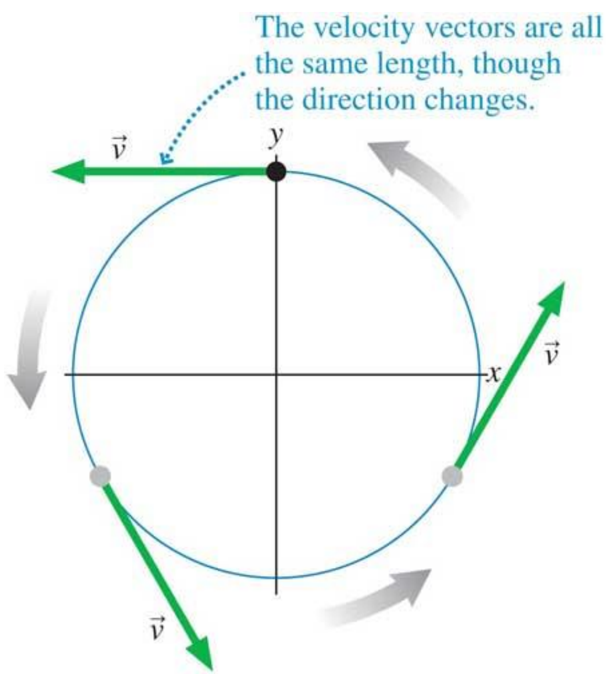
Circular Motion

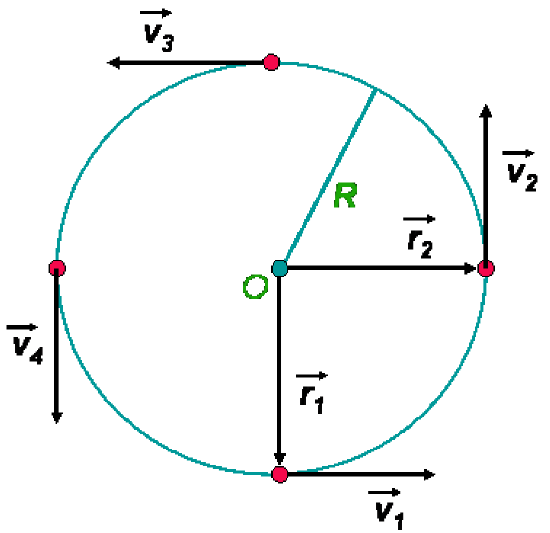
Period and Frequency



- **Uniform circular motion**
  - Constant speed
  - Continuously changing direction
- The time interval it takes an object to go around a circle one time, completing **revolution** is called a **PERIOD**.
- A period is represented by the symbol **T**.
- Rather than specify the time for one revolution, we can specify circular motion by its **FREQUENCY**, the number of revolutions per second, for which the symbol is ***f***.

