

- 7 (a) V and X are different isotopes of helium.

State one similarity and one difference between a nucleus of V and a nucleus of X.

.....

.....

..... [2]

- (b) (i) The nuclear binding energy **per nucleon** varies with nucleon number.

On Fig. 7.1, draw a graph showing this variation for nuclei with nucleon number from 1 to 250. Label the axes with appropriate values.

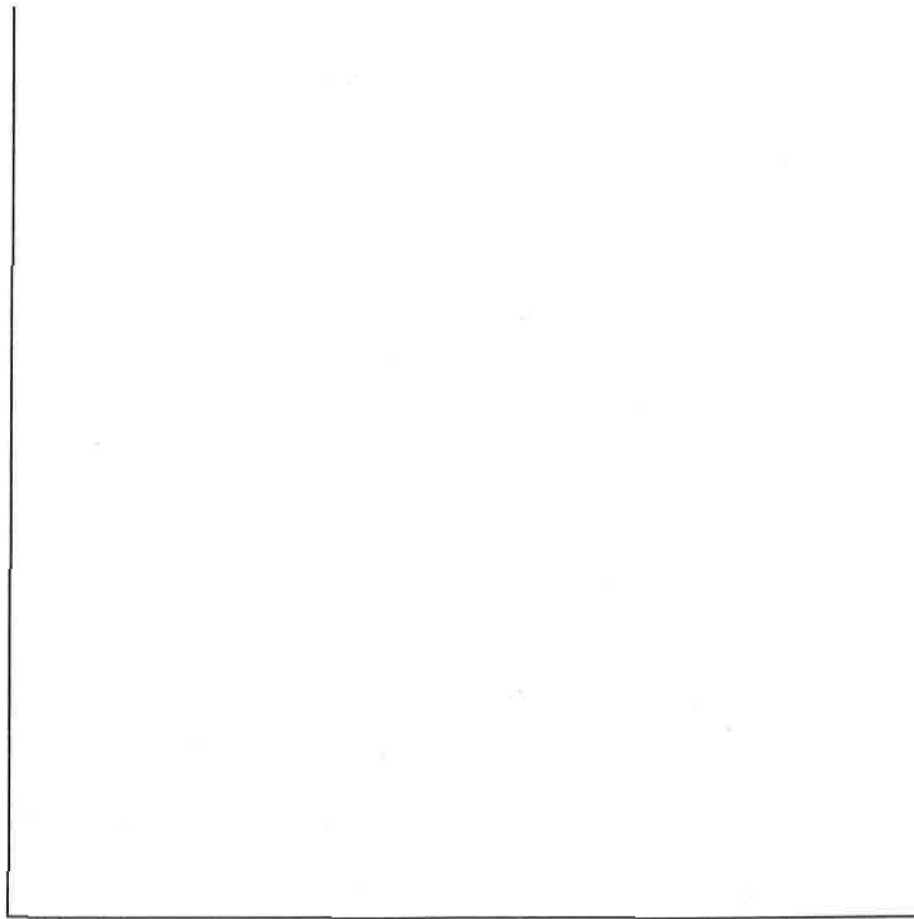


Fig. 7.1

[3]

- (ii) Explain the significance of the nuclear binding energy per nucleon for nuclear fusion.

.....

.....

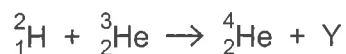
.....

..... [2]





(c) A ${}^4_2\text{He}$ nucleus is formed in this nuclear reaction:



(i) State **three** quantities that are conserved in all nuclear reactions.

1.
2.
3. [3]

(ii) Identify particle Y.

..... [1]

(iii) Explain, in terms of mass, why this nuclear reaction occurs.

..... [1]

(iv) Calculate the amount of energy released in the nuclear reaction.

mass of ${}^2_1\text{H}$ is 2.0141 u

mass of ${}^3_2\text{He}$ is 3.0160 u

mass of ${}^4_2\text{He}$ is 4.0026 u

mass of Y is 1.0078 u

energy = J [4]





- (v) Calculate the number of ${}^3_2\text{He}$ nuclei which must each fuse with a ${}^2_1\text{H}$ nucleus per second in order to emit energy at a rate of 20.0 W.

number = s^{-1} [2]

- (vi) In a house, there are fifteen lamps which consume electrical energy at a rate of 20.0 W each. The lamps are only switched on in the evenings.

Estimate the mass of ${}^3_2\text{He}$ that is required in order for this reaction to release the same amount of energy as the lamps in the house consume in one year.

State any assumption made.

mass = kg [2]

[Total: 20]

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