Section I
One hour
Answer all questions

1. a) State the principle on which the optical fibre operates.
State any two uses of optical fibre
Draw a labelled diagram of an optical fibre and show on the diagram how a ray of light is transmitted through the optical fibre. **(6 marks)**

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2. a) State the assumptions used in deriving the kinetic theory equation , $P = \frac{1}{3} \rho \overline{C}^2$ where P is the pressure exerted by the particles, ρ, is the density of the gas and $\sqrt{\overline{C}^2}$ the root mean square velocity. **(6 marks)**

3.

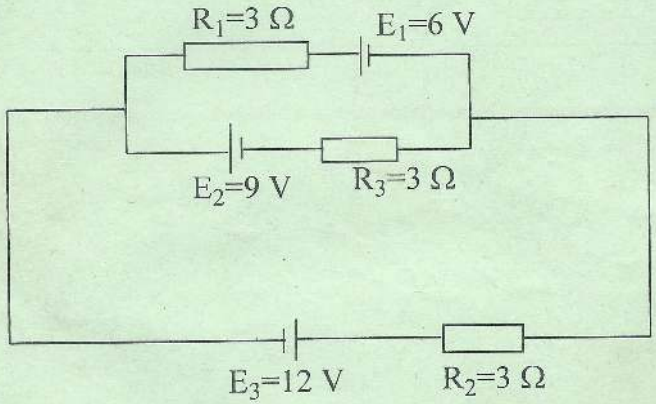

Figure 1.

Figure 1 is a circuit diagram showing how dc power sources (E_1, E_2 E_3) are connected with loads of resistances R_1, R_2 and R_3
Calculate the currents through R_1, R_2 and R_3 **(8 marks)**

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4. A 25 kg plank is suspended horizontally by a rope as shown on the diagram in figure 2.

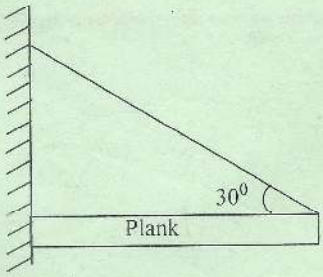

Figure 2

(a) Draw a diagram indicating the forces acting on the plank.
(b) Calculate the tension in the rope. **(4 marks)**

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5. Distinguish between solids and liquids using

   (a) Intermolecular forces

   (b) Molecular motion

   (c) Molecular arrangement

   (d) Intermolecular spacing

   (e) Bulk shape. **(6 marks)**

6. a) Draw two separate diagrams to show a p – n junction connected in the forward bias and reserved bias.

   b) When a p –n junction diode is connected in a circuit and is reserved bias, there is a very small leakage current across the junction. Explain the source of this current. How does the size of this current depend on temperature of the diode. **(6 marks)**

7. A tennis player drives a ball at 60 m s^{-1}; 10° to the horizontal and 50 cm above a tennis court.

   (a) Calculate the velocity at which the ball hits the court.

   (b) Sketch the velocity – time graph for the velocity of the ball. **(4 marks)**

SECTION II

One and a half hours
Answer all questions

Answer either 8 (a), (b), and (c) or 8 (d), (e) (f) and (g)

Either 8 (a), (b), and (c)

8. a) Define simple harmonic motion **(2 marks)**

b) Describe an experiment to measure acceleration of free fall, g, using a simple pendulum. Your description should include a diagram, procedure, precautions, observations and conclusion. **(8 marks)**

c) A small mass M is attached to the free end of a coiled spring on a smooth table. The other end of the spring is fixed and the mass puller through a distance of 8 mm and then released. If the spring constant is 10 N m^{-1}

(i) Prove that the motion of the mass at the end of the spring is simple harmonic **(3 marks)**

(ii) If the mass oscillates at frequency of 30 Hz. Calculate the value of M and the kinetic energy of the body when the extension is 3.0 mm. **(6 marks)**

(iii) State any assumption made in your calculations. **(1 mark)**

OR 8 (d), (e) (f) and (g)

8. (d) Define specific heat capacity **(2 marks)**

(e) Describe an experiment to determine the specific heat capacity of a metal
Your description should include a diagram, procedure, precaution, observation and conclusions. **(8 marks)**

(f) An engine is used to raise an 800 kg block of iron at a speed of 6.7 m s^{-1}. 0.5 kg of glycerine initially at a room temperature of 23 ^{0}C is required every second to maintain the temperature of the engine bearing at 0. The power developed by the engine is 1.0 x 10^{5} W. If the specific heat capacity of glycerine is 2.5 x 10^{3} J kg^{-1} K^{-1}. Calculate the value of θ **(5marks)**

