Topic 3B: Frictional Forces, Spring Force, Circular Motion and Universal Gravitation

Skill 25: Circular Motion

Uniform Circular Motion means that an object moves in a circular path with <u>constant speed</u> and <u>constant radius</u>

- The <u>direction of the velocity</u> is changing but not the magnitude (size)

- The velocity vector is always tangent to the circle (perpendicular to the radius) therefore we call it "tangential velocity"

tangential velocity of the object can be found using (For a single revolution)

$V = \frac{d}{T}$ where d = Circumference $= 2\pi r$

an time equals T (period of revolution)

So $V = \frac{2\pi r}{T}$

- Acceleration for motion on the circular path measures <u>the rate of change in the direction</u> of the tangential velocity vector

as the object moves from position 1 to position 2 the ratio of change in velocity Δv is the same as the change in position represented in terms of r.

$\frac{\Delta v}{v} = \frac{\Delta r}{r}$ $\Delta r = v\Delta t$ so $\frac{\Delta v}{v} = \frac{v\Delta t}{r}$ which mean $\frac{\Delta v}{\Delta t} = \frac{v^2}{r}$ (a_c)

change in velocity for circular motion is known as → "Centripetal acceleration" symbolized by a_c

centripetal means center seeking

- Centripetal Force (F_c) is a special form of net force which is always directed toward the center of a circle to keep an object on a circular path.

since F_c is a net force $F_{net} = ma$ becomes $F_c = ma_c$

where $a_c = v^2/r$ so $F_c = ma_c$ is also $F_c = \frac{mv^2}{r}$

$F_c = ma_c$ on PRT

$F_c = \frac{mv^2}{r}$ not on PRT

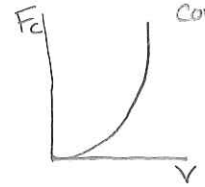
F_{net} or F_c always agree in direction with a or a_c, so

→ a_c and F_c are both directed toward the center of a circular path

→ velocity directed tangent to the circle (ie perpendicular to radius) "tangential velocity"

→ if centripetal force (F_c) disappears an object will follow tangent line in a straight line path and constant speed.

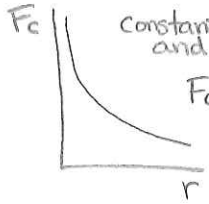
Graphs



constant mass & radius

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

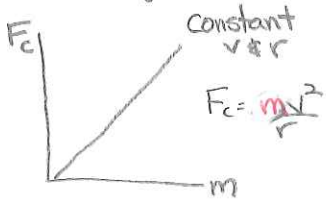
Any change in "v" means <u>change squared</u> for F_c



constant m and v

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

Any change in "r" means <u>opposite change</u> in F_c



Any change in "m" means <u>same change</u> in F_c