8 **(a)** Evidence for the existence of the nucleus came from the observations of how α-particles were scattered by thin metal foil in experiments.

(i) State the observation that provided evidence for

1. the small size of the nucleus as compared to that of the atom,

……

……

[1]

2. the nucleus being positively charged and containing the majority of the mass of the atom.

……

……

……

[2]

(ii) For the experiment, suggest why

1. α-particles are used,

……

……

……

[2]

……

2. a thin metal foil is used.

……

……

[1]

(b) The binding energy of various nuclei is commonly being determined in the study of nuclear sources.

(i) Use the data below to determine, to five significant figures, the binding energy of a nucleus of $^{16}_{8}O$.

Data:

mass of proton	=	1.007276 u
mass of neutron	=	1.008665 u
mass of oxygen nucleus	=	15.990527 u

[3]

binding energy = ……..…..……. MeV

(ii) The binding energy of $^{17}_{8}O$ is found to be 126.43 MeV.

State and explain which of these two isotopes of oxygen, $^{16}_{8}O$ or $^{17}_{8}O$ would be more stable.

[3]

……..……..

……..……..

……....

(c) Uranium-234 is an isotope of uranium that decays by -emission to form thorium-230. The average half-life of uranium-234 is about 2.5×10^5 years.

(i) Explain why the half-life is an average value.

……..……..

……..……..

[2]

……..……..

……....

(ii) In a sample of radioactive material, the ratio of uranium atoms to thorium atoms is 1:6.

1. Estimate the age of the sample, assuming that originally there is no thorium present.

α

[3]

age = ……..…….. years

2. State two assumptions that were made in the calculations.

……..……..……

……..……

[2]

……..……

……..……

(iii) State one effect of ionising radiation on living tissues and cells.

……..……..……

[1]

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