(g) A well lagged aluminum calorimeter of mass 80 g contains 150 g of water and 100 g of ice all at 0^{0} C. A heating coil rated 1.0 kW is put in the calorimeter and the mixture stirred until its temperature is 33 ^{0}C. Calculate how much ice is left after one minute. State any assumption you have made. **(5marks)**

Answer either 9a, b, c or 9d, e, f

Either 9a, b, c

9. a) Define the term resistivity. **(2 marks)**

b) The graph in figure 3 below shows how the resistance of a copper wire varies with its length at 20 ^{0}C

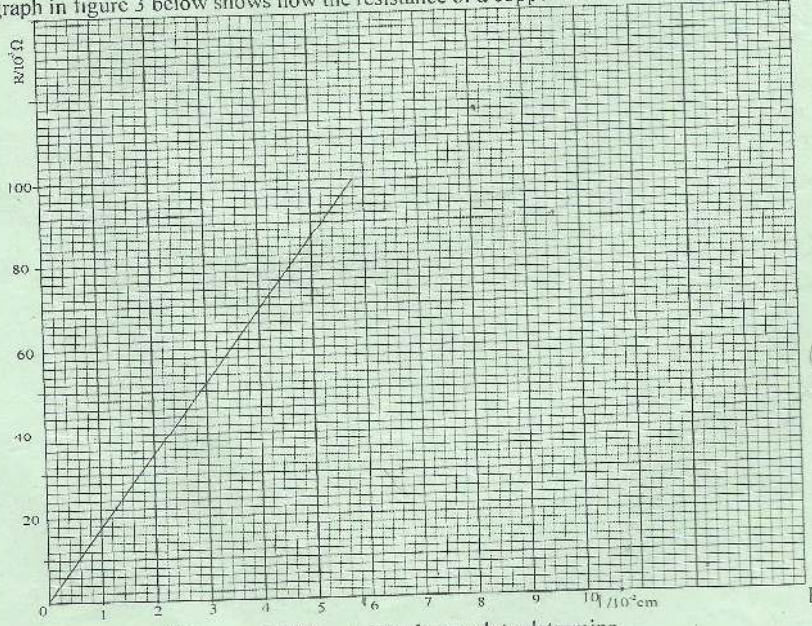


Figure 3

The wire has a thickness of 1.00 mm. Use the graph to determine.

(i) The resistivity of the wire. **(5 marks)**

(ii) The conductivity of copper wire. If the experiment were carried out at 30 °C. How would this affect the conductivity of the copper wire? **(4 marks)**

(iii) The length of the copper wire that has a resistance of 56 m Ω **(2 marks)**

(c) A milliameter has a resistance of 10 ohm and a full deflection of 10 m A. How would you convert it into

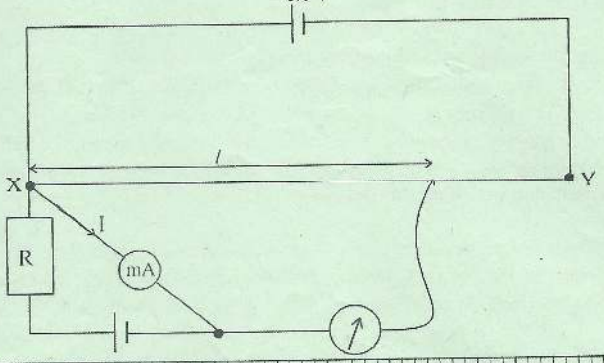
(i) An ammeter reading up to 10A

(ii) A voltmeter reading up to 10V. **(7 marks)**

Or 9d, e, f

9 d) State two conditions that must be satisfied for a balance to be obtained with a slide wire potentiometer. **(2 marks)**

