

- 7 (a) (i) Define resistance.

.....  
.....[1]

- (ii) Sketch the  $I$ – $V$  characteristics of a metallic conductor at constant temperature on Fig. 7.1(a) and a filament lamp on Fig. 7.1 (b). [2]

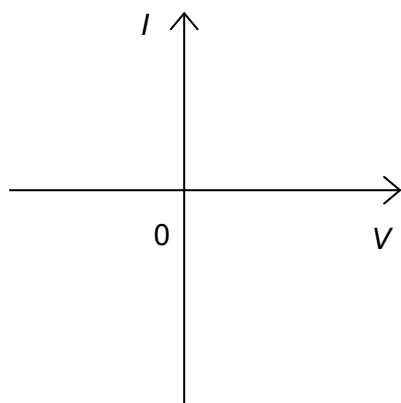


Fig. 7.1 (a)

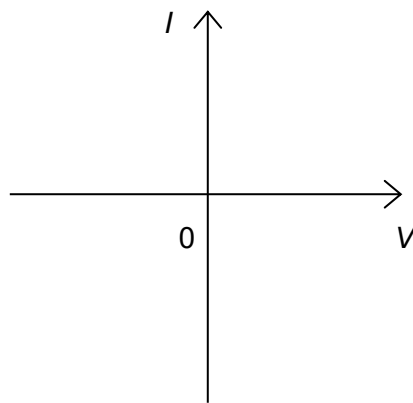
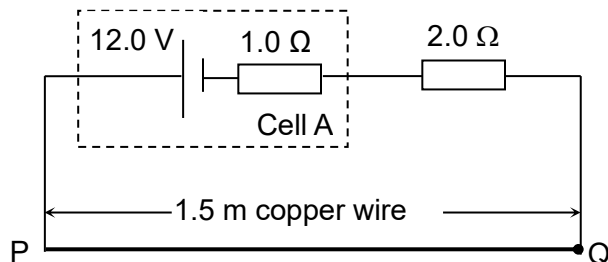


Fig. 7.1 (b)

- (b) The resistivity of copper is  $1.7 \times 10^{-8} \Omega \text{ m}$ . Calculate the resistance of a copper wire of length 1.5 m and cross-sectional area of  $3.2 \times 10^{-9} \text{ m}^2$ .

resistance = .....  $\Omega$  [2]

- (c) The copper wire in (b) is used to connect a circuit as shown in Fig. 7.2. Cell A has an e.m.f of 12.0 V and internal resistance 1.0  $\Omega$ . A 2.0  $\Omega$  resistance is also connected in series with cell A.

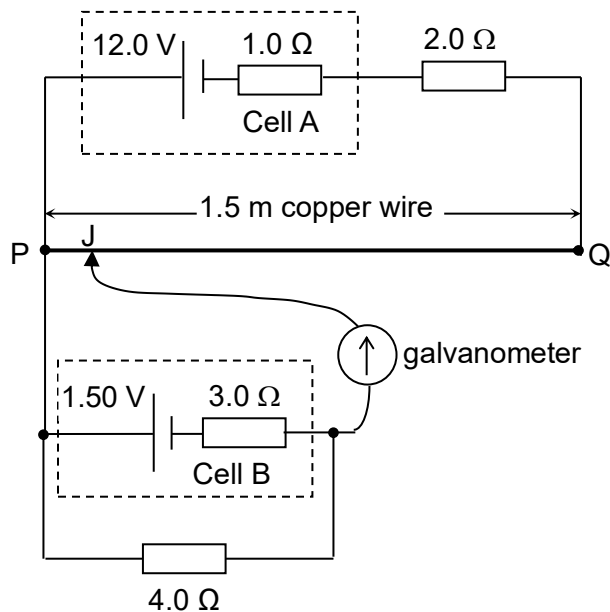


**Fig. 7.2**

Determine the drift velocity of the electrons flowing in the copper if the number of electrons per unit volume is  $8.5 \times 10^{28} \text{ m}^{-3}$ .

drift velocity = .....  $\text{m s}^{-1}$  [2]

- (d) (i) Cell B, a galvanometer and resistor of 4.0  $\Omega$  are now placed in parallel together with the circuit and is shown in Fig. 7.3. The movable contact J can be connected to any point along the wire PQ.



**Fig. 7.3**

Show that the potential difference across the copper wire PQ is 8.7 V when there is zero current in the galvanometer.

[1]

- (ii) Calculate the balance length PJ.

PJ = ..... m [3]

- (iii) The balance point is found to be too near P.

Suggest and explain how the circuit can be modified, without changing Cell B, to improve the accuracy of the balanced length PJ.

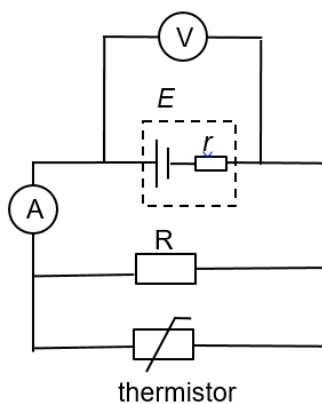
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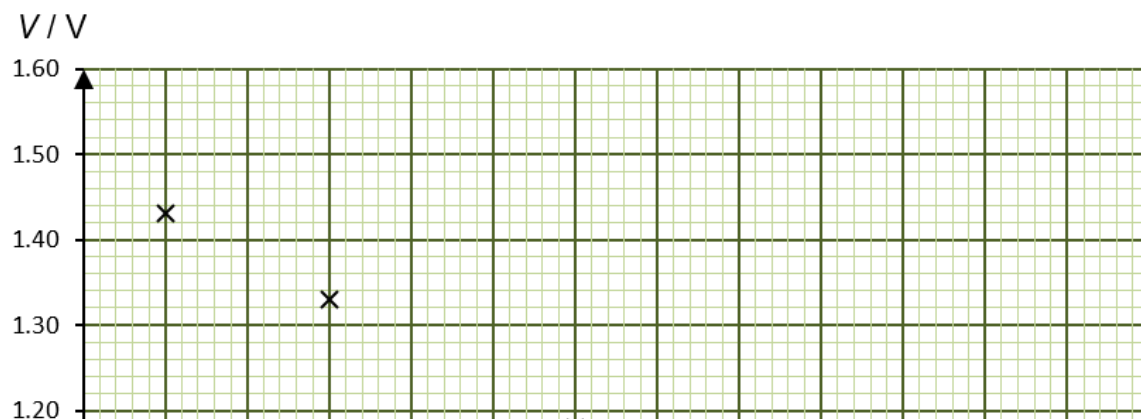
..... [2]

- (e) Fig. 7.4 shows a fixed resistor  $R$  and a thermistor connected in parallel to a battery with an electromotive force  $E$  and internal resistance  $r$ .



**Fig. 7.4**

Fig. 7.5 shows how the readings in the voltmeter  $V$  changes as current drawn from the battery,  $I$ , varies.



**Fig. 7.5**

- (i) Use Fig. 7.5 to determine  $E$  and  $r$ .

$$E = \dots\dots\dots \text{ V [2]}$$

$$r = \dots\dots\dots \Omega \text{ [2]}$$

- (ii) State and explain how the power dissipated in resistor R varies as temperature of the thermistor increases.

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..... [3]

[Total: 20]

**End of paper**