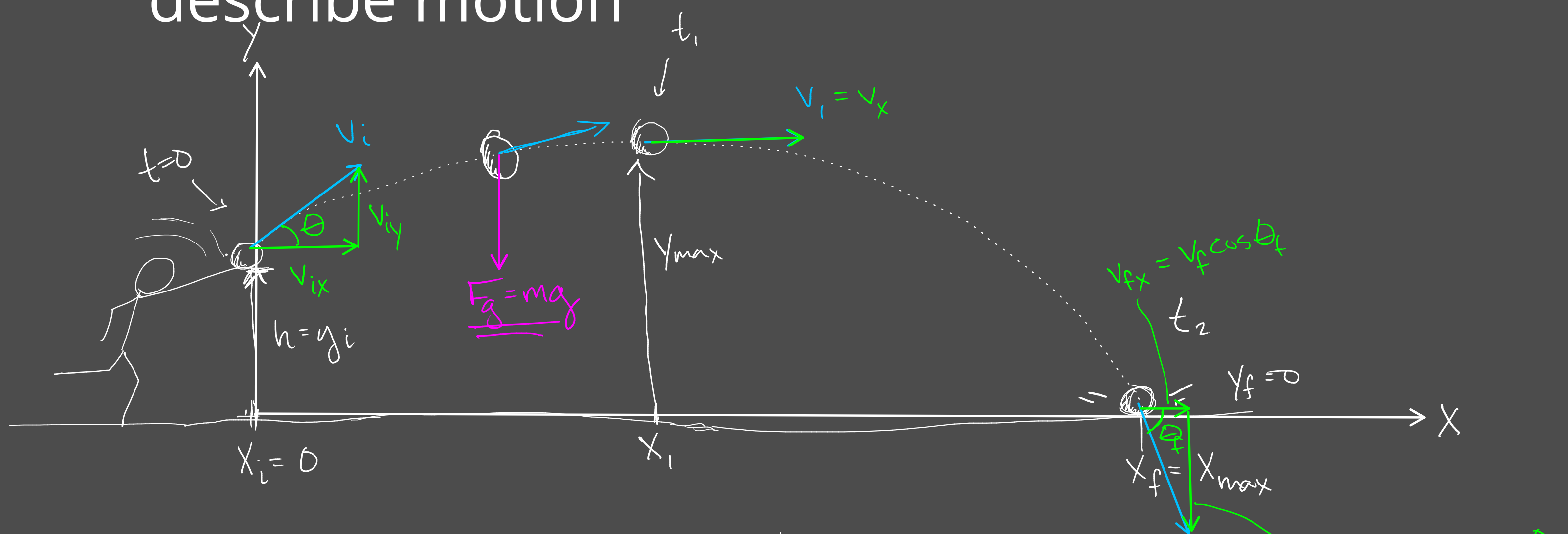
After this you can

- break velocity into vector components
- use the principles of Newton's law to break motion into two directions
- use kinematics to solve for unknown quantities to describe motion



$V_{iy} = V_i \sin\theta$

$V_{ix} = V_i \cos\theta$

x-direction

- $x(t) = x_0 + v_{xi} t + \cancel{\frac{1}{2} a_x t^2}$ $\quad \boxed{a_x = 0}$
- $x(t) = x_0 + V_x \cdot t$

