STUDENT'S PROPOSED ANSWERS TO JUNE 2008

JUNE 2009

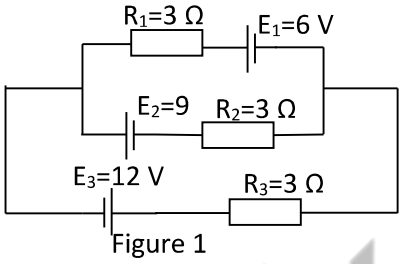
1. (a) (i) State the principle on which the optical fibre operates
   (ii)State any two uses of optical fibre
   (iii) Draw a labeled diagram of an optical fibre and show on the diagram how a ray of light is transmitted through the optical fibre.
2. (a) State the assumptions used in deriving the kinetic 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 $\overline{c^2}$ is the mean square speed.
3. 

Figure 1

Figure 1 is a circuit diagram showing how dc power s of resistances R_1, R_2 and R_3. Calculate the currents thro

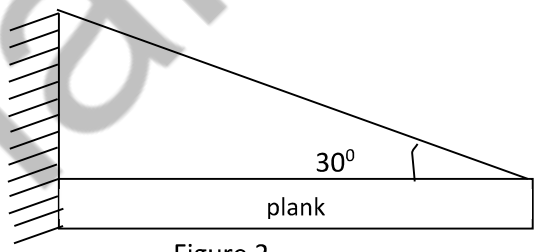


Figure 2

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

4. A 25 kg plank is suspended horizontally by a rope as

5. Distinguish between solids and liquids using
   (a) Intermolecular forces (b) molecular motion (c) molecular arrangement
   (d) Intermolecular spacing (e) bulk shape
6. (a) Draw two separate diagrams to show a p – n junction connected in the forward bias and reversed bias
   (b) When a p – n junction diode is connected in a circuit and is reversed bias, there is a very small leakage current across the junction. Explain the source of the current. How does the size of this current depend on temperature of the diode?
7. A tennis player drives a ball at $60ms^{-1}$; 10^0 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.
8. (a) Define simple harmonic motion
   (b) Describe an experiment to measure the acceleration of free fall, using a simple pendulum. Your description should include a diagram, procedure, precautions, observations and conclusion.

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

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

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

(iii) State any assumption made in your calculations

(d) Define specific heat capacity

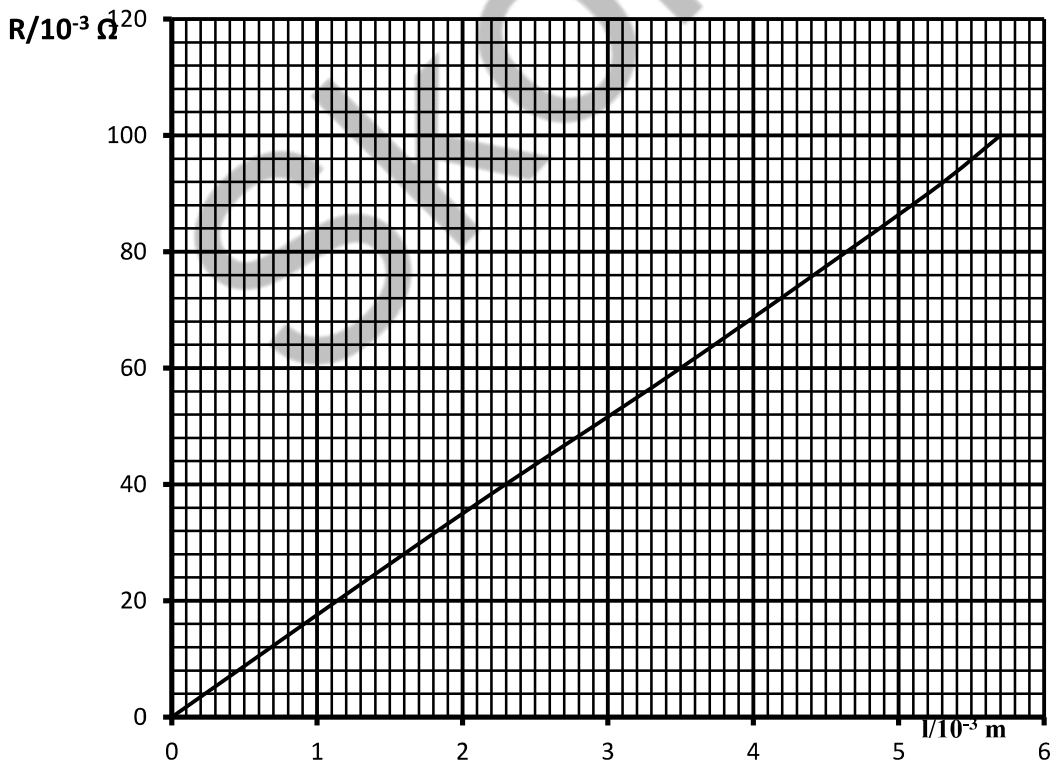
(e) Describe an experiment to determine the specific heat capacity of a metal. Your description should include a diagram, procedure, precaution, observation and conclusions.

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

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

9. (a) Define the term resistivity

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



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

(i) The resistivity of the wire.

