Phy40-Lesson 4
Velocity in the
Position-Time graph

1. Differentiate between speed and velocity.

2. Represent mathematically, the average velocity as,

$$v = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$$

Hence use the equation of motion;

$$x_f = vt + x_i$$

3. Interpret the slope of a position-time graph as the average velocity and the absolute value as the average speed

4. Explain how average velocity is different from instantaneous velocity

5. Explain the meaning of the slope of a position-time graph that is upward or downward and above or below the x-axis.

6. **Interpret the position of an object after a time interval by using;**

$$x_f = vt + x_i$$

Where, *v*= slope

$x_i = y - intercept$

Differentiate between speed and velocity.

Average Velocity of an object is its displacement divided by the corresponding time interval

$\Delta x = x_f - x_i$

$$v_{avg} = \frac{\Delta x}{\Delta t}$$

The SI unit of velocity is m/s

Velocity is a vector quantity.

Speed on the other hand is defined as the distance covered divided by the corresponding time interval

$$s = \frac{\mathrm{d}}{\Delta t}$$

Speed is also measured in m/s

Speed is a scalar quantity.

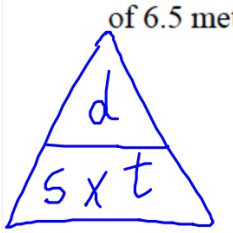
Velocity	Speed
1) $v = \frac{\Delta x}{\Delta t}$	1) $s = \frac{\text{distance}}{\text{time}}$
2) vector	2) scalar
3) measured in $[m/s]$	3) measured in $[m/s]$

$d = 50m \quad t = 3s$

1. If Steve throws the football 50 meters in 3 seconds, what is the average speed of the football?

$$s = \frac{d}{t} = \frac{50}{3} = 16.\overline{6} = 20\ m/s$$

2. If it takes Ashley 3 seconds to run from the batters box to first base at an average speed of 6.5 meters per second, what is the distance she covers in that time?



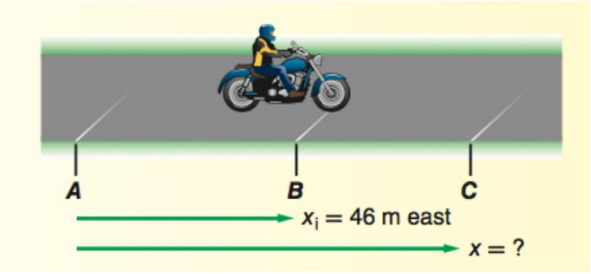
$$d = s \times t = 6.5 \times 3 = 19.5 = 20\ m$$

3. Bart ran 5000 meters from the cops and an average speed of 6 meters/second before he got caught. How long did he run?

$$t = \frac{d}{s} = \frac{5000}{6} = 833.\overline{3} = 800\ s$$

Find the position → $x_f = vt + x_i$

POSITION The figure shows a motorcyclist traveling east along a straight road. After passing point ***B***, the cyclist continues to travel at an average velocity of 12 m/s east and arrives at point ***C*** 3.0 s later. What is the position of point ***C***?