$$\boxed{\Delta x = V_x \cdot t}$$

- $V_{fx} = V_{ix} + \cancel{a_x t}$

$V_{fx} = V_{ix}$

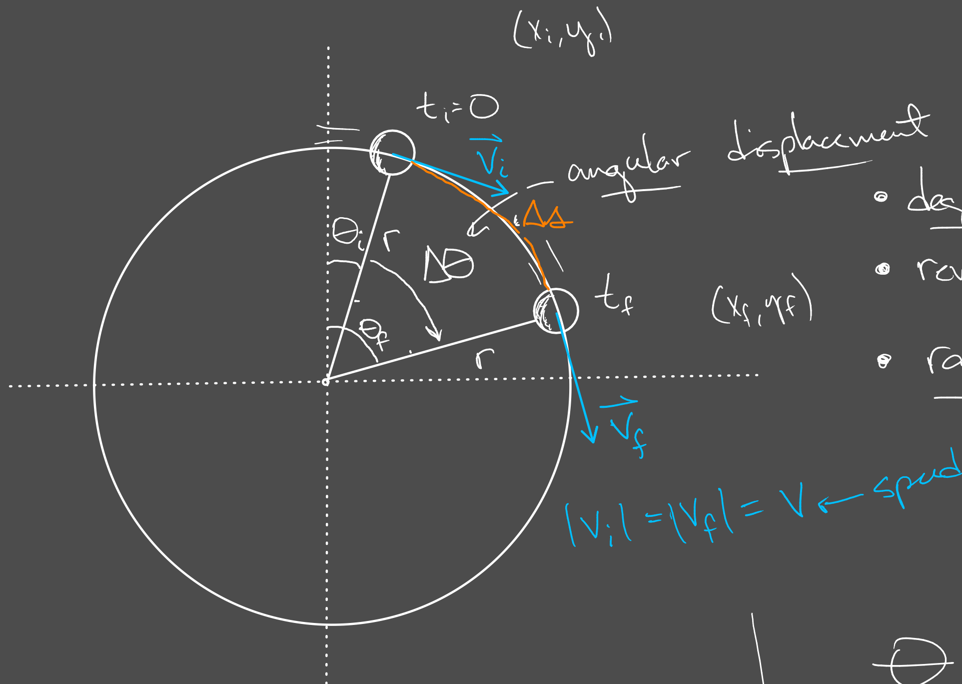
y-direction

- $y(t) = y_0 + v_{yi} t + \frac{1}{2} a_y t^2$

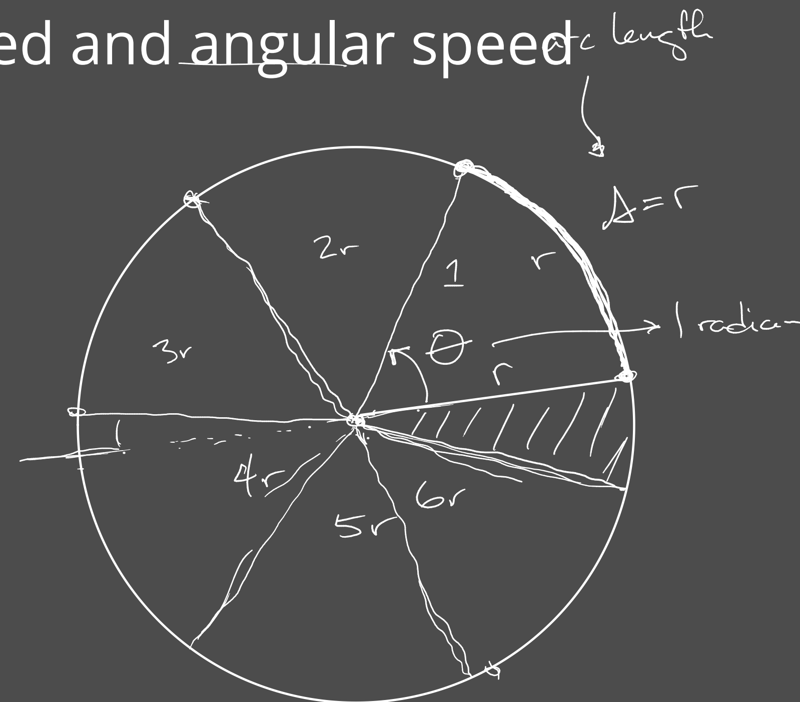
$a_y = -9.80\ m/s^2$

- $V_{fy} = V_{iy} + a_y t$
- $V_{fy}^2 = V_{iy}^2 + 2 a_y \Delta y$

After this you can
- describe circular motion
- apply the new angular units of radians
- discuss the connection between travel speed and angular speed



- degrees
- revolutions
- radians



$$s = \theta r$$

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

$$\frac{1}{r}\frac{\Delta s}{\Delta t} = \frac{\Delta\theta}{\Delta t}$$ — angular speed

$\omega \leftarrow$ omega

(velocity)

