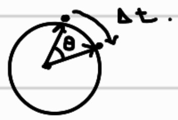
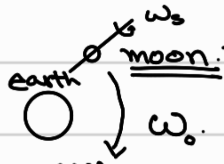
CH5 Circular Motion Pt.3

Some Quantities w/ their relations:

Quantity	Translation	Rotational	relation
Displacement	$\vec{d}$	θ → rad.	$s = r\theta$
velocity	$\vec{v} = \frac{\vec{d}}{t}$	$\omega = \frac{\Delta\theta}{\Delta t}$	$v = r\omega$
Acceleration	$a = \frac{\Delta v}{\Delta t}$	$\alpha = \frac{\Delta\omega}{\Delta t}$	$a_T = r\alpha$ ✓ $a_r = r\omega^2$ ✓
Mass/moment of Inertia	**m**	**I = mr²**	$I = \sum mr^2$
Force / Torque	**F = ma**	$\tau = r \times F$	
Kinetic Energy	**K.E** = $\frac{1}{2}mv^2$	$K.E_{rot} = \frac{1}{2}I\omega^2$	
Momentum	**p = mv**	$L = I\omega$	$L = \vec{r} \times \vec{p}$
Power	**P = Fv**	$P = \tau\ \omega$	
Work	**W = F . d**	$W = \tau\ .\ \Delta\theta$	
Impulse	$I = F \times \Delta t$	$I = \tau\ \Delta t$	
Equilibrium	$\sum F = 0$	$\sum \tau = 0$	



Artificial Satellites.



→ Object revolves around a planet → Satellite.

→ Moon is a natural satellite.

↳ Orbital & Spin velocity are same.

→ Artificial → man made ; eg: rocket / space ship.

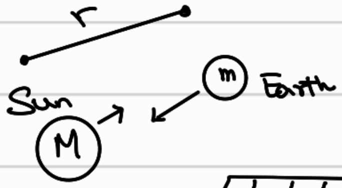
↳ orbits due to gravity effects.

- Critical velocity of orbit for artificial: $V_c = \sqrt{gR}$. $\sim 7.9\ kms^{-1}$.

- Period: $T = 5060s = 84$ mins.

Geostationary orbit ⟶ Parking orbit.

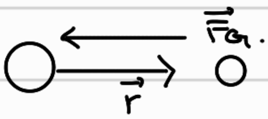
Universal law of gravitation.



$$F_G = -\frac{GMm}{r^2}$$

$F \propto \frac{1}{r^2}$
↓
inverse sq law.

Space-time.
(x, t)

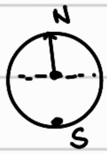


Accel. due to gravity: $g = -\frac{GM}{r^2}$.

$$g = \frac{4}{3}\pi \rho G r.$$

$\rho = \frac{m}{V}$

$V = \frac{4}{3}\pi r^3$



Variation in g.

$g' = \frac{GM}{(r+h)^2}$ or $g = \frac{GM}{r^2}$

$$g' = g\left(\frac{r}{r+h}\right)^2 = g\frac{r^2}{R^2}.$$

$R = r + h$

if $h << r$: $g' = g\left[1 - \frac{2h}{r}\right]$

Variation w\ depth: $g' = g\left[1 - \frac{d}{r}\right]$

Shape of earth: At eq: $g_e = \frac{GM}{R_e^2}$

At poles: $g_p = \frac{GM}{R_p^2}$

$g_p = g_e + 0.018\,m/s^2$.