M-GP General Physics 10/17

Distance vs Time Graph

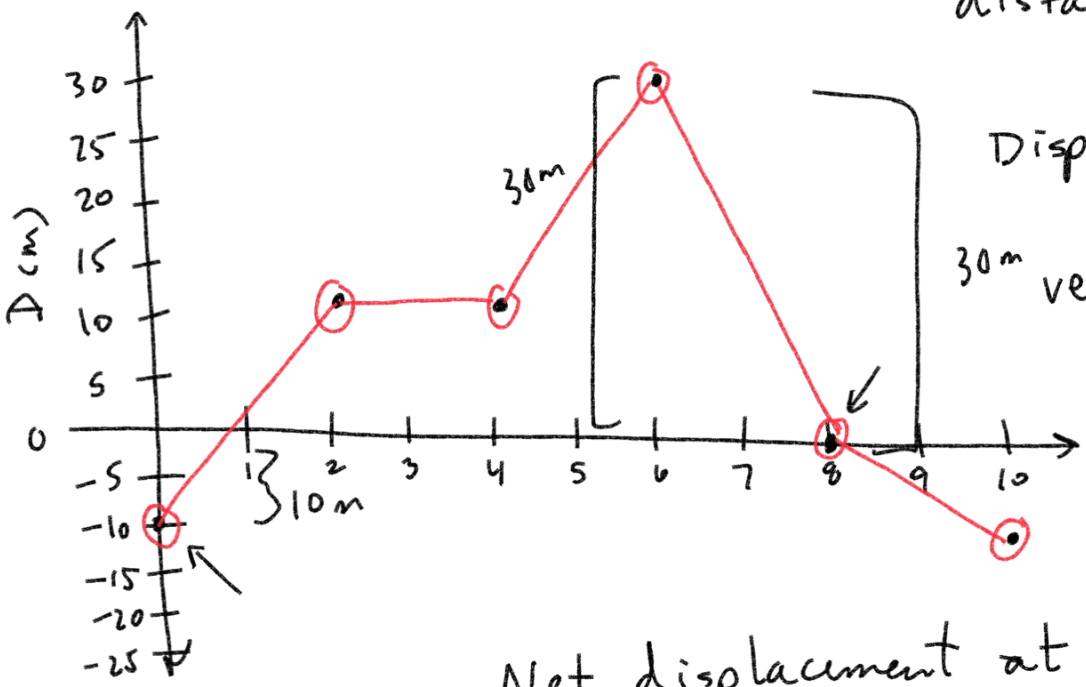
Displacement: net path length

distance: total path length

Displacement: $X_f - X_i$

vector: magnitude? direction

scalar: magnitude



Net displacement at $t = 4$

$$\Delta X = X_f - X_i$$
$$= 10m - (-10m) = \boxed{20m}$$

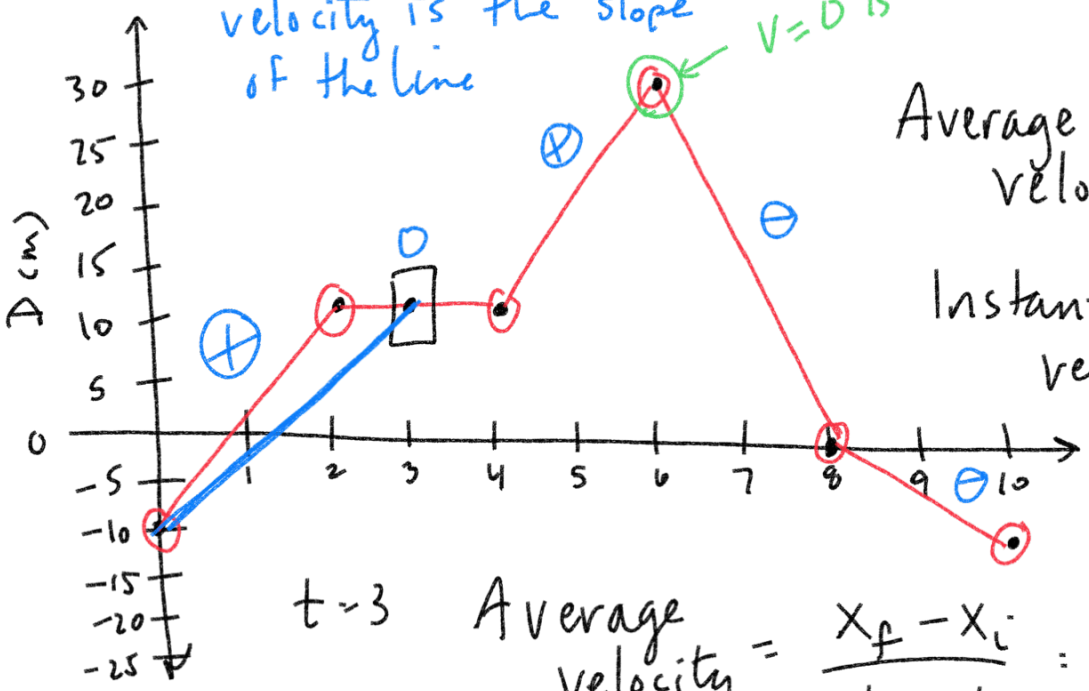
Net displacement at $t = 8$

$$\Delta X = X_f - X_i$$
$$= 0m - (-10m) = \boxed{10m}$$

Distance $t = 8$

$30m + 30m + 10m = \boxed{70m}$

Distance vs Time Graph



$$\text{Velocity} = \frac{\Delta X}{\Delta t}$$

$$\text{Average velocity} : \frac{X_f - X_i}{t_f - t_i}$$

Instantaneous velocity

$t = 3$ Average velocity $= \frac{X_f - X_i}{t_f - t_i} : \frac{10m - (-10m)}{3s - 0s}$

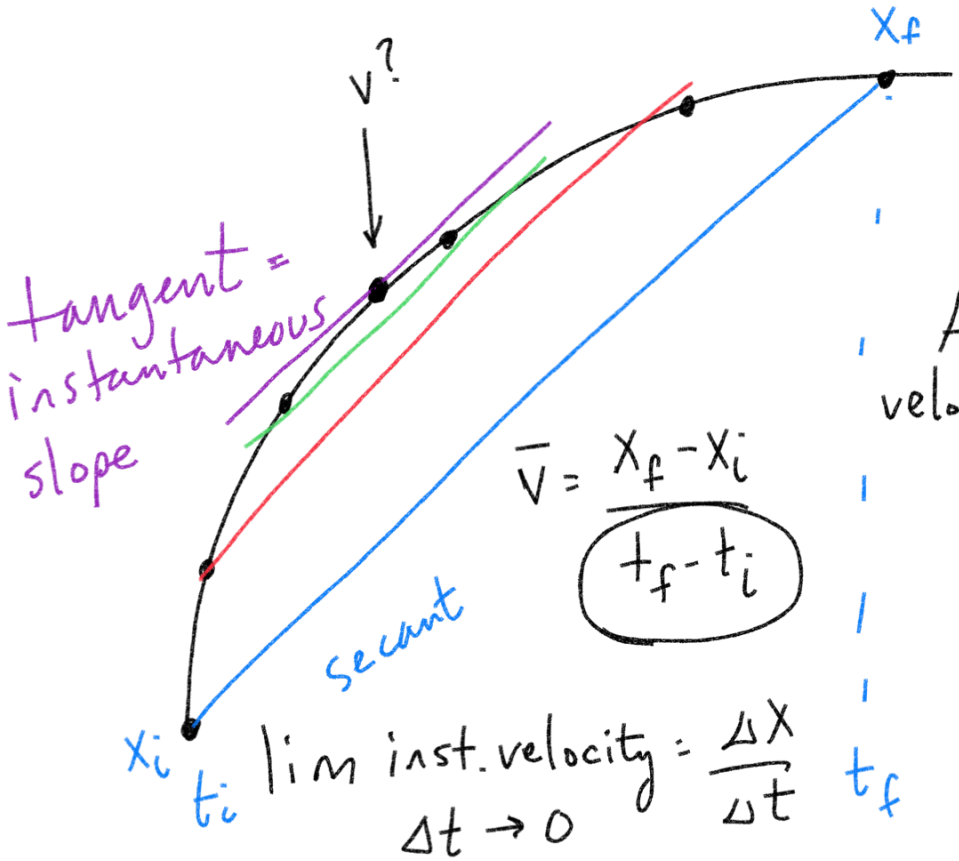
$\frac{20m}{3s}$ $\frac{20}{3}$ m/s

instantaneous velocity $= \boxed{0\ m/s}$

velocity = 0 when plateau or relative max or min

Instantaneous velocity = instantaneous slope

$$= \frac{dx}{dt}$$



$$\bar{v} = \frac{x_f - x_i}{t_f - t_i}$$

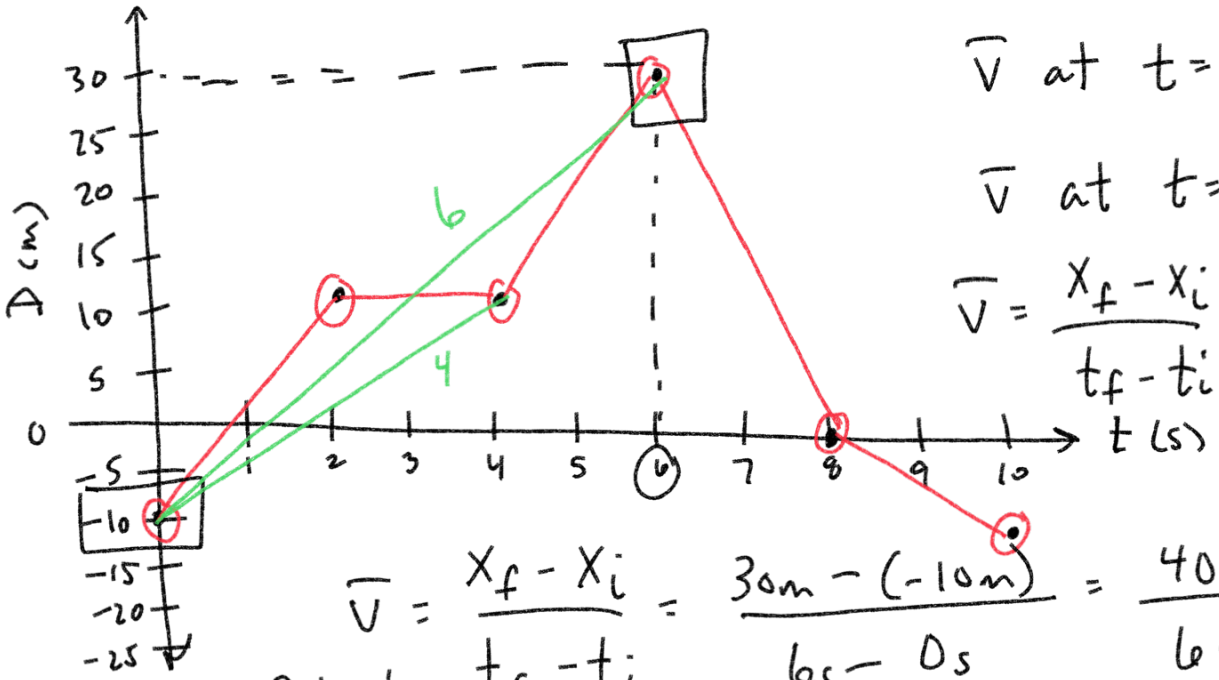
$$\lim_{\Delta t \to 0} \text{inst. velocity} = \frac{\Delta x}{\Delta t}$$

$\Delta v = \bar{v}$

velocity

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{\Delta y}{\Delta x} = \frac{x_f - x_i}{t_f - t_i}$$

Distance vs Time Graph



$\bar{v}$ at $t = 6$

$\bar{v}$ at $t = 4$

$$\bar{v} = \frac{x_f - x_i}{t_f - t_i}$$

$$\bar{v} = \frac{x_f - x_i}{t_f - t_i} = \frac{30\text{m} - (-10\text{m})}{6\text{s} - 0\text{s}} = \frac{40\text{m}}{6\text{s}} = \boxed{6.\overline{6}\ \text{m/s}}$$

@ $t = 6$

@ $t = 4$ $\quad \frac{10\text{m} - (-10\text{m})}{4 - 0} = \frac{20\text{m}}{4\text{s}} = \boxed{5\ \text{m/s}}$

