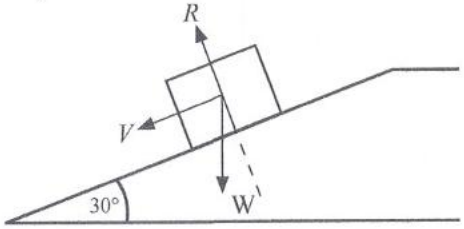
(4)



(5)



26. A uniform wooden crate of 10 kg is unloaded from the back of a truck using an inclined surface as shown in the figure. The inclined surface has an angle of 30° to the ground. If the crate is moving at a uniform velocity, what is the dynamic friction coefficient between the crate and the inclined surface?

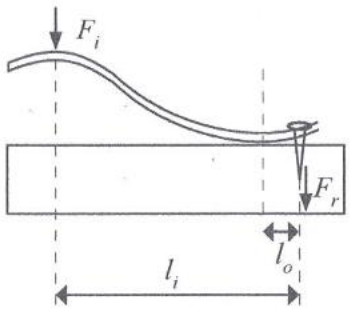


(1) $\frac{1}{2}$ (2) $\frac{1}{\sqrt{3}}$ (3) $\frac{1}{\sqrt{2}}$ (4) $\frac{\sqrt{3}}{2}$ (5) $\sqrt{3}$

[See page seven

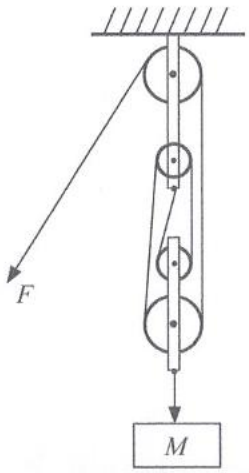
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27. Nail puller uses a simple lever mechanism to multiply the force as shown in the figure. If the resistance force exerted by the nail is F_r, what is the input force (F_i) required to remove the nail?



(1) F_r (2) $\frac{F_r}{l_o}$ (3) $\frac{F_r l_o}{l_i}$ (4) $\frac{F_r l_i}{l_o}$ (5) $\frac{F_r + F_i}{l_i + l_o}$

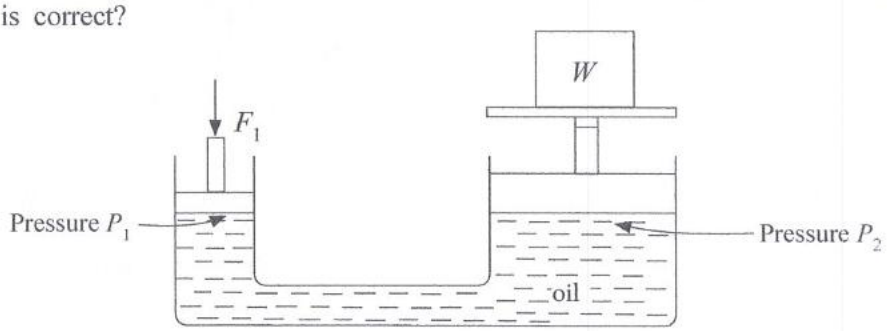
28. A frictionless pulley system is used to raise the load M shown in the figure. Assume the cable is non-elastic and the weight of the pulleys and the cable are negligible. What is the force 'F' required to keep the system in equilibrium?



(1) Mg/4 (2) Mg/2 (3) 2 Mg (4) 4 Mg (5) (M+4) g/4

29. The figure shows a schematic diagram of a hydraulic jack that is used to lift a weight of W. Which of the following statement is correct?

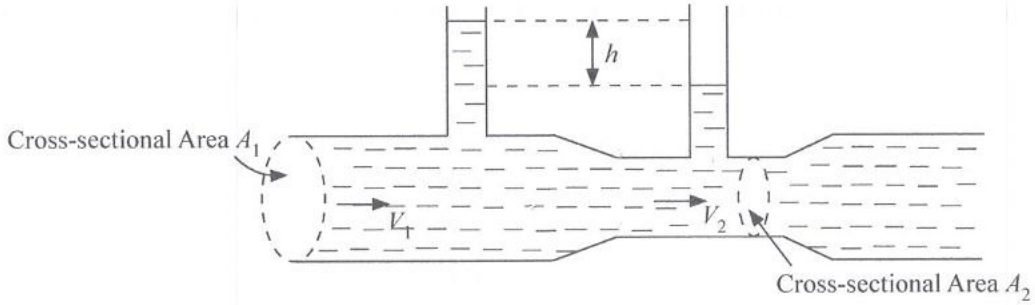
(1) $F_1 = W$ and $P_1 = P_2$
(2) $F_1 > W$ and $P_1 > P_2$
(3) $F_1 < W$ and $P_1 < P_2$
(4) $F_1 < W$ and $P_1 = P_2$
(5) $F_1 > W$ and $P_1 = P_2$



[See page eight

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30. A simple arrangement of a Venturimeter is shown in the figure below.



