



QUESTION WORKBOOK

Nuclear radius and density

Nuclear physics · Year 13

AQA 3.8.1.5 · OCR A 6.4.1

10 questions · 30 marks

NAVY SCREEN EDITION

SECTION A · Warm-up

A1 State the equation relating nuclear radius to nucleon number, and the value of the constant R_0 . [2]

A2 Calculate the radius of a nucleus with nucleon number $A = 64$ ($R_0 = 1.2 \times 10^{-15} \text{ m}$). [2]

A3 State what $R = R_0 A^{1/3}$ implies about the density of nuclear matter. [2]

SECTION B · Standard

B1 Calculate the radius of an aluminium nucleus, $A = 27$. [3]

- B2** Taking the mass of a nucleon as 1.66×10^{-27} kg, estimate the density of nuclear matter using $\rho = m / ((4/3)\pi R_0^3)$ per nucleon. [4]

- B3** Calculate the ratio of the radius of a nucleus with $A = 125$ to that of a nucleus with $A = 8$. [3]

- B4** Explain why the near-constant density of nuclei supports the idea that nucleons are packed closely together. [3]

SECTION C · Stretch

- C1** An alpha particle of kinetic energy 5.0 MeV is fired head-on at a gold nucleus ($Z = 79$). Estimate the distance of closest approach, where all its kinetic energy has become electrostatic potential energy ($k = 8.99 \times 10^9$, $e = 1.60 \times 10^{-19}$ C). [4]

- C2** Calculate the density of a carbon-12 nucleus ($A = 12$) from its radius and mass (nucleon mass 1.66×10^{-27} kg), and compare it with the value found for aluminium above. [4]

- C3** Describe how electron diffraction can be used to determine the radius of a nucleus. [3]