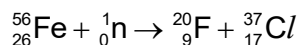


- 7 (a) Explain, with reference to the variation of binding energy per nucleon with nucleon number, why the following nuclear fission reaction of iron-56 ( $^{56}_{26}\text{Fe}$ ) to fluorine-20 ( $^{20}_9\text{F}$ ) and chlorine-37 ( $^{37}_{17}\text{Cl}$ ) would **not** result in an overall release of energy.



.....  
 .....  
 ..... [2]

- (b) A uranium-235 nucleus absorbs a neutron and becomes unstable. It then undergoes a fission reaction. One possible reaction is

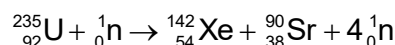


Table 7.1 shows the mass defects of the nuclei for this fission reaction.

**Table 7.1**

nuclei	mass defect / u
uranium-235 ( $^{235}_{92}\text{U}$ )	1.910
xenon-142 ( $^{142}_{54}\text{Xe}$ )	1.273
strontium-90 ( $^{90}_{38}\text{Sr}$ )	0.8405

Calculate the energy released from the fission of one nucleus of uranium-235.

energy = ..... J [2]

- (c) Strontium-90 is unstable and decays into the isotope yttrium-90.

A sample initially contains only nuclei of strontium-90. The half-life of strontium-90 is 28.8 years. The ratio

$$\frac{\text{number of decayed nuclei of strontium-90}}{\text{number of undecayed nuclei of strontium-90}}$$

is equal to  $R$ .

Determine the value of  $R$  after 144 years.

$$R = \dots\dots\dots [3]$$

- (d) A power source contains 0.13 kg of strontium-90. Each nucleus of strontium-90 that decays emits 0.546 MeV of energy.

- (i) Calculate the initial number  $N_0$  of nuclei of strontium-90 in the power source.

$$N_0 = \dots\dots\dots [1]$$

- (ii) Determine the initial activity of the source.

$$\text{activity} = \dots\dots\dots \text{ Bq } [1]$$

[Turn over

- (iii) Hence, determine the initial power output from the source due to the decay of strontium-90.

power output = ..... W [2]

[Total: 11]