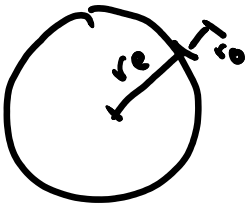
Universal Gravitation Wrap Up

Sunday, January 5, 2014 4:02 PM

Orbit and Constant Velocity Problem

$v_t = \frac{2\pi r}{T}$

A satellite is in orbit 500 km above the surface of the Earth. What is its velocity?



m_1 = mass earth = 5.98×10^{24} kg m_2 = mass of satellite

$F = \frac{Gm_1m_2}{r^2}$

$r = r_e + r_o = 6.38 \times 10^6 + 5 \times 10^5 = 6.88 \times 10^6 m$

What is happening?

⇒ centripetal acceleration

$F_c = \frac{mv^2}{r}$ $F = \frac{Gm_1m_2}{r^2}$

$\rightarrow \frac{mv^2}{r} = \frac{Gm_1m_2}{r^2}$

m of object

$v^2 = \frac{Gm_1}{r}$

$v = \sqrt{\frac{Gm_1}{r}} = \sqrt{\frac{6.67 \times 10^{-11} \cdot 5.98 \times 10^{24}}{(6.88 \cdot 10^6)}} = 7610 \text{ m/s}$

Masses cancel

This is a good thing - imagine velocity depending on the mass of the object orbiting

- Space walks would be a big problem