Consider the following statements regarding above figure.

(A) $A_1V_1 = A_2V_2$

(B) $V_1 = V_2 = \sqrt{2gh}$

(C) Energy per unit mass of fluid is same in both sections

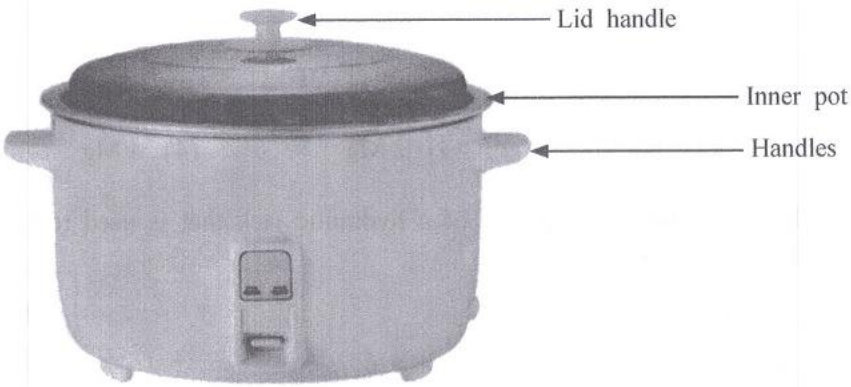
Out of the above, which statements/s is/are correct?

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

31. A cricket ground has a boundary distance of 40 m in all directions from the batting crease. If a batsman standing at the crease hits a ball at an angle 45° to the ground from the ground level, what is the minimum velocity of the ball required when leaving the bat to hit a six. (acceleration of gravity is 10 ms^{-2})

(1) 10 ms^{-1} (2) 15 ms^{-1} (3) 20 ms^{-1} (4) 30 ms^{-1} (5) 40 ms^{-1}

● The figure shows a commonly used domestic rice cooker. Referring to the figure, answer the questions **32**, **33** and **34**.



32. The inner pot of the rice cooker is made of aluminium alloy. Which manufacturing process is the most suitable for producing the inner pot?

(1) Sand casting (2) Deep drawing (3) Die forging
(4) 3-D printing (5) Extrusion

33. The plastic handles are lightweight and heat-resistant, Which manufacturing process is typically used to produce these?

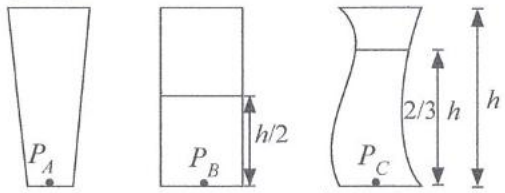
(1) 3-D printing (2) Thermoforming (3) Extrusion
(4) Blow moulding (5) Injection moulding

[*See page nine*

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34. What would be the most suitable joining process for joining the plastic lid handle to the main metal body of the lid?
(1) Riveting
(2) Screw
(3) Adhesive bonding
(4) Snap fits
(5) Welding

35. Consider the following figures.



Three containers A, B and C are used in a lab. All containers have the same height h. A student completely fill the container A with a fluid having the density ρ_0, half of the container B with a fluid having the density of $\rho_1 = 2\ \rho_0$ and 2/3 of the container C with a fluid having the density of ρ_0. Which of the following is true for the pressure at the bottom of the containers?

(1) $P_A = P_B$ and $P_B > P_C$
(2) $P_A = P_B$ and $P_B < P_C$
(3) $P_A = P_B$ and $P_B = P_C$
(4) $P_A > P_B$ and $P_B > P_C$
(5) $P_A < P_B$ and $P_B < P_C$

36. A bicycle is travelling at $5{\cdot}5\ m\ s^{-1}$ velocity. The rider applies a sudden constant force of 150 N by the brakes to stop the bike. Assuming the bike and the rider have a combined mass of 89 kg, what is the approximate braking distance required to completely stop the bicycle? Neglect the effect of air resistance and rider's reaction time.
(1) 8.1 m (2) 8.5 m (3) 9 m (4) 11.5 m (5) 16.8 m

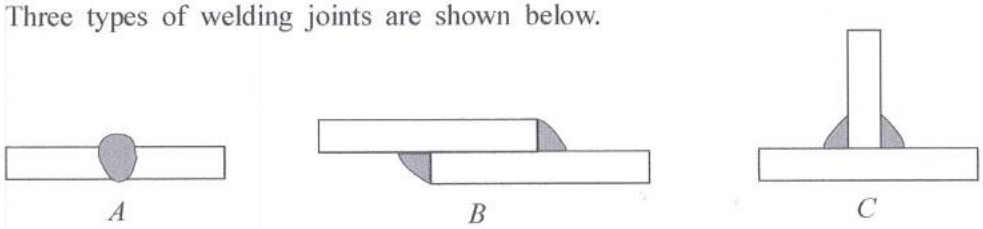
37. Consider the following statements regarding gears.
A - Spur gears are used to transmit power between perpendicular non-intersecting shafts.
B - Bevel gears are used to transmit power between perpendicular intersecting shafts.
C - Helical gears offer smoother and quieter operations than spur gears.
D - A worm and wheel mechanism is typically used to transmit power between parallel shafts.
Out of the above, which statements are correct?
(1) *A* and *B* only
(2) *B* and *C* only
(3) *A*, *B* and *D* only
(4) *A*, *C* and *D* only
(5) *A*, *B*, *C* and *D* all

