

**DO NOW**

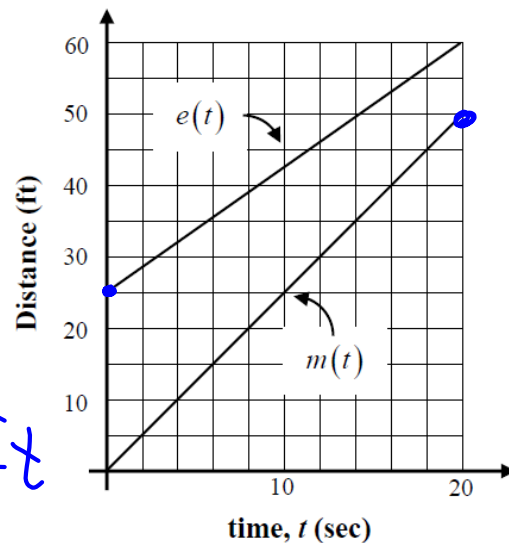
Max and his younger sister Evie are having a race in their backyard. Max gives his sister a head start and they run for 20 seconds. Max's distance, in feet, is given by  $m(t)$  and Evie's distance, in feet, is given by  $e(t)$ .

- (a) How much of a head start does Max give his sister?

25 ft

- (b) How far does Max run during the 20 second race? How far does Evie run?

Max = 50 feet  
Evie =  $60 - 25 = 35$  ft



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### Average Rate of Change for any Non-Linear Function

Finding the average rate of change is the same as finding the SLOPE of a line

For the function  $y = f(x)$ , the average rate that  $f(x)$  changes from  $x = a$  to  $x = b$  is given by:

$$\frac{f(b) - f(a)}{b - a} = \frac{y_2 - y_1}{x_2 - x_1}$$

Interval  
[a, b]  
Inequality  
 $a \leq x \leq b$

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## Average Rate of Change from an Equation

Given the function  $f(x) = x^2 + 3$ . Find its average rate of change from  $x = -1$  to  $x = 3$

$$f(-1) = (-1)^2 + 3$$

$$(-1, 4)$$

$$f(-1) = 1 + 3$$

$$f(-1) = 4$$

$$(3, 12)$$

$$f(3) = (3)^2 + 3$$

$$f(3) = 9 + 3$$

$$f(3) = 12$$

$$m = \frac{y_2 - y_1}{x_2 - x_1} \quad m = \frac{12 - 4}{3 - (-1)}$$

$$m = \frac{8}{4} = 2$$

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## Average Rate of Change from a Table

Find the average rate of change from  $x = 0$  to  $x = 2$

$$(0, 1) \quad (2, 9)$$

$$m = \frac{y_2 - y_1}{x_2 - x_1} \quad m = \frac{9 - 1}{2 - 0}$$

$$m = \frac{8}{2} = 4$$

Find the average rate of change over the interval  $1 \leq x \leq 3$

$$(1, 4) \quad (3, 16) \quad x=1 \quad x=3$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \frac{16 - 4}{3 - 1}$$

$$m = \frac{12}{2} = 6$$

x	f(x)
0	1
1	4
2	9
3	16

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## Average Rate of Change from a Graph

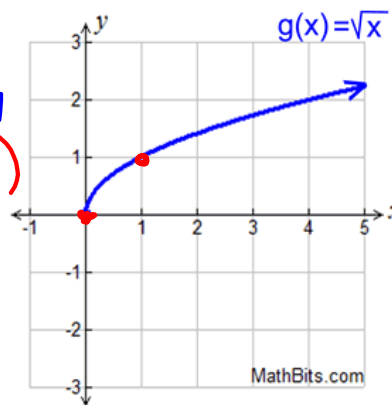
Find the average rate of change for the interval  $[0,1]$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \frac{1 - 0}{1 - 0} = 1$$

$$x=0 \quad x=1$$

$$(0,0) \quad (1,1)$$



Find the average rate of change for the interval  $[1,4]$

$$m = \frac{2 - 1}{4 - 1} = \frac{1}{3}$$

$$(1,1) \quad (4,2)$$

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## Average Rate of Change from an Equation

Find the average rate of change for the function

$f(x) = 1 + 4^x$  over the interval  $[0, 3]$

$$f(0) = 1 + 4^0$$

$$f(0) = 1 + 1$$

$$f(0) = 2$$

$$(0, 2)$$

$$f(3) = 1 + 4^3$$

$$f(3) = 1 + 64$$

$$f(3) = 65$$

$$(3, 65)$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\frac{65 - 2}{3 - 0} = \frac{63}{3} = 21$$

Dec 7-11:14 AM

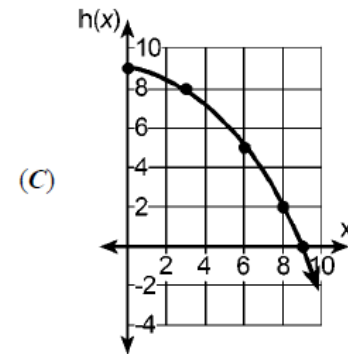
## Comparing Average Rate of Change

Given are three functions  $f(x)$ ,  $g(x)$  and  $h(x)$

(A)  $f(x) = -x^2 - 4$

(B)

$x$	$g(x)$
0	20
2	12
4	9
6	2



Arrange these three functions in increasing order from least to greatest in value for the average rate of change over the interval  $0 \leq x \leq 6$

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## Average Rate of Change Word Problem

A ball thrown in the air has a height of  $h(t) = -16t^2 + 50t + 3$  feet after  $t$  seconds.

- A) What are the units of measurement for the average rate of change of  $h$ ?

$$\frac{\Delta h(t)}{\Delta t} = \frac{\text{feet}}{\text{seconds}} = \text{feet per second}$$

- B) Find the average rate of change of  $h$  between  $t = 0$  and  $t = 2$

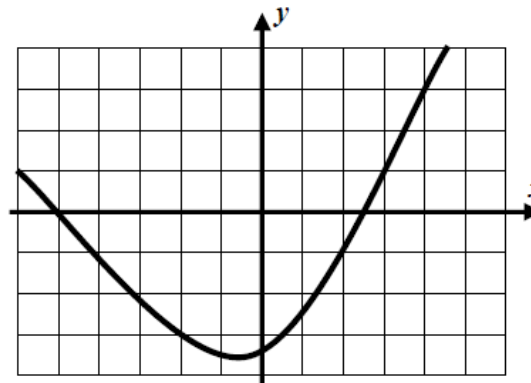
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Find the Average Rate of Change for each:

1) over the interval  $0 \leq x \leq 4$

$x$	$F(x)$
0	-3
1	-7
2	-7
3	-3
4	5

2) from  $x = -6$  to  $x = -2$



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3) Find the average rate of change for the function

$f(x) = x^2 + 2x - 1$  over the interval  $[-1, 2]$

Jan 21-11:47 AM