Warm Up:

Graph the function, and evaluate at $x = 1$ and $x = 3$.

$$p(x) = \begin{cases} \frac{1}{2}x^2 + 2 & \text{if } x \le 2 \\ \frac{1}{2}x + 3 & \text{if } x > 2 \end{cases}$$

$\frac{1}{2}(1)^2 + 2$

$P(1) = 2.5$

$\frac{1}{2}(3) + 3$

$P(3) = 4.5$

9. The buffet is free for children under 3, \$2 for children between 3 and 8, \$5 for children between 8 and 18, and \$8 for adults.

Buffet Prices	
Price (\$)	Age (yr)
0	$0 < x < 3$
2	$3 \le x < 8$
5	$8 \le x < 18$
8	$x \ge 18$

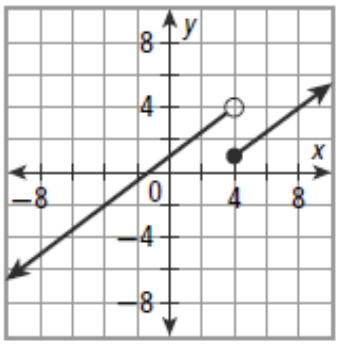
10. The average salary is \$45,000 for workers with less than 3 years' experience, \$55,000 for workers with 3 to 6 years' experience, \$68,000 for workers with 6 to 11 years' experience, and \$73,000 for workers with more than 11 years' experience.

Salaries in Technology	
Salary (thousand \$)	Experience (yr)
45	$0 \le x < 3$
55	$3 \le x < 6$
68	$6 \le x < 11$
73	$x \ge 11$

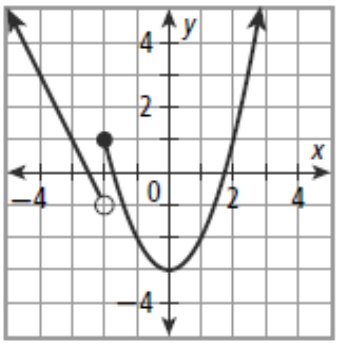
11. $g(-2) = (-2)^2 - 3 = 1$; $g(2) = 5$; $g(6) = 5$

12. $f(-2) = 12 - 9(-2) = 30$; $f(2) = 2^2 + 3(2) = 10$; $f(6) = 4^{(6)} = 4096$

13.



14.



16. $f(x) = \begin{cases} -5 & \text{if } x < -1 \\ -3x + 1 & \text{if } x \geq -1 \end{cases}$

17. $f(x) = \begin{cases} \frac{6}{5}x - 3 & \text{if } x < 5 \\ \frac{2}{5}x + 1 & \text{if } x \geq 5 \end{cases}$

18. $f(x) = \begin{cases} 2x + 5 & \text{if } x \leq -4 \\ 3 & \text{if } -4 \leq x \leq 4 \\ 2x - 3 & \text{if } x > 4 \end{cases}$

19. $f(x) = \begin{cases} 6 & \text{if } x \leq 4 \\ 6 + 3(x - 4) & \text{if } x > 4 \end{cases}$

21. $f(x) = \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{if } x < 0 \end{cases}$

22. $g(x) = \begin{cases} x - 4 & \text{if } x \geq 4 \\ -x + 4 & \text{if } x < 4 \end{cases}$

23. $h(x) = \begin{cases} 2x - 4 & \text{if } x \geq 0 \\ -2x - 4 & \text{if } x < 0 \end{cases}$

30a. \$400 plus 6% of the first \$5000 she sells, and an additional 9% for every dollar over \$5000 she sells.

b. $P(4000) = 400 + 0.06(4000) = \$640$

c. $P(5000) = 400 + 0.06(5000) = 700 < 900$, so Mary has to sell more than \$5000 worth of jewelry.

$$700 + 0.09(x - 5000) = 900$$
$$0.09(x - 5000) = 200$$
$$x - 5000 \approx 2222.22$$
$$x \approx 7222.22$$

Mary has to sell \$7222.22 worth of jewelry to earn \$900 in a week.

33. C

34. G;
$5(3) - 4 = 11 = 2(3) + 5$

35. B;
$f(-2) = 5 - (-2)^2 = 5 - 4 = 1$

9-3 Transforming Functions

Objectives

Transform functions.

Recognize transformations of functions.

9-3 Transforming Functions

In previous lessons, you learned how to transform several types of functions. You can transform piecewise functions by applying transformations to each piece independently. Recall the rules for transforming functions given in the table.

9-3 Transforming Functions

Transformations of $f(x)$	
Horizontal Translation	**Vertical Translation**
$f(x) \rightarrow f(x - h)$ left for $h < 0$ right for $h > 0$	$f(x) \rightarrow f(x) + k$ down for $k < 0$ up for $k > 0$
Reflection Across *y*-axis	**Reflection Across *x*-axis**
$f(x) \rightarrow f(-x)$ The graph is reflected across the *y*-axis.	$f(x) \rightarrow -f(x)$ The graph is reflected across the *x*-axis.
Horizontal Stretch/Compression	**Vertical Stretch/Compression**
$f(x) \rightarrow f\left(\frac{1}{b}x\right)$ stretch for $b > 1$ compression for $0 < b < 1$	$f(x) \rightarrow af(x)$ stretch for $a > 1$ compression for $0 < a < 1$

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9-3 Transforming Functions

Caution

Horizontal translations change both the rules and the intervals of piecewise functions. Vertical translations change only the rules.

