## Section 3.6 Solutions

\#1-56: let $f(x)=x^{2} \quad g(x)=\sqrt{x} \quad h(x)=|x| \quad k(x)=\sqrt[3]{x} \quad m(x)=x^{3}$
a) find the requested function
b) describe the transformation from the original function.
1a) $h(x+2)=|x+2|$
1b) shifts left 2
put +2 inside absolute value since it is inside the parenthesis
3a) $\mathrm{h}(\mathrm{x}+5)=|x+5| \quad$ 3b) shifts left 5
put +5 inside absolute value since it is inside the parenthesis
5a) $f(x+3)=(x+3)^{2}$
5b) shifts left 3 put +3 inside a parenthesis since it is inside the parenthesis
7a) $f(x+6)=(x+6)^{2}$
7b) shifts left 6
put +6 inside a parenthesis since it is inside the parenthesis
9a) $\mathrm{h}(\mathrm{x}-2)=|x-2|$
9b) shifts right 2
put -2 inside absolute value since it is inside the parenthesis
11a) $h(x-5)=|x-5| \quad 11 b)$ shifts right 5 put -5 inside absolute value since it is inside the parenthesis

13a) $\mathrm{g}(\mathrm{x}-3)=\sqrt{x-3}$
13b) shifts right 3
put -5 under the square root since it is inside the parenthesis
15a) $g(x-4)=\sqrt{x-4}$
15b) shifts right 4
put -4 under the square root since it is inside the parenthesis
17a) $f(x)+2=x^{2}+2$
17b) shifts up 2
the +2 goes after the $x^{2}$ since it is not in a parenthesis
19a) $\mathrm{g}(\mathrm{x})+5=\sqrt{x}+5$
19b) shifts up 5
the +5 goes after the square root since it is not in a parenthesis
21a) $h(x)-3=|x|-3 \quad$ 21b) shifts down 3 the -3 goes after the absolute value since it is not in a parenthesis

23a) $k(x)-6=\sqrt[3]{x}-6$
23b) shifts down 6
the -6 goes after the cubed root since it is not in a parenthesis
25a) $\mathrm{h}(\mathrm{x}+2)+1=|x+2|+1 \quad$ 25b) shifts left 2 , up 1
the +2 goes inside the absolute value since it is inside the parenthesis, the +1 goes after since it is not in the parenthesis

27a) $h(x+5)-1=|x+5|-1 \quad 27 b)$ shifts left 5 , down 1
the +5 goes inside the absolute value since it is inside the parenthesis, the -1 goes after since it is not in the parenthesis

29a) $g(x-2)+1=\sqrt{x-2}+1 \quad$ 29b) shifts right 2 up 1
put -2 under the square root since it is inside the parenthesis, the +1 goes after the square root since it is not in a parenthesis

31a) $g(x-5)-1=\sqrt{x-5}-1 \quad 31 b)$ shifts right 5 down 1
the -5 goes under the square root since it is inside the parenthesis, the -1 goes after since it is not in the parenthesis
33a) $-k(x)=-\sqrt[3]{x}$
33b) reflects over x-axis
the negative goes in front since it is not in the parenthesis

35a) $-\mathrm{h}(\mathrm{x})=-|x| \quad$ 35b) reflects over $x$-axis
the negative goes in front since it is not in the parenthesis
37a) $k(-x)=\sqrt[3]{-x} \quad 37 b)$ reflects over $y$-axis
the negative goes under the cubed root since it is inside the parenthesis
39a) $\mathrm{h}(-\mathrm{x})=|-x|$ or just $|x| \quad$ 39b) reflects over $y$-axis
the negative goes inside the absolute value since it is inside the parenthesis
41a) $\left.-f(x+2)+1=-(x+2)^{2}+1 \quad 41 b\right)$ reflects over $x$-axis, shifts left 2 and up 1
the negative goes in front of the parenthesis since it is not inside the parenthesis, the +2 belongs inside the parenthesis since it is in the parenthesis, the +1 goes after since it is not in the parenthesis

43a) $-f(x+5)-1=-(x+5)^{2}-1 \quad$ 43b) reflects over $x$-axis, shifts left 5 and down 1
the negative goes in front of the parenthesis since it is not inside the parenthesis, the +5 belongs inside the parenthesis since it is in the parenthesis, the -1 goes after since it is not in the parenthesis

45a) $-m(x-2)+1=-(x-2)^{3}+1 \quad$ 45b) reflects over $x$-axis, shifts right 2 , up 1
the negative goes in front of the parenthesis since it is not inside the parenthesis, the -2 belongs inside the parenthesis since it is in the parenthesis, the +1 goes after since it is not in the parenthesis

47a) $\left.-m(x-5)-1=-(x-5)^{3}-1 \quad 47 b\right)$ reflects over $x$-axis, shifts right 5 , down 1
the negative goes in front of the parenthesis since it is not inside the parenthesis, the -5 belongs inside the parenthesis since it is in the parenthesis, the -1 goes after since it is not in the parenthesis

49a) $2 f(x)=2 x^{2}$ 49b) stretches
the 2 goes in front since it is not in a parenthesis numbers greater than 1 multiplied by a function stretch the graph

53a) $\frac{1}{2} h(x)=\frac{1}{2}|x|$ 53b) compresses
the $1 / 2$ goes in front of the absolute value since it is not in the parenthesis

55a) $-\frac{1}{2} h(x)=-\frac{1}{2}|x| \quad$ 55b) reflects over x axis, and compresses
the $-1 / 2$ goes in front since it is not in the parenthesis
fractions between 0 and 1 compress, negative numbers reflect over $x$-axis
57) $f(x-2)$ (shift each point 2 to the right)

59) $f(x)-2$ shift each point down 2

61) $f(x-2)+1$ shift each point right 2 and up 1

63) $-f(x)$ reflect over $x$-axis by changing $y$-coordinate of each point

65) $f(x-1)$ shift each point to the right 1

67) $f(x)-1$ shift each point down 1

69) $f(x-1)+2$ shift each point 1 to the right and up 2

71) $f(-x)$ reflect over $y$-axis by changing the sign of each $x$

This will give you the original graph back. The original graph is symmetric to the $y$-axis, so reflecting the graph over the $y$-axis produces the original graph again.


