

Learning Targets:

Communicates clearly and explains reasoning. _____

Understands and applies the characteristics of a function. _____

For problems 1-2, complete the square to write the equation in vertex form. Show your work!

{1} $f(x) = x^2 - 8x + 12$

$$f(x) = x^2 - 8x + \frac{16}{1} + 12 - \frac{16}{1}$$

$$\left(\frac{b}{2}\right)^2 = \left(\frac{-8}{2}\right)^2 = (-4)^2 = 16$$

$$\boxed{f(x) = (x-4)^2 - 4}$$

vertex: (4, -4)

{2} $f(x) = \frac{4x^2}{4} + \frac{16x}{4} + \frac{8}{4}$

$$\frac{f(x)}{4} = x^2 + 4x + 2$$

$$\frac{f(x)}{4} = x^2 + 4x + \frac{4}{1} + 2 - \frac{4}{1}$$

$$\left(\frac{b}{2}\right)^2 = \left(\frac{4}{2}\right)^2 = (2)^2 = 4$$

$$\left(\frac{f(x)}{4} = (x+2)^2 - 2\right) \cdot 4 \Rightarrow \boxed{f(x) = 4(x+2)^2 - 8}$$

vertex: (-2, -8)

standard \rightarrow factored

(table $\frac{a \cdot c}{b}$ \downarrow backwards box when $a \neq 1$)

For problems 3-7, change the expression into factored form. Factor out any common factors.

$a=1$
 {3} $x^2 + 9x + 20$

$a \cdot c = 20$	$b = 9$
$1 \cdot 20$	$1 + 20 = 21$
$2 \cdot 10$	$2 + 10 = 12$
$4 \cdot 5$	$4 + 5 = 9$

$(x+4)(x+5)$

$a=1$
 {4} $x^2 - 8x + 7$

$a \cdot c = 7$	$b = -8$
$1 \cdot 7$	$1 + 7 = 8$
$-1 \cdot -7$	$-1 + -7 = -8$

$(x-1)(x-7)$

$a \neq 1$ factor out common factor = 3
 {5} $\frac{3x^2}{3} + \frac{6x}{3} + \frac{3}{3}$

$3(x^2 + 2x + 1)$

$a \cdot c = 1$	$b = 2$
$1 \cdot 1$	$1 + 1 = 2$

$3(x+1)(x+1)$
 or $3(x+1)^2$

$a \neq 1$ no common factor \ddagger
 {6} $3x^2 - 4x - 4$

$a \cdot c = -12$	$b = -4$
$1 \cdot -12$	$1 - 12 = -11$
$2 \cdot -6$	$2 - 6 = -4$
$3 \cdot -4$	$3 - 4 = -1$
$4 \cdot -3$	$4 - 3 = 1$
$6 \cdot -2$	$6 - 2 = 4$
$12 \cdot -1$	$12 - 1 = 11$

	$(3x+2)$		
x	$3x^2$	$2x$	$= (3x+2)(x-2)$
-2	$-6x$	-4	

$a \neq 1$ common factor = 3
 {7} $\frac{6x^2}{3} - \frac{21x}{3} - \frac{45}{3}$

$3(2x^2 - 7x - 15)$

$a \neq 1$

$a \cdot c = -30$	$b = -7$
$1 \cdot -30$	$1 - 30 = -29$
$2 \cdot -15$	$2 - 15 = -13$
$3 \cdot -10$	$3 - 10 = -7$

	$(2x+3)$		
x	$2x^2$	$3x$	$= (2x+3)(x-5)$
-5	$-10x$	-15	

+a opens up ↻

{8} From this equation in standard form, $f(x) = x^2 + 6x + 5$, find the indicated information:

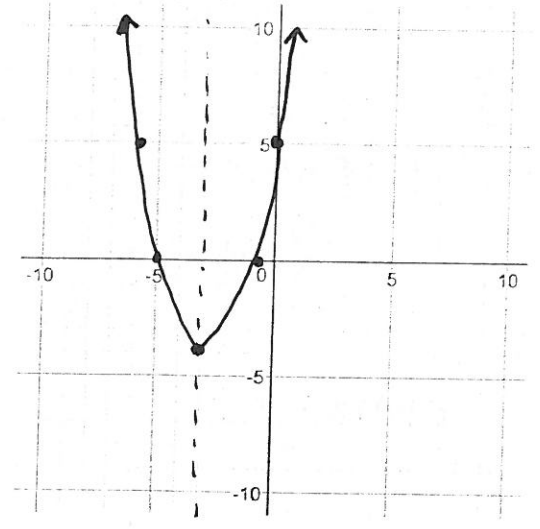
y-intercept: $y = 5$ or $(0, 5)$
(c)

Vertex Form: complete the square
 $f(x) = x^2 + 6x + 9 + 5 - 9$

$$\left(\frac{b}{2}\right)^2 = \left(\frac{6}{2}\right)^2 = (3)^2 = 9$$

$$f(x) = (x+3)^2 - 4$$

Draw the graph:



Axis of Symmetry: $x = -3$ (dashed line)
(x-coordinate of vertex)

Vertex: $(-3, -4)$

↑ remember to flip sign of x-value,

Factored Form: but not y-value
factor using table

$$\begin{array}{l|l} a \cdot c = 5 & b = 6 \\ \hline 1 \cdot 5 & 1 + 5 = 6 \end{array}$$

$$f(x) = (x+1)(x+5)$$

$$\begin{array}{l} x+1=0 \\ -1 \quad -1 \\ \hline x = -1 \end{array}$$

$$\begin{array}{l} x+5=0 \\ -5 \quad -5 \\ \hline x = -5 \end{array}$$

x-intercept(s): or $(-1, 0)$ and $(-5, 0)$

Make a table of 5 points:

x	y	
-6	5	mirrorpoint
-5	0	x-int
-3	-4	vertex
-1	0	x-int
0	5	y-int

{9} From this equation in factored form, $f(x) = (x - 6)(x + 4)$, find the indicated information:

