

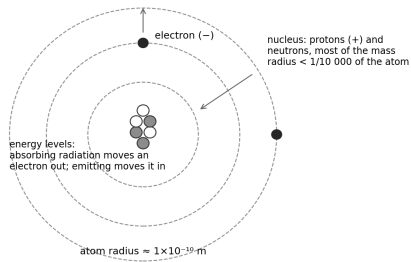
Topic 4: Atomic structure

AQA GCSE Physics 8463 · spec 4.4 · sheets 4.1–4.7

The unstable nucleus at the centre

- Atom radius about 10^{-10} m; nucleus holds most of the mass.
- Protons and neutrons in the nucleus; electrons in energy levels.
- Background radiation, fission and fusion are physics only.

Isotopes: same element, different neutrons



- Atomic number Z = protons; mass number A = protons + neutrons.
- Neutrons = $A - Z$; electrons = Z in a neutral atom.
- Isotopes: same Z , different A .

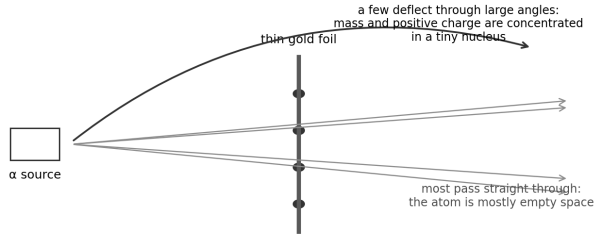
Your turn: three atoms

- P: $A=31$, $Z=15$; Q: $A=32$, $Z=16$; R: $A=31$, $Z=16$.
- Find the isotopes, P neutrons, and P charge after losing 3 electrons.

Three atoms worked

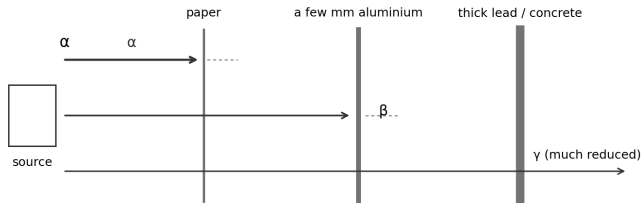
- 1 **Isotopes** Q and R share $Z = 16$ but A differs (32 vs 31).
- 2 **Neutrons** $A - Z = 31 - 15 = 16$.
- 3 **Ion** 15 protons, 12 electrons $\Rightarrow$ charge 3+.

Evidence replaced the pudding



- The development of the model of the atom: spheres → pudding → nuclear.
- Scattering evidence forced the change; Bohr, protons, neutrons followed.
- The model follows the evidence.

Three radiations, three barriers



- Alpha: helium nucleus, strongest ionising, stopped by paper.
- Beta: fast electron, stopped by a few mm of aluminium.
- Gamma: EM from the nucleus, reduced by thick lead.

Balance both rows

- Nuclear equations: balance mass (top) and charge (bottom).
- Alpha: mass -4 , charge -2 . Beta: mass same, charge $+1$.
- Gamma changes neither row.

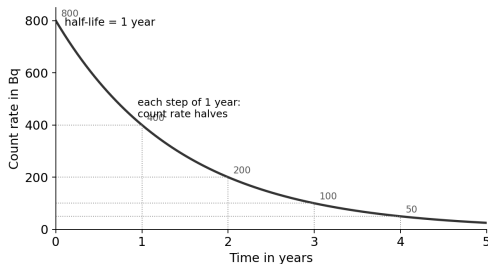
Your turn: polonium

- Polonium-210 ($Z = 84$) decays by alpha emission.
- Write the balanced equation.

Polonium worked

- 1 **Alpha rule** $A \rightarrow A - 4; Z \rightarrow Z - 2$.
- 2 **Apply** $210 - 4 = 206; 84 - 2 = 82$.
- 3 **Equation** ${}_{84}^{210}\text{Po} \rightarrow {}_{82}^{206}\text{X} + {}_2^4\text{He}$.

Half-life: the halving clock



- Decay is random — predictable only for large numbers.
- Half-life: time for nuclei or count rate to halve.
- Rate 800→200 Bq in 12 years: two halvings, 6 years.

Contamination sticks; irradiation passes

- Contamination: radioactive atoms ON the object.
- Irradiation: exposure to radiation; object stays clean.
- Tongs, distance, time, lead boxes.

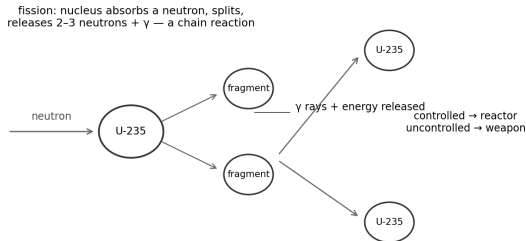
Background first, then measure

- Natural: radon, cosmic rays, food, medical.
- Man-made: weapons fallout, nuclear accidents.
- Subtract the background count before any calculation.

Half-life chooses the source

- Long half-life: active for decades — smoke alarms, waste.
- Short half-life: intense then gone — medical tracers.
- Medicine: gamma tracers explore; radiotherapy destroys.

Fission splits; fusion joins



- Fission: neutron absorbed, nucleus splits, chain reaction.
- Reactor controls the chain; a weapon does not.
- Fusion: two light nuclei join; mass becomes radiation energy.

Check yourself

- Checklist before you call this topic done.
- Balance both rows; halve the count rate.
- Contamination vs irradiation; fission vs fusion.