(ii) The conductivity of the copper wire. If the experiment were carried out at 30^0 C, how would this affect the conductivity of the copper wire?
(iii) The length of the copper that has resistance of 56 mΩ.
(c) A milliammeter has a resistance of 10 Ω and a full scale deflection of 10 mA. How would you convert it into?
(i) An Ammeter reading up to 10 A
(ii) A voltmeter reading up to 10 V
(d) State conditions that must be satisfied for a balanced to be obtained with a slide wire potentiometer.

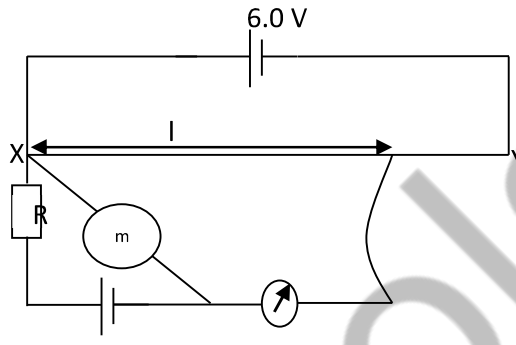


Figure 4

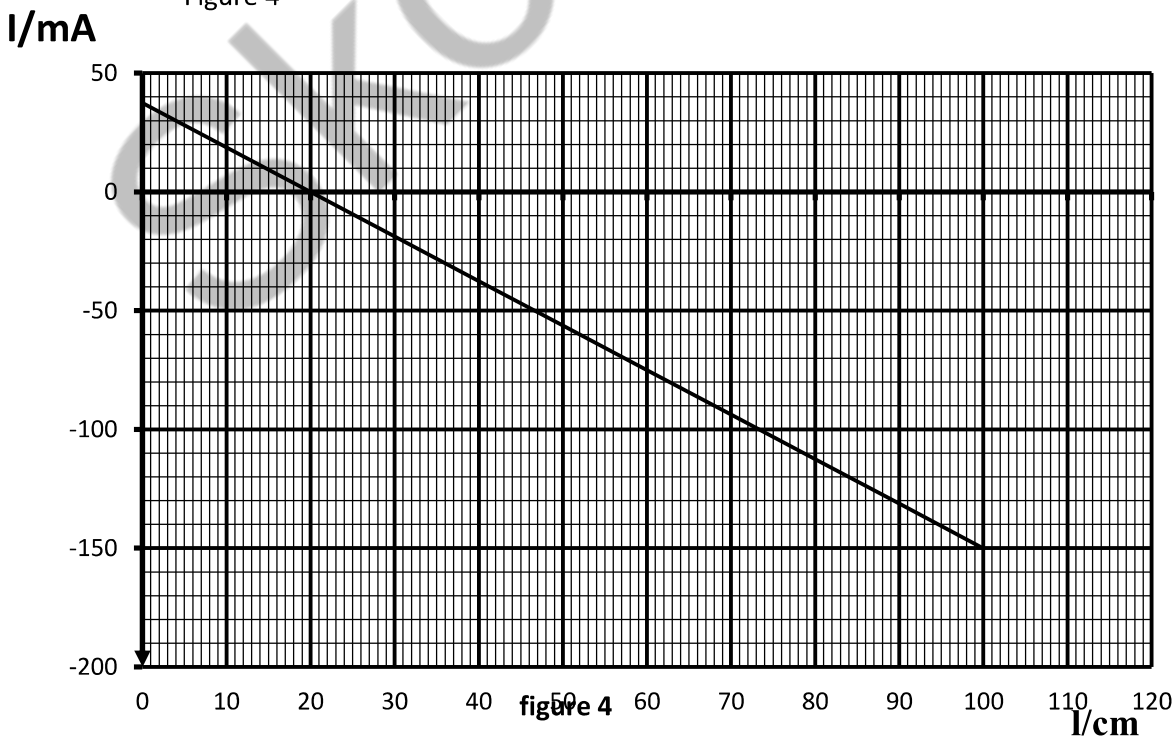


figure 4

The circuit of figure 4 is used to obtain data from which a graph of current I against balanced 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 can be positive, zero or negative

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

(iii) Hence, deduce the emf of the cell

(d) 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

(ii) Parallel to the field

(iii) At 30^0 to the field

10. (a) (i) Determine the dimensions of the universal gravitation constant G.

(b) Derive an expression for the acceleration, due to gravity at the earth's surface in terms of G, the radius of the earth R and it density, ρ.

(c) (i) 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.

(ii) Distinguish between electric and gravitational fields.

(d) (i) Distinguish between photoelectric emission and thermionic emission

(ii) State four observations obtained from the experiment on photoelectric emission.

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

(e) The $^{212}_{84}Po$ nucleus emits α particle when it decays

(i) What is the significance of 212 and 84 in $^{212}_{84}Po$

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

$^{212}_{84}Po \rightarrow {}^{4}_{2}\alpha +$

Calculate the energy that is emitted in the decay process of $^{212}_{84}Po$ in joules

Atomic mass: polonium = 211.9890 U, alpha particle = 4.0026 U, lead = 207.9767 U, where 1 U = 931 MeV.

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