$V_{avg} = 12\ m/s$ east

$\Delta t = 3.0\ s$

$x_c = ??$

$x_c = v \cdot t + x_B$

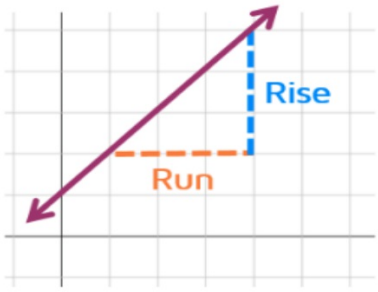
$= 12(3.0) + 46$

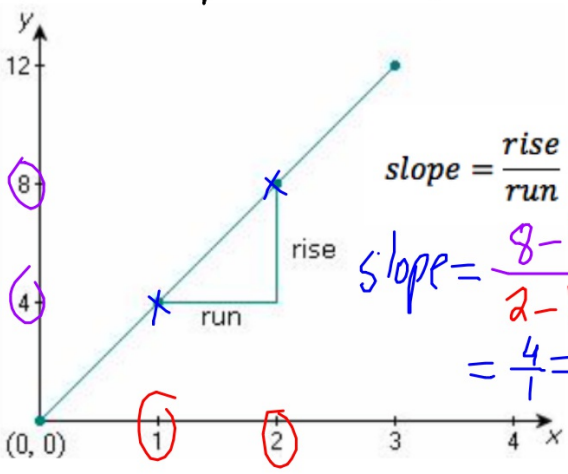
$= 36 + 46 =$ **82 m**

Interpret the slope of a position-time graph as the average velocity and the absolute value as the average speed

$$\text{Slope} = \frac{\text{Vertical Change}}{\text{Horizontal Change}} = \frac{\text{Rise}}{\text{Run}}$$

slope = steep

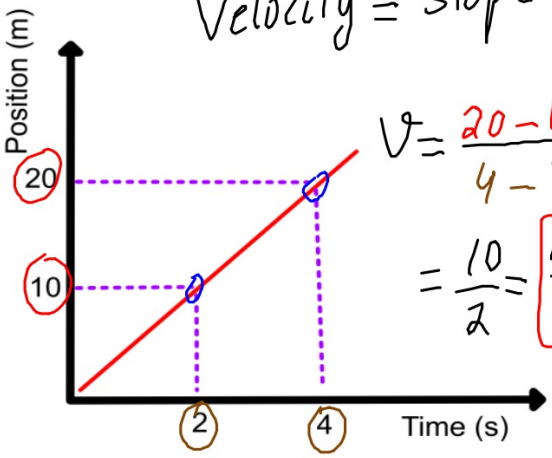




$$slope = \frac{rise}{run}$$

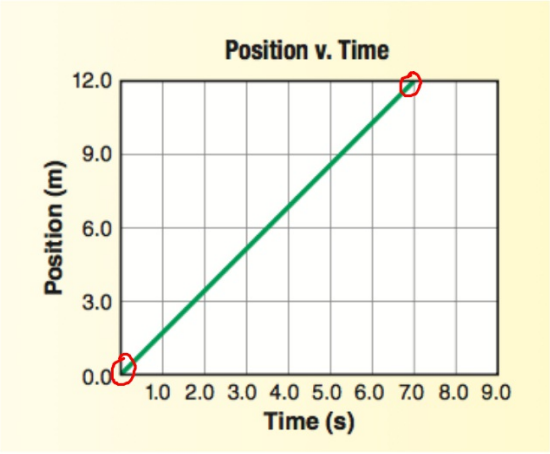
$$slope = \frac{8-4}{2-1} = \frac{4}{1} = 4$$

Velocity = slope



$$v = \frac{20-10}{4-2} = \frac{10}{2} = 5\ m/s$$

AVERAGE VELOCITY The graph at the right describes the straight-line motion of a student riding her skateboard along a smooth, pedestrian-free sidewalk. What is her average velocity? What is her average speed?



$$v = \frac{12.0 - 0.0}{7.0 - 0.0}$$

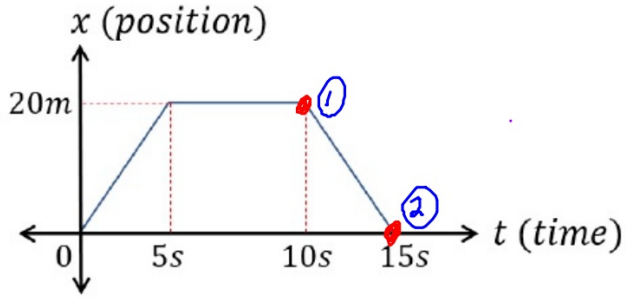
$$= \frac{12.0}{7.0} = 1.7 \text{ m/s}$$

$$S = \frac{d}{t} = \frac{12.0}{7.0}$$

$$= 1,7 \text{ m/s}$$

$$\begin{array}{r} 1.71 \\ 7\overline{)12.00} \\ -7\downarrow \\ \hline 50 \\ -49\downarrow \\ \hline 10 \\ -7 \\ \hline 3 \end{array}$$

Explain the meaning of the slope of a position-time graph that is upward or downward and above or below the x-axis.