38. In a heat exchanger of a boiler, copper tubes must be joined to steel sheets. It should ensure leak-tightness and ability to withstand high operating temperatures. What would be the most suitable joining methods for this?
(1) Threaded coupling (2) Adhesive bonding (3) Soldering
(4) Shrink fitting (5) Brazing

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39. Three types of welding joints are shown below.

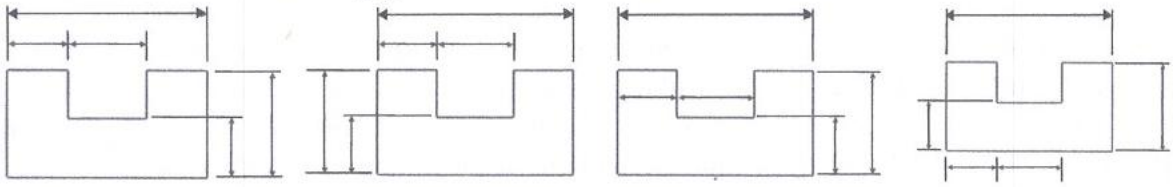


A *B* *C*

Which option gives the correct order of welding joint types?

(1) Lap joint, Tee-joint, Butt-joint
(2) Edge joint, Lap-joint, Butt-joint
(3) Edge joint, Lap-joint, Corner-joint
(4) Butt-joint, Lap-joint, Tee-joint
(5) Butt-joint, Edge joint, Tee-joint

40. Consider the four dimensioning practices shown below.

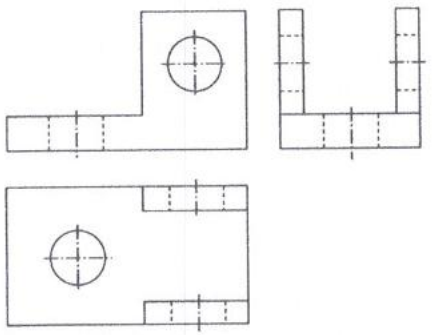


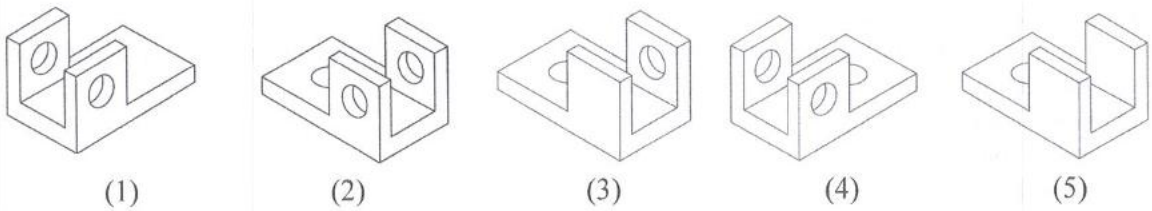
A *B* *C* *D*

Out of the above, what are the most suitable dimensioning practices used in engineering drawings?

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

41. What is the correct isometric view of the orthogonal projection shown in the figure below?





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

42. Old Otto engines have relatively large stroke (increased crank through) lengths compared to modern Otto engines. Which of the following statements correctly compares the power characteristics between them.

(1) Thermal efficiency increases with increasing crank length.
(2) Thermal efficiency decreases with decreasing stroke length.
(3) Compression ratio increases with increasing stroke length.
(4) Compression ratio decreases with decreasing stroke length.
(5) Torque increases with the increasing crank through.

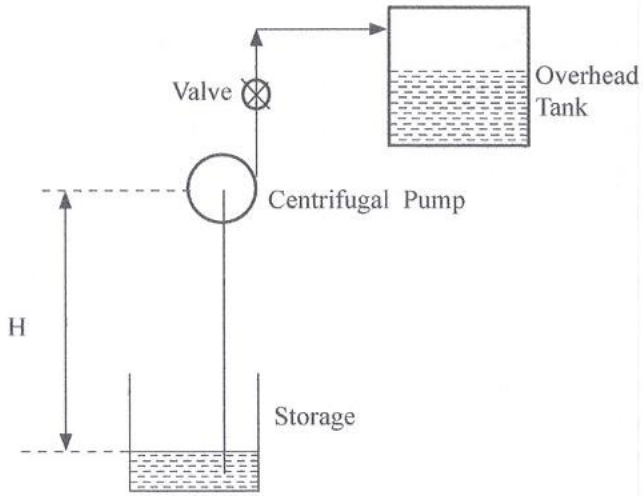
[*See page eleven*

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43. In a synchronous gearbox, the synchronizer units is used to,
(1) increase engine power output.
(2) match the speed of gears before engagement.
(3) reduce wear during gear shifting.
(4) provide automatic gear shifting.
(5) reduce the number of gears used in a sliding mesh gear box.

