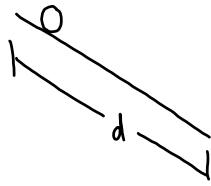Average Speed

Consider a ball rolling down an incline:
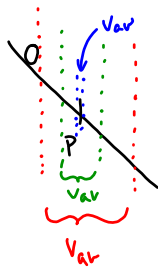

When you divide $\frac{d}{\Delta t}$
you get average speed.

$$V_{av} = \frac{d}{\Delta t}$$

We use the term average speed since speed is not constant.

Average speed is the ratio of the distance travelled to the time interval over which the body moves that distance.

Instantaneous Speed

Think of the instantaneous speed as the average speed when the distance travelled is <u>almost</u> zero and the time interval to travel that distance is <u>almost</u> zero.

$$V_{av} = \frac{d}{\Delta t}$$

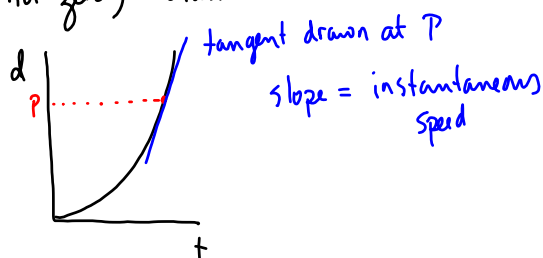$$V_{av} = \frac{0}{0}$$

problem → undefined

As the distance (and time interval) get closer to zero, the average speed will be closer to the instantaneous speed.

Mathematically we can express as a limit:

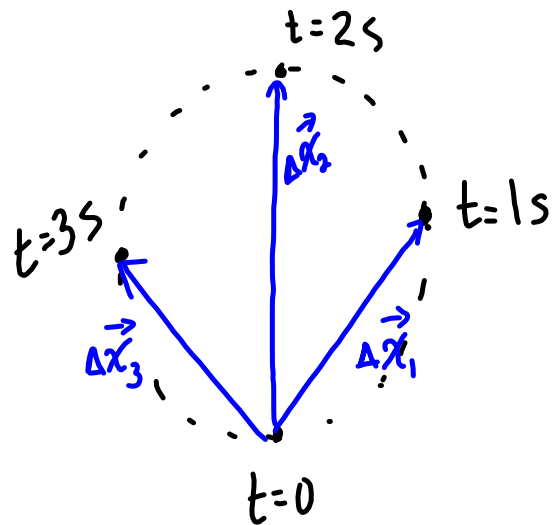$$\lim_{\Delta t \to 0}$$ $$V_{inst} = \lim_{\Delta t \to 0} \frac{d}{\Delta t}$$

↑ the limit as Δt approaches zero

The instantaneous speed of an object at point P is its speed at the instant that it passes P and it is the average speed calculated over an infinitely small (but not zero) distance around P.

tangent drawn at P

slope = instantaneous speed

Average Velocity

Consider an object moving
with a constant speed
around a circle. It
starts moving at time $t=0$

$t=2s$

$\vec{\Delta x_2}$

$t=3s$

$t=1s$

$\vec{\Delta x_3}$

$\vec{\Delta x_1}$

$t=0$

Average velocity: $\vec{V_{av}} = \dfrac{\vec{\Delta x}}{\Delta t}$

Average velocity is the ratio of the displacement
to the time interval over which the displacement occurs

NOTE: The magnitude and direction of the
average velocity will depend on the time interval
selected

NOTE: The direction of the average velocity
is the same as the direction of the displacement