Calculate the average velocity between [0s and 5s], [5s and 10s], [10s and 15s]

[0s → 5s]

$v = \frac{20-0}{5-0}$

$= \frac{20}{5} =$ 4 m/s

[5s → 10s]

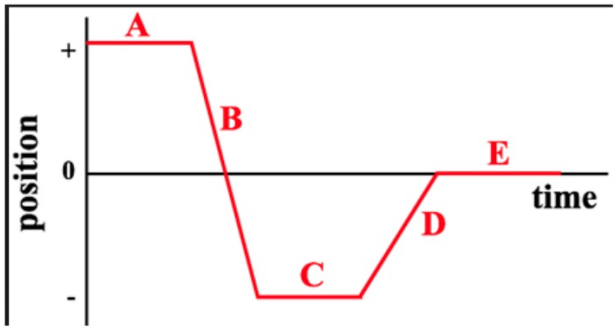
$v = 0$

At Rest

[10s → 15s]

$v = \frac{0-20}{15-10} = \frac{-20}{5}$

$=$ -4 m/s



Describe the motion of A, B, C, D, and E

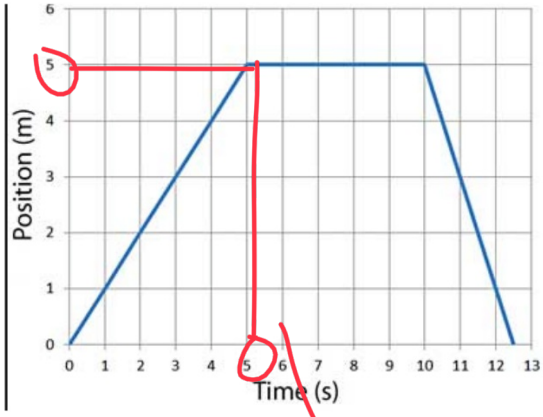
A : At Rest

B : negative velocity / moving to the Left at a constant speed.

C : At Rest

D : positive velocity / moving right at a constant speed

E : At Rest



When is the object at rest?

between 5s and 10s

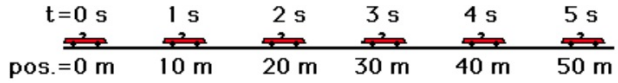
When is the object moving in the positive direction? at what speed?

between 0s and 5s. | $s = \frac{d}{t} = \frac{5}{5} = 1$ m/s

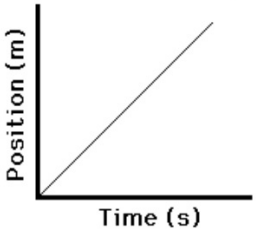
At what time interval does the object move fastest?

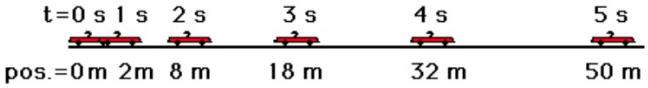
from 10s to 12.5s because the line is the steepest

Explain how average velocity is different from instantaneous velocity

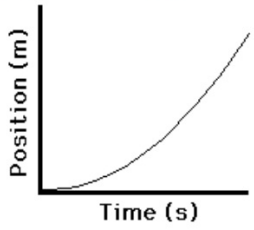


Constant Velocity
Positive Velocity





Positive Velocity
Changing Velocity (acceleration)



Average velocity	Instanteneous velocity
Is calculated for a time interval	Is the velocity at a certain time.
ex// [0s → 5s]	ex// at t = 2s
[10s → 20s]	