2017 found

SECTION C

Answer **all** the questions.

36 The Moon is in circular orbit around Earth at constant speed.

(a) Explain why we describe the Moon as accelerating towards the Earth.

vel is constant, changing towards the center. Δv is accel

.....

.....

..... **[2]**

(b) **(i)** Starting from the equation for circular motion show that the acceleration of the Moon towards the Earth is given by $a = \frac{4\pi^2 R}{T^2}$

where the Moon's orbital radius is R and the Moon's orbital time is T.

r = R

$a = \frac{v^2}{r}$ $\quad v = \frac{2\pi r}{T}$ $\quad v^2 = \frac{4\pi^2 r^2}{T^2}$

$\Rightarrow a = \frac{4\pi^2 R^2}{T^2 R}$

[1]

(ii) Show that the Moon's acceleration is less than $3\,\text{mm}\,\text{s}^{-2}$.

$R = 3.84 \times 10^8\,\text{m}$ $\quad T = 2.35 \times 10^6\,\text{s}$

$= 2.7 \times 10^{-3}\,\text{m s}^{-2}$

$= 2.7\,\text{mm s}^{-2}$

[1]

(iii) The Moon's orbital radius $R = 60 \times R_{\text{Earth}}$.
The gravitational acceleration at the Earth's surface $g = 9.8\,\text{m}\,\text{s}^{-2}$.
Calculate the acceleration due to the Earth's gravity at the Moon's orbit.
Compare this value to the value calculated in **(ii)**.

$\frac{9.8}{60^2}$ its an inverse square

acceleration = 0.0027 $\text{m}\,\text{s}^{-2}$

pretty close

..... **[3]**

Sample F

[1]

16 A satellite orbits the Earth in a circular orbit of height 2.3×10^6 m above the ground.

What is the angular velocity ω of the satellite?

radius of Earth = 6.4×10^6 m.
mass of Earth = 6.0×10^{24} kg

need to know

$T^2 = \frac{4\pi^2 r^3}{GM}$

$T = 8035$ s

$\omega = \frac{2\pi}{T} \Rightarrow \omega = 7.8 \times 10^{-4}$ rads/s

A 6.1×10^{-7} rad s^{-1}

B 3.3×10^{-5} rad s^{-1}

C 7.8×10^{-4} rad s^{-1}

D 5.7×10^{-3} rad s^{-1}

Your answer ☐

[1]