

- 6 (a) Radon-220 ( $^{220}_{86}\text{Rn}$ ), at rest, decays spontaneously to form polonium (Po). During this decay, an  $\alpha$ - particle of kinetic energy 6.29 MeV and a  $\gamma$ - ray photon of energy 0.55 MeV are emitted.

(i) Write down the nuclear equation to represent the decay of a Radon-220 nucleus.

[2]

(ii) Calculate in joules the energy of 1.0 MeV.

$$\text{energy} = \dots \text{ J} [1]$$

(iii) Calculate, for this decay,

1. the mass equivalence of the energy released during the decay, and

$$\text{mass} = \dots \text{ kg} [2]$$

2. the wavelength of the emitted  $\gamma$ -ray photon.

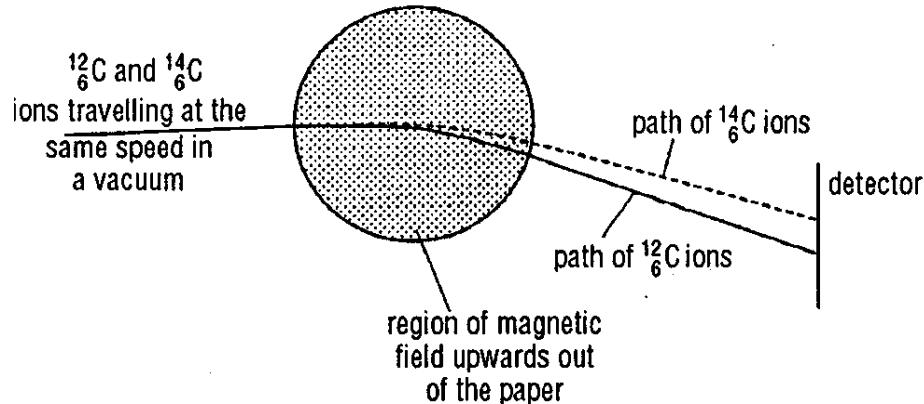
$$\text{wavelength} = \dots \text{ m} [2]$$

(b) Measurements are made of the activity of a specimen of carbon from pieces of wood found in a fireplace at an archaeological site. The specimen is found to contain one Carbon-14 (C-14) atom per  $8.6 \times 10^{10}$  Carbon-12 (C-12) atoms. In a modern firewood, the concentration of C-14 atoms is one C-14 atom per  $3.3 \times 10^{10}$  C-12 atoms. The difference between these two figures is because C-14 is radioactive and some atoms have decayed over the years.

- (i) The half-life of C-14 is 5700 years. C-12 is stable.  
Calculate the age of the wood from the ancient fire.

age of the wood = ..... years [3]

- (ii) The technique of dating described above is difficult to carry out accurately. This difficulty can be minimised by using all the C-14 atoms rather than just those which happen to undergo radioactive decay when the dating is being carried out. Carbon atoms from the wood can be ionised by removing one electron from each atom. They are then formed into a beam which is passed through a magnetic field as shown in Fig. 7.1.



**Fig. 7.1**

1. Explain why the paths of the two types of ions are different.

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2. Suggest why this method of measuring the ratio of C-14 to C-12 atoms is more reliable.

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