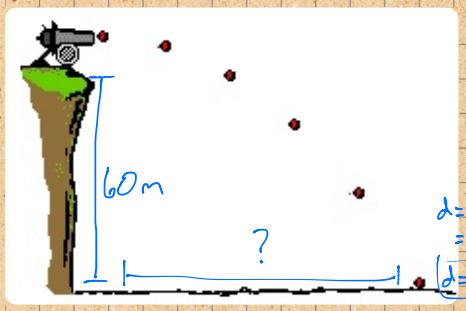
Warm-Up:

A cannon ball leaves a 60-meter high cliff with an initial horizontal velocity of 24 m/s. Predict the time required for the ball to fall to the ground and the horizontal distance between the edge and the ball's landing location.



X	y
$V_x = 24 m/s$	$V_{y_0} = 0 m/s$
$d_x = ?$	$V_{yf} =$
$t = ? = 3.5s$	$a_y = -9.8 m/s^2$
	$d_y = -60 m$
	$t = ?$

$d = V \cdot t$

$= 24 \cdot 3.5$

$d = 84.0m$

$d = \cancel{V_0 t}^{0} + \frac{1}{2} a t^2$

$-60m = \frac{1}{2} \cdot -9.8 \cdot t^2$

$t = 3.5s$

- Uniform Circular Motion: Constant Speed in a Circle
  - Is velocity constant? No
  - Is acceleration constant? Yes

- How do we determine speed: $V = \frac{d}{t}$
  - $2\pi r = d \cdot \pi$
  - Time to complete a cycle: Period = T

$$V_c = \frac{2\pi r}{T}$$

- Centripetal Acceleration: "center-seeking" acceleration

$$a_c = \frac{V_c^2}{r} = \left(\frac{2\pi r}{T}\right)^2 \cdot \frac{1}{r} = \frac{4\pi^2 r^2}{r T^2} = \frac{4\pi^2 r}{T^2}$$

$$a_c = \frac{4\pi^2 r}{T^2}$$

Ex:

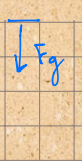
A car takes 3 min to go around a circular track with a diameter of 3 km. What is $a_c = ?$

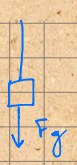
$$a_c = \frac{4 \cdot \pi^2 \cdot 1.5 km}{(3 min)^2} = 6.58 \frac{km}{min^2}$$

- Centripetal Force: Net force acts on an object in circular motion

$$F_c = m \cdot a_c = m \cdot \frac{4\pi^2 r}{T^2}$$

Ex1: A 0.5kg mass sits on a frictionless table attached to a hanging weight. The mass is twirled in a circle with 0.2 m radius at $V_c = 2.3 m/s$. $F_c = ?$





$$F_c = \frac{m \cdot v_c^2}{r} = \frac{0.5 \cdot (2.3\,m/s)^2}{0.2\,m} = 13.2\,N$$