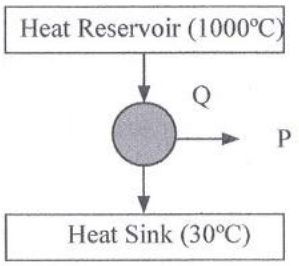
44. The deep bowl on top of the piston of a Diesel engine ensures,
(1) high volumetric efficiency.
(2) low volumetric efficiency.
(3) high compression ratio.
(4) low compression ratio.
(5) increased combustion air turbulence during combustion.

45. Consider the below figure.



Which of the following parameters does **not** influence the power consumption of the centrifugal pump used to transfer water from a tank on the ground to an overhead tank?
(1) Position of the valve
(2) Height H
(3) Width of the tank
(4) Tube diameter
(5) Height of the discharge from the pump

46. Consider the below figure.



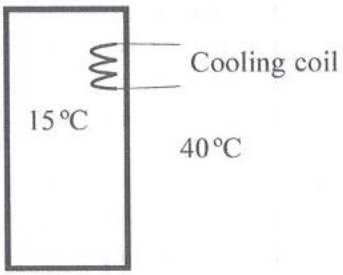
An ideal thermal power cycle working between a heat reservoir and heat sink which can generate the output power 'P' for a given heat flow of Q is shown in the figure. If P is the maximum possible power output from any cycle known to human can generate, which of the following statements is correct?
(1) P = Q (2) P = Q×30/1000 (3) P < Q
(4) P > Q (5) P = Q×1000/30

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● Answer both question **47** and **48** considering the following incidence.

47. A person is sitting in a glass room in an area where the outdoor temperature is 40°C, as shown in the figure. The temperature inside the glass room is reduced from 40°C to 15°C using a cooling coil.
If the temperature and dew point of air inside and outside of the room are initially 40°C and 20°C, which of the following statements is correct?



(1) Small water droplets could have been seen inside the room first.
(2) Small water droplets could have been seen outside the room first.
(3) Small water droplets could have been seen both inside and outside the room at the same time.
(4) No water droplets can be formed inside the room.
(5) No water droplets can be seen outside the room.

48. Consider the following instances of small water droplets formation on the interior surfaces of the glass wall,

A - when the air temperature inside the room is above 20°C
B - when the air temperature inside the room is below 20°C
C - when the relative humidity (RH) of air inside the room is 100% at 15°C
D - when the specific humidity of air inside the room is maximum at 15°C

Which statement/s of the above is/are correct?

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

49. Consider the following statements.

A - Cetane number of the biofuel
B - Viscosity of the biofuel
C - Octane number of the biofuel
D - Wear resistance

Important parameters which should be investigated before switching a diesel engine from diesel fuel to a new biofuel are,

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

50. In a water tank level control system, the water level is maintained at a desired value automatically using a level sensor, a controller and a motor-operated inlet valve. Which of the following correctly indicates the input, output, feedback element and plant of the system, respectively?

(1) Water inflow rate, water level, inlet valve, Sensor
(2) Desired water level (set point), Actual water level, level sensor, tank and valve system
(3) Level sensor signal, Desired water level, Tank, Controller
(4) Controller signal, Water flow rate, Valve, Level sensor
(5) Water pressure, Flow rate, Temperature sensor, inlet valve

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இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2025
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2025
General Certificate of Education (Adv. Level) Examination, 2025

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 (09 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 (03 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	
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Marking Examiner 1	
Marking Examiner 2	
Checked by	
Supervised by	

