Physics U6 Circular Motion Worksheet #3

Orbital Velocity - Orbital Period

Name:



When we have circular motion in space around Earth or similar body, the centripetal force is the force of gravity.

This means that . . .

Fc = Fg
ma_c= GMM/R²
m (v²/R) = GMM/R²
(v²/R) = GM/R²
v²/R = GM/R²
v² = GM/R
v =
$$\sqrt{GM/R}$$

orbital velocity = $v = \sqrt{GM/R}$

1. Calculate the orbital velocity for a satellite that is 300 km above the surface of the Earth.

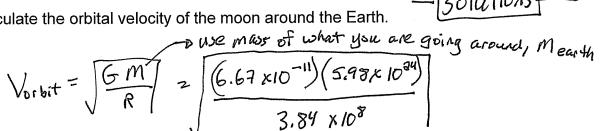
Calculate R (in meters) carefully.

$$R = 300,000m + 6.38 \times 10^{6}$$

$$R = 6.68 \times 10^{6}m$$

$$V = \frac{(6.67 \times 10^{-11})(5.98 \times 10^{24})}{(6.68 \times 10^{6})} = 7730 \text{m/s}.$$

2. Calculate the orbital velocity of the moon around the Earth.



3. Calculate the orbital velocity of the Earth around the Sun. - of what you are

$$V_{ORBIT} = \sqrt{\frac{GM}{R}} = \sqrt{\frac{(6.67 \times 10^{-11})(1.98 \times 10^{30})}{1.5 \times 10^{11}}}$$

4. Calculate the orbital velocity of a satellite 150 km above the surface of the Moon.

$$V_{OBSIT} = \frac{6 \text{ M}}{R} = \frac{(6.67 \times 10^{-11})(7.35 \times 10^{23})}{1.89 \times 10^{6}} = \frac{1610 \text{ m/s}}{1.89 \times 10^{6}}$$

Similar to above, starting with

Fc = Fg

ma_c= GMM/R²

m
$$(4\pi^2R/T^2)$$
 = GMM/R²
 $4\pi^2R/T^2$ = GM/R²
 $4\pi^2R^3/T^2$ = GM

 $4\pi^2R^3/GM$ = T²
 $T = \sqrt{4\pi^2R^3/GM}$

we can solve for orbital period T

5. Find the period of revolution for a satellite that is 400 km above the surface of the Earth.

$$T = \sqrt{\frac{4 \pi^2 R^3}{6 m}} = \sqrt{\frac{4 \pi^2 (6.780,000)}{(6.67 \times 10^{-11})(5.98 \times 10^{24})}} = \sqrt{\frac{5554 \text{ Sec.}}{(5.48 \times 10^{-11})(5.98 \times 10^{24})}} = \sqrt{\frac{5554 \text{ Sec.}}{(5.67 \times 10^{-11})(5.98 \times 10^{24})}}} = \sqrt{\frac{5554 \text{ Sec.}}{(5.67 \times 10^{-11})(5.98 \times 10^{24})}}}$$

6. Find the period of revolution for the moon around the Earth use must of $\frac{1}{4\pi^{3}}$ $= \frac{(4\pi^{3})(3.84\times10^{3})^{3}}{(6.67\times10^{-11})(5.98\times10^{24})}$

$$T^{a} = \frac{4\pi^{2}R^{3}}{6m} \rightarrow \sqrt[3]{\frac{T^{a}Gm}{4\pi^{2}}} = \sqrt[3]{R^{3}} = R. \qquad T = 86,400 \, \text{Sec}$$

$$R = \sqrt[3]{86,400} (6.67 \times 10^{-11}) (5.98 \times 10^{24}) = \sqrt[4]{250474} \, \text{m.} = R_{TOTAL}$$

$$-(R_{EARTH} = 6.38 \times 10^{4} \, \text{m.})$$

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$$= \sqrt[4]{350$$

$$V_{ORBIT} = \sqrt{\frac{GM}{R}} = \sqrt{\frac{(6.67 \times 10^{-11})(5.98 \times 10^{24})}{4.22 \times 10^{7}}} = 3074 \, \text{m/s}.$$

c) What do we call this type of orbit?