***Section 1 (1 hour)***

***Answer ALL questions***

1. (a) State Hooke's law. **(2 marks)**
   (b) Define the term'elastic limit'.
   (c) Give one example of a material that obeys Hooke's law and one example of a material that does not obey the Law. **(2 marks)**
   (d) Name an instrument whose functioning is based on Hook's law **(1 marks)**

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2. A boy pushes a box on a rough road such that it moves with constant velocity. **(2marks)**
   (a) Define velocity and state its SI units. **(1 mark)**
   (b) (i) Name the force acting between the box and road. **(1 mark)**
   (ii) How can this force be reduced? **(3marks)**
   (c) What is the net force acting on the box? Explain your answer.

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3. Three 4 Ω bulbs are connected to a 240 V power source through an ammeter as shown in Figure 1.

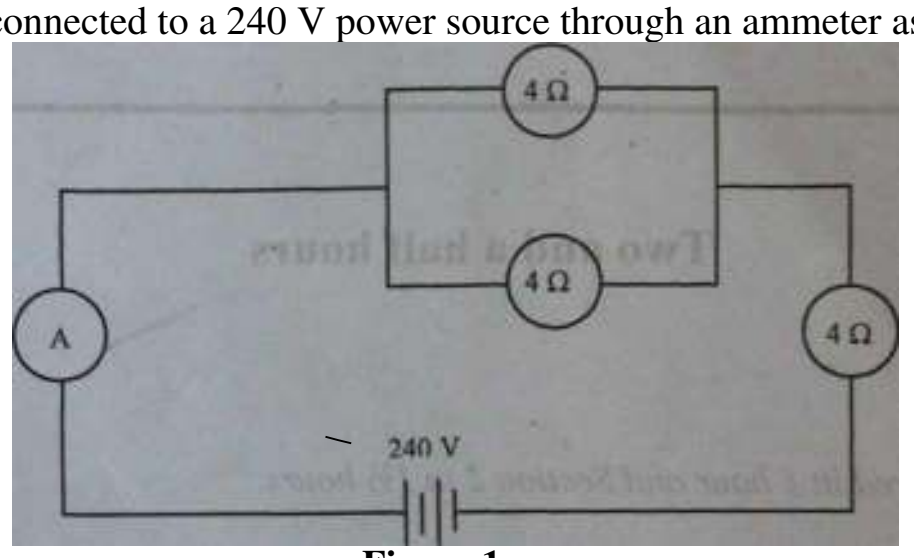


**Figure 1**

   (a) What property of the ammeter enables it to be connected as shown? **(1 mark)**
   (b) Give two advantages of connecting bulbs in parallel in our homes. **(2 marks)**
   (c) Calculate
   (i) the combined resistance of the above circuit. **(2 marks)**
   (ii) the current flowing through the ammeter. **(2 marks)**
   (iii) the power consumed when all the bulbs are in use. **(2 marks)**

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4. The element $^{14}_{6}C$ is an isotope of carbon and has a half-life of 5600 years. It decays to an element nitrogen N by emitting a beta particle.
   (a) Define the terms isotope and half-life. **(2 marks)**
   (b) Calculate the neutron to proton ratio (N/Z) of the element $^{14}_{6}C$ and state if the isotope is stable or not. **(3 marks)**
   (c) Write a balanced nuclear equation to show the decay process. **(2 marks)**

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5. Electricity is transmitted by using overhead aluminium cables.
   (a) State one other material that could be used in place of aluminium. **(1mark)**
   (b) State and explain two ways by which power loss is minimizedin the transmission of electricity**.** **(4 marks)**

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6. A student uses a convex lens to magnify a very tiny object. The lens has focal length 20 cm and is held 10 cm away from the tiny object.
   (a) Define focal length. **(1mark)**
   (b) Draw a ray diagram to show how the lens forms the magnified image. **(3 marks)**
   (c) Give two properties of the image formed. **(2 marks)**

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*Section 2 ($1\frac{1}{2}$ hours)*
***Answer ALL questions, choosing one question from each pair of alternatives***

**Answer either 7 (a), (b) and (c) OR 7 (d), (e) and (f)**

**EITHER 7 (a), (b) and (c)**

(a) The specific heat capacity of water is 4200 $Jkg^{-1}$ $K^{-1}$.
- (i) Define specific heat capacity. **(2 marks)**
- (ii) Describe an experiment to measure the specific heat capacity of water using the electrical method. Your description should include
  - an experimental setup the data collected
  - the use of the data to determine the specific heat capacity
  - any precaution taken. . **(7 marks)**
- (iii) In one of such experiments, 52500 J of heat energy was absorbedby 2.5 kg of water. Determine the temperature change produced. **(2 marks)**

