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**C2 Charge Carriers**

Data: Magnitude of the charge on an electron =  $1.60 \times 10^{-19}$  C

Free electron density of copper [Cu] =  $10^{29} \text{ m}^{-3}$

Free electron density of germanium [Ge] =  $10^{20} \text{ m}^{-3}$

- C2.1 How many electrons are needed to carry a charge of  $-6.00$  C?
- C2.2 How many electrons flow past a point each second in a  $5.0$  mA electron beam?
- C2.3 Alpha particles have twice the charge of an electron. What is the current caused by a radioactive source which emits  $3000$  alpha particles per second?
- C2.4 An electron gun emits  $3.0 \times 10^{21}$  electrons in two minutes. What is the beam current?
- C2.5 Assume all wires have a circular cross section. Calculate the values to complete the gaps in the table:

Diameter /mm	Cross sectional area /mm <sup>2</sup>	Material	Current /A	Drift velocity /m s <sup>-1</sup>
	2.5	Copper	13	(a)
	0.75	Copper	6.0	(b)
1.0		Copper	(c)	0.0050
	(d)	Copper	2.0	0.20
(e)		Germanium	2.0	0.20

- C2.6 In an experiment, a current of  $3.5$  A is being passed through a copper sulphate solution in a  $10$  cm cubical container, with the electrical terminals being opposite faces. This contains equal numbers of  $\text{Cu}^{2+}$  and  $\text{SO}_4^{2-}$  ions which have respectively  $+2$  and  $-2$  electron charge units. Assuming that the two ions have equal speed in the solution, and that there are  $6.0 \times 10^{26}$  of each per cubic metre of the solution, work out their mean speed.