

- 6 A uranium-238 nucleus, ${}_{92}^{238}\text{U}$, originally at rest, spontaneously decays to form a thorium (Th) nucleus and an alpha particle. A gamma ray is not emitted.

(a) Using the A_ZX notation, write down a nuclear equation representing the above decay.

[2]

- (b) (i) This alpha particle travelled 25 mm in a cloud chamber. On average, an alpha particle creates 5.0×10^3 ion pairs per mm of track in the chamber and the energy required to produce an ion pair is 5.2×10^{-18} J.

Show that the kinetic energy with which the alpha particle was emitted during the decay is 6.5×10^{-13} J. State one assumption made in the calculations.

.....
 [2]

- (ii) Calculate the initial speeds of the

1. alpha particle, and

speed = m s^{-1} [2]

2. the thorium nucleus.

speed = m s⁻¹ [2]

- (c) The thorium nucleus produced by the α -decay of uranium-238 is also radioactive, with a half-life of 24.1 days. For a 5.0 g sample of thorium, determine

- (i) the probability per unit time that a thorium nucleus will decay, and

probability per unit time = s⁻¹ [2]

- (ii) the activity of the sample.

activity = Bq [2]

[Total: 12]

Section B

Answer **one** question from this Section in the spaces provided.