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Circular Motion (p. 153 – 156)

I. Describing Circular Motion

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1. **An object moving in a circle at a constant speed has no acceleration.**

   Circle One : True **False** Changing direction!

2. **Define the term uniform circular motion.**

   Uniform Circular Motion – movement of an object or particle trajectory at a constant speed around a circle with a fixed radius

3. **What does the position vector, *r*, represent with uniform circular motion?**

   (radius) r = position of an object relative to the center of the circle

4. **When dealing with circles, the position vector length does not change.**

   Circle One : **True** False

5. **How is an objects displacement, Δr, determined for uniform circular motion?**

   $(\Delta r_2 - \Delta r_1)$

   By subtracting r_1 (initial time vector) from r_2 (end time vector)

6. **Write out the formula to determine average velocity for circular motion.**

   $$\bar{v} = \frac{\Delta r}{\Delta t} = \left(\frac{r_2 - r_1}{t_f - t_i}\right) \qquad v = \frac{\Delta d}{t}$$

7. **A velocity vector in circular motion has ~~the same~~ different direction as the displacement, but a ~~different~~ same length.**

   Circle One : True **False**

   r = constant
   direction = constantly changing

8. **What is the direction of acceleration when moving with circular motion?**

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   Towards center of circle

9. **As an object moves around a circle, the acceleration vector ~~stays the same~~ changes, but the length ~~changes.~~ stays the same.**

   Circle One : True **False**

10. **Define the term centripetal acceleration.**

    Centripetal Acceleration – center seeking acceleration of an object moving in a circle at a constant speed.

II. Centripetal Acceleration

1. **The angle between position vectors is equal to the angle between velocity vectors.**

   Circle One : **True** False

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   Angle $(r_2 - r_1)$ = Angle $(v_2 - v_1)$

   radius velocity

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

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2. If $\Delta r/r$ is equal to $\Delta v/v$, then derive the formula for centripetal acceleration.

1. Divide both sides by Δt.

$$\frac{\Delta r}{r\Delta t} = \frac{\Delta v}{v\Delta t}$$

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

2. Substitute $v = \Delta r/\Delta t$ and $a = \Delta v/\Delta t$.

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

3. Solve for a_c (*centripetal acceleration*).

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

3. What does the symbol *T* represent with circular motion?

$T =$ period (time needed to complete one revolution)

Circle Circumference $2\pi r$

4. Write out the formula to determine centripetal acceleration using time.

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

$$v = \frac{d}{t} = \frac{2\pi r}{T}$$

5. Define the term centripetal force.

<u>Centripetal Force</u> – net force toward the center of a circle when an object is moving in a circle

DEMO: Spinning kids in the air

6. List three examples of centripetal forces.

Merry-Go-Round

1. Carnival Rides 2. Discuss Spin 3. Ice-Skaters

7. Write out the formula to determine Newton's Second Law For Circular Motion.

$F_{net} = m a_c$ or $F = \frac{mv^2}{r}$

Bucket + Water DEMO

8. Identify the following when creating a coordinate system for circular motion.

Direction of acceleration = Towards center of circle

X-Axis Label = c (centripetal acceleration)

Y-Axis Label = tang (tangential → tangent to circle)

III. A Nonexistent Force

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1. Define the term centrifugal force.

No force present outward

<u>Centrifugal Force</u> – fictitious, nonexistent outward force (explained using Newton's 1st Law)

2. List three examples of "centrifugal forces".

1. Car on curve 2. High Jumpers 3. Silly Silo

Mrs. Dengle = Gremlins

Coriolis Effect – ball thrown across merry-go-round