$$f = \frac{1}{T} \text{ (units: } \frac{1}{s} \text{ or } s^{-1}\text{)}$$

Speed/Velocity in a Circle

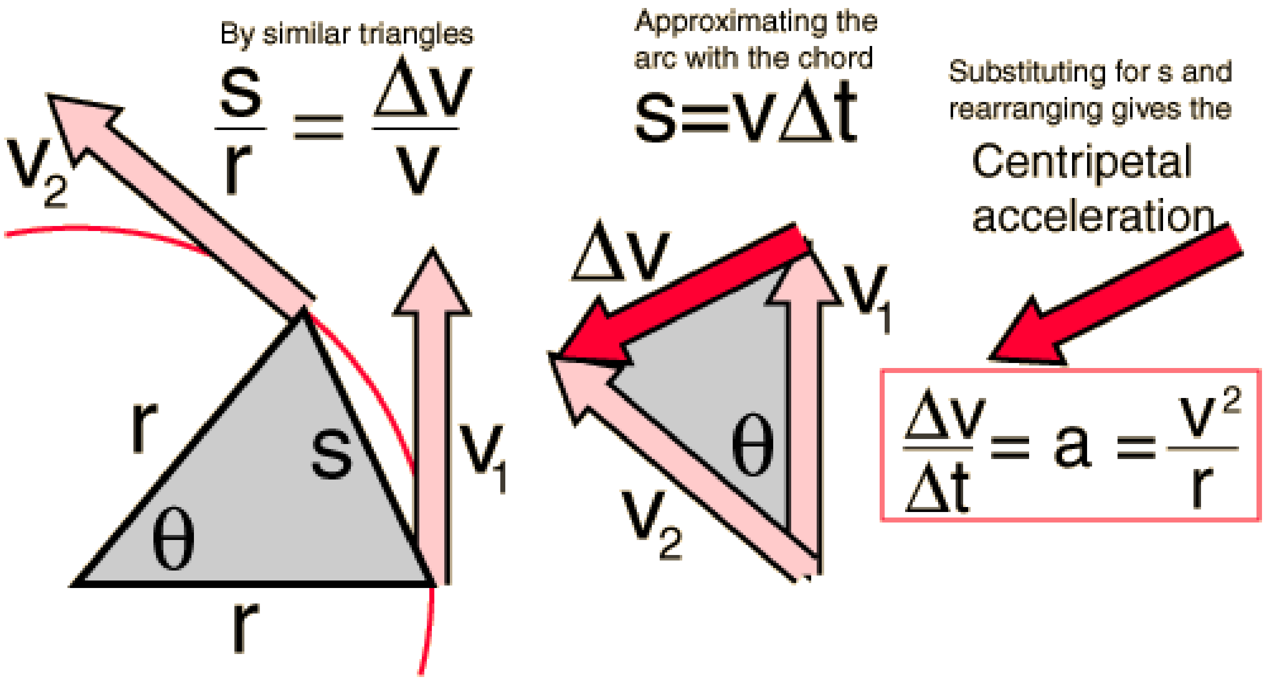


Speed is the MAGNITUDE of the velocity. And while the speed may be constant, the VELOCITY is NOT. Since velocity is a vector with BOTH magnitude AND direction, we see that the direction of the velocity is ALWAYS changing.

$$v(speed) = \frac{2\pi r}{T} = 2\pi f r$$

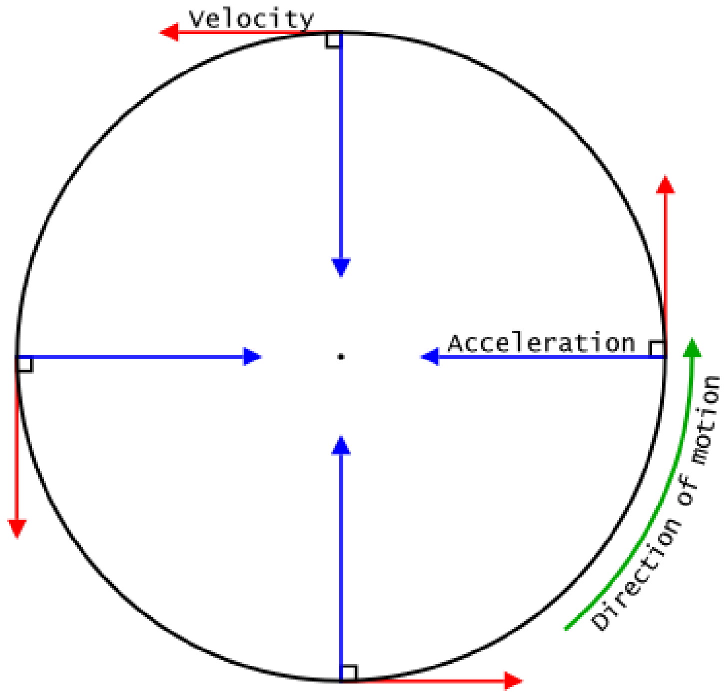
We call this velocity, TANGENTIAL velocity as its direction is draw TANGENT to the circle.

Centripetal Acceleration



Centripetal means “center seeking” so that means that the acceleration points towards the CENTER of the circle

Drawing the Directions correctly

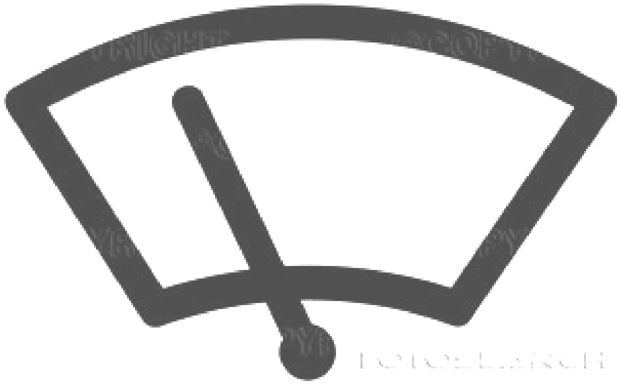


So for an object traveling in a counter-clockwise path. The velocity would be drawn TANGENT to the circle and the acceleration would be drawn TOWARDS the CENTER.

To find the MAGNITUDES of each we have:

$$v_c = \frac{2\pi r}{T} \qquad a_c = \frac{v^2}{r}$$

Examples



The blade of a windshield wiper moves through an angle of 90 degrees in 0.28 seconds. The tip of the blade moves on the arc of a circle that has a radius of 0.76m. What is the magnitude of the centripetal acceleration of the tip of the blade?

$$v_c = \frac{2\pi r}{T}$$

$$v_c = \frac{2\pi(.76)}{(.28 * 4)} = 4.26\, m/s$$

$$a_c = \frac{v^2}{r} = \frac{(4.26)^2}{0.76} = 23.92\, m/s^2$$