$\sim 6.7\ \text{m/s}$

Acceleration → $\frac{\text{change in velocity}}{\text{change in time}}$

velocity → $\frac{\text{change in displacement}}{\text{change in time}}$

$V = \frac{\Delta X}{\Delta t}$ $a = \frac{\Delta V}{\Delta t}$

$V = \frac{m}{s}$ $a = \frac{m/s}{s} = \boxed{m/s^2}$

Average acceleration $= \frac{V_f - V_i}{t_f - t_i}$

Instantaneous acceleration $= \frac{dV}{dt}$

Acceleration (vector quantity)
both magnitude & direction

$70\ mi/hr$ $70\ mi/hr^2$

Acceleration due to gravity $\approx 10\ m/s$

$f(x) = 2x^2 - 8x + 12$

position

↓

1st derivative is velocity

$2x^{2-1} - 8x^{1-1} + 12x^{0}$ $\quad x^0 = 1$

$\boxed{4x - 8} = f'(x)$

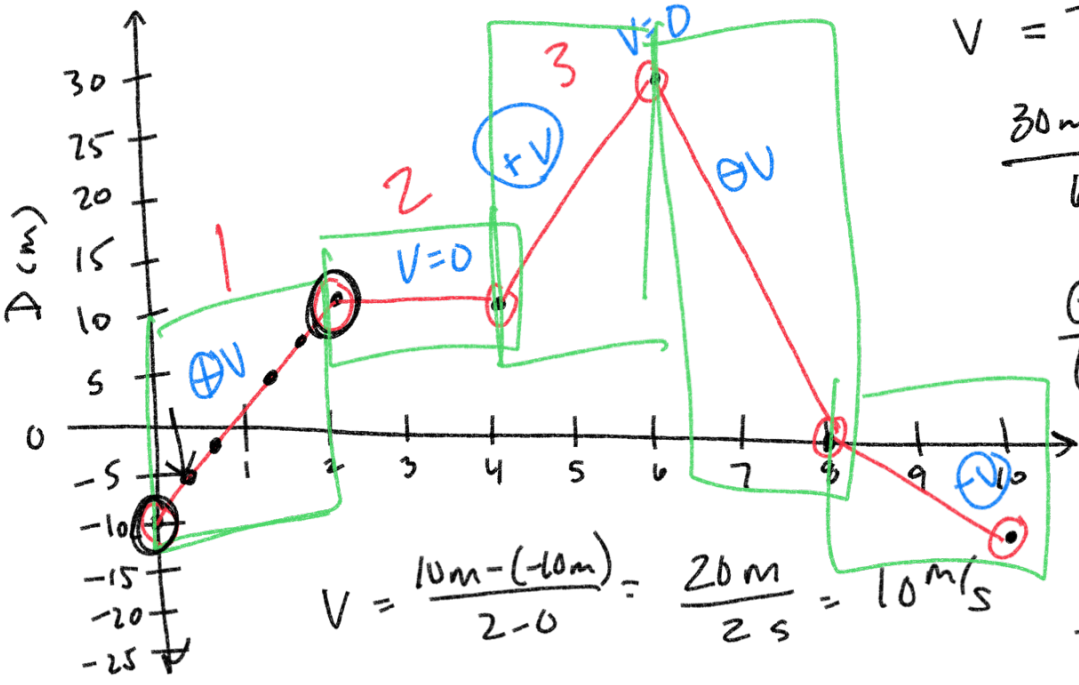
$4x - 8$

↓

2nd derivative is acceleration

$\boxed{4} = f''(x)$

Distance vs Time Graph



from $t=4 \rightarrow t=6$

$V = \bar{V}$

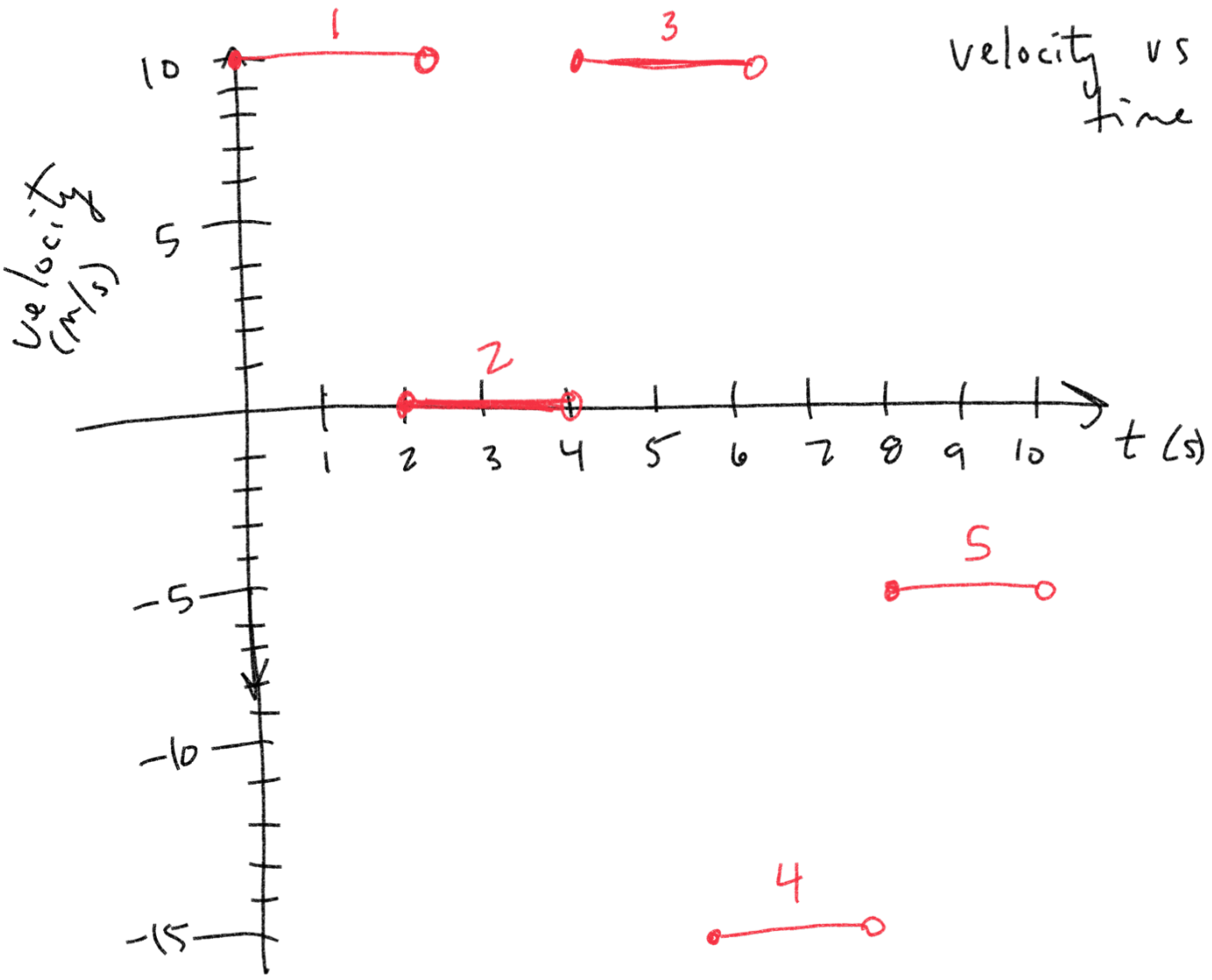
$\frac{30m - 10m}{6s - 4s} = \frac{20m}{2s} = 10\ m/s$

