

Derivatives represent instantaneous rates of change of a function with respect to a certain variable.

Example 1:

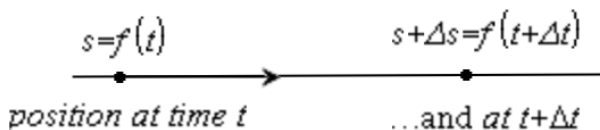
- a) Find the rate of change of the area of a circle with respect to the radius r .
- b) Evaluate the rate of change at $r = 5$.

A Moving Object:

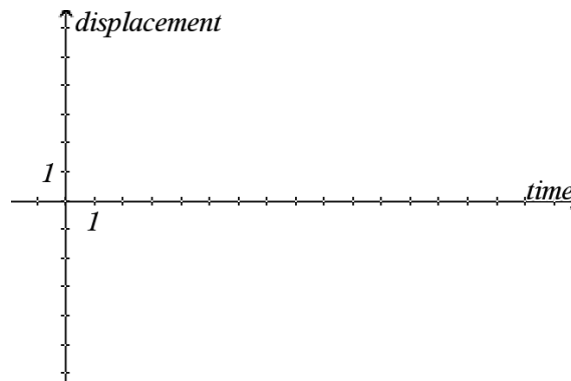
If an object moves along a straight line we can model its movement with a position function $s(t)$.

Displacement: How far away the object is from its starting position.

$$\Delta s = s(t + \Delta t) - s(t)$$



Average Velocity: $\frac{\text{displacement}}{\text{travel time}} = \frac{\Delta s}{\Delta t}$



Instantaneous Velocity: (velocity at any given time)

$$v(t) = \frac{ds}{dt} = \lim_{\Delta t \rightarrow 0} \frac{s(t + \Delta t) - s(t)}{\Delta t}$$

- The velocity function is the derivative of the position function.
- Velocity gives magnitude and direction.
- Speed is the absolute value of velocity.

$$\text{Speed} = |v(t)| = \left| \frac{ds}{dt} \right|$$

Acceleration: $a(t) = v'(t) = \frac{dv}{dt} = \frac{d^2s}{dt^2}$

