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QUESTION WORKBOOK

# Nuclear radius and density

Nuclear physics · Year 13

AQA 3.8.1.5 · OCR A 6.4.1

10 questions · 30 marks

PRINT EDITION


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## 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 ($R_0 = 1.2 \times 10^{-15}$ m). [2]

**A3** State what $R = R_0A^{1/3}$ 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 $1.66 \times 10^{-27}$ 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 $1.66 \times 10^{-27}$ 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]