Transformations of Functions

$$f(x) \rightarrow af(x-h)+k$$

What does _a_ do?	**What does _h_ do?**	**What does _k_ do?**
• reflect across the x-axis. (–a) • vertical stretch ($|a|>1$) • vertical shrink ($0<|a|<1$)	• moves left (+h) • moves right (–h)	• moves up (+k) • moves down (–k)

Describe the transformations that are applied.

Function	a	h	k
1. $f(x-3)+5$	None, N/A	Right 3	Up 5
2. $-f(x)+3$	Reflect across the x-axis	None	Up 3
3. $f(x+2)-3$	None	Left 2	Down 3
4. $\frac{1}{3}f(x)-7$	V. shrink of $\frac{1}{3}$	None	Down 7
5. $-3f(x+1)+5$ Part 1 Part 2	Reflect across the x-axis V. Stretch of 3	Left 1	Up 5

Consider the function: $f(x) = 3x + 2$, and apply the following transformations. Write the new function.

6. f(x) + 3 $3x + 2 + 3$ = $\boxed{3x+5=g(x)}$

7. f(x) – 2 $3x + 2 - 2$ = $\boxed{3x = g(x)}$

8. shift down 4 $3x+2-4$ = $\boxed{3x-2=g(x)}$
   $f(x)-4$

Consider the function: $g(x) = (x-2)^2 + 1$, and apply the following transformations. Write the new function.
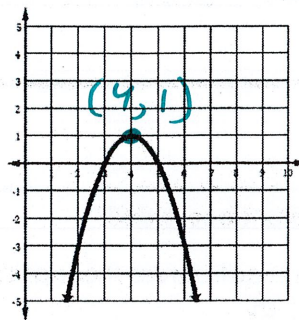
9. g(x) + 2 $(x-2)^2+1+2$ = $\boxed{(x-2)^2+3=h(x)}$

10. g(x – 2) $((x-2)-2)^2+1$ = $\boxed{(x-4)^2+1=h(x)}$

11. reflect over the x-axis and shift down 3 $-f(x)-3$ $-((x-2)^2+1)-3 = -(x-2)^2-1-3 = \boxed{-(x-2)^2-4}=h(x)$

12. shift right 1 and up 3 $f(x-1)+3$ $((x-1)-2)^2+1+3$ = $\boxed{(x-3)^2+4=h(x)}$

Given the graph of f(x) on the right, match the following three functions to their graphs.
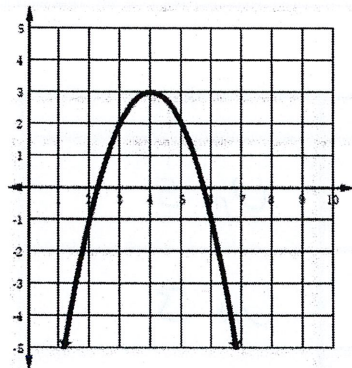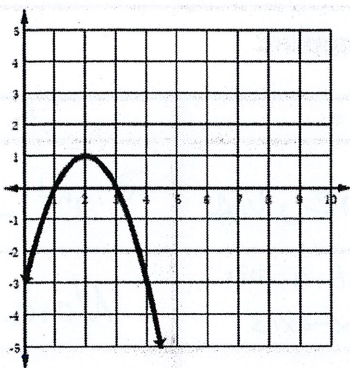
Down 2
13. $f(x) - 2$
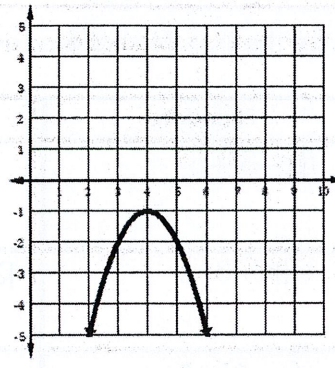
C

Up 2
14. $f(x) + 2$

A

Left
15. $f(x + 2)$

B

(4, 1)

A.

B.

C.

16. Which of the following functions represent a shift right 4 ad up 3?

A. $f(x + 4) - 3$ B. $f(x - 4) + 3$ C. $f(x - 4) - 3$ D. $f(x + 4) + 3$

17. Which of the following functions are reflected over the x-axis and shifted left 11?

A. $-f(x) - 11$ B. $-f(x) + 11$ C. $-f(x - 11)$ D. $-f(x + 11)$

18. Which of the following functions have been moved right 3 units?

A. $f(x) - 3$ B. $f(x) + 3$ C. $f(x - 3)$ D. $f(x + 3)$

19. Which of the following functions are reflected over the x-axis, shifted down 8, and left 9?

A. $-f(x - 8) + 9$ B. $-f(x + 9) - 8$ C. $-f(x - 8) - 9$ D. $-f(x - 9) - 8$