$\omega > 0$ counterclockwise

$\omega < 0$ clockwise

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

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

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

in radians

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

Circumference $= 2\pi r$

$360^\circ = 1$ revolution

$6.28\ldots$ rad $= 1$ revolution

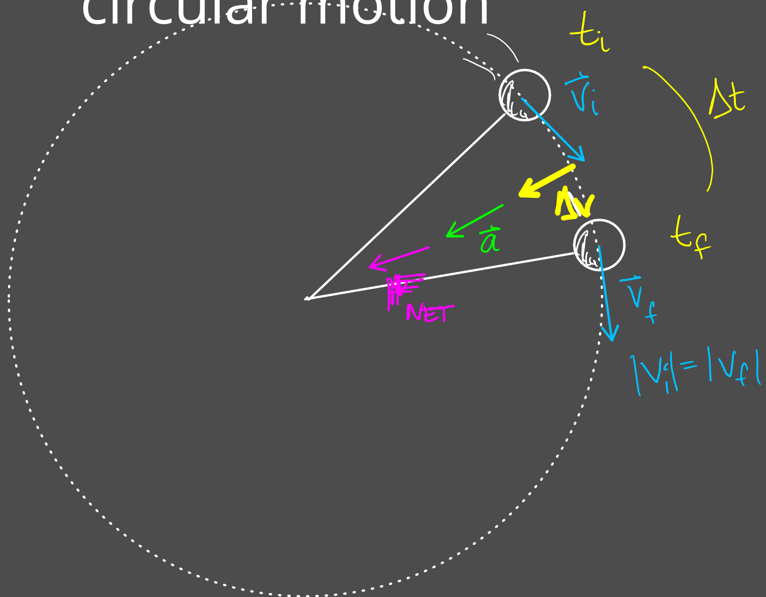
2π rad $= 1$ revolution

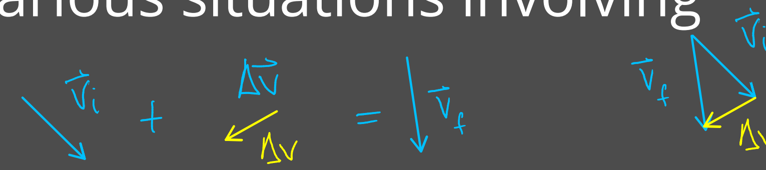
2π rad $= 360^\circ$

π rad $= 180^\circ$

After this you can

- apply Newton's 2nd law to cases of circular motion
    to discern the direction of acceleration
- discuss how a change in velocity can happen without a change in speed
- discuss how an acceleration can happen without a change in speed
- provide examples of forces involved in various situations involving
    circular motion





$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$

$$\boxed{|a_R| = \frac{v^2}{r}}$$ ← speed (constant)

a_R radial acceleration

$$\vec{F}_{NET} = m\vec{a}$$

$$\boxed{F_{NET,R} = m a_R}$$

radial net force (centripetal force)

$$\vec{F}_{NET} = m\vec{a}$$

$$F_{NET,x} = m a_x$$

$$F_{NET,y} = m a_y$$

$$\boxed{F_{NET,R} = \frac{m v^2}{r}}$$

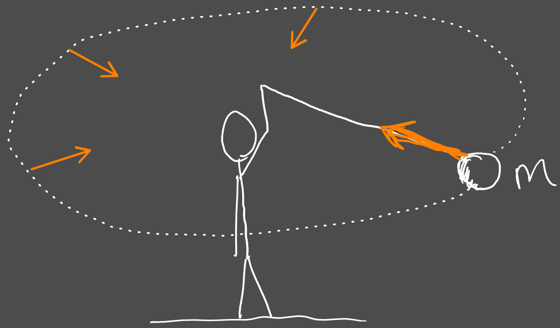
$$\boxed{F_{NET,R} = m \omega^2 r}$$

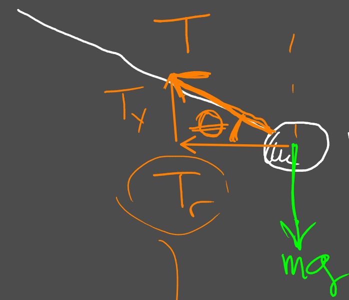
$$a_R = \frac{v^2}{r}$$

$$v = \omega \cdot r$$

$$a_R = \frac{(\omega \cdot r)^2}{r} = \frac{\omega^2 r^{\cancel{2}}}{\cancel{r}}$$

