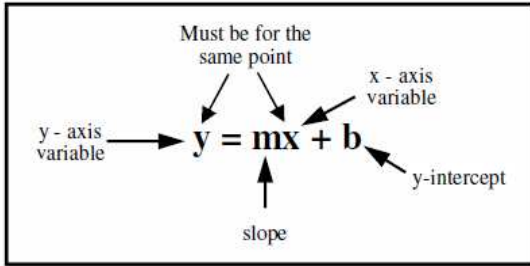


Name: \_\_\_\_\_

Period: \_\_\_\_\_

# The Linear Equation



The linear equation is the form of ANY straight line.

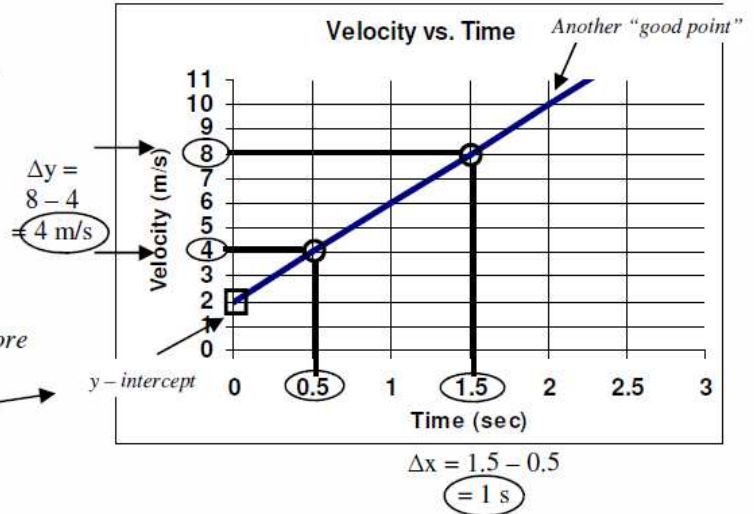
The linear equation is just a formula and like any other formula you can solve for any unknown given the other variables.

For example, if you are given x and y for a point and the y-intercept (b), you could solve for the slope of the line.

**Step 1:** Calculate slope (m) with two good points (where the line hits "cross hairs" [see graph]).

$$m = \frac{\text{rise}}{\text{run}} = \frac{\Delta y}{\Delta x} = \frac{4 \text{ m/s}}{1 \text{ s}} = 4 \text{ m/s}^2$$

The slope (the tilt) tells you the rate of change of y, not x. In this case slope tells us the change of velocity which is acceleration (notice the units: "m/s<sup>2</sup>"). More slope (more tilt) would mean more acceleration, the velocity would change faster.



**Step 2:** Find the y-intercept (b) (where the line crosses the y-axis).

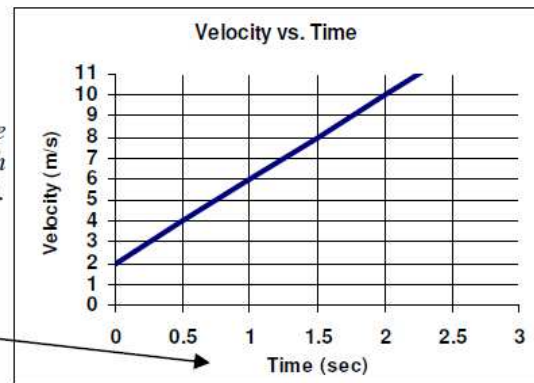
$b = 2 \text{ m/s}$

The y-intercept (the vertical shift) tells you the initial condition of the object: this object's initial velocity = 2 m/s (velocity at 0 sec).

**Step 3:** Find what the x and y variables are for this graph.

y-axis = velocity = v (in m/s)  
x-axis = time = t (in sec)

The y variable for this graph is velocity, v.



The x variable for this graph is time, t.

Why is this step so important? If you leave x and y in the linear equation it is easy to be confused when putting in numbers. Which one is time? Which one is velocity? If you change your variables there will be no confusion.

x and y will be different for each graph!

**Step 4:** Put all of the above into the linear equation to find the equation for this particular line.

$$y = v$$

$$x = t$$

$$m = 4 \text{ m/s}^2$$

$$b = 2 \text{ m/s}$$

$$y = mx + b \leftarrow \text{Any line}$$

$$v = 4t + 2 \leftarrow \text{THIS LINE}$$

**Step 5:** Use the linear equation to solve problems. You now have a formula for the object depicted on the graph. Given any x or y you can now solve for the other.

Example: When will the object graphed above be going 20 m/s?