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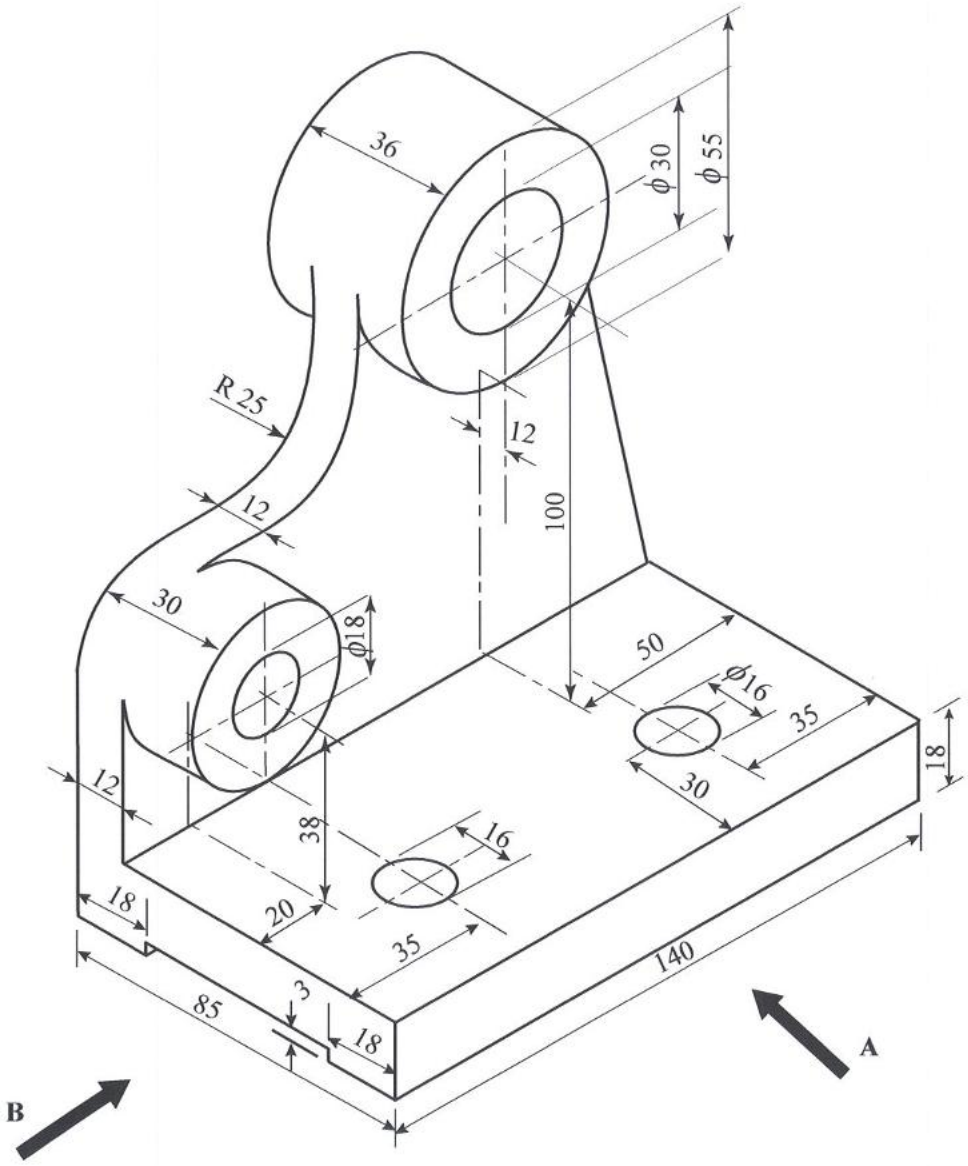
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PART A — Structured Essay

*Answer **all** questions on this **paper itself**.*
*(Each question carries **10** marks)*

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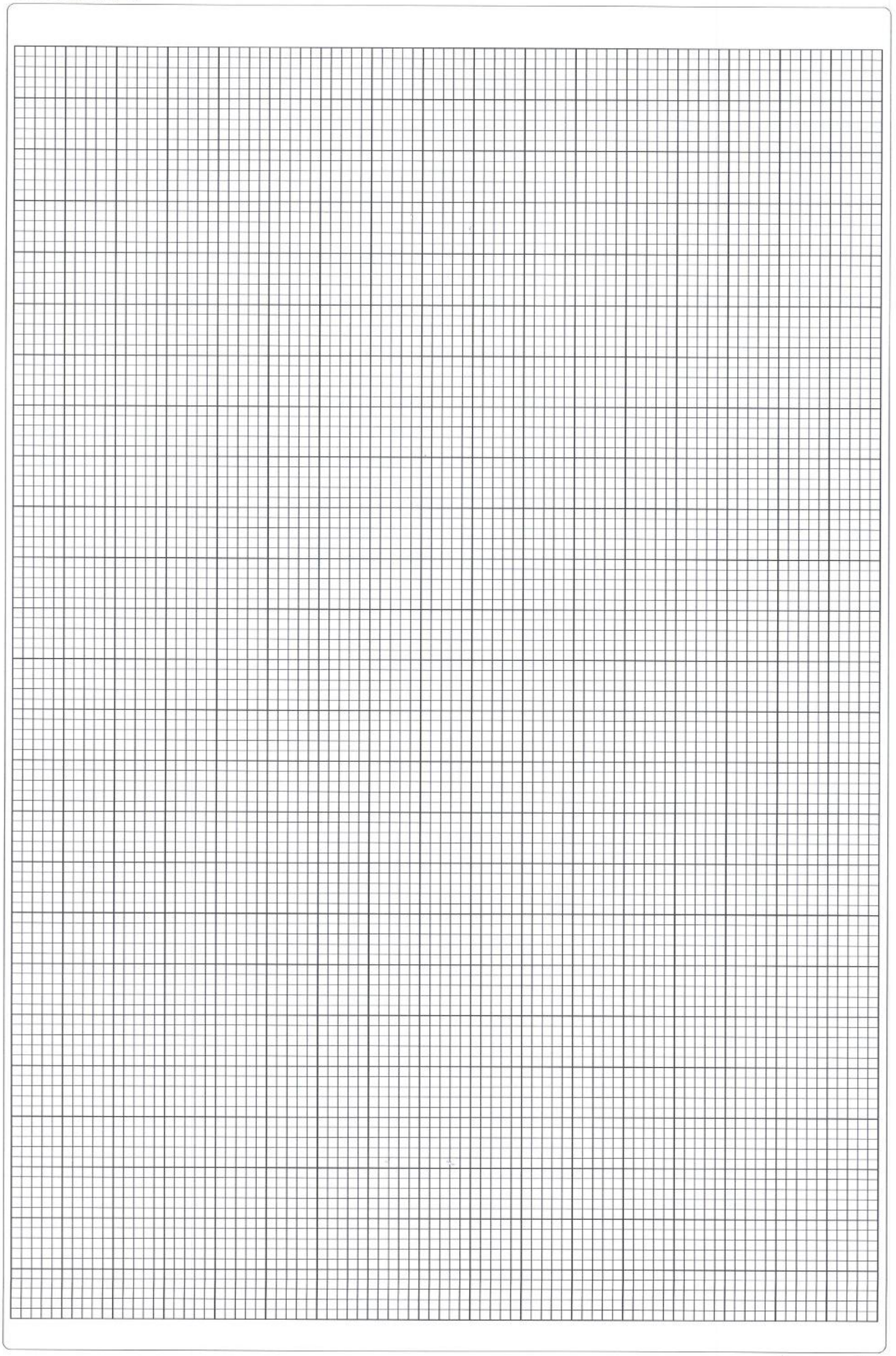
1. An isometric view of a machine component is shown in the figure. Draw the third-angle orthogonal projection views of the isometric view given in the figure using an appropriate scale and assuming missing dimensions. Indicate all relevant dimensions. Use the graph papers given on pages 3 and 4. All dimensions are in millimetres. The figure is **not** drawn into scale.



