InkPhysics

QUESTION WORKBOOK

Gravitational potential

Gravitational fields · Year 13

AQA 3.7.2.3 · CIE 13.4 · OCR A 5.4.4

10 questions · 30 marks

NAVY SCREEN EDITION

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SECTION A · Warm-up

A1 Define the gravitational potential at a point, stating where its zero is taken. [2]

A2 Calculate the gravitational potential at the surface of a planet of mass 6.0×10^{24} kg and radius 6.4×10^{6} m ($G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}). [2]

A3 Explain why gravitational potential is always negative. [2]

SECTION B · Standard

B1 Calculate the gravitational potential at a point 1.0×10^{7} m from the centre of the planet above (mass 6.0×10^{24} kg). [3]

B2 A 500 kg mass is moved from the planet's surface ($r = 6.4 \times 10^6$ m) to a point at $r = 1.28 \times 10^7$ m. Calculate the change in gravitational potential and hence the work done. [4]

B3 Using energy conservation, calculate the escape velocity from the surface of the planet (mass 6.0×10^{24} kg, radius 6.4×10^6 m). [3]

B4 The gravitational potential changes by 1.0×10^6 J kg^{-1} over a radial distance of 1.0×10^5 m. Estimate the gravitational field strength there, using $g = -\Delta V/\Delta r$. [3]

SECTION C · Stretch

C1 Calculate the minimum energy needed to move a 1000 kg spacecraft from the surface of the planet (potential -6.25×10^7 J kg^{-1}) to a great distance where the potential is effectively zero. [4]

C2 A satellite moves from an orbit at $r = 7.0 \times 10^6$ m to one at $r = 1.4 \times 10^7$ m. Calculate the change in gravitational potential between the two orbits. [4]

C3 Explain how the gravitational field strength and the gravitational potential are related through their graphs against distance. [3]