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QUESTION WORKBOOK

Newton's law of gravitation

Gravitational fields · Year 13

AQA 3.7.2.1, 3.7.2.2 · CIE 13.2, 13.3 · OCR A 5.4.2

10 questions · 30 marks

NAVY SCREEN EDITION

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SECTION A · Warm-up

A1 State Newton's law of gravitation for two point masses. [2]

A2 Two 5.0 kg point masses are 2.0 m apart. Calculate the gravitational force between them ($G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}). [2]

A3 Define gravitational field strength in terms of force and mass. [2]

SECTION B · Standard

B1 A planet of mass 6.0×10^{24} kg and its moon of mass 7.3×10^{22} kg are separated by 3.8×10^{8} m. Calculate the gravitational force between them. [4]

B2 Calculate the gravitational field strength at the surface of a planet of mass 6.0×10^{24} kg and radius 6.4×10^{6} m, using $g = GM/r^2$. [3]

B3 For the same planet, calculate the field strength at a distance of 1.28×10^{7} m from its centre (twice the surface radius), and comment on the result. [3]

B4 A 500 kg satellite orbits at 7.0×10^{6} m from the planet's centre. Calculate the gravitational field strength there and hence the gravitational force on the satellite. [3]

SECTION C · Stretch

C1 Mars has a mass of 6.4×10^{23} kg and a radius of 3.4×10^{6} m. Calculate the gravitational field strength at its surface. [4]

C2 At the surface of a planet of radius 6.4×10^{6} m the field strength is 9.81 N kg^{-1}. Calculate the mass of the planet. [4]

C3 Explain why the gravitational field strength decreases with height above a planet, and state the mathematical form of this decrease. [3]