Solutions

Each answer shows the steps, then the **result**.

2.1

- atoms of the same element (same proton number) with different numbers of neutrons

2.2

- protons = 11
- neutrons = $23 - 11 =$ **12**

2.3

- proton: relative charge +1
- neutron: relative charge 0

2.4

- the total number of protons and neutrons in the nucleus

3.1 B

- most passing straight through shows the atom is mostly empty space

3.2 D

- the positive alpha particles are repelled by the positive nucleus; uncharged neutrons would not be

3.3

(a) protons = 19

- neutrons = $40 - 19 =$ **21**
- electrons = 19

(b) it has one fewer neutron (20 instead of 21)

3.4

Any two conclusions, each with its observation:

- the nucleus is very small compared with the atom; most alpha particles pass straight through the foil
- the nucleus is positively charged; some alpha particles are deflected, repelled by the nucleus
- the nucleus contains most of the mass of the atom; a very few alpha particles bounce back

3.5

(a)

- two light nuclei join to form a heavier nucleus, releasing energy

(b)

- nucleons: $2 + 3 = 4 + 1$; protons: $1 + 1 = 2 + 0$, so helium is ${}^{4}_{2}\mathrm{He}$

$$ {}^{2}_{1}\mathrm{H} + {}^{3}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n} $$