

June 2015

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SECTION I
(One hour)
Answer ALL questions

1. (a) Name three ways through which a hot body can lose heat to the environment (3 marks)
 (b) A metal rod is held in the hand. The other end is put into a fire. State and explain how heat travels from the fire to the hand. (3 marks)
2. (a) Define, giving one example of each:
 (i) contact force (4 marks)
 (ii) non contact force
- (b) Car A of mass 1000 kg, moving at 60 m/s collides with car B of mass 1000 kg, moving in the opposite direction at a speed of 30 m/s. Both cars on collision stick together and travel at a speed, v . Determine v and say in which direction v is. (3 marks)

3. (a) Distinguish (by defining) between an intrinsic and an extrinsic semiconductor. State an example of each. (4 marks)
- (b) A current of 3 A flows past a point in a circuit in 20 s.
 (i) Determine the charge that has passed the point. (2 marks)
 (ii) Calculate the number of electrons that have passed the point (electronic charge, $e = 1.6 \times 10^{-19}$ C). (2 marks)

4. (a) State:
 (i) Faraday's law of electromagnetism (1 mark)
 (ii) Lenz's law of electromagnetism. (1 mark)

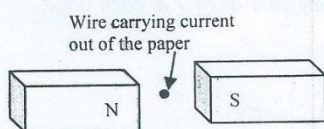


Figure 1

- (b) A straight wire carrying current is placed in between the poles of a magnet as shown in Figure 1.
 (i) Copy figure 1 without the wire and draw the magnetic field pattern between the poles of the magnet. (2 marks)
 (ii) Draw the field pattern for wire alone carrying current out of the paper (2 marks)
 (iii) Copy the diagram and draw the combined field pattern. (2 marks)
5. (a) Ultraviolet (UV) and infrared (IR) radiations are members of the electromagnetic spectrum.
 (i) State two properties that make them different. (2 marks)
 (ii) Name a device that can be used to detect each of the radiations. (2 marks)
 (iii) Name the electromagnetic wave which lies between UV and IR (1 mark)
6. (a) Define temperature and state its SI unit (2 marks)

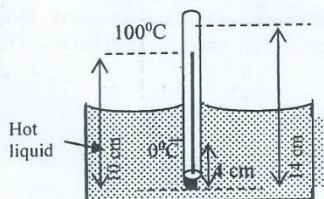


Figure 2

- (b) Figure 2 shows an uncalibrated thermometer with 0°C and 100°C marked as lower and upper fixed points respectively. The thermometer is put in a hot liquid. Given that the mercury length for 0°C is 4cm, that for 100°C is 14cm and that for hot liquid is 10cm, calculate the temperature of the hot liquid. (4 marks)

SECTION II

(1 ½ hours)

Answer ALL Questions

ANSWER either 7(a), (b) and (c) or 7(d), (e) and (f)

EITHER

- (a) (i) State Ohm's law and name a material that obeys the law. **(3 marks)**
 (ii) Define electromotive force (e.m.f) and potential difference (p.d). **(2 marks)**

(b) The following ammeter (A) and voltmeter(V) readings were taken in an experiment using a battery, a switch, a rheostat and a resistor in a circuit.

| | | | | | | |
|-----|---|-----|-----|-----|-----|-----|
| V/V | 0 | 1.5 | 3.0 | 4.5 | 6.0 | 6.9 |
| I/A | 0 | 0.5 | 1.0 | 1.5 | 2.0 | 3.0 |

- (i) Explain why the voltmeter and ammeter are connected as shown. **(4 marks)**
 (ii) Draw a graph of voltage (y-axis) against current (x-axis). **(5 marks)**
 (iii) Determine the slope of the graph and state its significance. **(3 marks)**

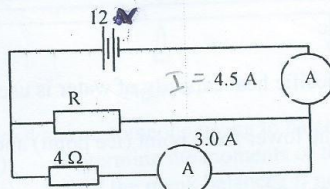


Figure 3

(c) Figure 3 shows a circuit operated using a 12 V battery. Calculate the value of R. **(3 marks)**

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

- (d) (i) State Snell's law of refraction. **(2 marks)**
 (ii) Define refractive index and critical angle **(2 marks)**
 (e) In an experiment, a tall beaker is placed on a black line drawn on a paper placed on a table. The tall beaker is filled to different levels with water and observed by placing the eye above the water. For each level, the real depth and its corresponding apparent depth are recorded. The results are given in the table below.

| | | | | | | |
|-------------------|-----|------|------|------|------|------|
| Real depth/cm | 8.1 | 12.0 | 16.0 | 20.0 | 24.2 | 28.0 |
| Apparent depth/cm | 5.9 | 9.1 | 12.0 | 15.1 | 18.1 | 21.0 |

- (i) Draw a labelled ray diagram to show how apparent depth comes about. **(3 marks)**
 (ii) Plot a graph of real depth (y-axis) against apparent depth(x-axis) **(5 marks)**
 (iii) Determine the slope of the straight line graph and state its significance. **(3 marks)**

Turn Over

- (f) Figure 4 shows light from a narrow source. The lens produces a parallel beam which falls on the prism.