(b) The lower and upper fixed points of a newly manufactured thermometer are found to beat the 2.0 cm and 35 cm mark respectively. When the thermometer is placed in contact with a body whose temperature is to be measured, the mercury thread rises to the 17 cm mark.
- (i) Define lower fixed point temperature. **(1 mark)**
- (ii) Define upper fixed point temperature. **(1 mark)**
- (iii) Determine the temperature of the body. (3 **marks)**

(c) (i)Define convection. **(2 marks)**
(ii) Describe an application of convection in everyday life. **(2 marks)**

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**OR 7 (d), (e) and (f)**

7. (d) The acceleration due to gravity near the earth's surface is 10 m $s^{-2}$.
- (i) Define acceleration (2 **marks)**
- (ii) Describe an experiment to measure the acceleration due to gravity near the earth's surface by the free fall method. Your description should include
  - an experimental setup
  - the data collected
  - the use of the data to determine g
  - any precaution taken. (7 **marks)**
- (iii) In one of such experiments an object was released from rest at a height of 20 m. Determine the time taken by the object to hit the ground. **(2 marks)**

(e) A trolley of mass 2 kg is moving with a velocity of 5 m $s^{-1}$ collides with a second stationary trolley of mass 8 kg and bounces back with a velocity of 3 m $s^{-1}$.
- (i) State the principle of conservation of linear momentum. **(2 marks)**
- (ii) Calculate the velocity of the second trolley after collision. **(3 marks)**

(f) A boy in a 100 m flat race accelerates from rest and completes the race in 15 s.
- (i) Define velocity and give its SI units. **(2 marks)**
- (ii) Sketch a velocity-time graph for the above motion? **(2 marks)**

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**Answer either 8 (a) and (b) and (c) OR 8 (d), (e) and (f)**

**EITHER 8 (a), (b) and (c)**

8. (a) (i) State Snell's law of refraction. (2 marks)

In an experiment to verify this law, the angles of incidence (i) and corresponding angles of refraction (r) were measured for light moving from air into a glass block and recorded in a table below.

| i/° | 20 | 30 | 40 | 50 | 60 | 80 |
|---|---|---|---|---|---|---|
| r/° | 13 | 19 | 25 | 30 | 35 | 41 |
| sin ***i*** | 0.34 | | | 0.75 | | |
| sin r | 0.22 | | | 0.50 | | |

**(2 mark)**

(ii) Copy and complete the table. **(5 marks)**

(iii) Plot a graph of sin ***i*** (y-axis) against sin r (x-axis).

(iv) Determine the slope of the graph. (2 marks)

(v) State the significance of the slope. (1 marks)

(b) (i) Define dispersion of light. (1 marks)

(ii) State the property of light responsible for dispersion. (1 marks)

(iii) Draw a ray diagram showing how a prism disperses white light. (2 marks)

(c) Ultraviolet (UV) and infrared (IR) radiations are both parts of the electromagnetic spectrum.

(i) State how each radiation can be detected. (2 marks)

(ii) Give one use of each radiation. (2 marks)

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**OR 8 (d). (e) and (f)**

8. (d) (i) State Hooke's law.

In an experiment to verify Hooke's law, the length (l) of a spring for corresponding stretching forces (F) were measured and recorded in the table below

| Force F /N | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 |
|---|---|---|---|---|---|---|---|---|
| Length l /cm | 20.0 | 21.3 | 23.2 | 24.4 | 26.0 | 27.4 | 29.1 | 30.8 |
| Extension e /cm | | | | 4.4 | 6.0 | | | |

(ii) Copy and complete the table. (2 marks)

(iii) Plot a graph of Force (y–axis) against extension (x–axis). (5 marks)

(iv) Determine the slope of your graph. (2 marks)

(v) State the significance of the slope. (1 marks)

**e.** From your understanding of pressure explain the following observations.

(i) Why dams are constructed such that the base is made thicker than the top. (2 mark)

(ii) Why a girl wearing sharp–heeled shoes will cause more pain if she steps on your foot, than wearing flat–heeled shoes. (2 marks)

**(f)** In a simple hydraulic machine a force of 60 N was applied at the effort piston of area 0.02 $m^2$.

(i) State two characteristics of the fluid used in such a machine. (2 marks)

(ii) Calculate the pressure acting on the effort piston (2 marks)

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**Answer either 9 (a), (b) and (c) OR 9 (d), (e) and (f)**

**EITHER 9 (a), (b) and (c)**

9. (a) When a longitudinal wave travels through air, the air layer is disturbed forming alternate regions of Compressions and rarefactions. The distance between a compression and the nearest rarefaction is 2 m.

(i) State the meaning of each underlined term. (3 marks)

(iii) Name an example of longitudinal waves. (1 mark)

(iii) Calculate the wavelength of the longitudinal wave. (2 marks)

(b) Figure 2 shows a displacement against distance graph for transverse water waves produced in a ripple tank when the vibrator is vibrating at 50 Hz.