(a) Front elevation looking from **A**
(b) End elevation looking from **B**
(c) The plan view

[see page three

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2. An advanced level school student is planning to buy a desktop computer for his further studies.

(a) Write a specification for a desktop computer that suits for his purpose.

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(b) State **three** software for his desktop computer and their relevant purposes.

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(c) The student is planning to obtain internet facility to his desktop computer. State **two** suitable internet connection methods.

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(d) The Student is planning to follow an online course where real time interactions are required.

(i) State **two** hardware components required for this purpose.

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(ii) State a software required for attending online courses.

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3. (a) (i) Briefly explain the working principle of a hydraulic disk brake system using a labelled diagram.

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(ii) A car with a mass of 1200 kg is moving at a speed of 72 km/h. Calculate the braking force required to stop the car in 50 m distance and assuming uniform deceleration. Neglect the driver's reaction time.

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(iii) Briefly explain the working principle of anti-lock braking system (ABS).

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(b) (i) Using a sketch explain briefly the working principle of an automotive turbocharger.

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(ii) Explain **two** benefits of turbocharged engine compared to a normal naturally aspirated engine.

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4. An inclined plane can be used to move an object from a lower level height to a higher level without lifting it vertically.

(a) Write an expression for the mechanical advantage of an inclined plane.

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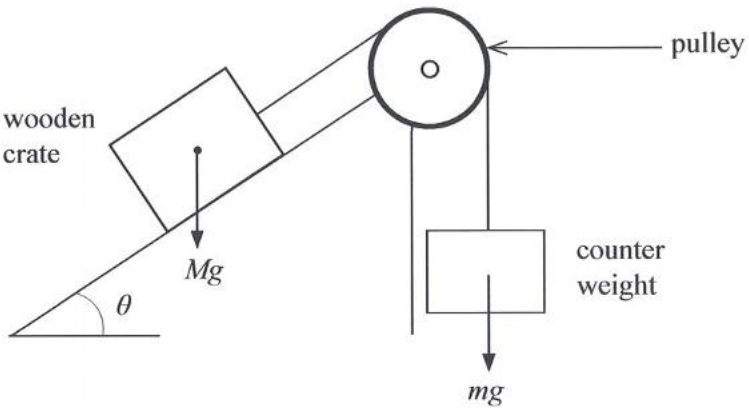
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(b) A wooden crate of uniform weight is pulled up in an inclined plane using a counter weight and a simple pulley mechanism as shown in the below figure. If the dynamic friction coefficient between the wooden crate and the surface is μ, write an expression for the acceleration using the given parameters.



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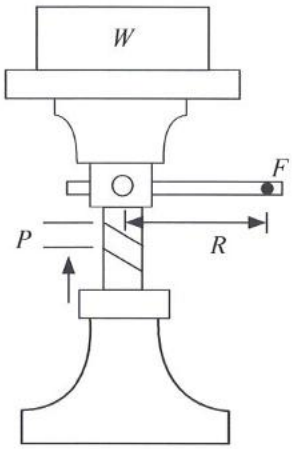
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(c) A screw can be considered as an inclined plane wrapped around a cylinder. It allows to move objects vertically with a small rotational force. Consider a screw jack used to lift a heavy weight W as shown in the figure.