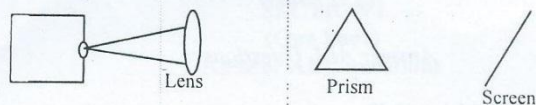


Figure 4

- (i) Copy the set up and continue the rays through it to the screen. State the nature of the spectrum produced (4 marks)
- (ii) The distance between the source and lens is 10 cm. What does this represent? (1 mark)

ANSWER EITHER 8(a),(b) and (c) or 8(d), (e)
EITHER 8(a),(b) and (c)

8. (a) (i) Define the specific heat capacity of a substance and state its SI unit (2 marks)
- (ii) Describe an experiment to determine the specific heat capacity of a solid, c . In your description, consider the following (7 marks)
- list the apparatus needed
 - draw a diagram of the set up
 - list the measurements to be taken
 - explain how the measurements are used to determine c
 - state a precaution
- (iii) Name and explain a device or situation in which the specific heat capacity of water is used. (3 marks)
- (b) A mercury-in-glass thermometer is constructed by determining the lower fixed point (ice point) and the upper fixed point (steam point)
- (i) Explain the effect of mineral impurities on each of the points. (2 marks)
- (ii) State two advantages of the school laboratory thermometer over the clinical thermometer. (2 marks)
- (c) (i) Explain why the part of a body on which spirit is poured feels cold after a while. (2 marks)
- (ii) Why do one's feet feel warm when on a carpet but cold on a bare cemented floor? (2 marks)

OR 8(d), (e)

- 8 (d) (i) Describe an experiment to determine the speed of sound in air by a simple direct method. In your description consider the following: (7 marks)
- list the apparatus needed
 - draw a diagram of the set up
 - list the measurements to be taken
 - explain how these measurements are used to determine the speed
 - state one precaution
- (ii) Name one device that produces a pure sound and one that produces an impure note. (2 marks)
- (iii) Why is it that during a thunder storm, light is seen before the sound is heard even though they are produced at the same time? (1 mark)
- (e) Water waves travelling at 1.3 m/s are produced in a ripple tank by a straight vibrator which makes 40 oscillations in 1 second.
- (i) Calculate the wavelength of the wave. (3 marks)

In the middle of the tank, these waves meet a straight barrier having an opening. Draw the wave fronts before and after they have passed the opening if the opening is:

- (ii) 2 cm (3 marks)
- (iii) 7 cm (2 marks)
- (iv) What is the name given to the effect observed above? (1 mark)
- (v) Describe a natural phenomenon which is due to the effect named in (iv). (1 mark)

ANSWER EITHER 9 (a) (b) and (c) or 9 (d), (e), (f) and (g).
EITHER 9 (a) (b) and (c)

9. (a) Differentiate a scalar quantity from a vector quantity and give one example of each. (4 marks)

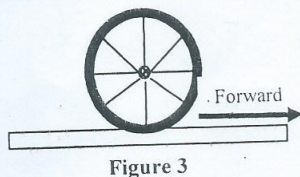


Figure 3

(b) Figure 3 shows the wheel of a bicycle accelerating forward on a road.

- (i) Draw the wheel and indicate the forces acting on it, indicating their respective directions as it Accelerates. (3 marks)
- (ii) Explain why banana peelings between the wheel and ground may cause the wheel to spin round. (2 marks)
- (iii) The mass of the bicycle and cyclist is 90.0 kg. What force is needed to cause an acceleration of 1.2 m s^{-2} ? (3 marks)
- (iv) Explain how the unbalanced force of the cyclist changes as the speed of the cyclist increases. (3 marks)

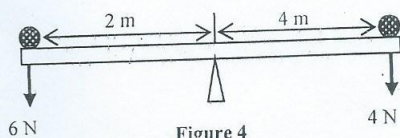


Figure 4

(c) Figure 4 shows someone trying to balance a uniform plank with a stone. The plank has negligible weight.

- (i) Determine the moments of the 6 N and of the 4 N forces respectively. (3 marks)
- (ii) Will the plank balance? If not, which way will it tip? (2 marks)

OR 9 (d), (e), (f) and (g)

9 (d) The nuclide of an atom is written as ${}^a_b\text{X}$.

- (i) What does a and b represent? (2 marks)
- (ii) Explain why an atom is considered neutral when it contains charged particles. (2 marks)

(e) ${}^{12}_6\text{C}$ and ${}^{14}_6\text{C}$ are isotopes of carbon.

- (i) Define the term isotope. (1 mark)
- (ii) Write down one similarity and one difference between the two nuclides of carbon. (2 marks)
- (iii) State a factor that determines the stability of an atom and determine which of the two nuclides of carbon is more stable. (4 marks)

(f) ${}^{14}_6\text{C}$ is present in all living materials and has a half-life of 5370 years. The activity of a sample of wood is measured to be 80 Bq.

- (i) Estimate the activity of the sample after two half-lives have elapsed. (2 marks)
- (ii) Explain why radiocarbon dating cannot be used to estimate the age of a rock. (2 marks)

(g) Uranium, ${}^{235}_{92}\text{U}$, is known to disintegrate when bombarded by a neutron into two nuclides.

- (i) State the type of reaction that has taken place. (1 mark)
- (ii) Explain why a neutron is effective in this process. (2 marks)
- (iii) Why does the uranium nucleus disintegrate when it is bombarded by the neutron? (2 marks)

Turn Over