Circular Motion

circular motion; *a.k.a.* "curvi-linear motion" ---> where direction changes continuously

uniform circular motion -----> when an object moves in a circular path with constant speed. [ex.'s: blades of a fan, hands of a clock]

Is the velocity of moving object constant? Is it accelerating?

Remember! speed ≠ velocity ------> vector (magnitude & direction)

*Changing either changes velocity, and object is thus accelerating!

*Because the direction is changing, it must be acted on by an unbalanced force (F_c), and therefore will accelerate according to Newton's laws of motion.

Which direction is the object accelerating? The direction of acceleration is in the direction of (F_c).

While (v) is tangential to circular path, (a) is toward the center --- "centripetal acceleration" (a_c).

$$\mathbf{a_c = v_T^2 / r}$$

ex; A race car travels 45 m/s around a circular track whose radius is 350 meters. What is the car's (a_c)?

sol; $a_c = v_T^2 / r =$ **5.8 m/s**

ex; The moon travels at 1,022 m/s around the earth with radius of 382,176,000 m. What is the moon's (a_c)?

sol; $a_c = v_T^2 / r =$ **0.0027 m/s²** (This value multiplied by 3,600 is equal to 9.8 m/s².)

How can we determine centripetal forces?

Use Newton's 2nd law: $\mathbf{F_c = ma_c = mv_T^2 / r}$

ex; A 5 kg object moves with a tangential velocity of 20 m/s around the center of a circle whose radius is 25 m.

a) What is (a_c)? sol; $a_c = v_T^2 / r =$ **16 m/s**

b) What is the centripetal force (F_c) required to keep this object in a circular motion?

sol; $F_c = ma_c =$ **80 N**

ex; What is the F_c which holds the moon in orbit? Mass of moon (m_m) = 7.35 x 10^{22} kg

sol; $F_c = (m_m)a_c$ ----> (7.35 x 10^{22} kg)(0.0027 m/s²) = **1.98 x 10^{20} N**

centrifugal effect ("**force**") ---> The *apparent* force directed radially outward from the center ("center-fleeing").

-This *apparent* force is equal and opposite to the inward (F_c).

-It is a pseudo-force because it is not caused by any force, but rather by the objects' inertial straight-line motion.