## Defining Circular Motion

IB PHYSICS | CIRCULAR MOTION

## Remember Newton's $1^{\text {st }}$ ?

A body will remain at rest or moving with constant velocity unless acted upon by an unbalanced force
"Law of Inertia"


## Try This...

> I'm usually running late for school and sometimes I forget my plate of pop tarts on the top of my car. What happens when I take a sharp turn to the right? Why?

## Remember back...

There are 3 ways that an object can be experiencing acceleration?


## You already know some of this...

If each blade in the wind farm animation is 30 meters long, estimate the speed (in $\mathrm{m} \mathrm{s}^{-1}$ ) of the tip of one turbine blade.


## Think about the Circle...

If you walked around this circle once, what is your total distance?

## What is a Radian??

We can define a circular distance in terms of a generic radius, r...

How many radians are there in one full revolution?

## Try this.

If a child on a merry-go-round rotates 3.5 times, what is their angular distance in radians?

If an ant on a record player spins for an angular displacement of 14 radians, how many revolutions has it experienced?

## Timing Circular Motion

## Period



## Angular Velocity

## For Linear Motion:

$$
v=\frac{\text { distance }}{\text { time }}=\frac{d}{t}
$$

## For Circular Motion:

## $\omega=\frac{\text { angular distance }}{\text { time }}$

If you have a single revolution:

$$
\omega=\frac{\text { angular distance }}{\text { time }}
$$



$$
\begin{aligned}
& \text { Time for one } \\
& \text { revolution }
\end{aligned}=\mathrm{T}
$$

## Try this

A ferris wheel takes 40 seconds to make on full revolution, what is its angular velocity in rad/s?

A car tire rotates with an average angular velocity of $29 \mathrm{rad} / \mathrm{s}$. In what time interval will the tire rotate 3.5 times?

## Linear Velocity

At any given point, an object with circular motion will also have an instantaneous linear velocity.

This velocity will be in the direction $\qquad$ to the curve


## Calculating Linear Velocity

## $d$ <br> $$
v=-
$$ <br> $$
v=
$$ <br> $t$

## Calculating Linear Velocity

$$
v=\frac{2 \pi r}{T} \quad \omega=\frac{2 \pi}{T}
$$

## IB Physics Data Booklet

## Sub-topic 6.1 - Circular motion

$$
\begin{aligned}
& v=\omega r \\
& a=\frac{v^{2}}{r}=\frac{4 \pi^{2} r}{T^{2}} \quad \omega=\frac{\text { angular distance }}{\text { time }}
\end{aligned}
$$

$$
\begin{array}{ll}
F=\frac{m v^{2}}{r}=m \omega^{2} r & \text { For one revolution } \\
& \omega=\frac{2 \pi}{T}
\end{array}
$$

## Try this....



Time for 1 Rotation:

$$
\mathrm{T}=10 \mathrm{~s}
$$

If the carousel spins at 1 complete rotation every 10 seconds, what is the angular and linear velocity of each row?

$$
\begin{array}{ll}
\omega=\frac{2 \pi}{T} & v=\omega r \\
\omega=\frac{2 \pi}{T} & v=\omega r
\end{array}
$$

## Try this....

If you were sitting 4 m from the center of a carousel spinning at $12 \mathrm{rad} \mathrm{s}^{-1}$ and threw a ball in the air, how fast would the ball continue in a straight line?

A woman passes through a revolving door with a tangential speed of $1.8 \mathrm{~m} \mathrm{~s}^{-1}$. If she is 0.8 m from the center of the door, what is the door's angular velocity?

## Lesson Takeaways

$\square$ I can convert between angular displacement in revolutions and radians
$\square$ I can define and measure the period of circular motion
$\square$ I can calculate angular velocity in rad/s
$\square$ I can describe and calculate tangential velocity based on the angular velocity and radius