P : Pitch of the screw

F : Rotational force

R : Length of the handle as shown in figure

Find the force F required to lift the weight W. Assume that the screw is well lubricated. The friction force can be neglected.

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Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka
இலங்கை பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2025
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2025
General Certificate of Education (Adv. Level) Examination, 2025

යාන්ත්‍රික තාක්ෂණවේදය II 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. Many civil engineering structures have failed due to landslides in Sri Lanka in recent past. These failures have cost many human lives and economic losses.

   (a) State **two** reasons for landslides.

   (b) Explain why the landslides are most devastating natural calamity.

   (c) Explain **two** precautions that should follow when constructing houses in hilly areas.

   (d) Explain **one** precautionary measure in preparing surrounding land to prevent landslides and soil erosions in mountainous areas.

6. A team of graduates launched "ABC Leaf Eco Products", a start-up focused on producing biodegradable and compostable packaging materials using waste from the coconut industry, such as husks and coir dust. Their main goal was to provide an eco-friendly alternative to harmful single-use plastics which commonly used in hotels, restaurants and supermarkets.

   By converting agricultural waste into valuable packaging, the project supports both environmental protection and rural livelihoods. Their products quickly gained national recognition for their quality, innovation and sustainability This leads several major hotel chains and retail outlets to adopt to these products this under as a part of their green business and waste reduction initiatives.

   (a) Mention **two** innovative aspects of their products.

   (b) Analyze how entrepreneurship can promote environmental sustainability. Explain this under **three** aspects.

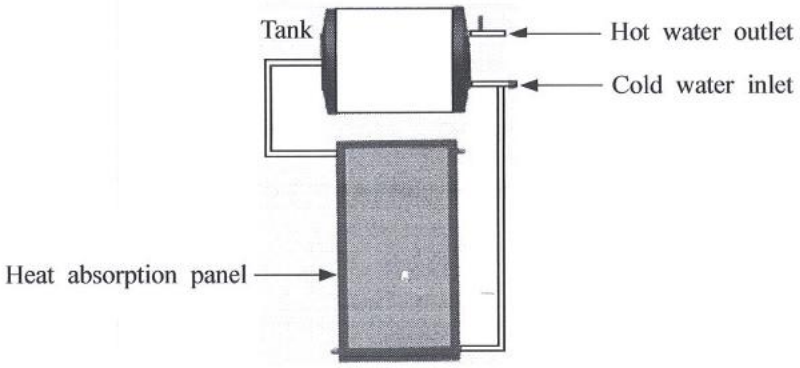
   (c) Describe under **two** points how the leadership and ethical qualities are used in this team.

   (d) Briefly describe **two** regional and **two** national returns expected from this project.

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7.



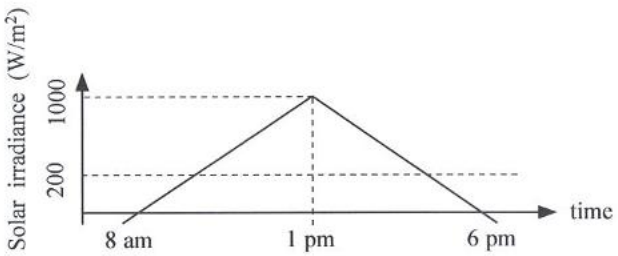
A solar water heating system is shown in the figure. Cold water enters the system and becomes hot when sunlight falls on it.

(a) Briefly describe the purpose of the cylindrical tank.

(b) Explain why the tank is installed above the solar heating panel.

(c) List **three** key factors that help the solar water heating panels to work efficiently.

(d) The following figure shows the solar irradiance (sunlight intensity) over a 10-hour period from 8.00 a.m. to 6.00 p.m.

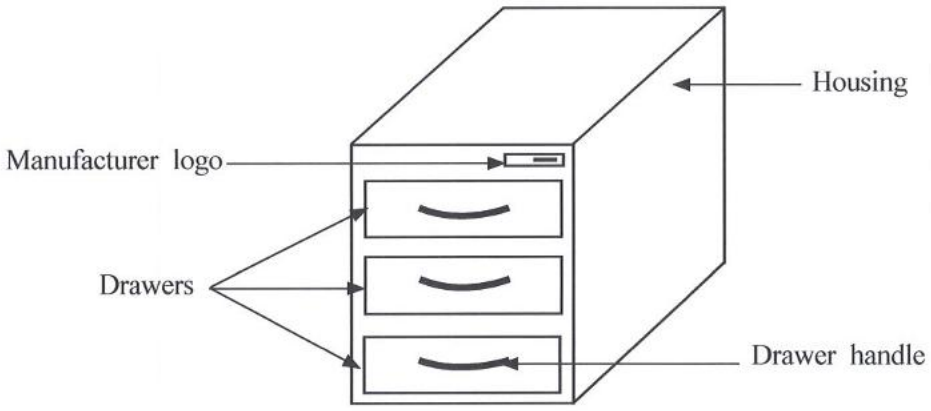


(i) If the solar hot water heater efficiency is 40%, calculate the maximum possible daily thermal energy yield in kJ/m^2.

