

Formulas

Given Derived Formulas (to know)

$$v = (2\pi r)/T \quad F_c = (mv^2)/2 = (4\pi^2 rm)/T^2$$

$$a_c = (v^2)/r \quad T_{orb} = (2\pi r^{3/2})/\sqrt{GM}$$

$$F_G = \quad E_{total} = -GMm/2r$$

$$(GMm)/r_2$$

$$E_p = -(GMm)/r \quad g = (GM)/r^2$$

$$\Delta E_p = GMm(1/r_f - 1/r_i)$$

$$v_{esc} = \sqrt{2GM/r}$$

$$v_{orb} = \sqrt{GM/r}$$

Key Concepts

$F_{net} = F_c$ on any object undergoing uniform circular motion

Vertical Circular Motion: over a hill, object swung with a string, loopy loop, etc.

Top of swing: $v = \sqrt{rg}$ → min. speed to maintain

Bottom of swing: $F_T = (mv^2)/r + mg$ → max. tension in the string

Variable M → no motion object (i.e. Earth being orbited)

Variable m → with motion object (i.e. satellite orbiting Earth)

To Remember

F_N is present when an object is on the ground (i.e. car on a curve)

Interstellar space station is in **space** → **no gravity** in space → only force is F_N the apparent weight of something

i.e. ... F_G of person A **due** to person B → person A is being affected

i.e. ... at 15500m **above** the surface of Earth → $r = R_E + 15500m$

If no r_i mentioned → $r_i = \infty$

If any final or initial variables are mentioned → $\Sigma E_i = \Sigma E_f$

E_T of any orbiting object in a gravitational field is **always negative**

Geosynchronous: to move at the same speed as the Earth

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