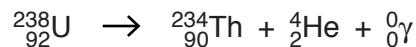


- 12 (a) Define the *binding energy* of a nucleus.

.....
.....
.....

[2]

- (b) A stationary nucleus of uranium-238 ($^{238}_{92}\text{U}$) decays to form a nucleus of thorium-234 ($^{234}_{90}\text{Th}$). An α -particle and a gamma-ray photon are emitted. The equation representing the decay is



The masses of the nuclei are given in Fig. 12.1.

| nucleus | mass/u |
|-------------|-----------|
| uranium-238 | 238.05076 |
| thorium-234 | 234.04357 |
| helium-4 | 4.00260 |

Fig. 12.1

- (i) State the relationship between the binding energies of the nuclei that is consistent with this reaction being energetically possible.

.....
.....

[1]

- (ii) Calculate, for this reaction,

1. the change, in u, of the mass,

$$\text{change of mass} = \dots \text{u} [1]$$

2. the total energy, in J, released.

$$\text{energy} = \dots \text{J} [2]$$

- (iii) State and explain whether the energy of the gamma-ray photon is equal to the energy released in the reaction.

.....
.....
.....

[2]

[Total: 8]

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