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QUESTION WORKBOOK

Fission and fusion

Nuclear physics · Year 13

AQA 3.8.1.6, 3.8.1.7 · CIE 23.1 · OCR A 6.4.4

10 questions · 31 marks

NAVY SCREEN EDITION

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SECTION A · Warm-up

A1 Describe what happens in induced nuclear fission. [2]

A2 Explain what is meant by a chain reaction. [2]

A3 State what is meant by the critical mass of a fissile material. [2]

SECTION B · Standard

B1 Complete and balance the fission reaction: $^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + x\ {}^{1}_{0}n$. Find x, and check the proton numbers balance. [4]

B2 A single fission event converts a mass of 3.5×10^{-28} kg into energy. Calculate the energy released, in joules and in MeV ($c = 3.0 \times 10^{8}$ m s^{-1}, 1 MeV = 1.60×10^{-13} J). [4]

B3 Explain why very high temperatures are needed for nuclear fusion to occur. [3]

B4 A fusion reaction releases 17.6 MeV of energy. Calculate the energy in joules and the mass converted ($c = 3.0 \times 10^{8}$ m s^{-1}). [3]

SECTION C · Stretch

C1 Each fission of a uranium-235 nucleus releases about 200 MeV. Estimate the energy released by the complete fission of 1.0 kg of uranium-235 ($N_A = 6.02 \times 10^{23}$ mol^{-1}, 1 MeV = 1.60×10^{-13} J). [4]

C2 Compare nuclear fission and nuclear fusion in terms of the fuel used, the conditions required and the products. [4]

C3 Using the binding energy per nucleon curve, explain why energy is released in both fission and fusion. [3]