Figure 4



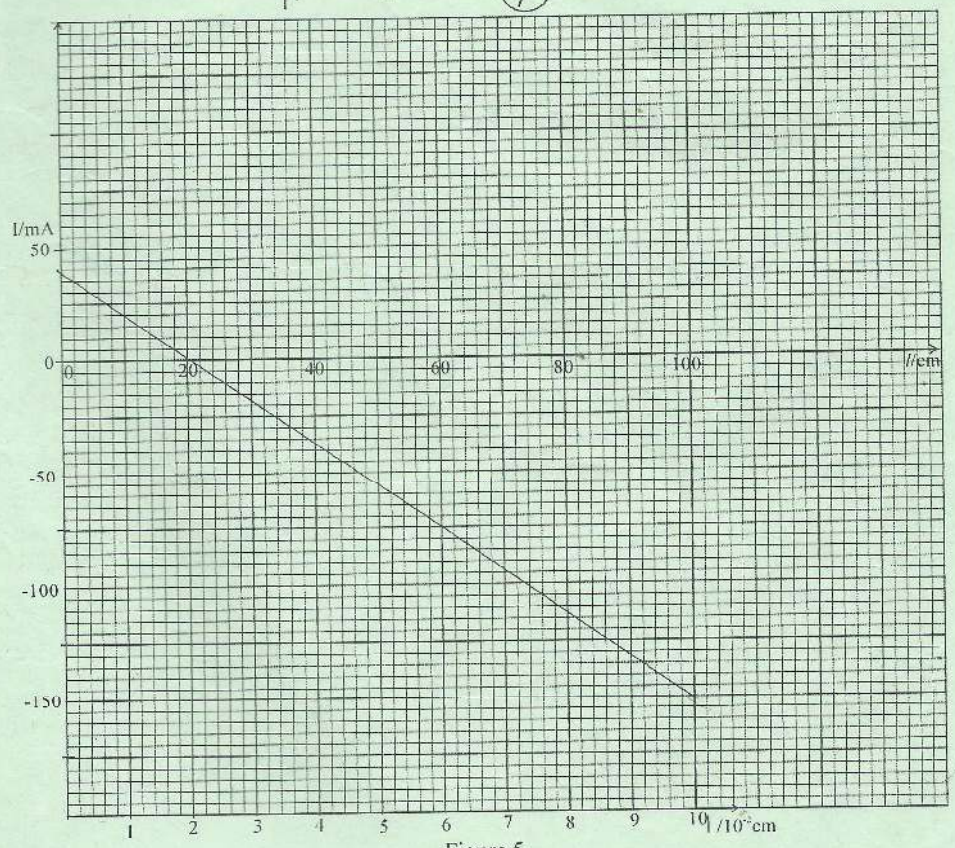


Figure 5

The circuit of figure 4 is used to obtain data from which a graph of current, I against balance length L, is drawn as in figure 5. The internal resistance of the cell is negligible.

(i) Explain why for different values of L, the current I can be positive, zero or negative **(3 marks)**

(ii) Using the graph, calculate the resistance of R. What assumption have you made in your calculations? **(6 marks)**

(iii) Hence, deduce the emf of the cell. **(3 marks)**

(e) The flux density between the poles of a powerful electromagnet is 2.5 T. What is the force exerted on 15 mm of wire carrying a current of 3.0 A when the wire is

(i) At right angles to the field **(3 marks)**

(ii) Parallel to the field **(1 mark)**

(iii) At an angle of 30^0 to the field. **(2 marks)**

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10. **Answer either 10 a, b, and c or 10 d and e**

Either 10 (a), (b), and (c)

a)(i) Determine the dimensions of the universal gravitation constant G. **(3 marks)**

(ii) Derive an expression for the acceleration, g, due to gravity at the earths surface in terms of G, the radius of the earth R and its density, ρ. **(5 marks)**

b) A communication satellite revolves round the earth in a circular orbit at a height of 36.000 km above the earth's surface. Find the satellite's period of revolution in hours. Comment on the result. **(8 marks)**

c) Distinguish between electric and gravitational fields. **(4 marks)**

Or 10 d, and e

10 (d) (i) Distinguish between photoelectric emission and thermionic emission. **(2 marks)**

(ii) State four observations obtained from experiment on photoelectric emission. **(4 marks)**

(iii) Choose any two of the observations and account for them in terms of the quantum theory of light. **(5 marks)**

(e) The $^{212}_{84}p_0$ nucleus emits α particles when it decays.

(i) What is the significance of 212 and 84 in the $^{212}_{84}p_0$. **(2 marks)**

(ii) Write out and complete the equation below representing this decay.

$$^{212}_{84}p_0 \rightarrow {}^{4}_{2}\propto + \qquad \textbf{(2 marks)}$$

(iii) Calculate the energy that is emitted in the decay process of $^{212}_{84}p_0$ in joules

Atomic mass:	Polonium	= 211,9890U
	Alpha particle	= 4.0026U
	Lead	=207.9767U
	1U	=931 MeV

(5 marks)