(ii) Determine the minimum size of hot water panel area required if the tank capacity is 300 *l* and expected temperature of the water at night is 60 °C Take ambient temperature as 25 °C. Assume that there is no water used in daytime and neglect the heat dissipation to the environment.

Part C

8. The figure shows a steel filing cabinet commonly used in offices.



(a) If the manufacture of the cabinet starts with a metal sheet of thickness 1.2 mm, list **three** manufacturing processes, to produce drawer in the order of production.

(b) Describe **two** welding processes that can be used to join the sheet panels in manufacturing the cabinet.

(c) Mention **two** appropriate fastening methods for each of the following.

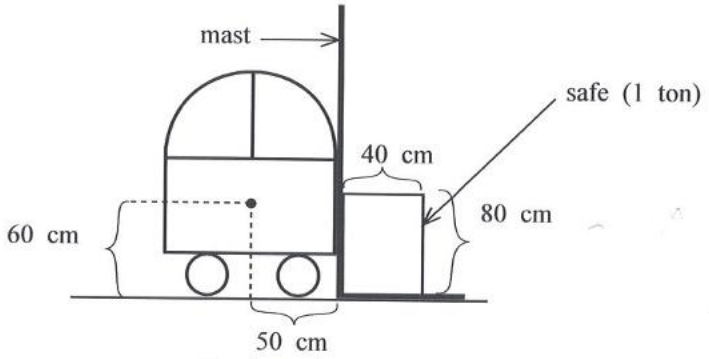
(i) Fastening manufacturer's logo to the cabinet body

(ii) Fastening drawer handle to the drawer front panel

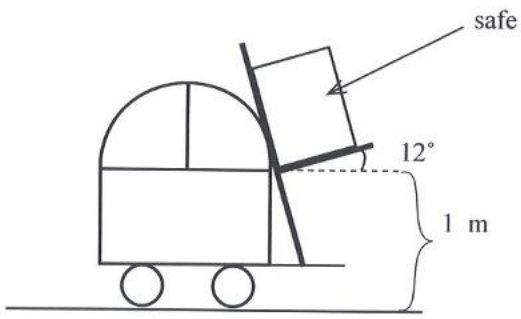
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(d) Same company produces safes of different sizes.



Configuration *A*
(just lifted from the ground)



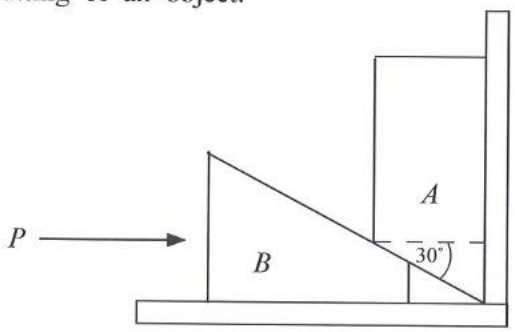
Configuration *B*
(After lifting and tilting)

A 4 ton forklift is required to lift a safe weighing 1 ton to load it to a lorry. The centre of gravity of the forklift is 60 cm above the ground vertically and 50 cm away from the mast as shown in the figure.

(i) Calculate the vertical and horizontal position of the combined centre of gravity for the configuration *A*.

(ii) If the safe is lifted by 1 m the mast is tilted backward to 12° as shown in the configuration *B*, calculate the change in vertical and horizontal position of the centre of gravity compared to the combined centre of gravity in configuration *A*.

9. A wedge is a simple machine that is designed to minimize the force required to perform the task of splitting, breaking or cutting of an object.



(a) Provide **three** examples of wedges used in practical applications.

(b) A simple wedge is used to lift a metal block (*A*) of 500 N as shown in above figure. The wedge (*B*) has a weight of 50 N. The static friction coefficient between all surfaces is 0.4.

(i) Draw the forces applied on metal Block *A* and the wedge *B* using a suitable diagram.

(ii) Find minimum force *P* required to overcome the static friction to begin the lift of block *A*.

10. A conventional electric iron is designed to maintain the soleplate at a constant temperature suitable for ironing different types of fabric. The iron uses a bimetallic strip thermostat as a feedback control element. The user sets the temperature according to the fabric (e.g.,cotton, silk). The thermostat compares the actual soleplate temperature with the set temperature. When the soleplate temperature rises above the user-selected value, the thermostat bends and disconnects the electrical contact, turning off the heater. When the temperature drops below the set level, the thermostat straightens and reconnects the circuit, turning the heater on again. This cycle maintains the temperature within the desired range.

(a) Identify the main components of this control system. Classify each as input, process, output, sensor, or controller.

(b) Explain whether this is an open-loop or closed-loop control system giving reasons.

(c) Discuss **two** limitations of this conventional control system.

(d) Suggest possible modern improvements for each limitations given above (c).

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