Graph Transformations

On this page, $d>0$ and $c>1$. $f(x)$ is a function whose graph we know.

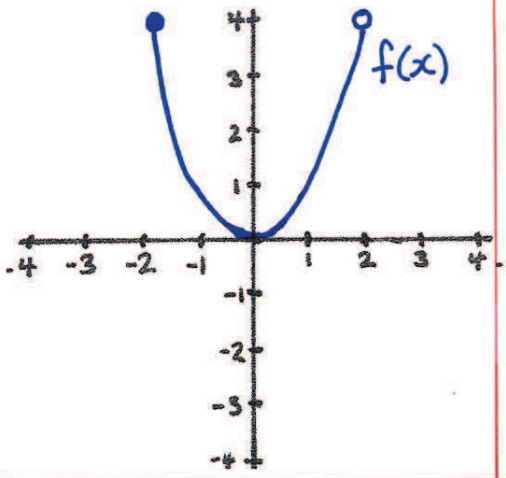
New function	How points in graph of $f(x)$ become points in graph of new function.	How the overall picture changes
$f(x)+d$	$(a,b) \longmapsto (a,b+d)$	shift up by d
$f(x)-d$	$(a,b) \longmapsto (a,b-d)$	shift down by d
$cf(x)$	$(a,b) \longmapsto (a,cb)$	stretch vertically by c
$\frac{1}{c}f(x)$	$(a,b) \longmapsto (a,\frac{b}{c})$	shrink vertically by c
$-f(x)$	$(a,b) \longmapsto (a,-b)$	flip over x-axis
change occurs "after f"	change occurs in second coordinate	change is vertical
change occurs "before f"	change occurs in first coordinate	change is horizontal
$f(x+d)$	$(a,b) \longmapsto (a-d,b)$	shift left by d
$f(x-d)$	$(a,b) \longmapsto (a+d,b)$	shift right by d
$f(cx)$	$(a,b) \longmapsto (\frac{a}{c},b)$	shrink horizontally by c
$f(\frac{x}{c})$	$(a,b) \longmapsto (ca,b)$	stretch horizontally by c
$f(-x)$	$(a,b) \longmapsto (-a,b)$	flip over y-axis

change in these columns may seem counterintuitive for this second grouping of five functions.

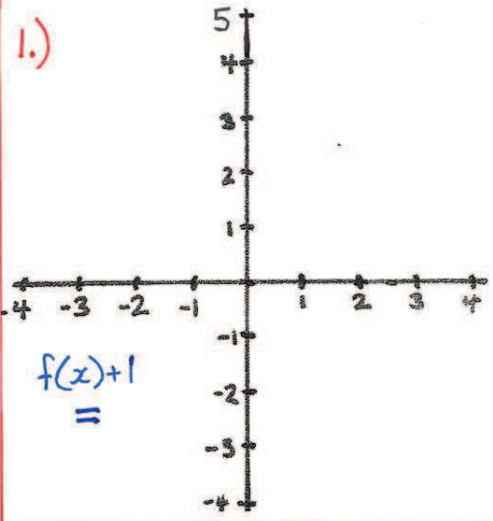
On this page,

$f: [-2, 2) \longrightarrow \mathbb{R}$

$f(x) = x^2$



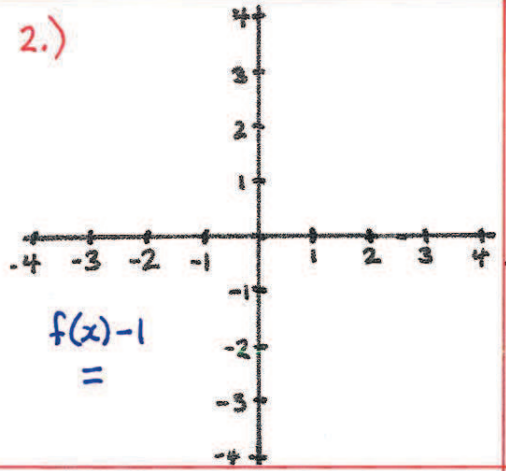
1.)



$f(x)+1$

$=$

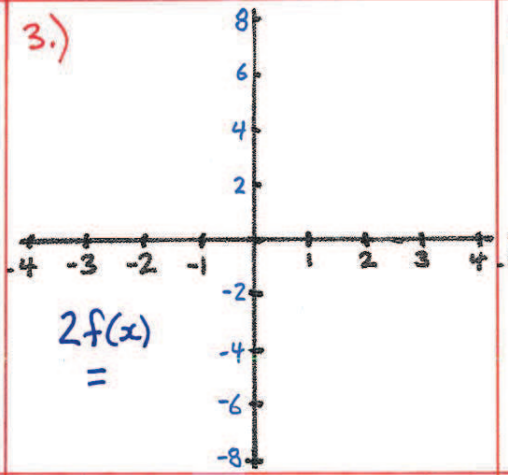
2.)



$f(x)-1$

$=$

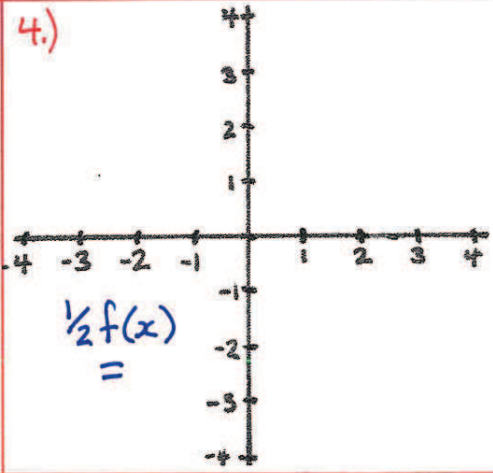
3.)



