Distance = Rate x Time

$$d = rt$$

Rate of Change

(Slope)

Solve for r

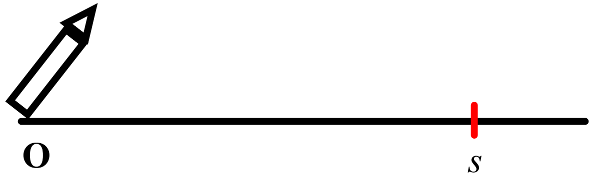
$$r = \frac{d}{t}$$

$$r = \frac{\Delta d}{\Delta t}$$

Rates of Change

(Slope)

Suppose a rocket starts form rest at a point O
and is at a distance s feet from O along a straight path
at the end of t seconds



Equation: $s = 10t2$

Domain : R
Range: nonnegative R

$f(t) = 10t2$

$f(t)$ = **distance traveled in time** t **from** $t = 0$
(change in distance)

$f(1) =$

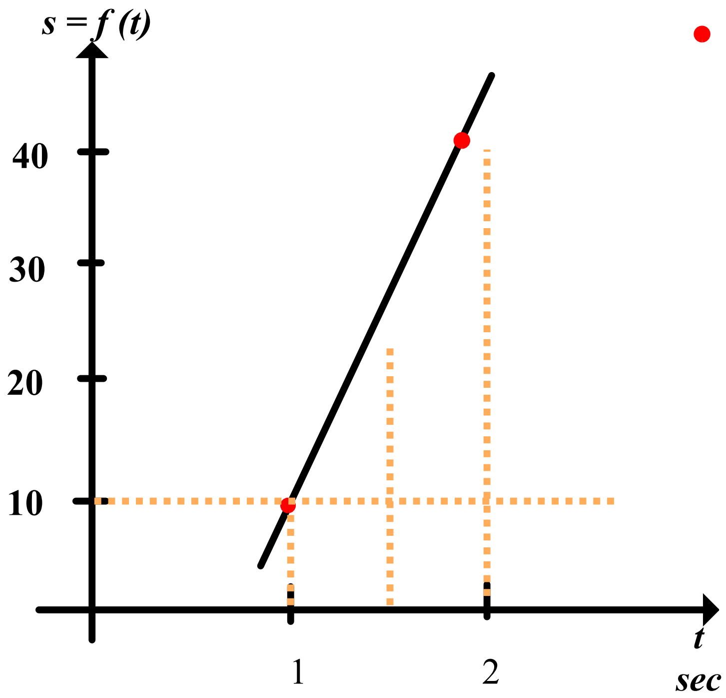
Distance travelled from $t = 0$ **to** $t = 1$

$f(2) =$

Distance travelled from $t = 0$ **to** $t = 2$

$f(t) = 10\,t2$

Average Speed $= \dfrac{\Delta d}{\Delta t}$



Average Speed over the time interval from $t = 1$ to $t = 2$

Average Speed $= \dfrac{\Delta d}{\Delta t}$ ⟶

Average Speed over the time interval from $t = 1$ to $t = 1.5$

What is the speed <u>at</u> $t = 1$?

(instant)

$f(t) = 10t2$

$$r = \frac{\Delta d}{\Delta t}$$

So how do we find the speed at that particular instant .... $t = 1$???

Find <u>Average Speeds</u> over <u>*short time intervals*</u>

from $t = 1$ to $t = 1 + h$

for *smaller and smaller positive* values of h

h	0.2	0.1	0.05	0.01	0.001
$\frac{f(1+h) - f(1)}{h}$	22	21	20.5	20.1	20.01

What value does the speed seem to be approaching?

The ratio can be made as close as desired to 20 by taking sufficiently small values of $h, h \neq 0$

Instantaneous Velocity

$$\lim_{h \to 0} \frac{f(t+h) - f(t)}{h}$$

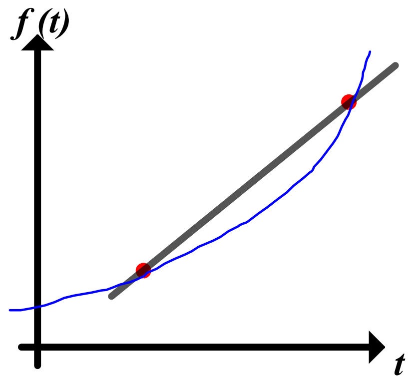
$s = 10t2$

Find the average speed of the rocket from $t = 3$ to t = 5

Find the speed of the rocket at $t = 5$

Average Rate of Change = slope of a *secant line* through 2 points

$$rave = \frac{f(t+h) - f(t)}{h}$$



Instantaneous Rate of Change = slope of *tangent line* at point

$$rinst = \lim_{h \to 0} \frac{f(t+h) - f(t)}{h}$$