නව/පැරණි නිර්දේශය – புதிய/பழைய பாடத்திட்டம் – New/Old Syllabus

NEW/OLD

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2019 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2019 ஓகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2019

15.08.2019 / 1300 – 1500

යාන්ත්‍රික තාක්ෂණවේදය I
பொறிமுறைத் தொழினுட்பவியல் I
Mechanical Technology I

15 E I

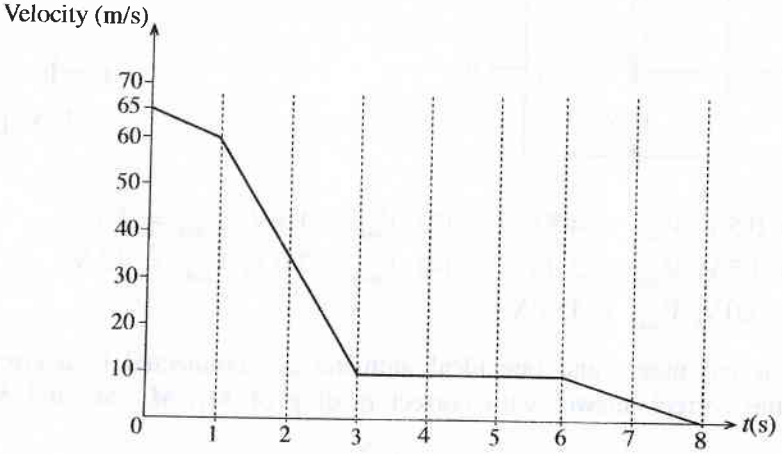
පැය දෙකයි
இரண்டு மணித்தியாலம்
Two hours

Instructions:

* *Answer **all** the questions.*
* *Write your **Index Number** in the space provided in the answer sheet.*
* *Use of calculators is not allowed.*
* *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.*

1. Of which of the following is the 'light year' a unit?
(1) light intensity (2) mass (3) time (4) distance (5) frequency

● Answer questions **2** to **3** using the following graph.
The graph shows the motion of a landing aircraft after it touches down the runway. After 3 seconds of sudden deceleration, it moves in a constant velocity of 10 m/s until 6th second.



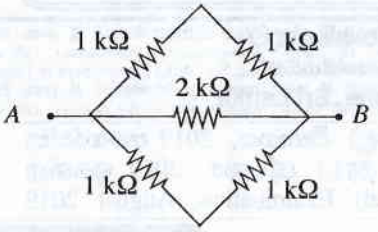
2. What is the displacement of the aircraft during its first 3 seconds?
(1) 132.5 m (2) 140 m (3) 185 m (4) 212.5 m (5) 215 m

3. What is the average deceleration of the aircraft, if it comes to a stop in 8 seconds?
(1) $[(65 - 60) / 1 + (60 - 10) / 2 + (10 - 0) / 5] \div 8$ ms^{-2}
(2) $[(65 - 60) / 1 + (60 - 10) / 2 + (10 - 0) / 5]$ ms^{-2}
(3) $(65 - 60) / 3 + (10 - 0) / 5\ ms^{-2}$
(4) $(65 - 0) / 4\ ms^{-2}$
(5) $(65 - 0) / 8\ ms^{-2}$

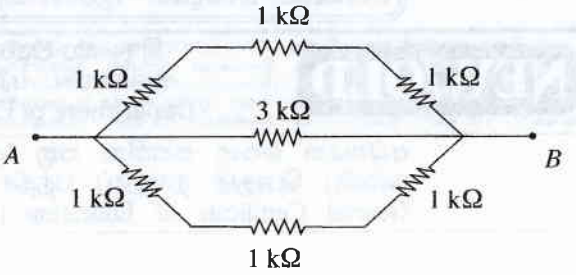
[See page two

4. Select the resistor arrangement which has the lowest resistance between points A and B.

(1)



(2)



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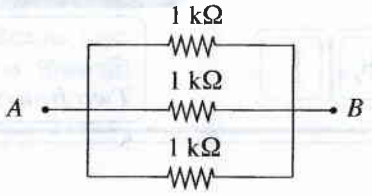
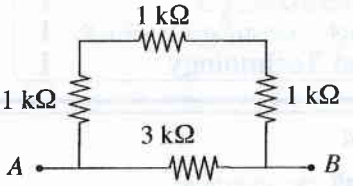
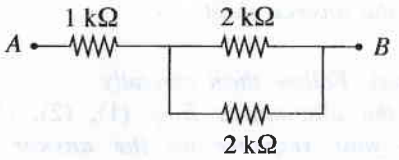


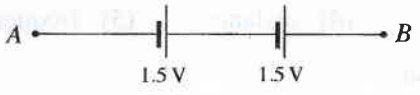
(4)

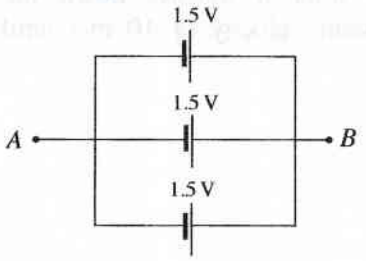


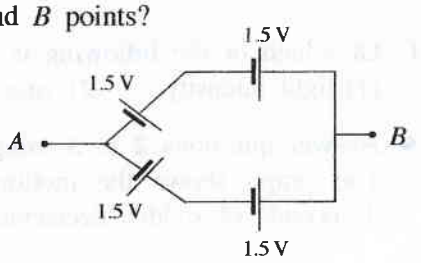
(5)

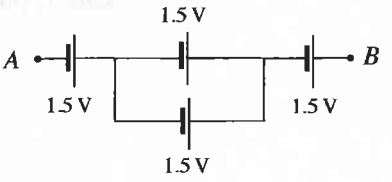


5. Consider following battery arrangements prepared by a student. What are the minimum voltage (V_{min}) and maximum voltage (V_{max}) obtained between A and B points?



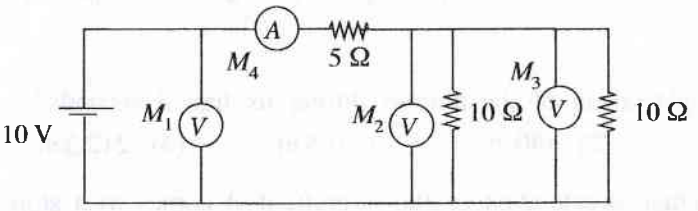






(1) V_{min} = 0.5 V, V_{max} = 4.5 V (2) V_{min} = 1.5 V, V_{max} = 4.5 V
(3) V_{min} = 1.5 V, V_{max} = 3.0 V (4) V_{min} = 3.0 V, V_{max} = 4.5 V
(5) V_{min} = 5.0 V, V_{max} = 15.0 V

6. Three ideal voltmeters and one ideal ammeter are connected in a circuit as shown in the figure. What is the correct answer with correct reading of M_1, M_2, M_3 and M_4 in same order?



(1) 5 V, 2.5 V, 2.5 V, 1 A (2) 10 V, 5 V, 5 V, 2 A (3) 10 V, 10 V, 5 V, 1 A
(4) 10 V, 5 V, 5 V, 1 A (5) 5 V, 5 V, 5 V, 2 A

7. Select the answer with correct parameters of standard domestic electricity supply of Sri Lanka.
(1) 230 V AC, 60 Hz (2) 230 V DC, 50 Hz (3) 230 V AC, 50 Hz
(4) 260 V AC, 60 Hz (5) 260 V AC, 90 Hz

[*See page three*

8. Which of the following is **not** a software used in computer?
(1) MS Office (2) C++ (3) JAVA
(4) MS Word (5) Hard disk

9. Figure *A* and *B* show two V-pulleys driven by a V-belt and a round rope respectively. Belt and rope both do not touch the flat surface of the V-grove and the shape of the rope remains unchanged. Select the correct statement from the following about its functioning.

