Do not write outside the box

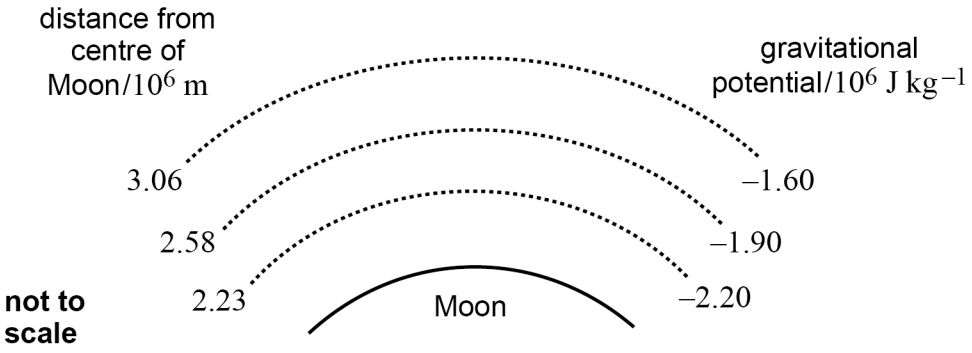
0 3 . 1 Define gravitational potential at a point.

[1 mark]

work done in bringing a 1Kg mass from infinity to that point

0 3 . 2 **Figure 2** shows the positions of equipotential surfaces at different distances from the centre of the Moon.

Figure 2



Explain how the equipotential surfaces in **Figure 2** show that the gravitational field is **not** uniform.

[1 mark]

if it were uniform then the equipotentials would be equal spaced - and they are not. THe V varies in equal steps but the distance does not

Do not write outside the box

0 3 . 3 Calculate, using **Figure 2**, the escape velocity at the surface of the Moon.

radius of Moon = 1.74×10^6 m

[4 marks]

Find mass of the moon - pick some data r=2.23x10^6 V=-2.2x10^6

$V = -\frac{GM}{r} \Rightarrow M = \frac{Vr}{G} = \frac{2.2\times10^6 \times 2.23\times10^6}{6.67\times10^{-11}}$

$M = 7.36\times10^{22}$ kg

To find esc vel you convert all the V into Ek

$\frac{GMm}{r} = \frac{1}{2}mv^2$ $m = 1$ kg

$\sqrt{\frac{2GM}{r}} = v$

escape velocity = 2400 m s^{-1}

2 sf

6

Turn over for the next question

Do not write outside the box

0 9 What is the angular speed of a satellite in a geostationary orbit around the Earth?

[1 mark]

A 1.2×10^{-5} rad s^{-1} ⬭

B 7.3×10^{-5} rad s^{-1} ⬭

C 4.2×10^{-3} rad s^{-1} ⬭

D 2.6×10^{-1} rad s^{-1} ⬭

2π rads in 24 hr

$\frac{2\pi}{24\times60\times60} = 7.3 \times 10^{-5}$

1 0 A planet of mass M and radius R rotates so quickly that material at its equator only just remains on its surface.

What is the period of rotation of the planet?

material is effectively orbiting and grav force = centripeta;

A $2\pi\sqrt{\frac{R}{GM}}$ ⬭

B $2\pi\sqrt{\frac{GM}{R}}$ ⬭

C $2\pi\sqrt{\frac{R^3}{GM}}$ ⬭

D $2\pi\sqrt{\frac{GM}{R^3}}$ ⬭

$$\frac{GMm}{R^2} = \frac{mv^2}{R} \rightarrow v^2 = \frac{GM}{R}$$

$$v = \frac{d}{t} \rightarrow v = \frac{2\pi R}{T}$$

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

$$\rightarrow T = 2\pi\sqrt{\frac{R^3}{GM}}$$

Do not write outside the box

1 1 Satellites **N** and **F** have the same mass and are in circular orbits about the same planet. The orbital radius of **F** is greater than that of **N**.

Which is greater for **F** than for **N**?

[1 mark]

less **A** gravitational force on the satellite ⬭

less **B** angular speed ⬭

less **C** kinetic energy ⬭

✓ **D** orbital period ⬭

1 2 An object moves freely at 90° to the direction of a gravitational field.

The acceleration of the object is

Gravity will pull into circular orbit

[1 mark]

A zero. ⬭

B opposite to the direction of the gravitational field. ⬭

C in the direction of the gravitational field. ⬭

D at 90° to the direction of the gravitational field. ⬭

Turn over for the next question