$2f(x)$

$=$

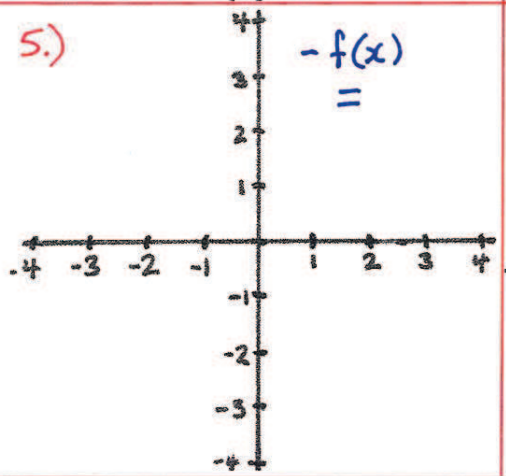
4.)



$\frac{1}{2}f(x)$

$=$

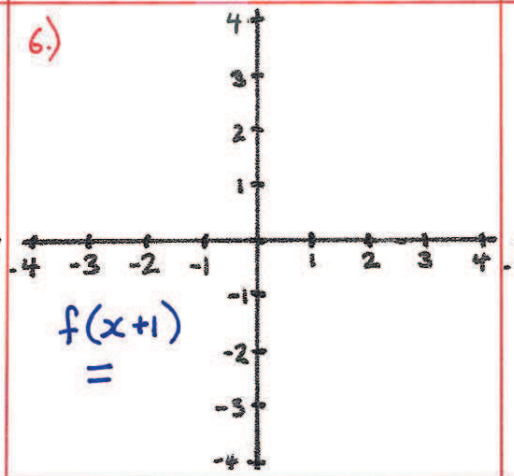
5.)



$-f(x)$

$=$

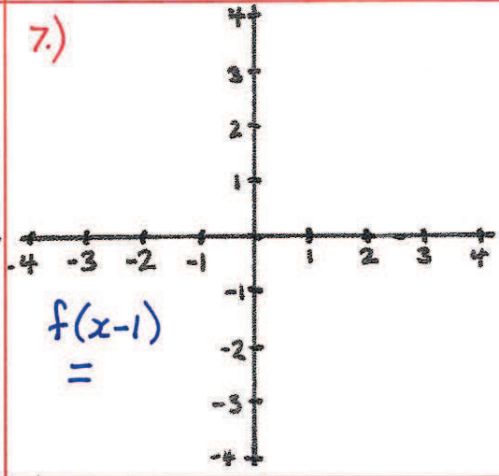
6.)



$f(x+1)$

$=$

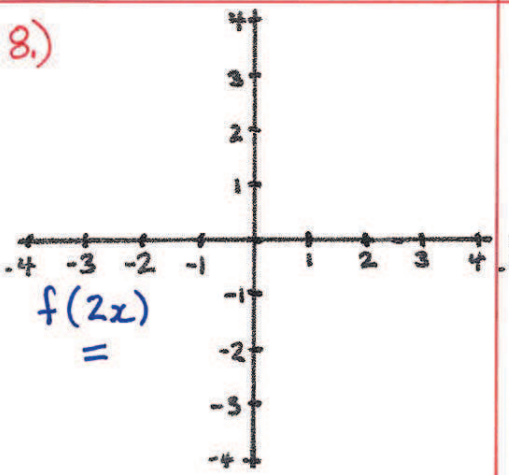
7.)



$f(x-1)$

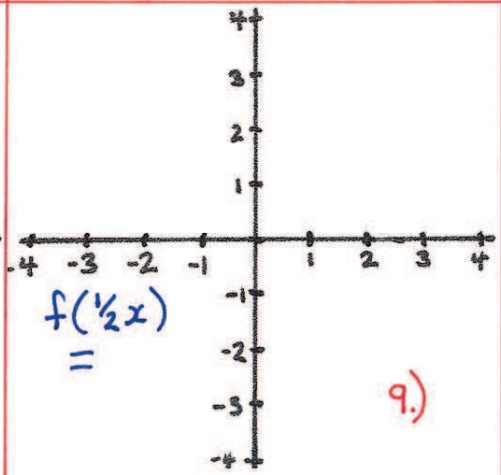
$=$

8.)



$f(2x)$

$=$

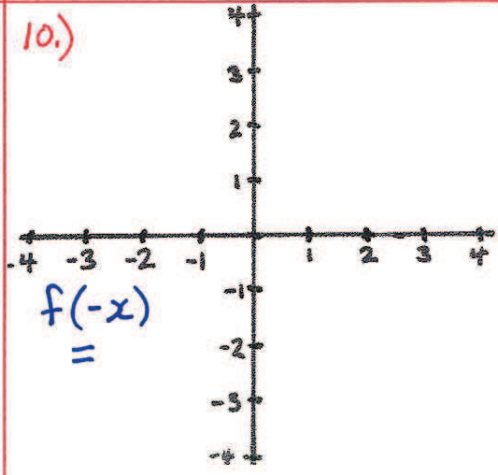


$f(\frac{1}{2}x)$

$=$

9.)

10.)



$f(-x)$

$=$