Circular Motion IB Physics Content Guide

Big Ideas

- Objects moving in a circle are experiencing acceleration since the direction of the velocity is constantly changing
- Centripetal acceleration and centripetal force are always directed toward the center of the circle
- The net force for a body in circular motion is equal to the centripetal force
- It is useful to draw a free body diagram to determine what forces are present at a given position

Content Objectives

1 – Defining Circular Motion

I can convert between angular displacement in revolutions and radians			
I can describe and calculate the properties of period and frequency			
I can calculate angular velocity			
I can describe and calculate tangential velocity based on the angular velocity and radius			
I can determine the direction and magnitude of centripetal acceleration and centripetal force			

2 – Vertical Circular Motion

I can draw correctly proportioned free body diagrams for horizontal and vertical circular motion			
I can compare the forces on an object at different positions in vertical circular motion			
I can identify the combination of forces that make up the net force that results in circular motion.			
I can determine the magnitude and direction of the forces needed to move in a vertical circle			

3 – Circular Motion, Friction, and Angles

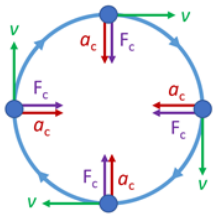
I can draw a free body diagram when circular motion is produced by a reaction or friction force			
I can solve problems that involve friction to create circular motion			
I can solve circular motion problems that incorporate components of an angled force			

Circular Motion

Shelving Guide

	Variable Symbol	Unit
Distance	d	m
Angular Distance	θ	rad
Angular Velocity	ω	rad s^{-1}
Linear Velocity	v	m s^{-1}
Centripetal Acceleration	*a*	m s^{-2}
Centripetal Force	F_c	N

Draw in vectors for v, a_c, and F_c →



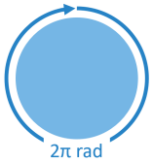
Data Booklet Equations:

$$v = \omega r$$

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

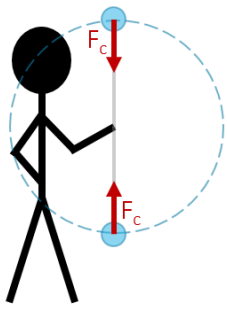
$$F = \frac{mv^2}{r} = m\omega^2 r$$

Defining Circular Motion



Period	T	s	Angular Velocity	ω	rad s^{-1}
Time per revolution			$\omega = \frac{2\pi}{T}$		

Vertical Circular Motion



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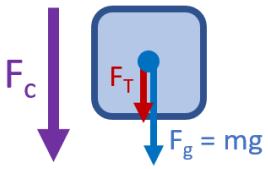
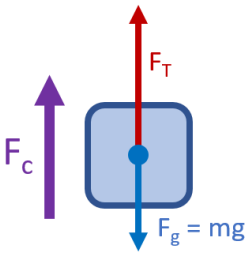


$F_{net} = F_c = F_T + F_g$

Bottom:



$F_{net} = F_c = F_T - F_g$

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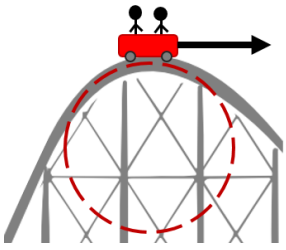

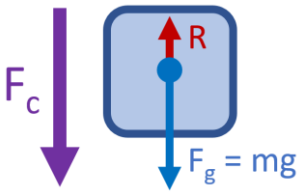

$F_{net} = F_c = F_g - R$

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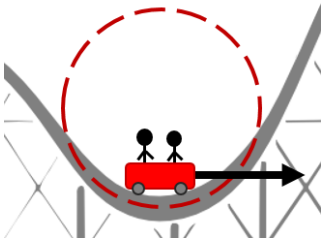
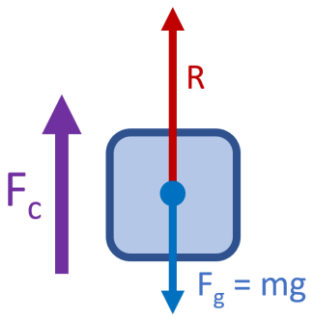
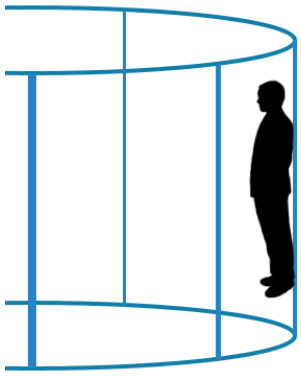
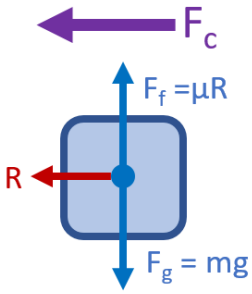




$F_{net} = F_c = R - F_g$

Circular Motion with Friction and Angles

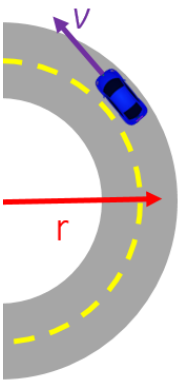


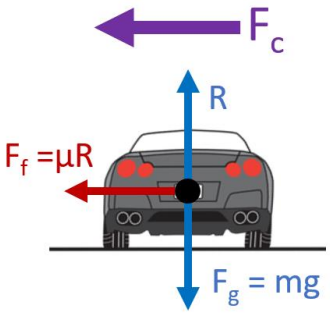


Relationships between variables:

$$F_f = F_g$$

$$F_c = R$$

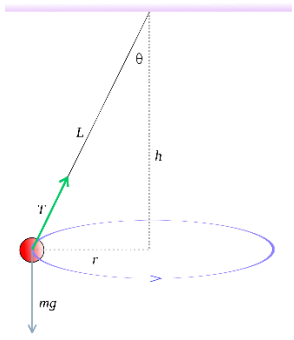


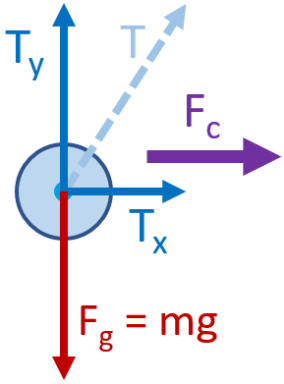


Relationships between variables:

$$R = F_g$$

$$F_c = F_f$$





Relationships between variables:

$$T_y = F_g$$

$$F_c = T_x$$