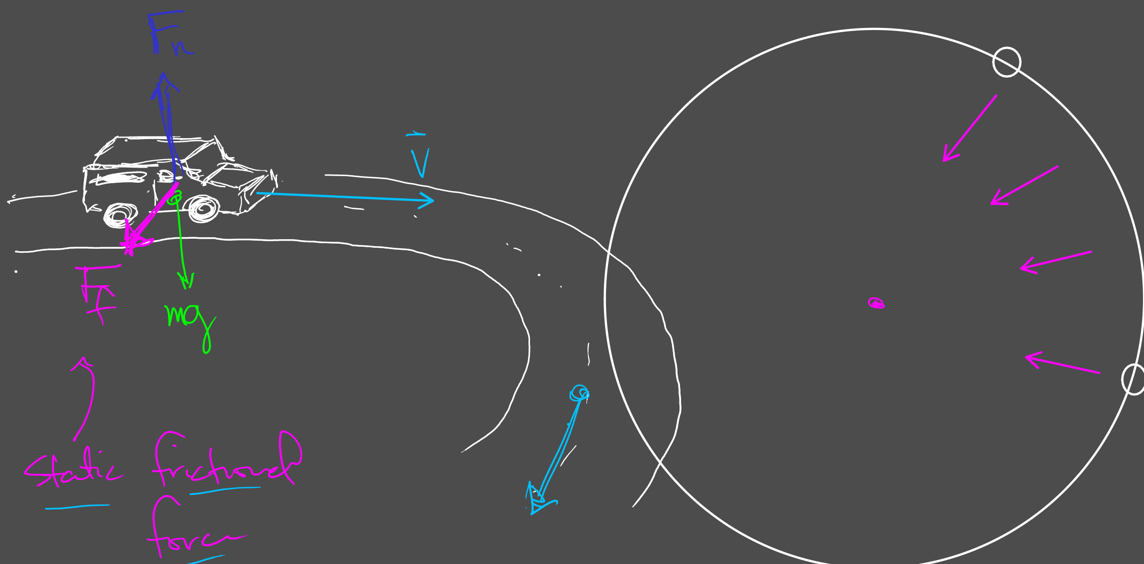
$$\boxed{a_R = \omega^2 r}$$



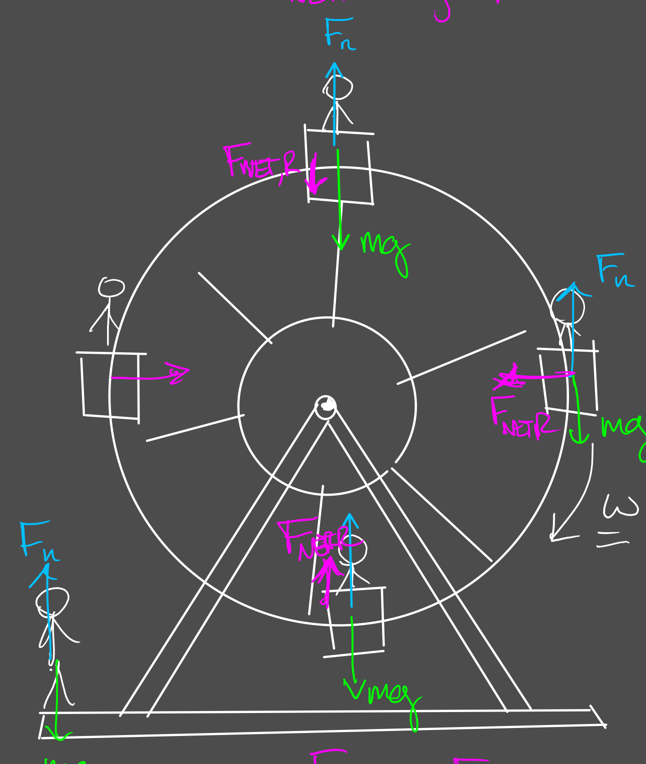


$$T_y = mg$$

$$T_r = F_{NET,R} = \frac{mv^2}{r}$$



$$F_{NET,R} = mg - F_n$$



$$F_{NET,R} = \underline{F_n} - mg$$