

Name of the Student: _____

Max. Marks : 24 Marks

Time : 24 Minutes

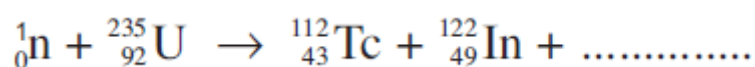
Q1.

- (a) State what is meant by the binding energy of a nucleus.

(2)

- (b) (i) When a ${}_{92}^{235}\text{U}$ nucleus absorbs a slow-moving neutron and undergoes fission one possible pair of fission fragments is technetium ${}_{43}^{112}\text{Tc}$ and indium ${}_{49}^{122}\text{In}$.

Complete the following equation to represent this fission process.



(1)

- (ii) Calculate the energy released, in MeV, when a single
- ${}_{92}^{235}\text{U}$
- nucleus undergoes fission in this way.

binding energy per nucleon of ${}_{92}^{235}\text{U} = 7.59 \text{ MeV}$

binding energy per nucleon of ${}_{43}^{112}\text{Tc} = 8.36 \text{ MeV}$

binding energy per nucleon of ${}_{49}^{122}\text{In} = 8.51 \text{ MeV}$

energy released _____ MeV

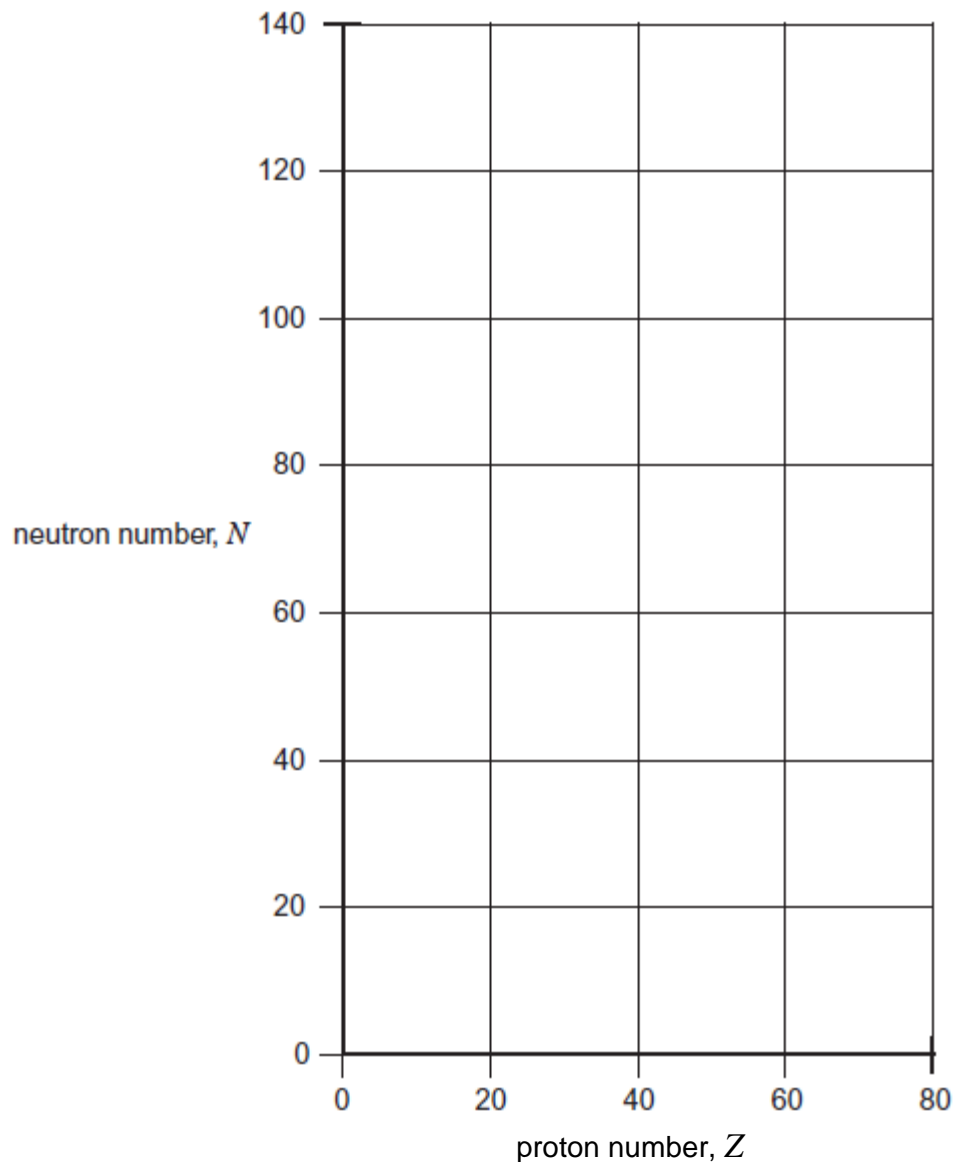
(3)

(iii) Calculate the loss of mass when a ${}^{235}_{92}\text{U}$ nucleus undergoes fission in this way.

loss of mass _____ kg

(2)

(c) (i) On the figure below sketch a graph of neutron number, N , against proton number, Z , for stable nuclei.



(1)

(ii) With reference to the figure, explain why fission fragments are unstable and explain what type of radiation they are likely to emit initially.

(3)

(Total 12 marks)

Q2.

- (a) (i) Define the atomic mass unit.

(1)

- (ii) State and explain how the mass of a ${}^4_2\text{He}$ nucleus is different from the total mass of its protons and neutrons when separated.

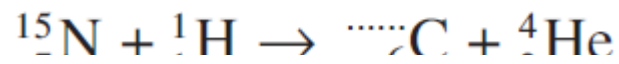
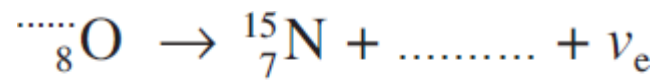
(2)

- (b) Explain why nuclei in a star have to be at a high temperature for fusion to take place.

(3)

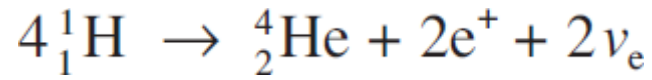
- (c) (i) In massive stars, nuclei of hydrogen ${}^1_1\text{H}$ are processed into nuclei of helium ${}^4_2\text{He}$ through a series of interactions involving carbon, nitrogen and oxygen called the CNO cycle.

Complete the nuclear equations below that represent the last two reactions in the series.



(3)

(ii) The whole series of reactions is summarised by the following equation.



Calculate the energy, in Me V, that is released.

nuclear mass of ${}^4_2\text{He} = 4.00150 \text{ u}$

energy _____ Me V

(3)

(Total 12 marks)