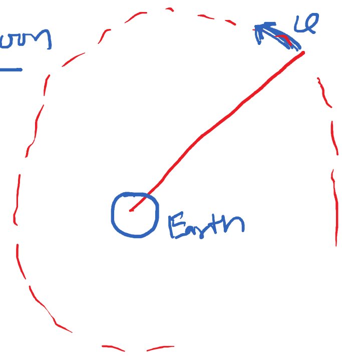
Moon's Motion

Friday, February 26, 2021 5:48 PM

Orbital velocity of the Moon



$\boxed{\text{distance} = 2\pi d}$

Actual Rev period of Moon = 27.3 days

$$v = \frac{\text{distance}}{\text{time}} = \frac{2\pi d}{28\,\text{days}}$$

$$\boxed{d = 3.84\times10^{8}\,\text{m}} \approx 1000\ \text{m/sec}$$

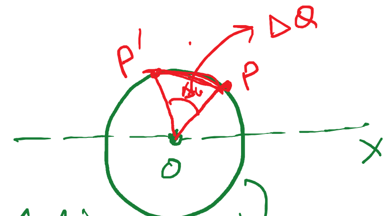
$$v = \frac{2\times3.14\times3.84\times10^{8}\,\text{m}}{28\times24\times3600} \approx 996.8 \approx 1000\ \text{m/sec}$$

$\boxed{\text{Moon is moving with the velocity of } 1\ \text{Km/sec in its orbit}}$

In Case Circular motion, $\boxed{a = \frac{v^2}{r}}$ — General Purpose

$$\boxed{a_{moon} = \frac{V_{moon}^{2}}{d}}$$

$\Rightarrow$ P covers a distance PP′ in time Δt



$PP' = \Delta S$

$\Delta S = r\,\Delta\theta$ [arc length = radius × angle]

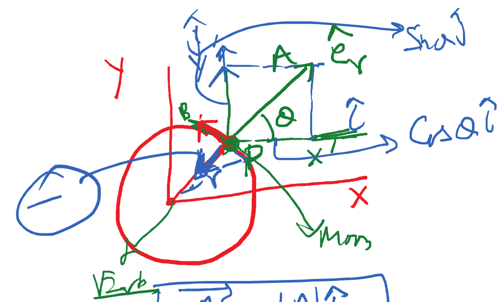
$$\Rightarrow \left(\frac{\Delta S}{\Delta t} = r\,\frac{\Delta\theta}{\Delta t}\right) \Rightarrow \boxed{v = r\omega}$$

$\uparrow \omega$

Relationship between Linear & angular Paramenter

Velocity & Acceleration

Friday, February 26, 2021 6:34 PM



$$\vec{r} = \vec{OP} = OP\,\hat{e}_r$$

$$\hat{e}_r = \cos\theta\,\hat{i} + \sin\theta\,\hat{j}$$

$$OP = r$$

$$\boxed{\vec{r} = r(\cos\theta\,\hat{i} + \sin\theta\,\hat{j})}$$

$$\boxed{\vec{A} = |A|\hat{i}}$$

$$\boxed{\vec{v} = \frac{d\vec{r}}{dt}}$$

$$\Rightarrow \vec{v} = \frac{d\vec{r}}{dt} = \frac{d}{dt}\left[r(\cos\theta\,\hat{i} + \sin\theta\,\hat{j})\right]$$

$$= r\left[-\sin\theta\,\underbrace{\frac{d\theta}{dt}\,\hat{i} + \cos\theta\,\frac{d\theta}{dt}}_{\omega}\,\hat{j}\right]$$

$$\boxed{\vec{v} = r\omega\left[-\sin\theta\,\hat{i} + \cos\theta\,\hat{j}\right]}$$

$$\vec{a} = \frac{d\vec{v}}{dt} = \frac{d}{dt}\left[r\omega\left[-\sin\theta\,\hat{i} + \cos\theta\,\hat{j}\right]\right]$$

$$\vec{a} = r\left[\omega\frac{d}{dt}\left[-\sin\theta\,\hat{i} + \cos\theta\,\hat{j}\right]\right] + \frac{d\omega}{dt}\left[-\sin\theta\,\hat{i} + \cos\theta\,\hat{j}\right]$$

$$= r\omega\left[-\cos\theta\frac{d\theta}{dt}\hat{i} - \sin\theta\frac{d\theta}{dt}\hat{j}\right] + r\frac{d\omega}{dt}\hat{e}_t$$

$$= -r\omega^2\left[\cos\theta\,\hat{i} + \sin\theta\,\hat{j}\right] + r\frac{d\omega}{dt}\hat{e}_t$$

$$= -r\omega^2\hat{e}_r + r\frac{d\omega}{dt}\hat{e}_t \Rightarrow r\cdot\frac{d}{dt}\left(\frac{v}{r}\right)\hat{e}_t$$

$$v = r\omega$$

$$\boxed{\omega = \frac{v}{r}}$$

$$\boxed{\vec{a} = -r\omega^2\hat{e}_r + \frac{dv}{dt}\hat{e}_t}$$

Uniform Circular motion $\Rightarrow$ $\boxed{\frac{dv}{dt} = 0}$

$$a = \frac{v_2 - v_1}{\Delta t}$$

t_1 ↓ v $\quad$ t_2 ↓ v

$$\boxed{\vec{a} = -r\omega^2\hat{e}_r}$$

$$\boxed{\omega = \frac{v}{r}}$$

$$\boxed{\vec{a} = -r\omega^2 \hat{e}_r}$$

$$\boxed{\omega = \frac{v}{r}}$$

$$\boxed{a = \omega^2 r}$$

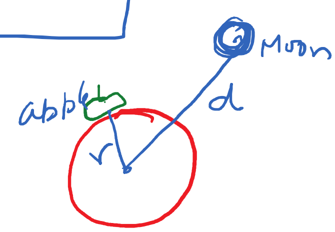
$$a = \left(\frac{v}{r}\right)^2 r$$

$$\boxed{a = \frac{v^2}{r^2} r = \frac{v^2}{r}}$$

$$\boxed{\vec{a} = -r\omega^2 \hat{e}_r}$$

In case of the circular motion, object always fell a acceleration towards the Centre

$$\boxed{a_{moon} = \frac{V_{moon}^2}{d}} \approx \boxed{2.7\times10^{-3}\ m/sec^2}$$



$$a_{apple} = 9.8\ m/sec^2$$

$$a_{moon} = 2.7\times10^{-3}\ m/sec^2$$

$$\boxed{\frac{a_{apple}}{a_{moon}} = \frac{9.8}{2.7\times10^{-3}} \approx 3600}$$

Moon's Motion.

Friday, February 26, 2021 7:11 PM

$r = 6400\ km \quad d = 3.8 \times 10^5\ km$

$$\boxed{\frac{d_{moon}}{d_{apple}} = \frac{3.8 \times 10^5}{6400} = 60}$$

(i) Accelration of moon is 3600 times weaker than the accelration an apple.

(ii) distance between Moon and Earth is 60 times higher than the distance between apple and Earth.

$$\Rightarrow \boxed{\frac{1}{(60)^2} = \frac{1}{3600}}$$

$$\boxed{ma \propto \frac{1 \times m}{d^2}}$$

$F = ma$

$$\boxed{F \propto \frac{mM}{d^2}}$$

$$\Rightarrow \boxed{F = G\frac{Mm}{d^2}}$$

G – Univershal Constant of gravitation