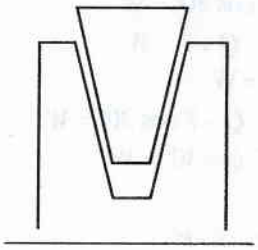


Figure *A*

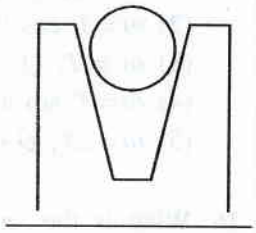


Figure *B*

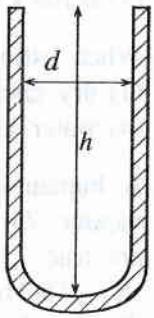
(1) V-belt and rope should have same tension before slip.
(2) V-belt slips first.
(3) Rope slips first.
(4) Slip cannot be analytically explained.
(5) Slip depends on the diameter of the rope.

10. A common function of solar PV cells and Solar hot water heaters is
(1) generation of electricity. (2) generation of heat.
(3) generation of water. (4) generation of both heat and electricity.
(5) generation of noise.

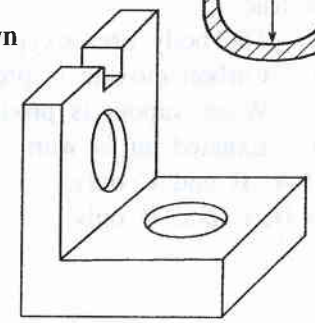
11. Which of the following energy forms can be converted into work in a most efficiently way?
(1) electricity (2) heat (3) pneumatic (4) sea wave (5) wind

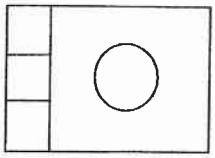
12. Consider the following statements on renewable energy sources.
A - Solar energy is renewable.
B - Biomass is non-renewable.
C - Coal is renewable.
D - Hydro power is non-renewable.
Which of the above statements are **incorrect**?
(1) A, B and C only. (2) A, B and D only. (3) A, C and D only.
(4) B, C and D only. (5) All A, B, C and D.

13. What measuring instrument can be used to accurately measure the depth (*h*) and the internal diameter (*d*) of a test tube?
(1) Micrometer screw gauge
(2) Meter ruler
(3) Vernier calliper
(4) Measuring tape
(5) Protractor

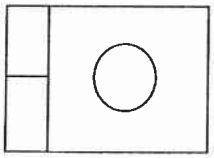


14. Which option gives the plan view of the machine component shown in figure?

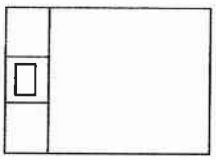




(1)



(2)



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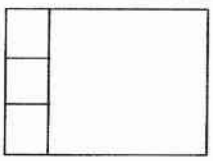

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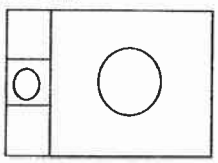
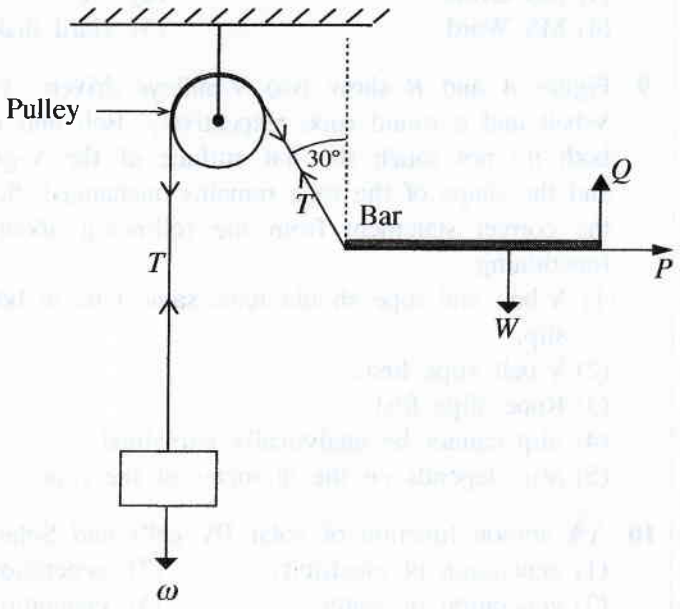


(5)

[See page four

• A bar is at a stable position as in the figure below. Use the figure to answer questions **15** and **16**.



15. Select the correct answer.

(1) $\omega = T,\ Q + T\cos 30° = W$
(2) $\omega = T\cos 30°,\ Q + T = W$
(3) $\omega = T,\ Q + T = W$
(4) $\omega = T\sin 30°,\ Q - T\cos 30° = W$
(5) $\omega = 2T,\ Q + T\cos 30° = W$

16. What is the value of P?

(1) ω
(2) $\omega \sin 30°$
(3) $\omega \cos 30°$
(4) $W + \omega \sin 30°$
(5) $W + \omega$

17. Consider the following statements.

A - Frictional coefficient between a metal and same metal is higher than that of the metal on ice.
B - Frictional coefficient is expected to reduce when a surface begins to move over the other.
C - Sand is sometimes used to increase traction between two surfaces.
D - Surface roughness has negligible influence when determining the theoretical frictional force.

Which of the above statements are true about sliding between two surfaces?

(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) All A, B, C and D.

18. A 10 W LED Lamp is installed in a house. It is consuming 10% more power due to an internal fault in the lamp. It is switched ON for 5 hours daily. What is the monthly (30 days) energy consumption?

(1) 0.165 kWh (2) 0.55 kWh (3) 1.65 kWh (4) 5.5 kWh (5) 16.5 kWh

19. When extinguishing a fire caused due to a volatile flammable liquid, best material to be used is

(1) dry chemical spray. (2) carbon dioxide jet. (3) compressed air jet.
(4) water jet. (5) foam extinguisher.

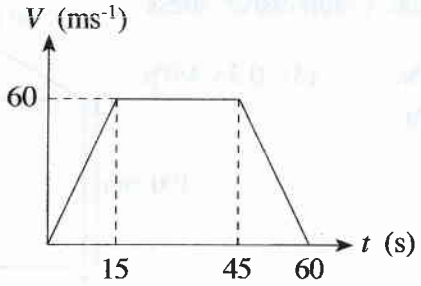
20. A human being inhales about 78% Nitrogen, 21% Oxygen and 1% others. Exhales 4% Water vapour, 75% Nitrogen, 16% Oxygen, and 4% Carbon dioxide. Which of the following statements are true?

A - The body uses oxygen to breakdown foods to create energy.
B - Carbon dioxide is produced by human cells.
C - Water vapour is produced from moisture in the respiratory system.
D - Exhaled air is warmer than the inhaled air.

(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) All A, B, C and D.

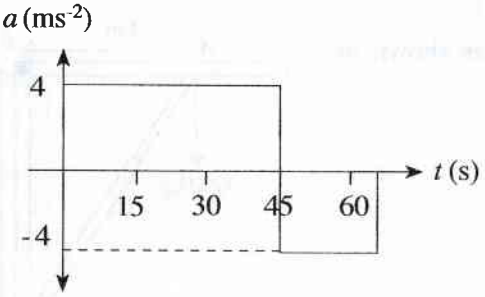
[See page five

21. A vehicle travels along a straight road from point A to B and its velocity is as shown in the figure below.

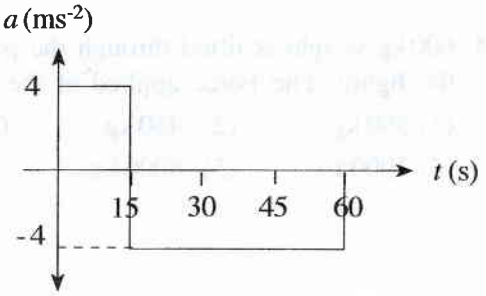


Which diagram indicates the acceleration (a) of the vehicle?

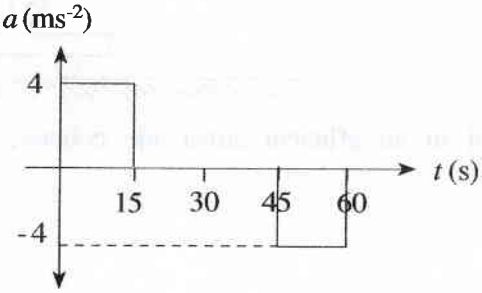
(1)



(2)



(3)



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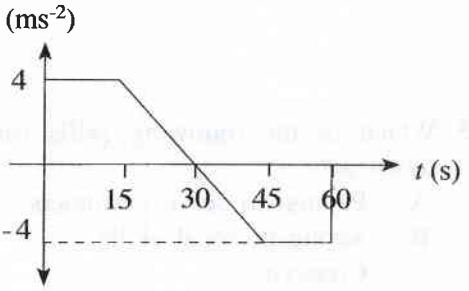
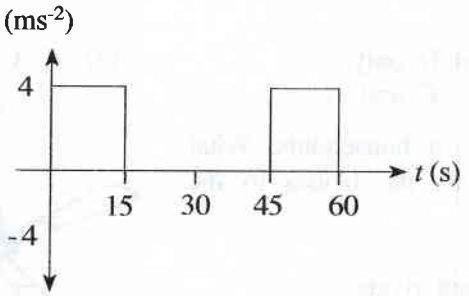
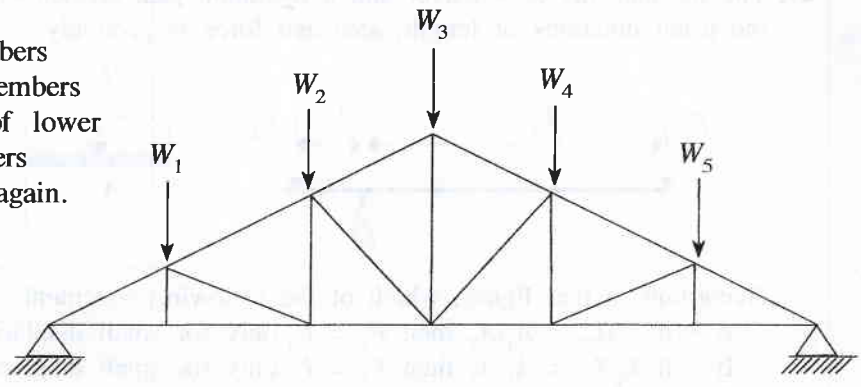


(5)



22. The roof truss shown in the figure is used to support roof loadings, W_1, W_2, W_3, W_4 and W_5. In order to reduce central deflection due to roof loading, following suggestions have been proposed.

A - Add more diagonal members
B - Remove few diagonal members
C - Increase section areas of lower and bottom chord members
D - Connections are welded again.



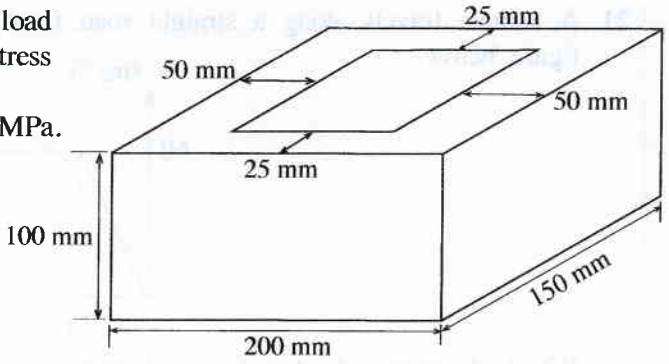
Which of the above suggestions are correct?

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

[See page six

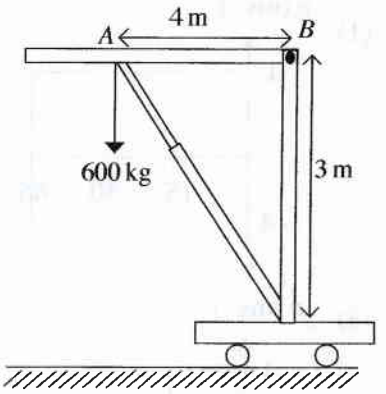
23. A hollow cement block is subjected to 10 kN load as shown in the figure. Axial Compressive stress applied on the block is

(1) 33 kPa. (2) 50 kPa. (3) 0.33 MPa.
(4) 0.5 MPa. (5) 5 MPa.



24. 600 kg weight is lifted through the portable jack as shown in the figure. The Force applied at the arm *AB* is

(1) 300 kg. (2) 450 kg. (3) 600 kg.
(4) 1000 kg. (5) 8000 kg.



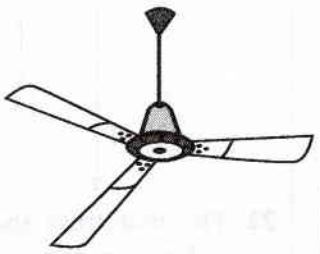
25. Which of the following skills can be observed in an efficient street-side cobbler, who mends footwear?

A - Passion to serve customers
B - Strong personal skills.
C - Creativity.
D - Competitiveness.

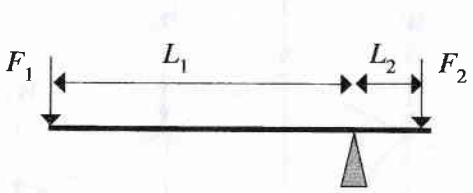
(1) A, B and C only. (2) A, B and D only. (3) A, C and D only.
(4) B, C and D only. (5) All A, B, C and D.

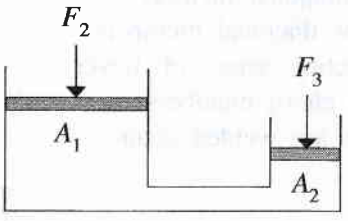
26. The figure shows a common ceiling fan used in households. What assembling method/methods could be used to fix the blades to the rotor?

(1) screws (2) welds
(3) rivets (4) screws and rivets
(5) screws and welds



27. The mechanisms of a leaver and a hydraulic jack are shown in the figure. *L*, *A* and *F* represent the usual notations of length, area and force respectively.





According to that figure, which of the following statements are **incorrect**?

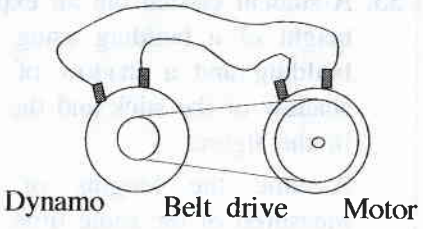
A - If $L_1/L_2 = A_1/A_2$ then $F_1 = F_3$ only for small displacements of F_1
B - If $L_1/L_2 = A_1/A_2$ then $F_1 = F_3$ only for small displacements of F_3
C - If $L_1/L_2 = A_1/A_2$ then $F_1 = F_3$ always
D - Always $F_1 > F_3$

(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) All A, B, C and D.

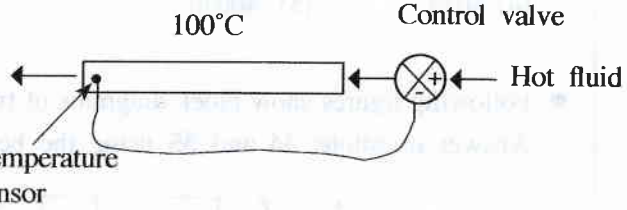
[*See page seven*

28. Which of the following statements is correct?

(1) If the rated voltage of the dynamo is greater than that of the motor, the system can self-sustain.
(2) If the rated voltage of motor is greater than that of the dynamo the system can self-sustain.
(3) The system can never be self-sustained.
(4) Pulley diameters should be in a correct ratio for the system to be self-sustained.
(5) The system can self-sustain at any specification of it.



29. If it is necessary to keep the entire upper surface of the chamber shown in the figure hot at 100°C accurately, when cold air is blown over it, which of the following methods is more appropriate?



(1) Hot flue gas can be used as the hot fluid with the above control system.
(2) Steam can be used as hot fluid without above control system.
(3) Hot thermic fluid could be used with the control system.
(4) It is impossible to keep the surface at 100°C.
(5) The surface can be kept at 100°C independent of the nature of the fluid.

30. Which of the following statements are correct when a turbo-charged engine is compared with a naturally aspirated engine for a given swept volume and a compression ratio?

A - Naturally aspirated engine generates relatively less power compared to turbo charged engine.
B - The power output of the naturally aspirated engine running at constant speed depends on the altitude.
C - The power output of the turbo-charged engine running at constant speed depends on the altitude.
D - Both engines have similar thermal performances.

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

31. The head of a centrifugal water pump is

(1) the water flow rate of the pump.
(2) the power of the pump.
(3) the maximum height that water can be pumped.
(4) the diameter of the pump outlet.
(5) the maximum height that any liquid can be pumped.

32. Consider the following statements.

A - Keep everything at a reachable distance.
B - Work at proper heights.
C - Minimize excessive force.
D - Reduce pressure points.

What are the principles of ergonomics, out of the above?

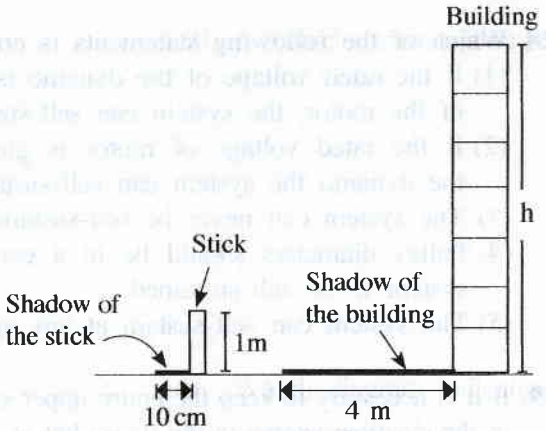
(1) A, B and C only. (2) A, B and D only. (3) A, C and D only.
(4) B, C and D only. (5) All A, B, C and D.

[See page eight

33. A student carried out an experiment to find the height of a building using the shadow of the building and a shadow of a stick. Details of shadow of the stick and the building are shown in the figure.

Assume the lengths of the shadows are measured of the same time. What is the height of the building?

(1) 10 m (2) 20 m (3) 40 m
(4) 80 m (5) 400 m



- Following figures show block diagrams of two control systems.

Answer questions **34** and **35** using the below block diagrams.

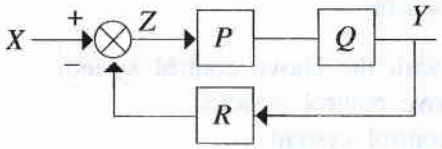


Figure 01

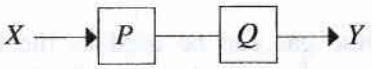


Figure 02

34. Select the choice which shows the correct information about the above control systems.

	Figure 01	**Figure 02**	*Z*	*Y*
(1)	Closed loop	Open loop	Input	Error
(2)	Closed loop	Open loop	Error	Output
(3)	Open loop	Closed loop	Input	Output
(4)	Closed loop	Open loop	Output	Input
(5)	Open loop	Closed loop	Error	Output

35. Consider the following statements about the two control systems above.

A - *P* is the controller
B - *Q* is the output
C - *R* is the sensor
D - *X* is the input

Which statements are correct when compared with the above figures?

(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) All A, B, C and D.

36. Workstations should be designed to reduce the noise to permissible noise level since too much noise causes stress. Which of the following statements **does not** explain the ergonomically recommended actions for this?

(1) Equipment generating high noise should be installed in soundproof rooms.
(2) Workstations are separated by partitions.
(3) Workstations can be equipped with sound absorbing floors.
(4) Office equipment with permissible noise level should be used.
(5) Workstations should be kept with attractive appearance.

37. Which of the following cutting tool material is most suitable for cutting hard and brittle workpiece material?

(1) High speed steels (2) Low Carbon steels (3) High Carbon steel
(4) Carbides (5) Cast-cobalt alloy

[*See page nine*

38. Permanent deformation of material with time due to constant load and variable temperature is known as

(1) Elasticity. (2) Isotropy. (3) Stiffness. (4) Hardness. (5) Creep.

39. A tolerance is an acceptable amount of dimensional variation that will allow a component to function correctly. Which of the following statements are true for tolerances of a component?

A - It is impossible to manufacture a part to an exact size or geometry.
B - Tolerance allows for interchangeability of parts.
C - Tolerance reduces the amount of materials used.

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

40. Which of the following heat treatment processes are used to convert Mild Steel into High Carbon Steel?

A - Annealing
B - Normalizing
C - Case hardening

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

41. Which of the following statement/statements is/are true for the measurement of cutting tool life?

A - number of workpieces machined between tool sharpenings
B - time the tool is in contact with the workpiece
C - volume of material removed between tool sharpenings

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

42. Which of the following statement/statements is/are true for the loads supported by an automobile frame?

A - Weight of the body, passengers and cargo loads
B - Torque from engine and transmission
C - Sudden impacts from collisions

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

43. Which of the following statement/statements is/are true about the use of bumpers in cars?

A - To reduce the impact in case of low speed collisions
B - To improve the aerodynamics of a car
C - To increase the engine performance

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

44. Which of the following resistance/resistances oppose the motion of a vehicle?

A - Rolling resistance
B - Gradient resistance
C - Air resistance

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

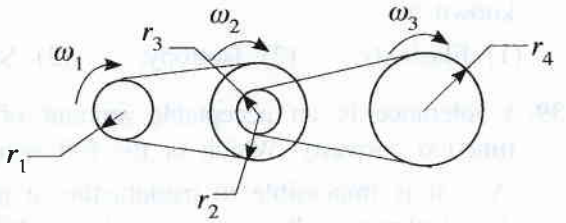
45. Which material is used to manufacture piston compression rings?

(1) Cast iron (2) Steel (3) Aluminium (4) Bronze (5) Titanium

[*See page ten*

46. A belt drive system is shown in the figure. Select the correct expression in relation to it.

(1) $\omega_1 r_2 r_3 = \omega_2 r_1 r_4$
(2) $\omega_1 r_1 r_2 = \omega_3 r_3 r_4$
(3) $\omega_1 r_3 = \omega_3 r_4$
(4) $\omega_1 r_1 = \omega_3 r_2$
(5) $\omega_1 r_1 r_3 = \omega_3 r_2 r_4$



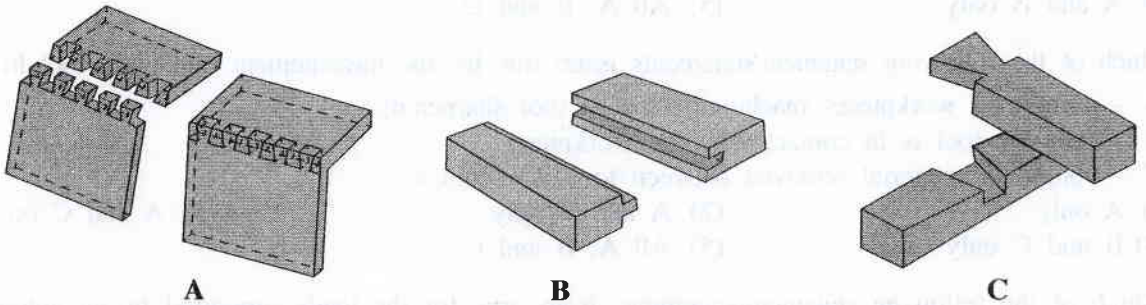
47. Following statements describe the radiator of a vehicle.

A - It transfers heat away from the engine.
B - It is placed in a well-ventilated place of the vehicle.
C - It is used to prevent overheating of the engine of a vehicle.
D - It transfers heat to the combustion chamber.

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) All A, B, C and D.

48. Three joints that are used to make wood furniture are shown in the figure.



A **B** **C**

What is the correct answer that gives the names of the joints **A**, **B** and **C**?

	A	**B**	**C**
(1)	Half lap	Dovetail	Tongue and groove
(2)	Dovetail	Tongue and groove	Half lap
(3)	Tongue and groove	Half lap	Dovetail
(4)	Mortise and tenon	Dovetail	Tongue and groove
(5)	Dovetail	Tongue and groove	Mortise and tenon

49. What are the factors that influence the swing of the ball bowled by a fast bowler in the game of cricket?

A - One side of the ball being rougher than the other.
B - Orientation of the seam of the ball at delivery.
C - The pace (speed) of the ball.
D - The initial spin upon delivery.

(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) All A, B, C and D.

50. What is the most appropriate reason to have corrugation in roofing sheets?

(1) To drain water during rain.
(2) To increase the strength.
(3) To improve the ventilation of buildings.
(4) To reflect sunlight.
(5) To reflect the heat from the sun.

* * *

නව/පැරණි නිර්දේශය – புதிய/பழைய பாடத்திட்டம் – New/Old Syllabus

NEW/OLD

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

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2019 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2019 ஓகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2019

යාන්ත්‍රික තාක්ෂණවේදය II பொறிமுறைத் தொழினுட்பவியல் II **Mechanical Technology II**	**15 E II**	**17.08.2019 / 1300 – 1610**

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 and decide on the questions that you give priority in answering.

Index No. : .....

Important :

* *This question paper consists of **11** 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 (03 pages)

* *Select minimum of **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	1	
	2	
	3	
C	4	
	5	
	6	
Total		

Total

In Numbers	
In Words	

Code Numbers

Marking Examiner 1	
Marking Examiner 2	
Checked by	
Supervised by	

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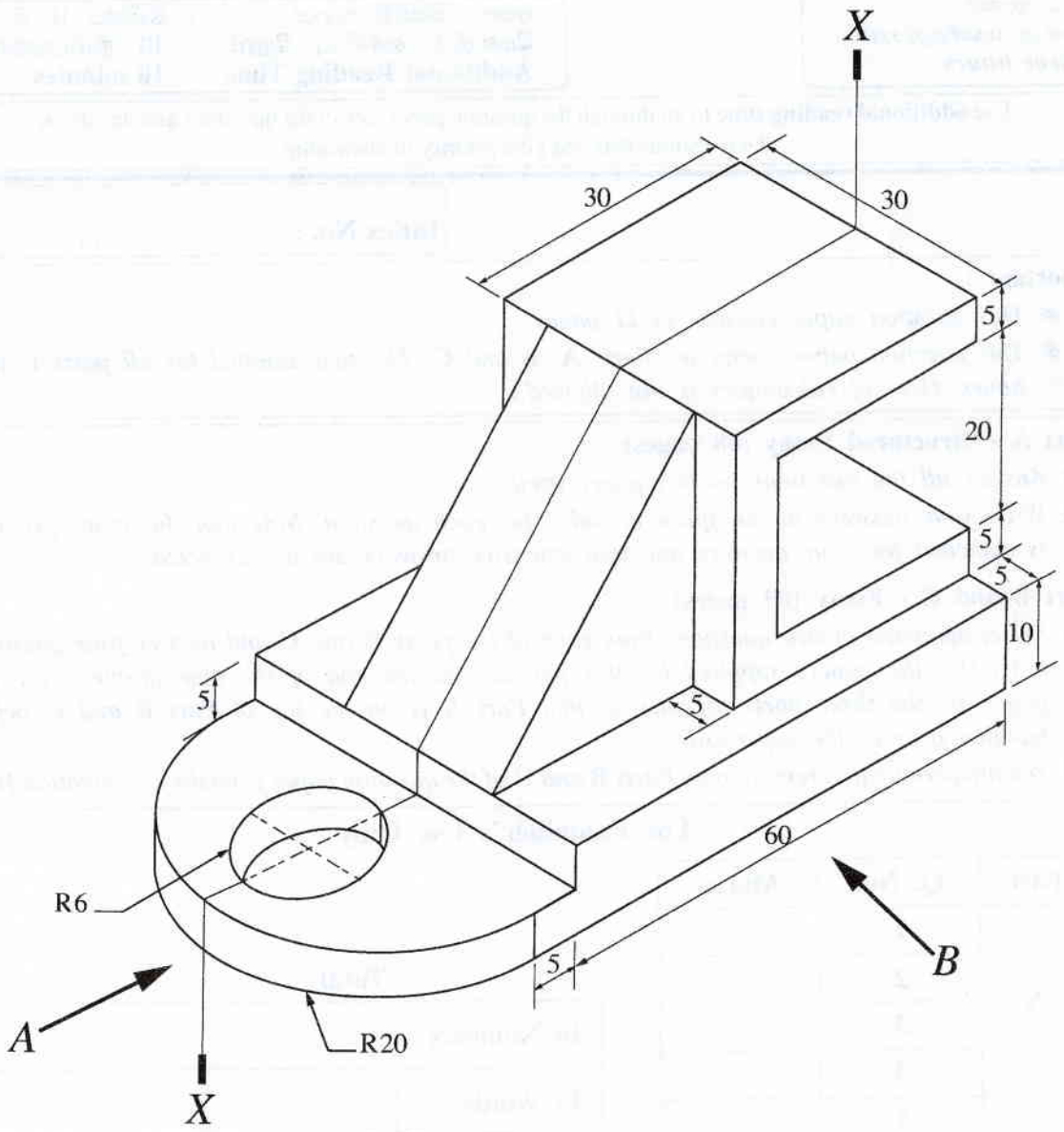
PART A – Structured Essay

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

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

1. An isometric view of a machine component is shown in the figure. Machine component is symmetric along the vertical plane passing through X-X. Assuming any missing dimensions, draw the following views to a suitable scale using first angle projection principle.
Show all relevant dimensions in the sketches. Use the graph sheets given on page **3** and **4** to answer the questions. (All dimensions are in mm.)



(i) Front elevation seen through direction A.

(ii) End elevation seen through direction B.

(iii) Plan.

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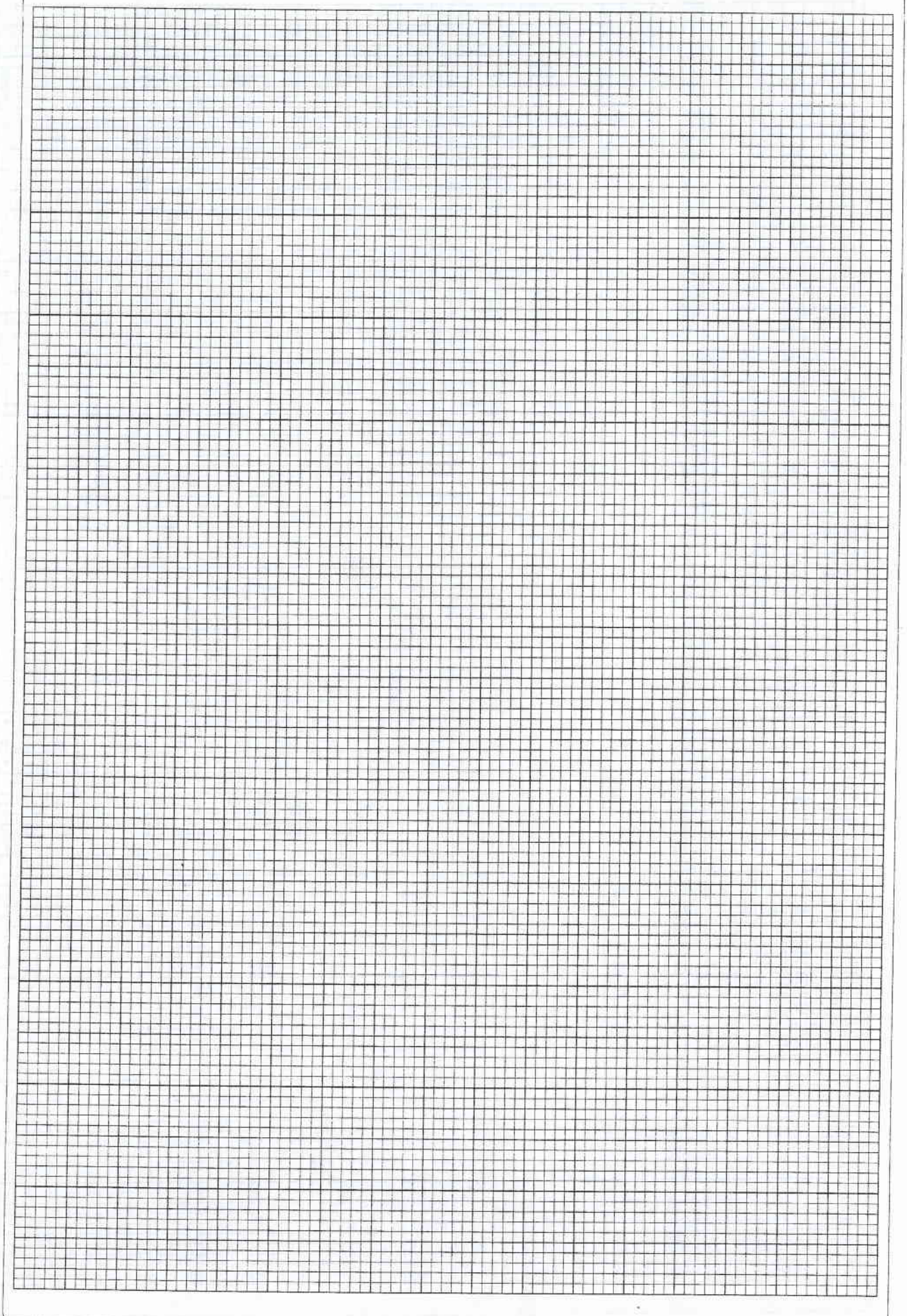

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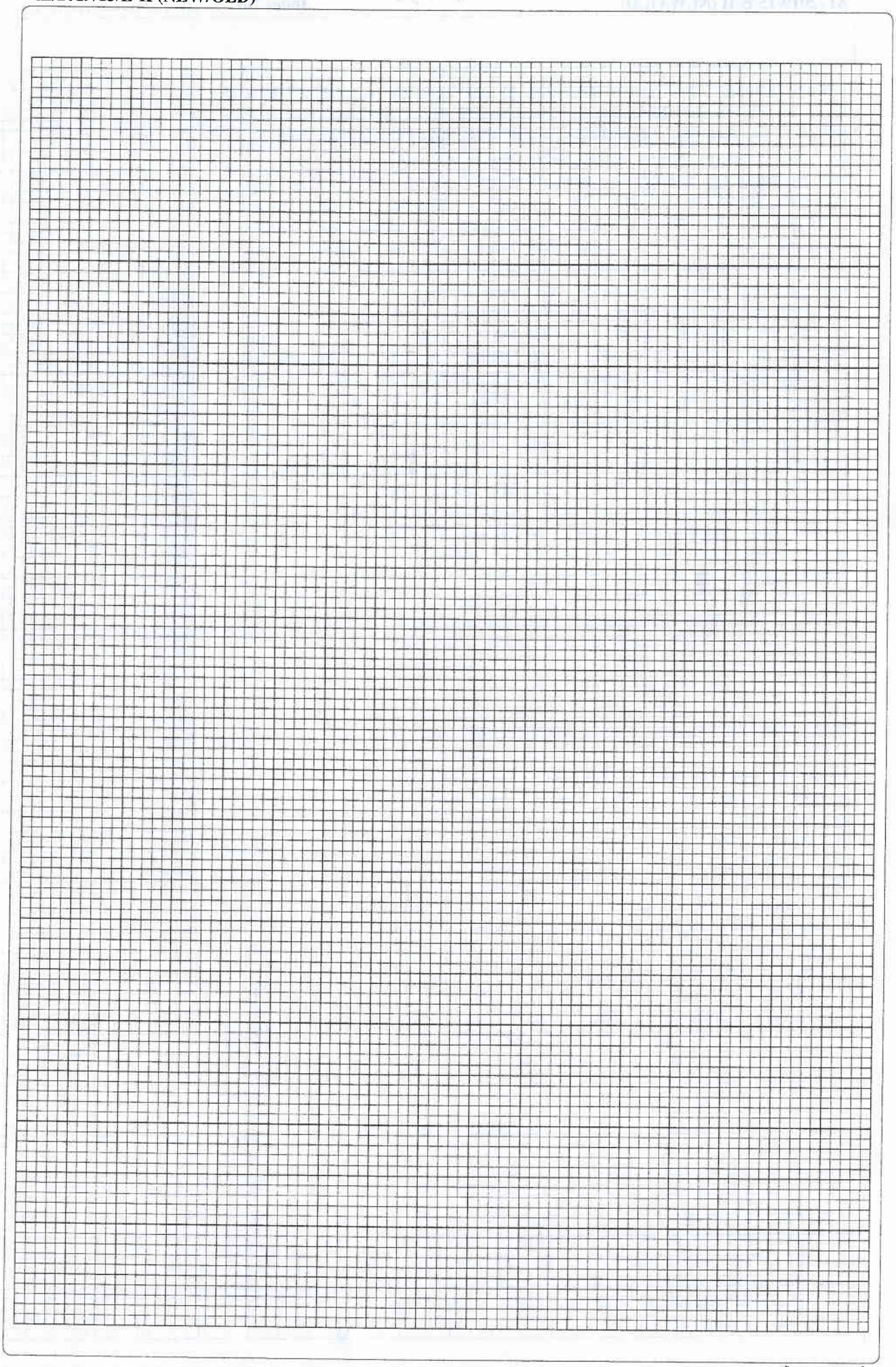

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2. A group of teachers from City School are planning to have an interactive classroom with following special functions.

