PHY138 - Mechanics - Class 7 - Oct 2/06

Height! Same as a ball thrown straight up with speed $v_i \sin\theta$

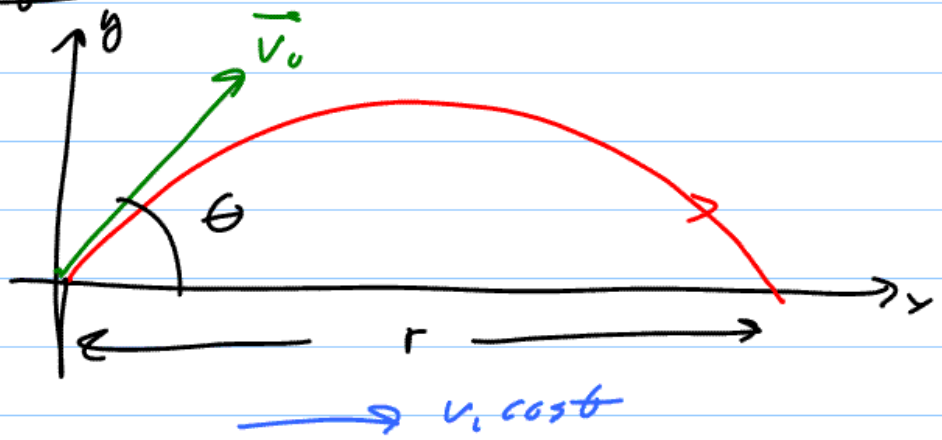
t_1: time from release to maximum height.

$$\Delta v = a \Delta t$$

$$v_i \sin\theta = g t_1$$

$$h = \frac{v_i^2 \sin^2\theta}{2g}$$

Range



t_2: time from max. height to back to the ground.

$$t_1 = t_2$$

$$t_{total} = t_1 + t_2 = \frac{2 v_1 \sin(\theta)}{g}$$

$$r = v_1 \cos\theta \, \frac{2 v_1 \sin(\theta)}{g} \Rightarrow$$

$$\boxed{r = \frac{v_1^2 \sin(2\theta)}{g}}$$

r_{max}: $\theta = \frac{\pi}{4}$ radians $= 45°$

Bullfrogs! Marsh (1964)!

$v_1 \sim 2$ m/s

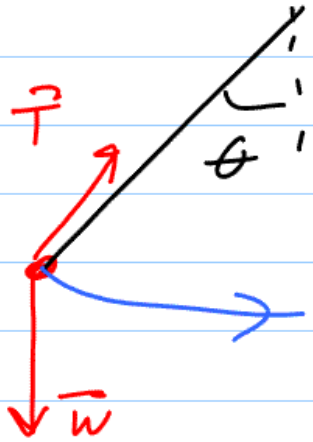
$\theta \sim 0.52$ radians $\sim 30°$

$r \cong 0.35\ m$

§6.4- Relative Motion

Omitted from syllabus.

CHAPTER 7
MOTION IN A CIRCLE



$T\cos\theta = w$

ignore

Horizontal component:

$T\sin\theta$

points to center of circle

$\hat{v}$ tangent to circle

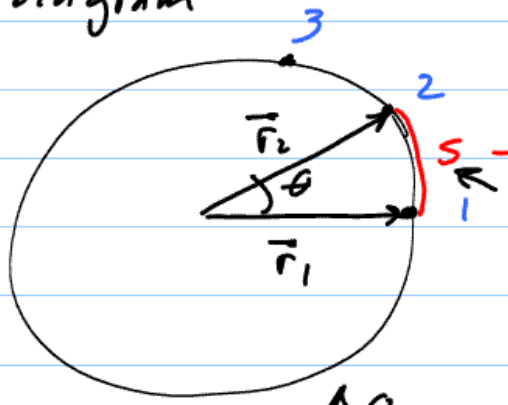
v constant

=

$\hat{a}$ to center of circle

§7.2 - Velocity & Acceleration

Motion Diagram



$\Delta\theta$ angular displacement

angular velocity $\omega_{avg} = \frac{\Delta\theta}{\Delta t}$

"omega"

$$\omega_{inst} = \lim_{\Delta t \to 0} \frac{\Delta\theta}{\Delta t} = \frac{d\theta}{dt}$$

Convenient Coord System

$$\vec{v} = v\hat{t}$$

$$\vec{a} = a\hat{r}$$

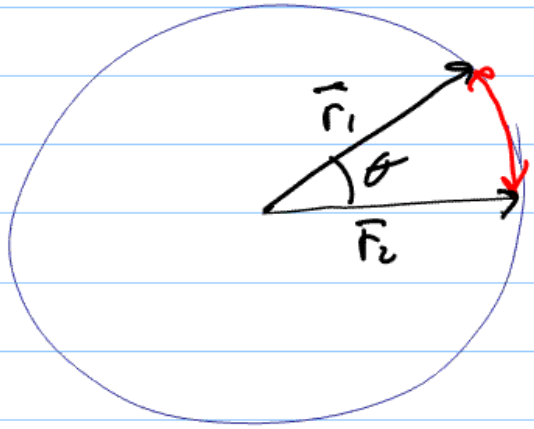
↖ "centripetal"

center-seeking

test proves! $\frac{v^2}{r} = \omega^2 r$

Uniform Motion! $v = \text{const}$

$a_{\text{centripetal}} = \text{const}$



s = arc length

$\theta_{\text{radians}} \equiv \frac{s}{r}$

$s = \theta r$

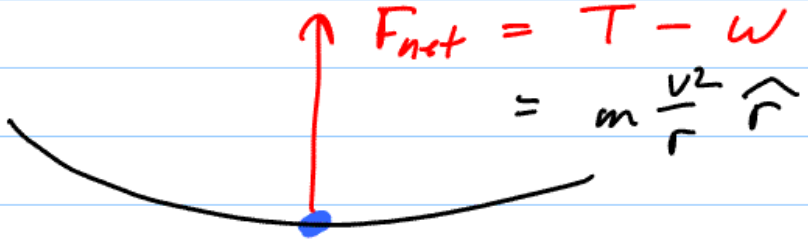
$$v = \frac{ds}{dt} = \frac{d(\theta r)}{dt} = r\frac{d\theta}{dt}$$

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

§7.3 Dynamics

$$\vec{F}_{net} = m\vec{a} = m\frac{v^2}{r}\hat{r}$$

Tarzan? at bottom



§7.4- Circular Orbits