Solution: use the linear equation for this line.

$$v = 20 \text{ m/s} \quad v = 4t + 2 \quad 18 = 4t$$

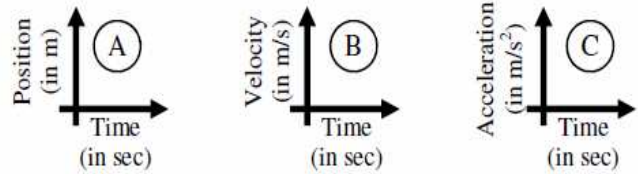
$$t = \text{_____} \quad 20 = 4t + 2 \quad t = 18/4$$

$$\quad \quad \quad 20 - 2 = 4t \quad t = 4.5 \text{ sec}$$

The object will be going 20 m/s at 4.5 seconds. (Notice this is a point beyond the graph. This is known as extrapolation. "Extra" = outside.)

1. m, b, x, or y?

- A. \_\_\_ vertical axis.            F. \_\_\_ Gives initial condition.  
B. \_\_\_ Slope                      G. \_\_\_ Independent variable  
C. \_\_\_ y-intercept                H. \_\_\_ Rate of change of y.  
D. \_\_\_ horizontal axis            I. \_\_\_ Are constants.  
E. \_\_\_ Dependent variable.    J. \_\_\_ Are variables.



2. Write the equation for slope.

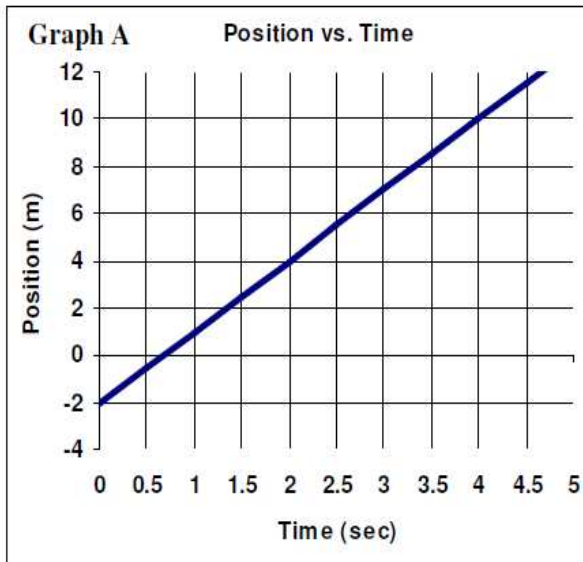
3. Write the equation that defines a line.

4. Use the graphs above to answer the following.

- A. What is the y variable for graph C?  
B. What is the x variable for graph B?  
C. What is y for graph A?  
D. What is x for graph B?  
E. In the linear equation what is y for graph B?

5. Use the two graphs *below* to answer the following questions.

- A. What is the y variable for Graph B?  
B. What is the x variable for Graph A?  
C. What is the y-intercept for Graph A?  
D. What is the y-intercept for Graph B?  
E. Over time, what changes in Graph A?  
F. So, what does the slope of Graph A show?  
G. Over time what changes in Graph B?  
H. So, what does the slope of Graph B show?



6. Use Graph A above to answer the following questions.

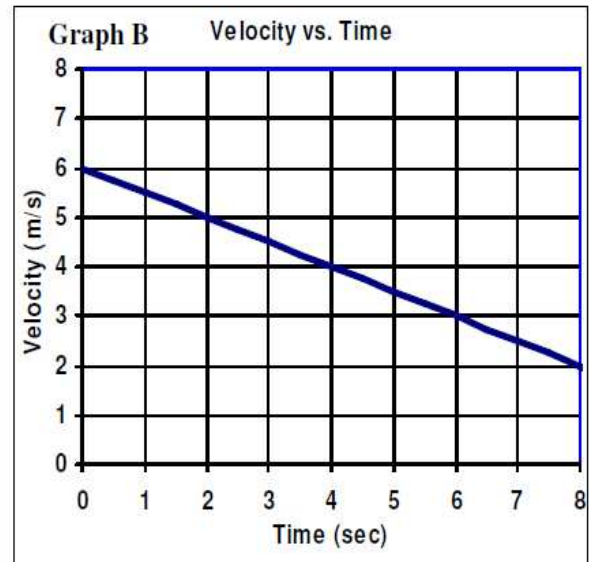
- A. On the above graph, calculate the line's slope.  
B. Put a square around the y-intercept.  
C. Write the linear equation variables for this line:

m =                      D. Write the linear equation  
b =                      for this line:  
y =  
x =

E. Meters would go into what part of this linear equation?

F. At what time will the object be at 15 meters?

G. What is the initial position of the object?



7. Use Graph B above to answer the following questions.

- A. On the above graph, calculate the line's slope.  
B. Put a square around the y-intercept.  
C. Write the linear equation variables for this line:

m =                      D. Write the linear equation  
b =                      for this line:  
y =  
x =

E. Seconds would go into what part of this linear equation?

F. How fast is the object going after 10.5 seconds?

G. What is the initial velocity of the object?