Write the new functions. You only have to change the parameters if the function moves left or right...

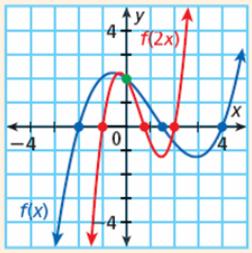
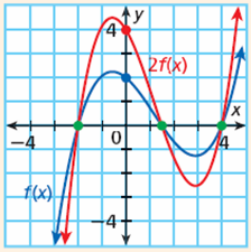
Given $f(x) = \begin{cases} -\frac{1}{2}x & \text{if } x < 0 \\ \frac{1}{2}x^2 & \text{if } x \geq 0 \end{cases}$ write the rule $g(x)$, a vertical stretch by a factor of 3.

$$g(x) = \begin{cases} -\frac{3}{2}x, & x < 0 \\ \frac{3}{2}x^2, & x \geq 0 \end{cases}$$

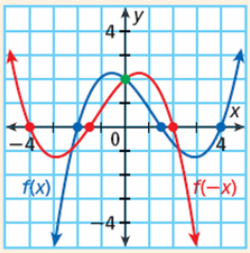
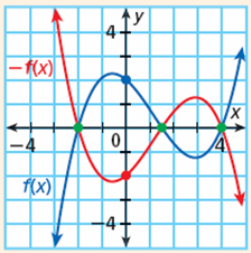
Given $f(x) = \begin{cases} x^2 & \text{if } x \leq 0 \\ x - 3 & \text{if } x > 0 \end{cases}$ write the rule for $g(x)$, a horizontal stretch of $f(x)$ by a factor of 2.

$$g(x) = \begin{cases} \left(\frac{1}{2}x\right)^2, & x \leq 0 \\ \frac{1}{2}x - 3, & x > 0 \end{cases}$$

9-3 Transforming Functions

Effects of Transformations on Intercepts of $f(x)$	
Horizontal Stretch or Compression by a Factor of b	Vertical Stretch or Compression by a Factor of a
	
x-intercepts are multiplied by b. y-intercept stays the same.	x-intercepts stay the same. y-intercept is multiplied by a.

9-3 Transforming Functions

Reflection Across y-axis	Reflection Across x-axis
	
x-intercepts are negated. y-intercept stays the same.	x-intercepts stay the same. y-intercept is negated.

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Identify the *x*- and *y*-intercepts of *f*(*x*). Without graphing *g*(*x*), identify its *x*- and *y*-intercepts.

$f(x) = -2x - 4$; $g(x) = f\left(\frac{1}{2}x\right)$

$y = -2x - 4$

$b = 2$

$-2 \cdot 2 = -4$ $(-4, 0)$

$(0, -4)$

$y = -2(0) - 4$

$y = -4$ $(0, -4)$

$0 = -2x - 4$

$4 = -2x$

$x = -2$ $(-2, 0)$

$f(x) = x^2 - 1$; $g(x) = f(-x)$

$y = x^2 - 1$

$(0, 1)$

$y = 0^2 - 1$

$y = -1$ $(0, -1)$

$(1, 0)(-1, 0)$

$0 = x^2 - 1$

$0 = (x - 1)(x + 1)$

$x = 1$ or -1

$(1, 0)$ $(-1, 0)$

Identify the *x*- and *y*-intercepts of $f(x)$. Without graphing $g(x)$, identify its *x*- and *y*-intercepts.

$f(x) = \frac{2}{3}x + 4$ and $g(x) = -f(x)$

$y = \frac{2}{3}x + 4$

$y = \frac{2}{3}(0) + 4$

$y = 4$ $(0, 4)$

$0 = \frac{2}{3}x + 4$

$-4 = \frac{2}{3}x$

$x = -6$ $(-6, 0)$

$(0, -4)$

$(-6, 0)$

$f(x) = x^2 - 9$ and $g(x) = \frac{1}{3} f(x)$

Given $f(x) = \frac{1}{3}(x-2)^2$ and $g(x) = 2f(x) - 3$ and graph $g(x)$.

V.S. by factor 2

Down 3

$y = \frac{1}{3}(x-2)^2$

$y = \frac{1}{3}(0-2)^2$

$y = \frac{1}{3}(-2)^2$

$y = \frac{4}{3}$ $(0, \frac{4}{3})$

~~$(0, \frac{8}{3})$~~

$(0, -\frac{1}{3})$

$0 = \frac{1}{3}(x-2)^2$

$(x-2)^2 = 0$

$x = 2$ $(2, 0)$

Given $f(x) = 2^x - 4$ and $g(x) = -\frac{1}{2}f(x)$, graph $g(x)$.

Homework:

p. 676 #8-18, 22, 25-26, 32-34