Angular Displacement

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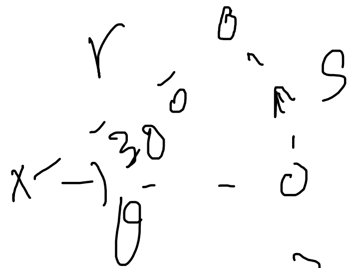

$\theta = 30^\circ$

In radians, $360^\circ = 2\pi$ rad.

Definition:

$$\text{angle (rad)} = \frac{\text{arc length}}{\text{radius}}$$

$$\theta = \frac{s}{r}$$

If rotation is 360°,

arc length = circumference

In rad., $\theta = \frac{2\pi r}{r} = 2\pi$ rad

Common eqs:

rad	(°)
π	180
$2\pi/3$	120
$\pi/2$	90
$\pi/3$	60
$\pi/4$	45
$\pi/6$	30

understand and use the concept of angular velocity to solve problems

Angular Velocity

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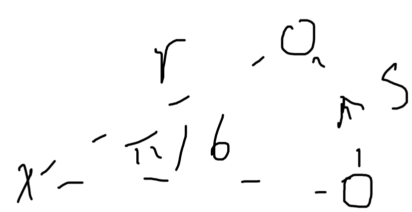
e.g.



1s

$$\text{angular velocity} = \frac{\text{angular displacement}}{\text{time}}$$

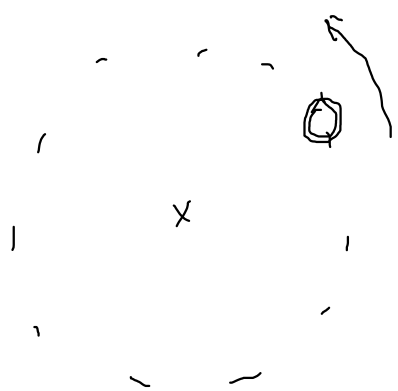
$$= \frac{\pi/6}{1}$$

$$= \frac{\pi}{6} \text{ rad/s}$$

Formula:

$$\boxed{\omega = \frac{\theta}{t}}$$

e.g.



$\omega = \frac{\pi}{6}$ rad/s

Time for 1 revolution?

1 revolution → $\theta = 360° = 2\pi$ rad

$$t = \frac{\theta}{\omega} = \frac{2\pi}{\pi/6} = 12 \text{ s}$$

Angular Velocity 2

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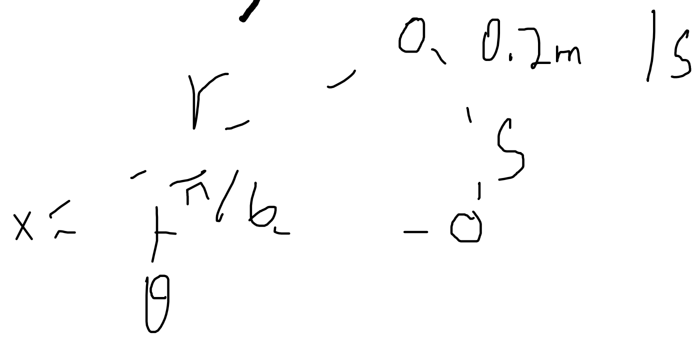
e.g.



Angular velocity

$$\omega = \frac{\pi/6 \text{ rad}}{1 \text{ s}}$$

angle

$$\frac{\pi}{6} = \frac{0.2 \text{ m}}{r}$$

$$\frac{\pi}{6} \times r = 0.2\text{m}$$

$$\frac{\pi/6}{1\text{s}} \times r = \frac{0.2\text{m}}{1\text{s}}$$

New formula → $\boxed{\omega \times r = v}$

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e.g. $\omega = \frac{\pi}{6}$ rad/s, $r = 2$ m.

Find linear velocity.

$$v = r\omega = 2 \times \frac{\pi}{6} = \frac{\pi}{3} \text{ m/s}$$

describe qualitatively motion in a curved path due to a perpendicular force, and understand the centripetal acceleration in the case of uniform motion in a circle

Centripetal Acceleration

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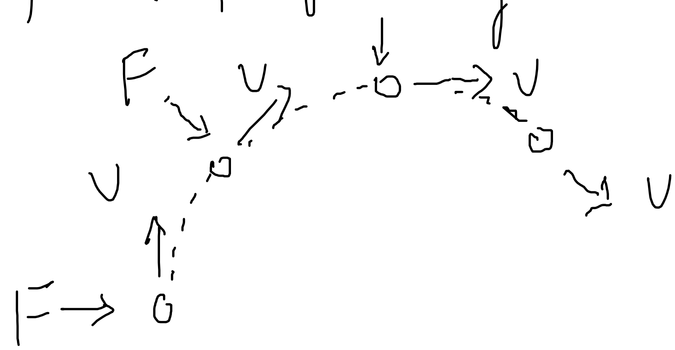
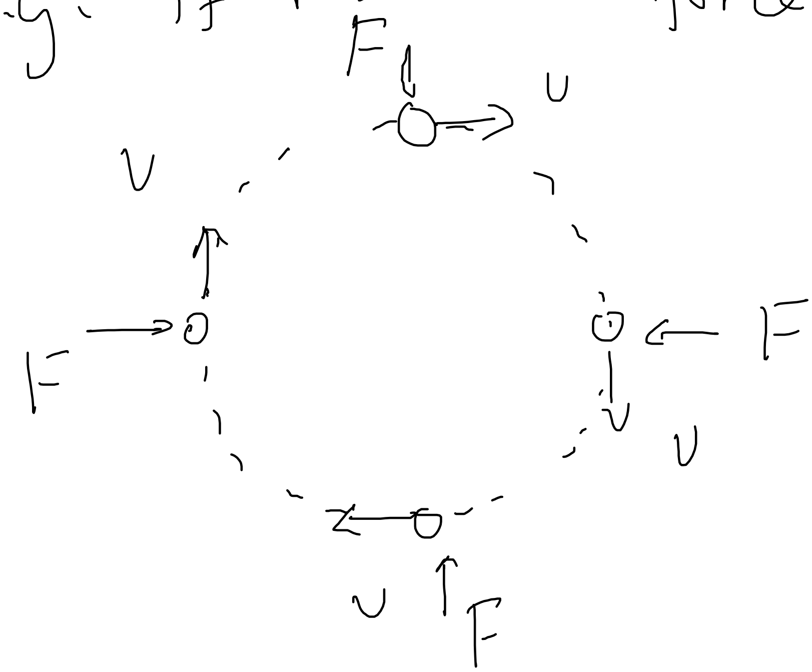
e.g. keep pushing sideways:



