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
- If an object is moving at a constant speed in a circle, there is a net force directed toward the center of the circle
- It is useful to draw a free body diagram to determine what forces are present at a given position

1 – Defining Circular Motion

I can convert between angular displacement in revolutions and radians			
I can define and measure the period of circular motion			
I can calculate angular velocity in radians per second			
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 – Circular Motion in Force Fields

I can calculate the speed of an orbiting object based on the distance and mass of the object it's orbiting around			
I can describe the motion of a charged particle in a magnetic field			
I can use the magnetic force with circular motion to calculate the properties of a particle moving through a magnetic field			

3 – Orbits

I can describe Kepler's Three Laws of Planetary Motion			
I can use Kepler's 3rd Law to mathematically compare the period and radius of an orbit			

4 – Vertical Circular Motion

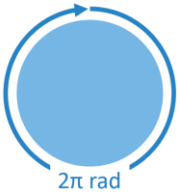
I can draw correctly proportioned free body diagrams for horizontal and vertical circular motion			
I can compare the forces on an object at different positions in vertical circular motion			
I can identify the combination of forces that make the net force that results in circular motion.			
I can determine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

5 – Circular Motion Scenarios

I can draw and solve a problem when circular motion is produced by a normal force			
I can draw and solve a problem when circular motion is produced by a friction force			
I can draw and solve a problem when circular motion is produced by components of an angled tension force			

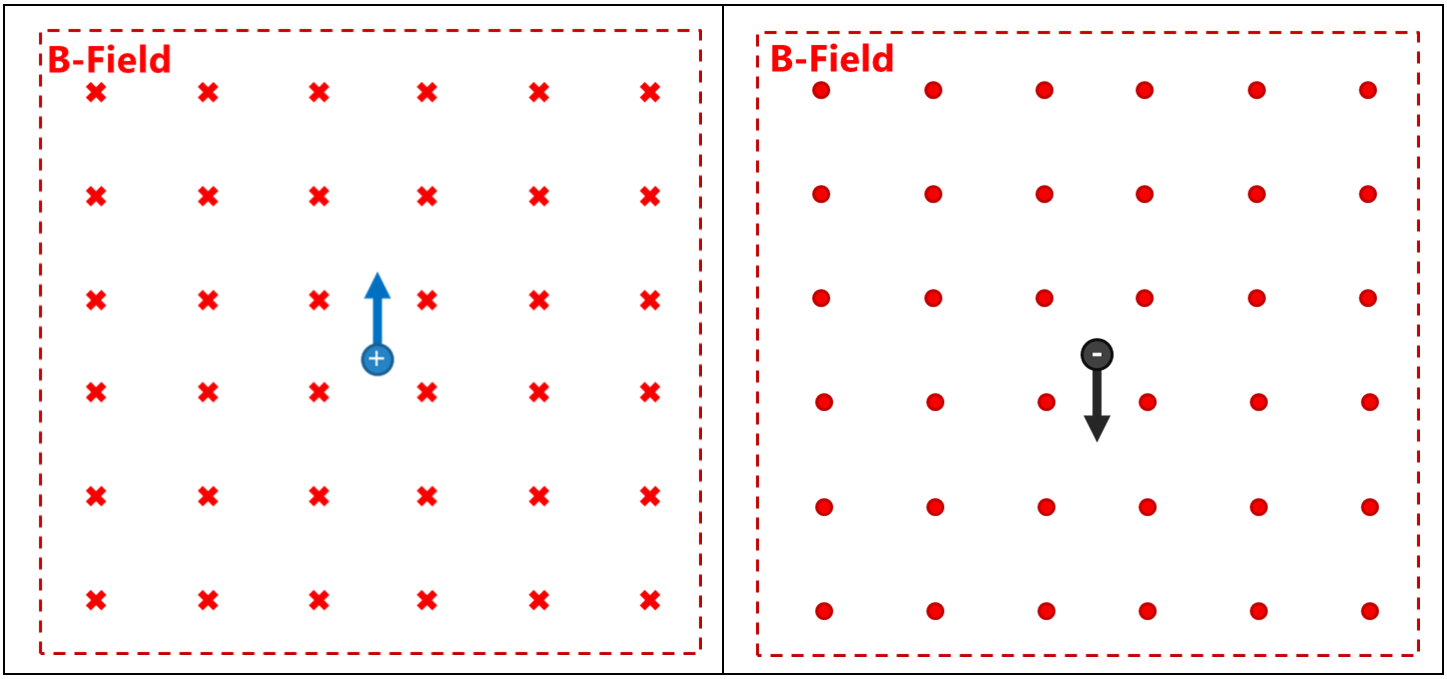
	Variable Symbol	Description	Unit
$F = ma$ $a = \frac{v^2}{r} = \omega^2 r = \frac{4\pi^2 r}{T^2}$ $v = \frac{2\pi r}{T} = \omega r$	F		
	m		
	a		
	v		
	ω		
	r		
	T		

Defining Circular Motion

	Period			Angular Velocity		

Circular Motion in Force Fields

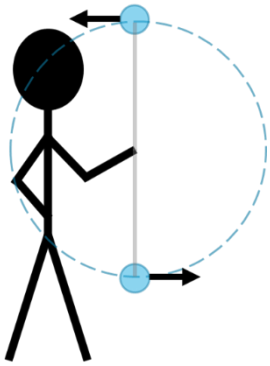
Relationship between gravitational field strength and circular motion acceleration	

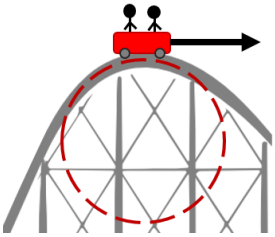
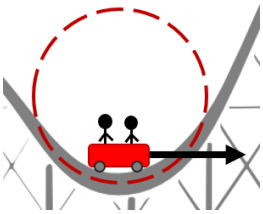
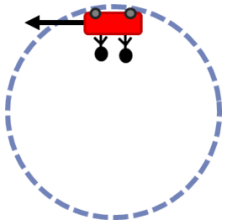


Orbits

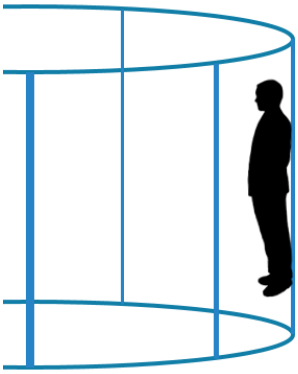
Kepler's 1st Law	The orbit of every planet is an _____ with the Sun at one focus.
Kepler's 2nd Law	A line drawn from a planet to the Sun sweeps out equal areas in equal times.
	Closer to the star =
Kepler's 3rd Law	A planet's orbital period is related to its average distance from the Sun
	$T^{\square} = \frac{4\pi^2}{GM} r^{\square}$

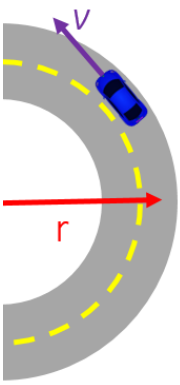
Vertical Circular Motion

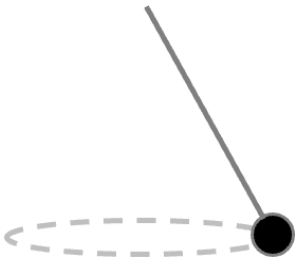
	Top:	Bottom:

Top:		Bottom:		Loop:	
					

Circular Motion with Friction and Angles

		Relationships between variables:

		Relationships between variables:

		Relationships between variables: