## C2 Charge Carriers

Data: Magnitude of the charge on an electron = $1.60 \times 10^{-19}$ C
Free electron density of copper [Cu] = $10^{29}$ m$^{-3}$
Free electron density of germanium [Ge] = $10^{20}$ 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$^2$ | Material | Current /A | Drift Velocity /m s$^{-1}$ |
|---|---|---|---|---|
| | 2.5 | Copper | 13 | (a) |
| | 0.75 | Copper | 6.0 | (b) |
| 1.0 | | Copper | (c) | 0.005 |
| | (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 $Cu^{2+}$ and $SO_4^{2-}$ 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.