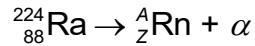


- 6** The isotope Radium-224 undergoes spontaneous decay and as a result, ionising radiation is produced. A stationary Radium- 224 nucleus decays to a Radon (Rn) nucleus by emitting an α -particle with no gamma emission as shown in the equation below. The daughter nucleus is an isotope of Radon (Rn).



- (a)** A deuterium nucleus has half the mass number and charge of the α -particle. Explain why a helium nucleus is more likely to be produced in the decay rather than two deuterium nuclei.

.....

..... [1]

- (b)** Determine the number of neutrons and protons in a nucleus of Rn.

Number of neutrons =

Number of protons = [1]

- (c)** The mass of the Radium nucleus is greater than the combined mass of the nuclei of Radon and the α -particle. Use a conservation law to explain how this decay is possible.

.....

..... [1]

- (d) The kinetic energy of the Rn nucleus is 0.1037 MeV. Determine the energy of the α -particle given the following information:

$$\text{rest mass of } {}_{88}^{224}\text{Ra} = 224.0202 \text{ u}$$

$$\text{rest mass of Rn} = 220.0114 \text{ u}$$

$$\text{rest mass of } \alpha\text{-particle} = 4.0026 \text{ u}$$

$$\text{Energy of } \alpha\text{-particle} = \dots \text{ MeV [4]}$$

- (e) As the α -particle travels in air, ionisation of air occurs. A neutral molecule becomes an ion-electron pair. The energy required to produce an ion-electron pair from a neutral molecule at atmospheric pressure is 31 eV.

By estimating the range of an α -particle in air, calculate to two significant figures, the number of ion-electron pairs produced per unit length as the α -particle is stopped in air at atmospheric pressure.

Number of ion-electron pairs produced per unit length = m^{-1} [3]