Mark scheme for Topic 7

1 **a** **i** To allow a more accurate determination of the scattering angle. **[1]**

ii To avoid absorption of the alpha particles.

To eliminate the possibility of multiple scatterings. **[2]**

b To explain small angle deflections.

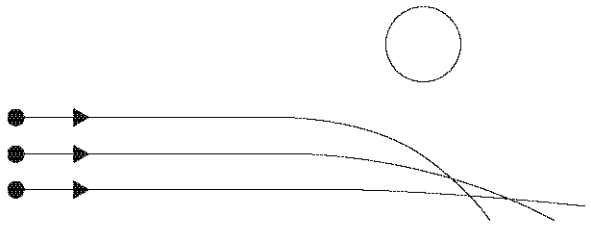
Most of the volume of the atom must be empty.

To explain large angle deflections.

The mass and the positive charge of the atom must be concentrated in a very small volume. **[4]**

Exam tip: your answer must be logical.

c



[2]

d The isotope has the same electric charge.

And so no change is expected. **[2]**

2 **a** A gas is kept at low pressure.

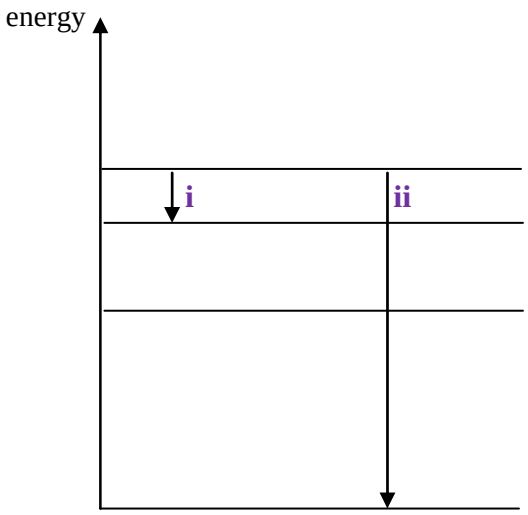
The gas is exposed to a high electric field.

The light emitted by the gas is analysed in a spectrometer/diffraction grating. **[3]**

b The light observed in atomic spectra has specific wavelengths.

These result when electrons make transitions between specific energy levels in the atom. **[2]**

c



[2]

3 **a** Random: it cannot be predicted which nucleus will decay or when it will decay.

Spontaneous: the decay cannot be prevented from happening/cannot be accelerated. **[2]**

Exam tip: it is important that you know the answer to this question.

b **i** ${}^{32}_{15}\mathrm{P} \rightarrow {}^{32}_{16}\mathrm{S} + {}^{0}_{-1}\mathrm{e} + \bar{\nu}$

for each correct particle on the right hand side **[3]**

ii The ratio will become 15:1 after 4 half-lives.

And so the time is $4 \times 14.3 = 57.2$ d. **[2]**

c The mass difference is $3.19739\times10^{7} - 3.19721\times10^{7} = 1.8\times10^{-4}$ u.

Energy released is $1.8\times10^{-4}\times931.5 = 0.168$ MeV. **[2]**

4 **a** Fission: the process in which a nucleus heavier than nickel 62 splits into lighter nuclei and releases energy.

Fusion: the process in which two nuclei (much lighter than nickel 62) join into a heavier nucleus and release energy. **[2]**

b **i** Circle around the region of nickel 62. **[1]**

ii Energy is released when the total binding energy of the products is greater than that of the reactants.

This is the case based on the curve for both fission and fusion. **[2]**

Exam tip: you must be familiar with energy released and binding energy.

c Binding energy on the right: $144\times8.4 + 89\times8.7 = 1983.9$ MeV.

Binding energy on the left: $235\times7.6 = 1786$ MeV giving a difference of about 198 MeV. **[2]**