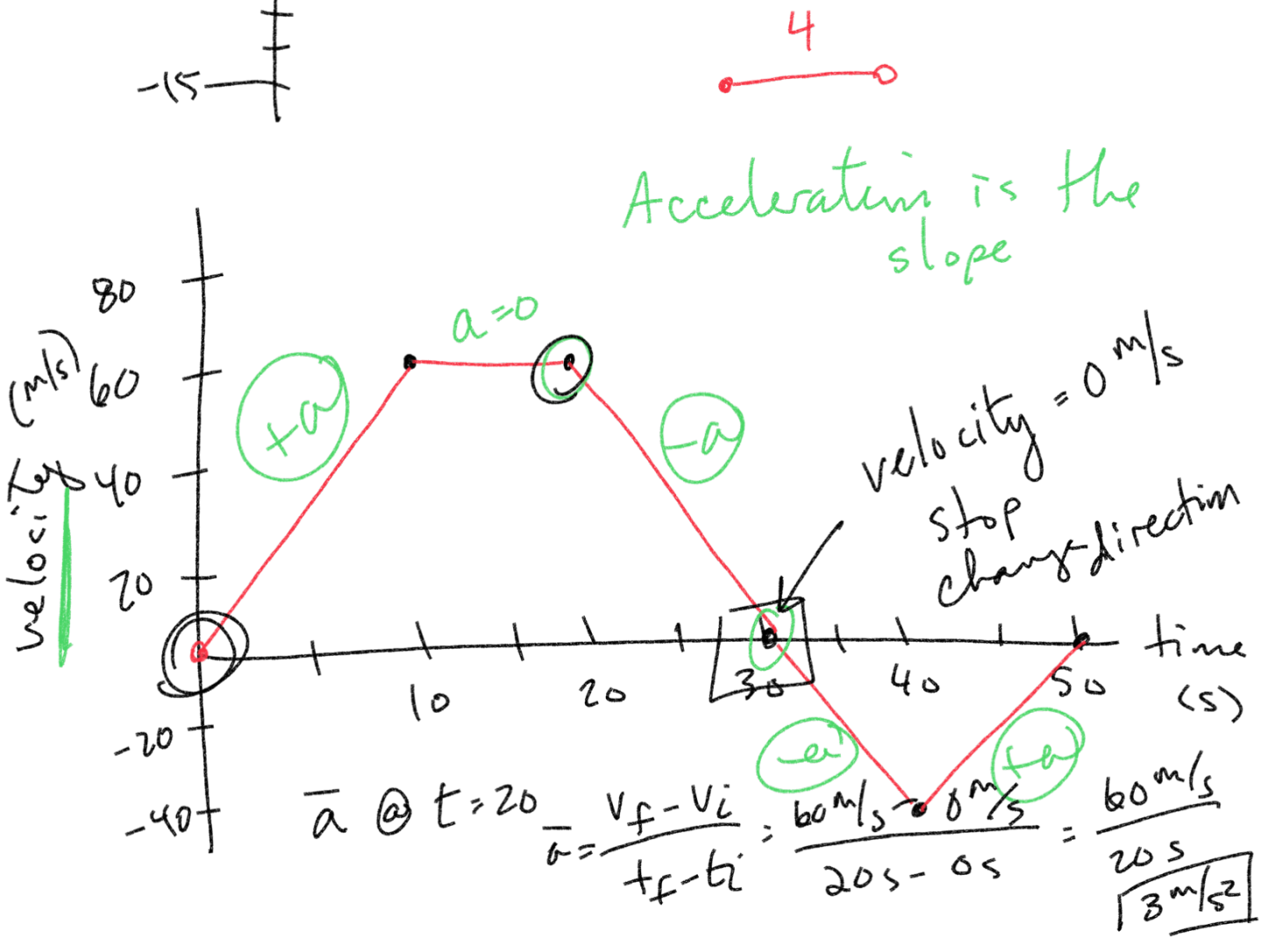
$\frac{0m - 30m}{(8-6)s} = \frac{-30m}{2s} = -15\ m/s$

$V = \frac{10m - (-10m)}{2-0} = \frac{20m}{2s} = 10\ m/s$

$\frac{-10m - 0m}{10s - 8s} = \frac{-10m}{2s}$

$-5\ m/s$


Velocity vs time
Velocity (m/s)
10
5
-5
-10
-15
1
2
3
4
5
1 2 3 4 5 6 7 8 9 10
t (s)


Acceleration is the slope
80
60
40
20
-20
-40
(m/s)
velocity
a=0
+a
-a
velocity = 0 m/s
stop
change direction
10
20
30
40
50
time
(s)
-a
+a
ā @ t=20
ā = (vf - vi) / (tf - ti) = (60 m/s - 0 m/s) / (20 s - 0 s) = 60 m/s / 20 s
3 m/s²