Circular Motion

1. A review of the concepts

1. Uniform Circular Motion- An object that moves in a circle at a constant speed (v) is said to experience uniform circular motion. The magnitude of the velocity remains constant, but the direction is continuously changing.

1. Radial- behavior toward and away from the center of the circle
2. Tangential- behavior along the edge of the circle
3. Centripetal forces- a force that acts on a body moving in a circular path and is directed toward the center around which the body is moving.

Rotation vs Revolution

1. Rotation(or spin)- when a body turn about an internal axis
2. Revolution- when a body turns about an external axis
    a. Earth rotates around an axis
    b. Earth revolves around the sun

2. At least 3 common mistakes or misconceptions relevant to the topic and how to avoid them

1. Variables
2. What equation to use
3. Frequency VS Period

Variables

v= Velocity; m/s

v_t = tangential velocity; m/s

r= Radius; m

M= Mass; kg

F_c= Centripetal force; $kg*m/s^2$

a_c= Centripetal acceleration; m/s^2

f= Frequency; Hz

T= Period; s

What equation to use

$a_c = V^2/r$

$F_c = mv^2/r$

$T = 1/f$

$v = 2\pi\ r/T$

Frequency VS Period

Frequency (f)	Period (T)
The number of revolutions per second	The time it takes to make a full revolution
Measured in Hertz	Measured in seconds
1Hz= 1 revolution/second	T=1/f

FRQ strategies

- How do you figure out what an FRQ is asking you to do?
  - Always look at the units being used, kg, v, m, and m/s.
  - Look for keywords like radius, period, and speed.
    - Most FRQ will tell you what to find, if not use these ideas.
- Is there any information needed to answer different FRQs that might be implied rather than directly stated?

  - Centripetal forces like tension, friction and gravity are usually implied in FRQ's

Example problem 1: Ball and chain

You are swinging a 15 kg ball attached to its 5m long chain and it is moving at 20 m/s. What is the force of tension of the chain?

Equation you will need:

$F_c = mv^2/r$

Step 1: use equation to solve

$$F_c = mv^2 / r$$

$$= (15\,kg)(20\,\tfrac{m}{s})^2 / (5m)$$

$$= 1200\,N$$

Example problem 2: Amusement park ride

A person on an amusement park ride is 6 meters from the center. The ride makes 120 revolutions every minute. What is the speed of the passenger on the edge of the ride?

step 1 : convert

$$\frac{120\ \text{rev}}{\text{min}} \times \frac{2\pi\ \text{rad}}{1\ \text{rev}} = 753.98\ \text{rad/min}$$

step 2: use equation to solve

$$v = r\omega$$

$$v = (6\text{m})(753.98\ \text{rad/min})$$

$$v = 4524\ \text{m/min}$$

Example problem 3:

What is the centripetal acceleration of the person on the ride?

Step 1: use equation to solve

$$a_c = v^2 / r$$

$$a_c = (4524)^2 / (6m)$$

$$a_c = 3411096 m/min^2$$

Example problem 4: tangential velocity

What is the tangential velocity of a ball spun on a 2m long string if the ball makes 10 revolutions every 2 seconds?

step 1: convert

$$\frac{10\ \text{rev}}{2\text{s}} \times \frac{2\pi\ \text{rad}}{1\ \text{rev}} = 31.4\ \text{rad/s}$$

step 2: use equation to solve

$$v = r\omega$$

$$v = (2\text{m})(31.4\ \text{rad/s})$$

$$v = 62.8\ \text{m/s}$$

Example problem 5: centripetal acceleration

What is the centripetal acceleration of a car that rounds a bend that has a 50m radius at 10 m/s?

Step 1: use equations to solve

$$a_c = v^2 / r$$

$$a_c = (10 \tfrac{m}{s})^2 / (50m)$$

$$a_c = 2 \ m/s$$

4. Five practice multiple choice questions for the class

https://play.kahoot.it/#/k/2949ccb4-2736-4bce-adc6-a0f4ebe9e96a