They have installed an interactive multimedia projector. Teacher can write on the board by using a digital pen and content can be stored in the memory. Digital pen is not an ink pen. It will show in display in digital form. Content can be transferred to the computer connected at the teacher's desktop. Further, this can be used to comment on top of other content such as power point presentations, word documents, web pages etc.

Furthermore, they have planned to use this interactive classroom for getting the service of university lecturers using video conferencing facilities. Students are given facilities to interact with the lecturer.

Assume you are assigned to give the Information Technology support for the team.

(a) State **three** software required for the laptop at the teacher's desk in addition to specific software and drivers of interactive display.

(1) .....

(2) .....

(3) .....

(b) State **three** types of additional hardware required for the interactive classroom in addition to computers or laptops.

(1) .....

(2) .....

(3) .....

(c) Assume all student are using their laptops. State **two** options for networking student laptops and connecting them with the teacher's laptop.

(1) .....

(2) .....

(d) Students are requested to submit their classroom assignments online. State **one** facility suitable for this purpose.

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(e) In group activities, students are requested to collaboratively develop group reports. State **one** facility suitable for this purpose.

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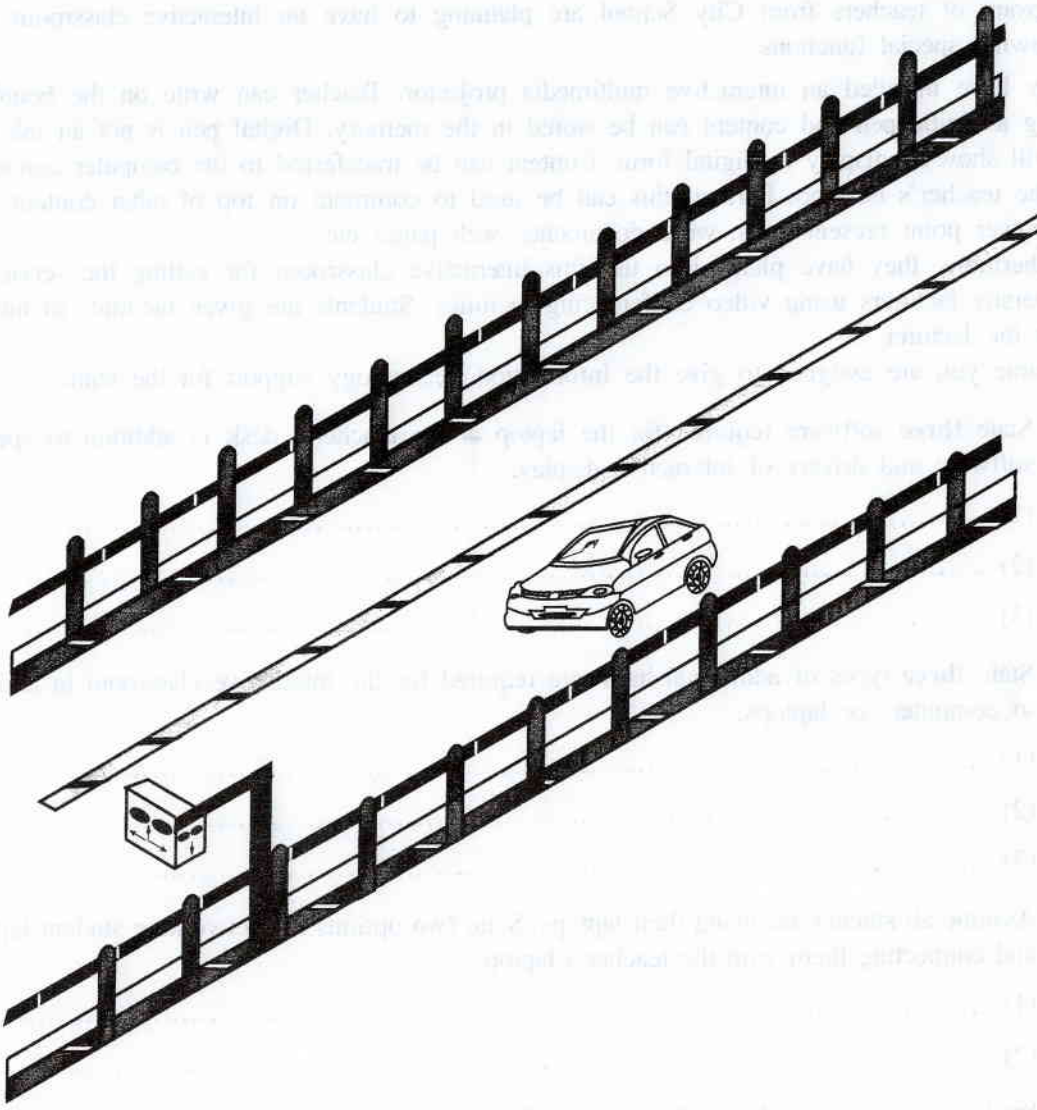
3.



It is proposed to install a sensor system to capture the speed of motor vehicles in the Southern Expressway. According to the proposed system, there is a 5 km distance between two sensors that have been installed to measure the average speed within that distance. A motor car takes 2.5 minutes to travel between the two sensors. Assume the maximum average speed limit in the expressway is 100 km/h.

(a) Is the car speed within the legal maximum average limit? Justify your answer with proper calculations.

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(b) A driver notices that the speed of the car is 100 km/h at a given instance according to the speedometer. When he exits the expressway toll gate, the receipt indicates the average speed as 82 km/h. Explain the reason/reasons for this with a velocity-time graph for the full journey. The driver does not take any break.

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(c) In rainy days the authorities advise to drive slow because of the risk of accidents. A car suddenly hits the fence at the speed of 96 km/h in a rainy day which resulted it to drift away from the road and hit the fence and come to a standstill. If the car weighs 1 200 kg, calculate the energy absorbed by the fence. State any assumption you made.

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(d) State any **three** components in the drive chain of a car and list a manufacturing process for each component.

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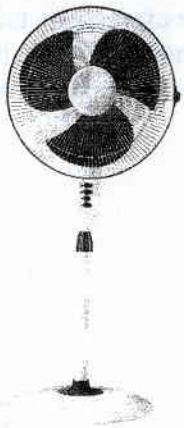
4. You are to design a pedestal fan as shown in the figure.



(i) State the critical dimensions that should be considered in order to increase the air flow of the fan.

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(ii) Briefly describe **two** safety measures that you include in the fan.

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(iii) Identify **three** main components of the fan and name suitable materials to manufacture them.

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නව/පැරණි නිර්දේශය – புதிய/பழைய பாடத்திட்டம் – New/Old Syllabus

NEW/OLD

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2019 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2019 ஓகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2019

යාන්ත්‍රික තාක්ෂණවේදය II
பொறிமுறைத் தொழினுட்பவியல் II
Mechanical Technology II

15 E II

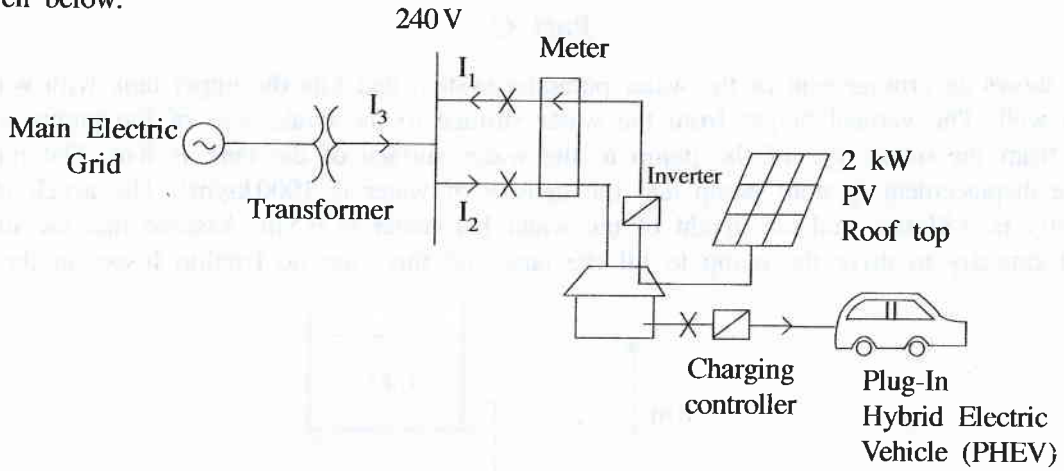
Essay

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

Part B

1. Safety at public places like bus/railway stations, schools and market places is paramount for the people to roam free and also to carry out their economic activities. The feeling of lack of safety could adversely affect the economy of a country.
   (a) List **three** types of safety issues that could take place in a public place.
   (b) Briefly explain **two** modern technological solutions that can be used to improve safety by addressing issues you mentioned in (a) above.
   (c) Briefly explain **two non-technical** solutions that can be used to improve safety by addressing issues you mentioned in (a) above.
   (d) Discuss with **two** points, how the lack of safety at public places can **adversely affect** the economy of Sri Lanka.

2. Integration of electronic vehicles into 'Smart homes' is a green concept introduced for energy management for domestic customers. Assuming you are the owner of this proposed 'Smart homes', answer the following questions based on the power circuit given in the following figure and details given below.



PHEV Battery Specification : 10 kWh battery takes 5 hours to charge fully. Vehicle is used only 20 days per month and every day it is charged fully using the main supply. Once charged fully, 20 km can be run without using 'Petrol'.

Roof top PV : 2 kW panels:
Assume that PV produces energy of an average of 5 hours per day in full capacity with 100% efficiency. Energy is sold to the CEB for a cost of Rs. 20.00 per unit.
1 unit = 1 kWh

[see page ten

Before buying PHEV, the average energy consumption was 200 units per month. Domestic customer Tariff for electricity is as follows.

Monthly Consumption (kWh)	Unit charge (Rs.)
0 – 60	8
61 – 90	10
91 – 120	28
121 – 180	32
>180	45

Fixed charge for a customer above 180 units usage per month is Rs. 540.00.

(a) What is total energy generated by the 2kW PV roof top per month?

(b) What is the total energy consumed by the 'PHEV' for charging per month?

(c) What is the total income from selling energy to Ceylon Electricity Board?

(d) What is the Net-Electricity Bill per month?

(e) Assuming the Petrol cost is Rs. 150.00 and from one litre the vehicle can run 10 km, what is your opinion regarding the usage of charging PHEV using main supply?

3. World elderly population increase rapidly. However, there is a problem of availability of skilled care givers and new generation is busy with their daily activities. Technological solutions are being developed to address this problem. The elderly people prefer to be in their homes rather than living in special elderly care homes.

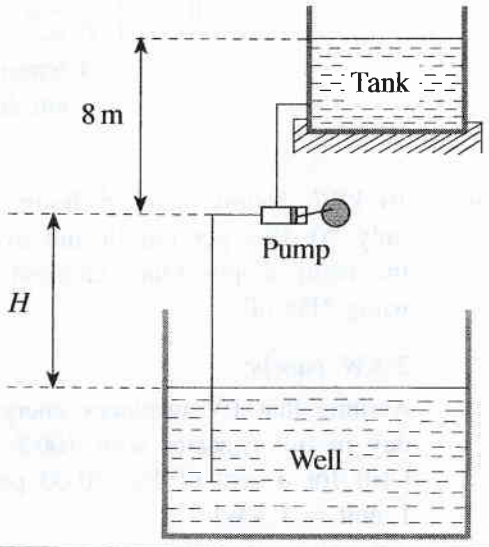
(a) Discuss **three** technological innovations that can be used to improve physical and mental well-being of the elderly.

(b) Select **one** technological innovation mentioned in (a) above and explain how it can be used to keep elderly in their own homes rather than in a home for elders, taking into consideration the busy life style of the present generation.

(c) Discuss **two** instances where technology can assist elderly people to attend to their daily activities independently.

Part C

4. Figure shows an arrangement of the water pumping system that fills the upper tank with water from a deep well. The vertical height from the water surface to the intake eye of the pump is H. The height from the intake eye of the pump to the water surface of the tank is 8 m. The pump is a positive displacement (piston) pump and the density of water is 1000 kg/m^3. The acceleration due to gravity is 9.81 m/s^2 and the height of the water barometer is 9.5 m. Assume that the motor has enough capacity to drive the pump to fill the tank and there are no friction losses in the system.



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(a) Write down **four** parameters that determine the height H.

(b) If $H = 6\,m$ and water flow rate is $1\,m^3$/minute and the electromechanical efficiency of the pump is 75%, calculate the power consumption of the pump.

(c) What will be the power consumption, if the pump was lowered into the well by 2 m from the current position?

(d) If $H = 12\,m$, can the pump deliver water to the tank? Explain your answer.

5. You are asked to design and develop an Electric Cargo Tricycle (ECT) as shown in Figure 1. The tricycle has vehicle layout which has one wheel in front and two wheels in back as shown in Figure 2.

Figure 1

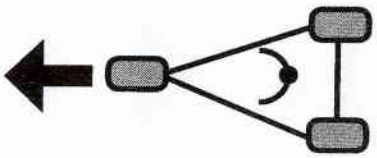

Figure 2

(a) Name **three** main systems that should be considered, when designing the ECT.

(b) What type of an electric motor is suitable for this ECT? Give reasons for your selection.

(c) One of your classmates suggests using the vehicle layout shown in Figure 6 (c). State **two** advantages and **two** disadvantages of having two wheels in the front and one wheel in back. Instead of one wheel infront and two wheels in back.

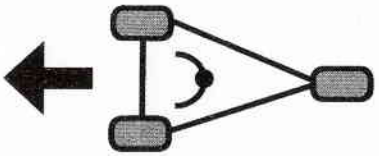

Figure 3

(d) Propose a suitable material for fabricating the chassis and the structure of the ECT. Give reasons for your proposal.

6. Following figure shows a metal string hopper (Idiyappam) press maker commonly used in Sri Lanka as a home kitchen appliance.

(a) What are the materials used for fabricating this string hopper press maker available commercially?

(b) Identify components of the string hopper press maker and briefly explain their manufacturing processes.

(c) In order to reduce the fatigue of the user, you are asked to improve the design of this string hopper press maker using linkage mechanism. Propose a suitable design to improve this string hopper press maker. Briefly describe the working principle of the proposed design using clear diagrams.

* * *

(a) Write down four parameters that determine the height H.

(b) If H = 60m and water flow rate is 1m³/minute and the electromechanical efficiency of the pump is 75%, calculate the power consumption of the pump.

(c) What will be the power consumption, if the pump was lowered into the well by 2m from the current position?

(d) If H= 120m can the pump deliver water to the roof? Explain your answer.

5 You are asked to design and develop an Electric Cargo Tricycle (ECT) as shown in Figure 2. The tricycle has a cubic frame which has one wheel in front and two wheels in back as shown in Figure 2.

(a) Name three main systems that is connected with developing the ECT.

(b) What type of motor is suitable for this ECT? Give reasons for your answer.

(c) Draw the pins diagram of 555 timer IC and explain how it operates in astable mode.

(d) Explain the function and use of the following components in the circuit diagram shown in Figure 3:

(i) Diode D1

(ii) Capacitor C1

(iii) Resistor R1

(iv) Resistor R2

Figure 3