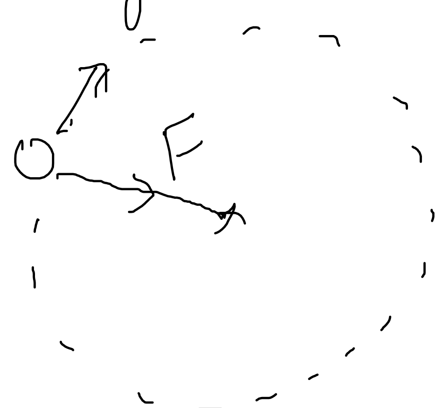
a body will bend round

e.g. if resultant force constant:



get perfect circle.

Reverse logic:



To go round in circle, must have **Centripetal force.**

Centripetal Acceleration 2

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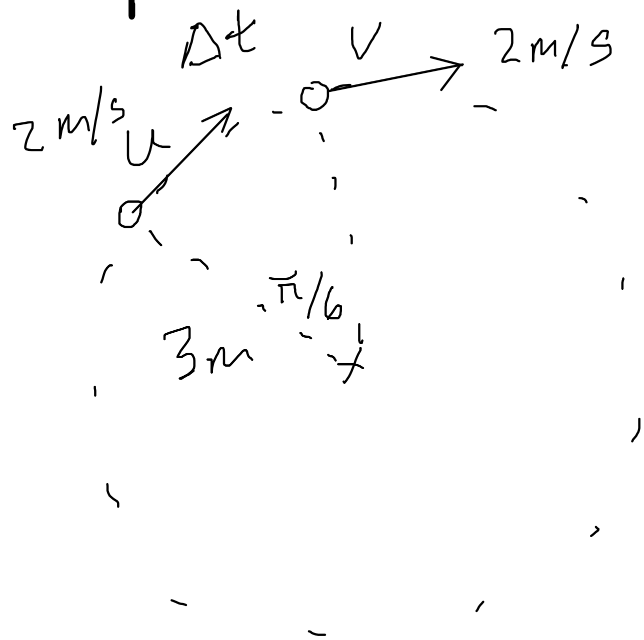


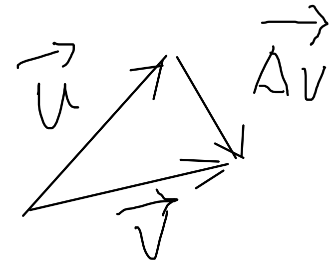
Is there acceleration??

↓

Yes! because velocity is a vector

↓

and direction changed:



Over time Δt,

average acceleration $= \dfrac{\Delta v}{\Delta t}$

At one point in time, instantaneous acceleration

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

towards centre of circle.

E.g. (above):

Centripetal acceleration $= \dfrac{v^2}{r} = \dfrac{2^2}{3}$ m/s^2

recall and use centripetal force F = mr ω^2, F = mv^2/r to solve problems.

Centripetal Force

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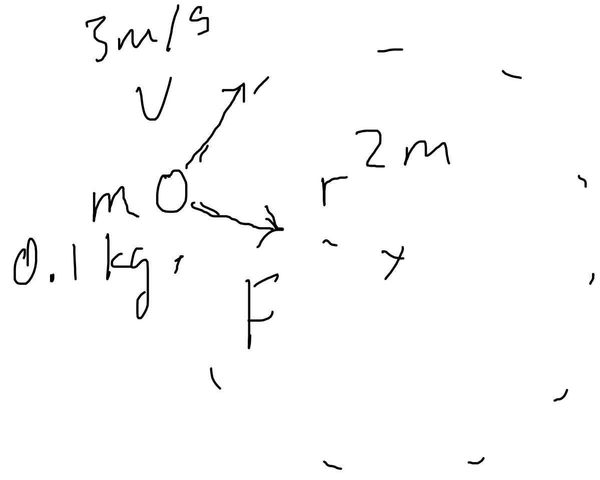

Centripetal acceleration

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

Newton's 2nd law

$$F = ma$$

∴ Centipetal force

$$\boxed{F = \frac{mv^2}{r} = m\omega^2 r}$$

e.g. (above) $F = \frac{0.1 \times 3^2}{2} = 0.45\,N$

<u>Note:</u>

* If body is stone on string, then F comes from <u>tension</u>.

† If car on road, then F from <u>friction</u>.