$a=1$ so ↻
 $x-6=0$ → $+6 +6$ → $x=6$
 $x+4=0$ → $-4 -4$ → $x=-4$

x-intercept(s): $(6, 0)$ and $(-4, 0)$

Vertex Form: average the x-intercepts:

$\frac{6 + -4}{2} = \frac{2}{2} = 1$

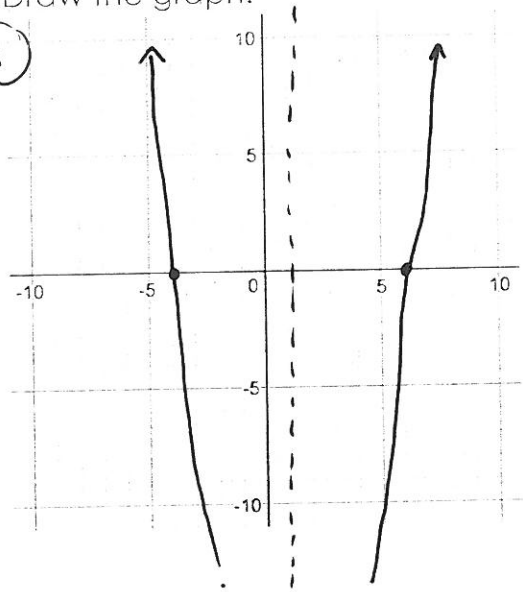
$f(1) = (1-6)(1+4)$
 $= (-5)(5)$
 $= -25$

this is the y-value of the vertex

this is the x-value of the vertex.

let's plug it in for x

Draw the graph:



Make a table of 5 points:

x	y	
-4	0	x-int
0	-24	y-int
1	-25	vertex
2	-24	mirror point
6	0	x-int

rewrite: $(a=1)$

$f(x) = (x - 1)^2 - 25$

remember to change the sign

Axis of Symmetry:

$x=1$

Vertex: $(1, -25)$ ← too low to graph! oops ☹

Standard Form: FOIL/BOX

$f(x) = (x - 6)(x + 4)$

$f(x) = x^2 + 4x - 6x - 24$

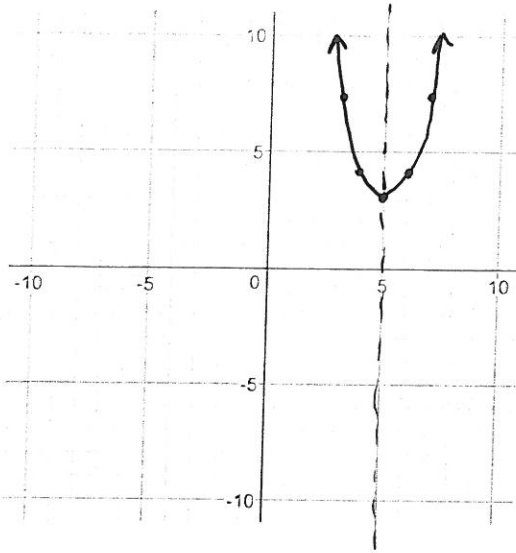
$f(x) = x^2 - 2x - 24$

* If you want, you can find standard form first and then complete the square to find vertex form

y-intercept: $(0, -24)$ or $y = -24$

For problems 10-11, graph the equation using at least two points on either side of the vertex, list the vertex and axis of symmetry, list how many x-intercepts the graph has, and describe the transformation(s) using complete sentences.

{10} $f(x) = (x - 5)^2 + 3$



x	y
3	3
4	4
5	3
6	4
7	3

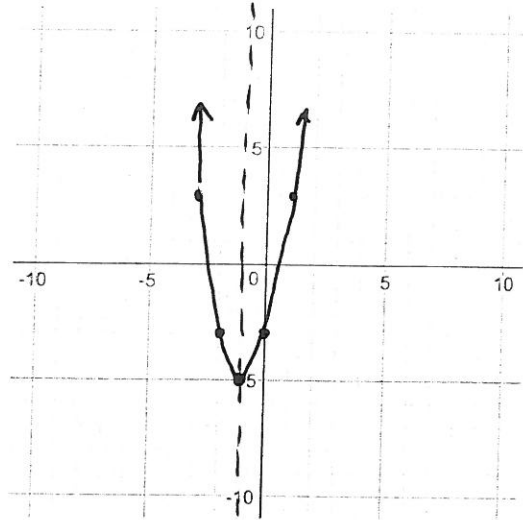
Vertex: $(5, 3)$

Axis of Symmetry: $x = 5$

of x-intercepts: 0

Transformations: move right 5
move up 3

{11} $f(x) = 2(x + 1)^2 - 5$



x	y
-3	3
-2	-3
-1	-5
0	-3
1	3

Vertex: $(-1, -5)$

Axis of Symmetry: $x = -1$

of x-intercepts: 2

Transformations: move left 1
move down 5
stretch vertically
by a factor of 2

For problem 12, identify the vertex and write the vertex-form equation of the parabola graphed.

{12} $f(x) = -1(x - 3)^2 + 6$

Vertex: $(3, 6)$

