

# Velocity & Other Rates of Change (Section 3.4)

\* Instantaneous Rate of Change:  $f'(a) \rightarrow$  first derivative @ point "a"

ex:  $A = \pi r^2$  inst. rate of change @  $r=10$ .

$$A' = 2\pi r \rightarrow A'(10) = 2\pi(10) = \boxed{20\pi}$$

\* Average Velocity:  $v(t) = \frac{\text{displacement}}{\text{time traveled}} = \frac{\Delta \text{position}}{\Delta \text{time}} = \frac{\Delta s}{\Delta t} = \frac{ds}{dt} = s'(t)$

(slope)

First Derivative

\* Speed:  $|v(t)| = \left| \frac{ds}{dt} \right| \rightarrow$  speed has no direction  
speed is always (+)

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

\* Free-fall Constants (on Earth):  $s = \frac{1}{2}gt^2 \rightarrow g = 32 \text{ ft/sec}^2$  OR  $9.8 \text{ m/sec}^2$

$$s = 16t^2 \text{ OR } s = 4.9t^2$$

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ex: #14

Mars:  $s = 1.86t^2 \rightarrow s' = 1.86(2t)$   
 $s' = 3.72t$

$$\frac{16.6}{3.72} = \frac{3.72t}{3.72}$$

$$t = \boxed{4.462 \text{ sec}}$$

Jupiter:  $s = 11.44t^2$   
 $s' = 11.44(2t)$   
 $s' = 22.88t$

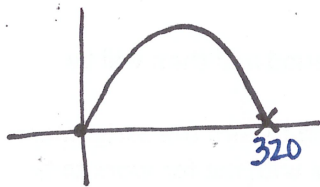
$$\frac{16.6}{22.88} = \frac{22.88t}{22.88}$$

$$t = \boxed{0.726 \text{ sec}}$$

$$s' = v = 16.6 \text{ m/sec?}$$

ex: #16

Moon:  $s = 832t - 2.6t^2$



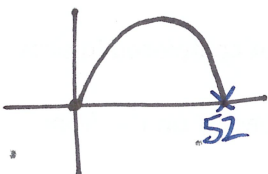
$$2.6t(320 - t) = 0$$

$\downarrow$        $\downarrow$   
 0        320

$$\boxed{320 \text{ sec}}$$

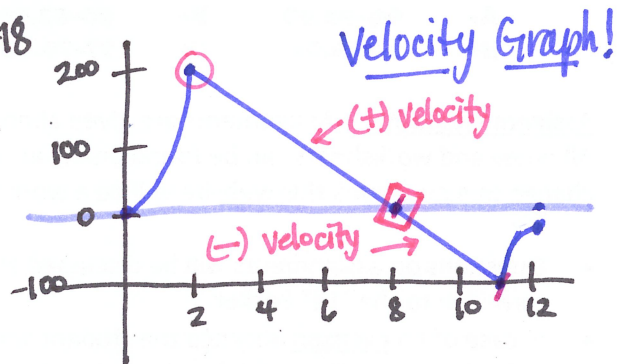
Earth:  $s = 832 - 16t^2$

$$16t(52 - t) = 0$$



$$\boxed{52 \text{ sec}}$$

#18



- vel @ engine stop? 190 ft/sec
  - when did engine stop? 2sec.
  - highest pt? 8sec    vel? 0 ft/sec
  - when did parachute open?  $\approx 11$ sec    vel?  $-90 \text{ ft/sec}$
  - fell for how long before parachute?  $\approx 3$ sec
  - greatest accel? 2sec
- constant accel? 2 to 11sec