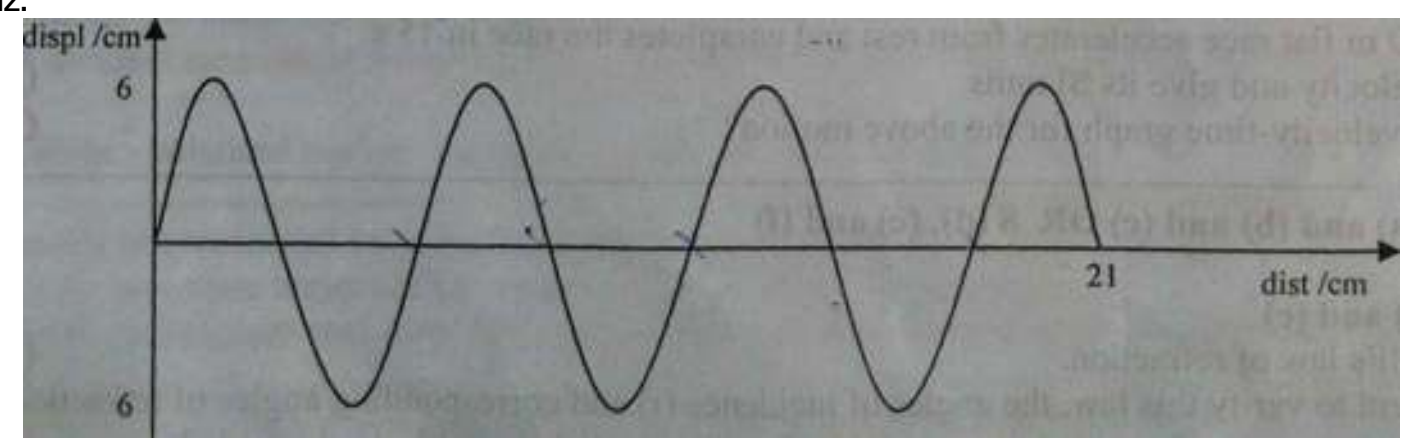



Figure 2

(i) Define transverse waves and give another example. (2 marks)

(ii) What is the frequency of vibration of the wave particles? Explain. (2 marks)

(iii) Calculate the wavelength of the wave. (2 marks)

(iv) Calculate the speed of the wave. (2 marks)

(v) State and explain if the wave would be diffracted if it is allowed to pass through a gap of 4 cm. (2 marks)

(c) The sound note produced by a string instrument depends on the tension and length of string. Explain how these factors can be varied and how each of them is related to frequency. (4marks)

OR 9 (d), (e) and (0

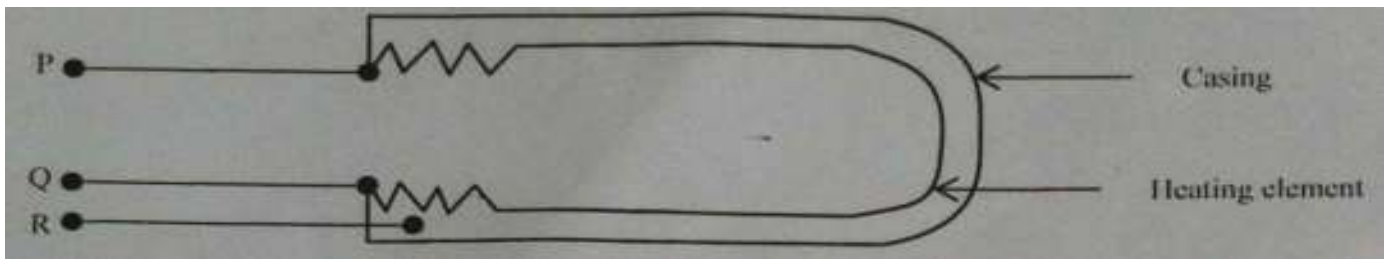
(d) A glass rod is rubbed with a dry cloth. The rod becomes charged and can pick up small pieces of paper.

(i) Explain the origin of charge on the rod and state the type of charge on it. **(2 marks)**

(ii) Explain why the rod would not be charged if the cloth was wet. **(2 marks)**

(iii) Explain why on taking the charged rod close to the cap of a positively charged gold leaf electroscope, the leaf .diverges more. **(2 marks)**

(e) The figure 3 shows some connections in an electric iron. P is the 'live' connection.




(i) Name the connections denoted Q and R. **(2 marks)**

(ii) which of the connections should a fuse be installed? Explain. **(2 marks)**

(iii) Which of the connections is a protectivedevice? What does it protect and how? **(3 marks)**

(iv) If the appliance is rated 240V 480 W, which among the fuses rated 1.5 A, 3 A and 13 A will be suitable for it? **(3 marks)**

(f) A copper wire is used as a resistor in an electric circuit. State and explain how each of the following actions affects the size of the current in the circuit:

(i) Increasing the length of the wire. **(2 marks)**

(ii) Increasing the thickness of the wire. **(2 marks)**

1.