

7.1 Atomic structure and radiation

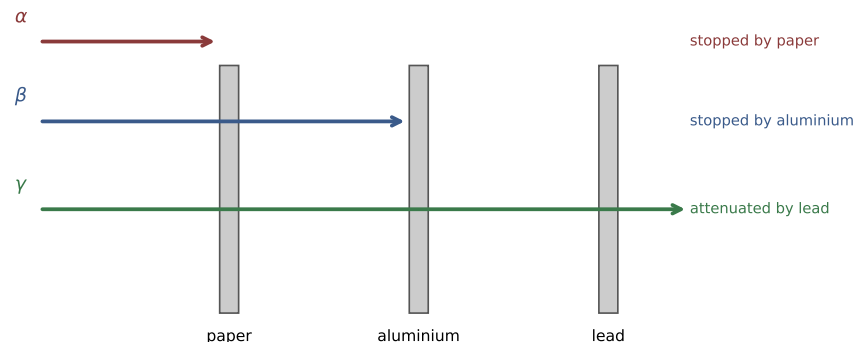
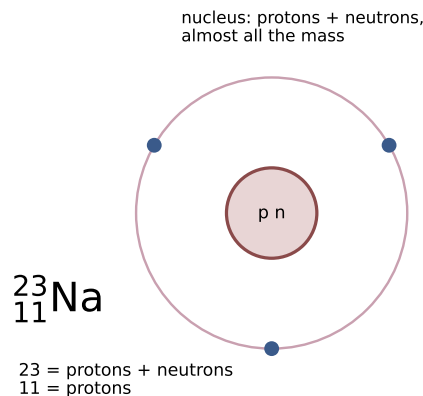
Name: _____ Class: _____ Date: _____ Total: 14 marks

Objective

Cover atomic structure and ionising radiation (3.7.1–3.7.2): the nuclear model with alpha-scattering evidence, particle properties and notation, the three radiations with penetration and ionisation, balanced equations, background radiation, (P) half-life and contamination versus irradiation. Original OxfordAQA practice.

1 Key knowledge and worked examples

■ Notation, balance and penetration



A falls by 4 and Z by 2 in alpha decay; A stays and Z rises by 1 in beta decay.

2 Practice

2.1 Give the relative mass and charge of a neutron. [2]

2.2 In $^{40}_{20}\text{Ca}$, how many neutrons? [1]

2.3 Name the radiation with the strongest ionising power. [1]

2.4 Which radiation passes through aluminium? [1]

2.5 (P) Define half-life. [1]

3 Exam-style questions

3.1 Describe how alpha scattering by gold foil led to the nuclear model of the atom. [3]

3.2 Balance the beta decay of potassium-40: ${}_{19}^{40}\text{K} \rightarrow ? + {}_{-1}^0\text{e}$. [2]

3.3 (P) A source's count rate falls from 800 to 200 counts/min in 12 hours. Determine the half-life. [3]

Solutions

2.1 Mass 1, charge 0.

2.2 $40 - 20 = 20$ neutrons.

2.3 Alpha.

2.4 Gamma.

2.5 (P) The time for half the unstable nuclei in a sample to decay (equally, for the count rate to halve).

3.1 Most alpha particles passed straight through – the atom is mostly empty space; a few were deflected through large angles – concentrated positive charge; very few bounced back – the mass and charge sit in a tiny, dense nucleus.

3.2 Mass number stays 40; proton number rises to 20: ${}_{20}^{40}\text{Ca}$.

3.3 $800 \rightarrow 400 \rightarrow 200$ is two half-lives; half-life = $12/2 = 6$ hours.