

Name of the Student: _____

Max. Marks : 26 Marks

Time : 26 Minutes

Q1.

- (a) The equation $F = BIl$, where the symbols have their usual meanings, gives the magnetic force that acts on a conductor in a magnetic field.

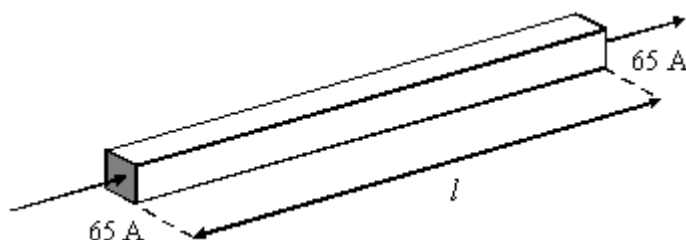
Given the unit of each of the quantities in the equation.

F _____ B _____
 I _____ l _____

State the condition under which the equation applies.

(2)

- (b) The diagram shows a horizontal copper bar of 25 mm × 25 mm square cross-section and length l carrying a current of 65 A.



- (i) Calculate the minimum value of the flux density of the magnetic field in which it should be placed if its weight is to be supported by the magnetic force that acts upon it.

density of copper = $8.9 \times 10^3 \text{ kg m}^{-3}$

- (ii) Draw an arrow on the diagram above to show the direction in which the magnetic field should be applied if your calculation in part (i) is to be valid. Label this arrow M.

(5)**(Total 7 marks)**

Q2.

- (a) The circuit shown in **Figure 1** may be used to determine the internal resistance of a battery. An oscilloscope is connected across the battery as shown. **Figure 2** represents the screen of the oscilloscope.

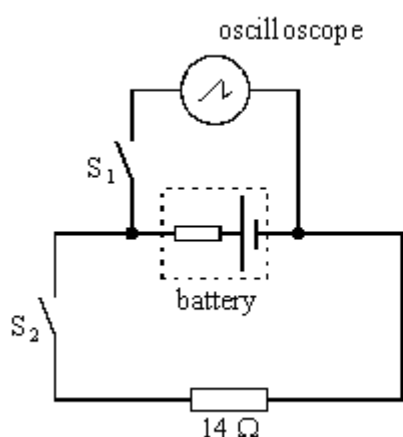


Figure 1

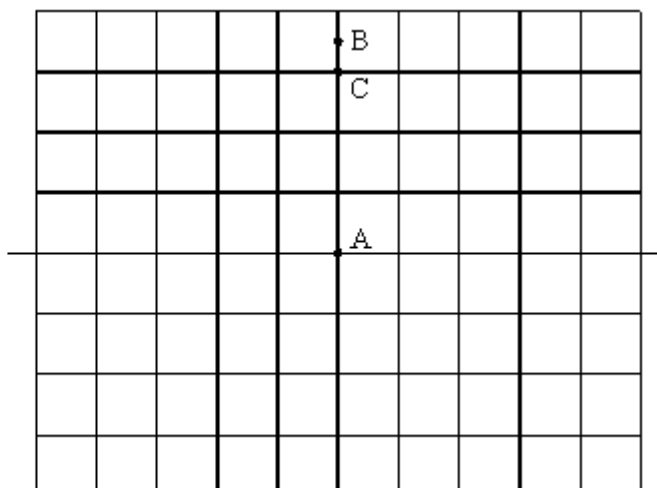


Figure 2

The time base of the oscilloscope is switched off throughout the experiment. Initially the switches S_1 and S_2 are both open. Under these conditions the spot on the oscilloscope screen is at A.

- (i) Switch S_1 is now closed, with S_2 remaining open. The spot moves to B. State what the deflection AB represents.

- (ii) Switch S_1 is kept closed and S_2 is also closed. The spot moves to C. State what the deflection AC represents.

- (iii) The vertical sensitivity of the oscilloscope is 0.50 V div^{-1} . Calculate the current through the 14Ω resistor with both switches closed.

