



Physics. *You work it out.*

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Essential Pre-Uni Physics F6.4

A Level



Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Mass of Earth = 5.98×10^{24} kg

Radius of Earth = 6400 km

The Moon's orbit round the Earth has a radius of 3.8×10^8 m. Calculate the Moon's speed in its orbit.

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Physics. *You work it out.*

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Essential Pre-Uni Physics F6.5

A Level



Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Mass of Earth = 5.98×10^{24} kg

Radius of Earth = 6400 km

Part A Orbiting the Earth

If you want something to orbit the Earth at a height of 200 km above the surface, at what speed must it travel? Give your answer to 3 significant figures.

Part B Time period

What is the time period of the orbit in Part A? Give your answer to 3 significant figures.

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Essential Pre-Uni Physics F6.6

A Level



Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Mass of Earth = 5.98×10^{24} kg

Radius of Earth = 6400 km

Part A Kepler's Third Law

Starting from $F = \frac{GMm}{r^2}$ and $F = \frac{mv^2}{r}$, derive Kepler's 3rd Law relating the radius of an orbit r to the mass of the planet M and the orbital speed v .

Give your answer in a form where r is on the left hand side of the equation and all other terms are on the right hand side.

The following symbols may be useful: G , M , π , r , v

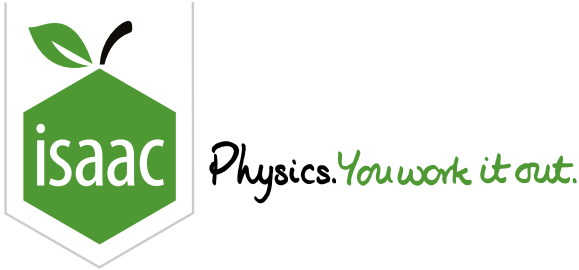
Part B Time period

Repeat the question, but this time to relate r and M to the time period T .

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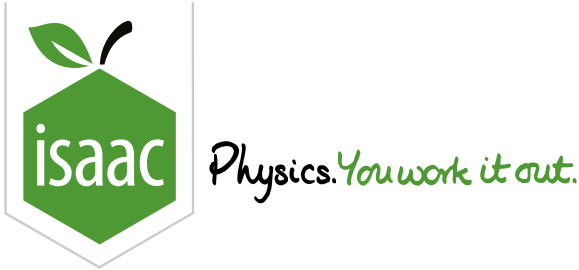
Orbits 26.3

A Level
P P P

Calculate the radius of the Moon's orbit around the Earth given that Moon takes approximately 27 days to orbit the Earth and the mass of the Earth is 6.0×10^{24} kg.

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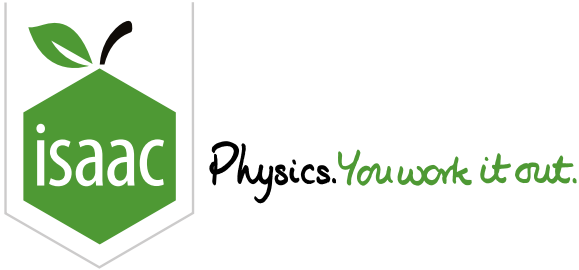
Orbits 26.5

A Level
P P P

Calculate the orbital period of Jupiter in units of Earth years given that the mass of the Sun, $M = 2.0 \times 10^{30}$ kg, the mass of Jupiter, $m = 1.9 \times 10^{27}$ kg and the average radius of Jupiter's orbit around the sun is $R = 7.8 \times 10^8$ km.

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Orbits 26.7

A Level



61 Cygni is a wide binary star system. It contains two stars of nearly equal mass which orbit once around their mid point every 659 years. They are 1.26×10^{13} m apart. Assuming that the two stars have equal mass, calculate:

Part A Speed

the speed of the stars.

Part B Total mass

the total mass of the system.

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Physics. *You work it out.*

Orbits 26.2

A Level

P

P

P

A positron of charge $+q$ and mass m enters a magnetic field B travelling at a speed v perpendicular to the direction of the magnetic field.

Part A Radius of orbit

Derive an expression for r in terms of q , B , m and v .

The following symbols may be useful: B , m , q , r , v

Part B From positron to proton

If we now change the particle from a positron to a proton, keeping the magnetic field and the velocity of the particle the same, what would happen? Complete the sentence below.

The proton will move in a with .

Items:

circular

non-circular

straight

orbit

line

a smaller

a larger

the same

varying

no

radius

curvature

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Orbits 26.9

A Level



In a particle accelerator protons are accelerated in the $+x$ -direction until they have a velocity of $v = 6.5 \times 10^6 \text{ m s}^{-1}$. They then pass into a magnetic field of strength 0.1 T that is oriented in the $+y$ -direction.

Part A Direction of motion

In which direction do the protons accelerate when they first enter the magnetic field?

- ☐ $+x$ direction
- ☐ $-x$ direction
- ☐ $+y$ direction
- ☐ $-y$ direction
- ☐ $+z$ direction
- ☐ $-z$ direction

Part B Radius

What is the radius of the orbital path that the protons take?

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Essential Pre-Uni Physics H6.4

A Level



Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Part A Momentum of a muon

Work out the momentum of a muon (same charge as an electron, but mass = $207 \times$ electron mass) taking a curved path with a 90 cm radius perpendicular to a 0.0076 T magnetic field.

Part B Momentum of an electron

Work out the momentum of an electron which would take the same path in the same field as question H6.4.

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