Practice Question Set For A-Level
Subject : Physics
Paper-2 Topic: Fields And Their Consequences(Nuclear Physics)

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Name of the Student:_____
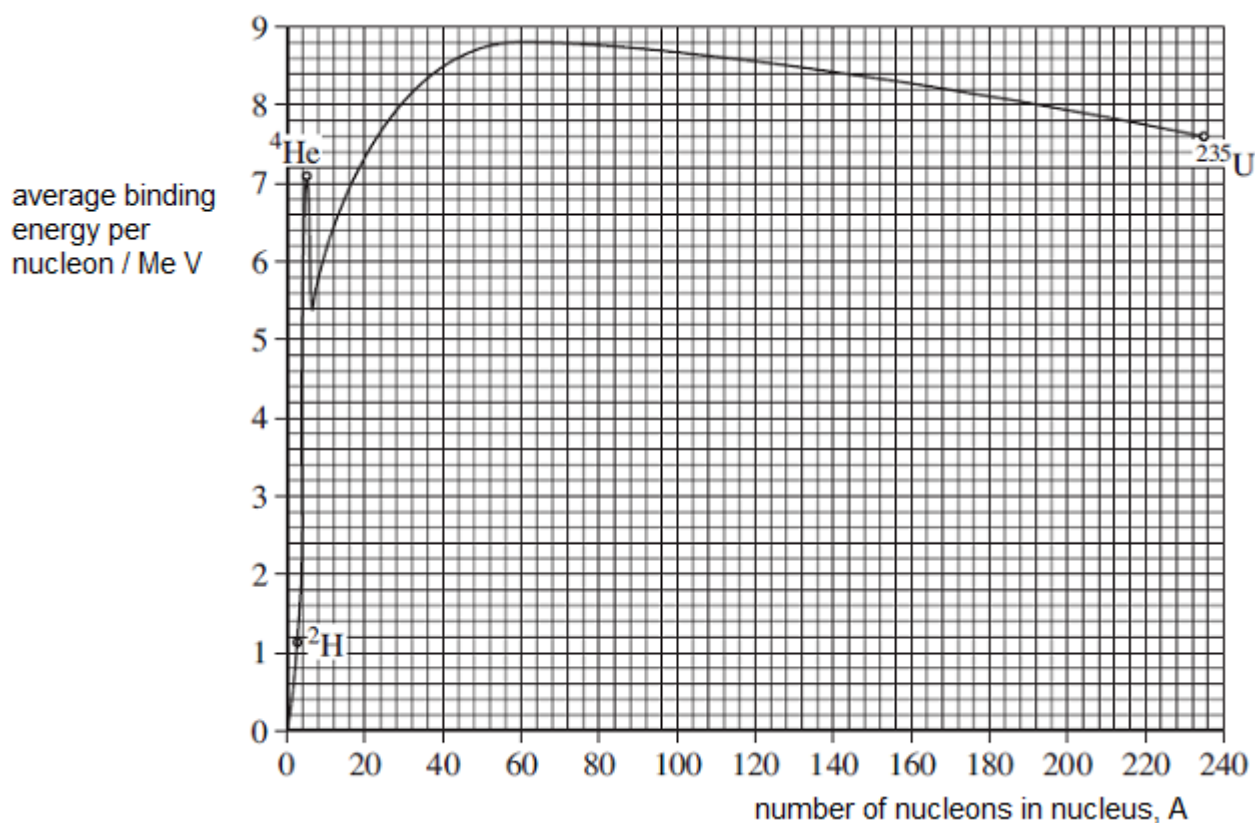
Max. Marks : 22 Marks   **Time : 22 Minutes**

Q1.

The figure below shows the variation in binding energy per nucleon with nucleon number.

(a)   A uranium-235, ^{235}U, nucleus fissions into two approximately equally sized products. Use data from the graph to show that the energy released as a result of the fission is approximately 4 × 10^{-11}J.
Show on the graph how you have used the data.

(4)

(b)   Using the data below, show that the energy available from the fusion of two hydrogen-2,^{2}H, nuclei to make a helium-4,^{4}He, nucleus is approximately 3.7×10^{-12} J.

$$\text{mass of } ^2\text{H} = 2.0135 \text{ u}$$
$$\text{mass of } ^4\text{He} = 4.0026 \text{ u}$$

(4)

(c)   Compare the energy available from the complete fission of 1 kg of uranium-235 with the energy available from the fusion of 1 kg of hydrogen-2.

_____

_____

(3)

(d)   Fission and fusion reactions release different amounts of energy. Discuss other reasons why it would be preferable to use fusion rather than fission for the production of electricity, assuming that the technical problems associated with fusion could be overcome.

_____

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(2)
(Total 13 marks)

Q2.

(a)   In a radioactivity experiment, background radiation is taken into account when taking corrected count rate readings in a laboratory. One source of background radiation is the rocks on which the laboratory is built. Give **two** other sources of background radiation.

source 1 _____

source 2 _____

(1)

(b)   A γ ray detector with a cross-sectional area of 1.5×10^{-3} m^2 when facing the source is placed

0.18 m from the source.
A corrected count rate of 0.62 counts s^{-1} is recorded.

(i) Assume the source emits γ rays uniformly in all directions.
Show that the ratio

$$\frac{\text{number of } \gamma \text{ photons incident on detector}}{\text{number of } \gamma \text{ photons produced by source}}$$

is about 4 × 10^{-3}.

(2)

(ii) The γ ray detector detects 1 in 400 of the γ photons incident on the facing surface of the detector.
Calculate the activity of the source. State an appropriate unit.

answer = _____ unit _____

(3)

(c) Calculate the corrected count rate when the detector is moved 0.10 m further from the source.

answer = _____ counts s^{-1}

(3)
(Total 9 marks)