InkPhysics

QUESTION WORKBOOK

Orbits and satellites

Gravitational fields · Year 13

AQA 3.7.2.4 · CIE 13.2 · OCR A 5.4.3

10 questions · 31 marks

PRINT EDITION

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SECTION A · Warm-up

A1 Explain what provides the centripetal force that keeps a satellite in orbit. [2]

A2 State the relationship between the orbital period T and orbital radius r for a satellite (Kepler's third law). [2]

A3 State two features of a geostationary orbit. [2]

SECTION B · Standard

B1 A satellite orbits a planet of mass 6.0×10^{24} kg at a radius of 7.0×10^{6} m. By equating the gravitational and centripetal forces, calculate its orbital speed. [4]

B2 For the satellite above ($r = 7.0 \times 10^6$ m, $v = 7561$ m s^{-1}), calculate its orbital period. [3]

B3 Calculate the radius of a geostationary orbit around a planet of mass 6.0×10^{24} kg, using $T^2 = 4\pi^2 r^3 / GM$ with a period of 24 hours (86400 s). [4]

B4 Compare a low Earth orbit with a geostationary orbit in terms of altitude, period and a typical use. [3]

SECTION C · Stretch

C1 A 500 kg satellite orbits a planet of mass 6.0×10^{24} kg at $r = 8.0 \times 10^{6}$ m. Calculate (a) its kinetic energy, (b) its gravitational potential energy and (c) its total energy. [4]

C2 A moon orbits a planet of mass 6.0×10^{24} kg with a period of 1.0×10^{5} s. Calculate the radius of its orbit. [4]

C3 Explain why a geostationary satellite must be placed in an orbit directly above the equator. [3]