

Warm-Up:  
Find the difference quotient:  
 $\frac{f(x+h) - f(x)}{h}$

for each function:

a)  $f(x) = x^2 - 5x + 8$

$$\frac{(x+h)^2 - 5(x+h) + 8 - (x^2 - 5x + 8)}{h}$$

$$\frac{x^2 + 2xh + h^2 - 5x - 5h + 8 - x^2 + 5x - 8}{h}$$

$$\frac{2xh + h^2 - 5h}{h}$$

$$h + 2x - 5$$

b)  $f(x) = (2/x) + 5$

$$\frac{\frac{2}{x+h} + 5 - \left(\frac{2}{x} + 5\right)}{h}$$

$$\frac{\frac{2}{x+h} - \frac{2}{x}}{h}$$

$$\frac{\frac{2x - 2h}{x(x+h)}}{h} = \frac{-2h}{x(x+h)h}$$

$$= -\frac{2}{x(x+h)}$$

Oct 10-3:25 PM

### 3.4 Graphs & Transformations

Transformations -- shifting, stretching, or compressing a graph.

Vertical Shift  $f(x) + c$

- for  $c > 0$ , shift up  $c$  units
- for  $c < 0$ , shift down  $c$  units

ex)  $f(x) = x^2$ ,  $g(x) = x^2 + 5$  shift up 5  
 $h(x) = x^2 - 7$  shift down 7

Horizontal Shift  $f(x + c)$

- for  $c > 0$ , shift left  $c$  units
- for  $c < 0$ , shift right  $c$  units

ex)  $f(x) = x^2$ ,  $g(x) = (x-6)^2$  shift right 6  
 $h(x) = (x+8)^2$  shift left 8

Vertical Stretch/Compression  $c f(x)$

- for  $c > 1$ , stretch by a factor of  $c$
- for  $0 < c < 1$ , compress by a factor of  $1/c$

ex)  $f(x) = x^2$ ,  $g(x) = 7x^2$  vert. stretch by 7  
 $h(x) = 1/3 x^2$  vert. compress by 3

Reflections

- $-f(x)$  reflects the graph across the x-axis
- $f(-x)$  reflects the graph across the y-axis

ex)  $f(x) = x^2$ ,  $g(x) = -x^2$  reflect across x  
 $h(x) = (-x)^2$  reflect across y

Oct 10-3:26 PM

1) parent function:  $f(x) = \sqrt{x}$

write the rule of a function that will shift the graph left 4 units

$$g = \sqrt{x+4}$$


write a function that will vertically stretch by a factor of 2

$$g = 2\sqrt{x}$$

write a function that will reflect across the x-axis

$$g = -\sqrt{x}$$

write a function that will do all 3 above transformations

$$g(x) = -2\sqrt{x+4}$$


Oct 10-3:43 PM

2) If the parent is  $f(x) = x^3 + 5$ ,

Write a function that will shift vertically down 7, and reflect across the y-axis

$$g(x) = -x^3 - 2$$

$$x^3 + 5 - 7 \rightarrow x^3 - 2 \rightarrow (-x)^3 - 2$$

write a function that will shift horizontally right 4, then reflect across the x-axis

$$-[(x-4)^3 + 5]$$

$$-(x-4)^3 - 5$$

Oct 10-3:50 PM

3) Name the transformations from parent to child if  $f(x) = x^2 - x + 8$

$$g(x) = (x-3)^2 - (x-3) + 8$$

h. shift R+3

$$h(x) = 4x^2 - 4x + 32 = 4(x^2 - x + 8)$$

v. stretch by 4

$$j(x) = -2x^2 + 2x - 16$$

$$-2(x^2 - x + 8)$$

v. stretch by 2, Reflect x

$$k(x) = (x+1)^2 - (x+1) + 20$$

$$x^2 - x + 8$$

h. Left+1, v. up 12

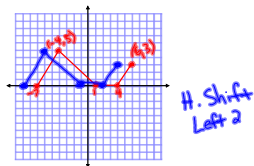
$$m(x) = x^2 - x$$

$$x^2 - x + 8$$

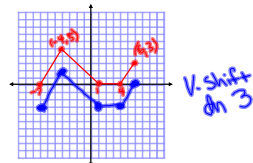
v. shift dn 8

Oct 10-3:52 PM

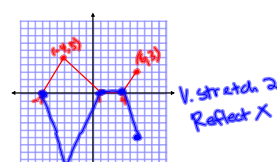
4) The graph of the parent  $f(x)$  is shown below. Sketch the graph of each transform.



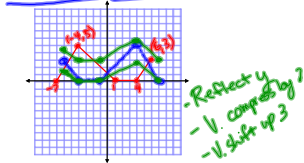
$$g(x) = f(x+2)$$



$$h(x) = f(x) - 3$$



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



$$\frac{1}{2}f(-x) + 3$$

HW: p 157 #8-28e

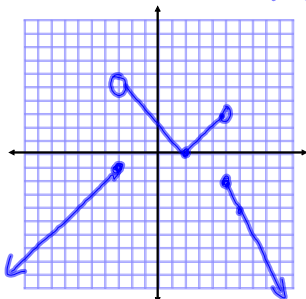
Oct 10-3:58 PM

Quiz Practice

Ex) Graph Piecewise Funct.

$$f(x) = \begin{cases} x+2, & x \leq -3 \\ |x-2|, & -3 < x < 5 \\ -2x+8, & x \geq 5 \end{cases}$$

$\rightarrow (-3, -1) m=1$   
 $\rightarrow (-3, 5) (5, 3) \& (2, 0)$   
 $\rightarrow (5, -2) m=-2$



Inc:  $(-\infty, -3)(2, 5)$   
 Dec:  $(-3, 2)(5, \infty)$

Oct 14-3:04 PM

Find Domain:

1)  $f(x) = 3 - \sqrt{8-2x}$

$$\sqrt{8-2x} \geq 0$$

$$8-2x \geq 0 \quad \leftarrow 4$$

$$-2x \geq -8$$

$$x \leq 4 \quad (-\infty, 4]$$

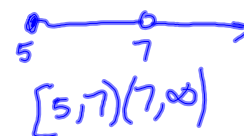
↑  
flip

2)  $g(x) = \frac{\sqrt{x-5}}{x^2-49}$

$$x^2-49 \neq 0 \quad \sqrt{x-5} \geq 0$$

$$x^2 \neq 49 \quad x-5 \geq 0$$

$$x \neq \pm 7 \quad x \geq 5$$



Oct 14-3:05 PM