- (iv) Hence, calculate the internal resistance of the battery.

(6)

- (b) The oscilloscope is now connected to an alternating voltage source of rms value 3.5 V .

- (i) Calculate the peak value of the alternating voltage.

- (ii) Draw on **Figure 3** what you would expect to see on the oscilloscope screen, if the time base is still switched off and the voltage sensitivity is altered to 2.0 V div^{-1} .

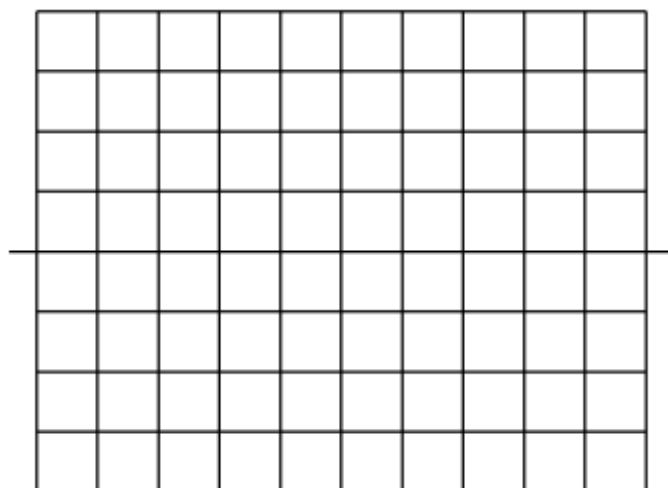


Figure 3

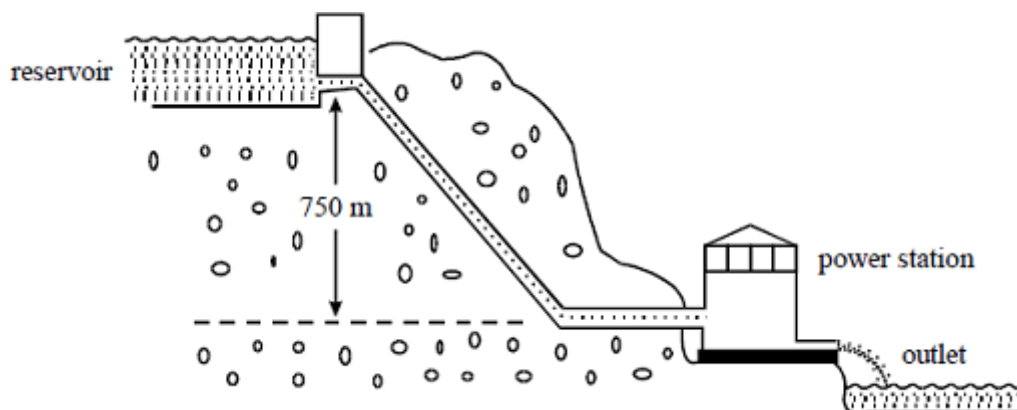
(3)

(Total 9 marks)

Q3.

A hydroelectric power station has a power output of 2.0 MW when water passes through its turbines at a rate of $1.4 \text{ m}^3 \text{ s}^{-1}$. The water is supplied from a reservoir which is 750 m above the power station turbines, as shown in the diagram below.

density of water = 1000 kg m^{-3}



(a) Calculate

- (i) the mass of water passing through the turbines each second,

- (ii) the loss of potential energy per second of the water flowing between the reservoir and the

power station turbines,

- (iii) the efficiency of the power station.

(6)

- (b) The turbines drive generators that produce alternating current at an rms potential difference of 25 kV which is then stepped up to an rms potential difference of 275 kV by means of a transformer.

- (i) Calculate the rms current supplied by the generators to the transformer when the power output of the generators is 2.0 MW.

- (ii) The transformer has an efficiency of 95%. Calculate the output current of the transformer.

(4)

(Total 10 marks)