

4.7 Transformations with Quadratic Equations
Honors Algebra 2

The Vertex Form of a quadratic function is $y = a(x-h)^2 + k$
 where (h, k) is the vertex of the parabola.
 Completing the Square can be used to write a quadratic function in vertex form.

Write each of the following quadratics in Vertex Form.

Find the vertex, x-intercepts and y-intercept of the graph of each parabola:

1. $y = x^2 - 4x - 21$

$$y = (x^2 - 4x) - 21$$

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

$$y = (x^2 - 4x + 4) - 21 - 4$$

↑
subtract 4
to balance!

$$y = (x - 2)^2 - 25$$

$$h = 2 \quad k = -25$$

$$(2, -25)$$

y-int:

$$y = (0 - 2)^2 - 25$$

$$= 4 - 25$$

$$= -21$$

$$(0, -21)$$

x-int:

$$0 = (x - 2)^2 - 25$$

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

$$\pm 5 = x - 2$$

$$2 \pm 5 = x$$

$$x = 7, -3$$

Vertex: $(2, -25)$ y-int: $(0, -21)$

X-int: $(7, 0)$ x-int: $(-3, 0)$

2. $y = \frac{1}{3}x^2 + 6x + 20$

$$y = \frac{1}{3}(x^2 + 18x) + 20$$

$$y = \frac{1}{3}(x^2 + 18x + 81) + 20 - 27$$

$$y = \frac{1}{3}(x + 9)^2 - 7$$

$$h = -9 \quad k = -7$$

$$(-9, -7)$$

y-int:

$$y = \frac{1}{3}(0 + 9)^2 - 7$$

$$= \frac{1}{3}(81) - 7$$

$$= 27 - 7$$

$$= 20$$

$$(0, 20)$$

x-int:

$$0 = \frac{1}{3}(x + 9)^2 - 7$$

$$7 = \frac{1}{3}(x + 9)^2$$

$$21 = (x + 9)^2$$

$$\pm\sqrt{21} = x + 9$$

$$-9 \pm \sqrt{21} = x$$

Vertex: $(-9, -7)$ y-int: $(0, 20)$

X-int: $(-9 + \sqrt{21}, 0)$ x-int: $(-9 - \sqrt{21}, 0)$

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3. $y = -\frac{1}{2}x^2 - 8x + 14$

$$y = -\frac{1}{2}(x^2 + 16x) + 14$$

$$y = -\frac{1}{2}(x^2 + 16x + 64) + 14 + 32$$

$$= -\frac{1}{2}(x+8)^2 + 46$$

$$(-8, 46)$$

y-int:

$$y = -\frac{1}{2}(0+8)^2 + 46$$

$$= -\frac{1}{2}(64) + 46$$

$$= -32 + 46$$

$$= 14$$

$$(0, 14)$$

x-int:

$$0 = -\frac{1}{2}(x+8)^2 + 46$$

$$-46 = -\frac{1}{2}(x+8)^2 \quad -8 \pm \sqrt{92} = x$$

$$92 = (x+8)^2 \quad -8 \pm 2\sqrt{23} = x$$

$$\pm\sqrt{92} = x + 8$$

Vertex: $(-8, 46)$ y-int: $(0, 14)$

X-int: $(-8+2\sqrt{23}, 0)$ x-int: $(-8-2\sqrt{23}, 0)$

4. $y = -x^2 + 7x + \frac{11}{4}$

$$y = -(x^2 - 7x) + \frac{11}{4}$$

$$y = -(x^2 - 7x + (\frac{7}{2})^2) + \frac{11}{4} + (\frac{7}{2})^2$$

$$y = -(x - \frac{7}{2})^2 + \frac{11}{4} + \frac{49}{4}$$

$$y = -(x - \frac{7}{2})^2 + \frac{60}{4}$$

$$y = -(x - \frac{7}{2})^2 + 15$$

$$(\frac{7}{2}, 15)$$

y-int:

$$y = -(0 - \frac{7}{2})^2 + 15$$

$$= -\frac{49}{4} + 15$$

$$= -\frac{49}{4} + \frac{60}{4}$$

$$= \frac{11}{4}$$

x-int:

$$0 = -(x - \frac{7}{2})^2 + 15$$

$$15 = (x - \frac{7}{2})^2$$

$$\pm\sqrt{15} = x - \frac{7}{2}$$

$$\frac{7}{2} \pm \sqrt{15} = x$$

Vertex: $(\frac{7}{2}, 15)$ y-int: $(0, \frac{11}{4})$

X-int: $(\frac{7}{2} + \sqrt{15}, 0)$ x-int: $(\frac{7}{2} - \sqrt{15}, 0)$

Ways to graph $y = ax^2 + bx + c$

1) change to vertex form

2) $x = -\frac{b}{2a}$ AoS

vertex: $(-\frac{b}{2a}, f(-\frac{b}{2a}))$

y-int and mirror

5. Graph the following functions:

a. $y = 4x^2 - 16x - 40$

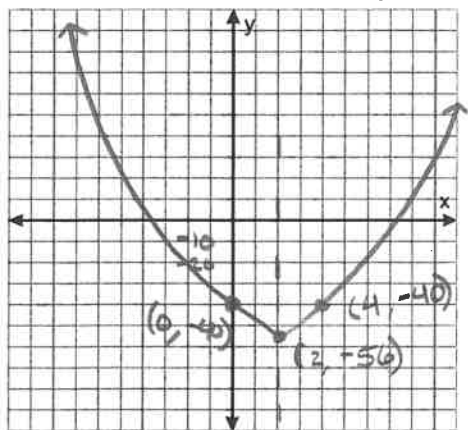
$y = 4(x^2 - 4x) - 40$

$y = 4(x^2 - 4x + 4) - 40 - 16$

$= 4(x - 2)^2 - 56$

$(2, -56)$

y-int = -40



$x = 2$ AoS

b. $y = (x - 3)^2 - 2$

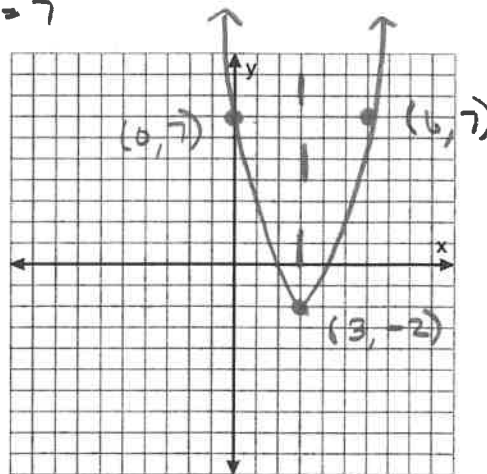
$(3, -2)$

y-int

$y = (0 - 3)^2 - 2$

$= 9 - 2$

$= 7$



c. $y = (x - 5)^2 + 3$

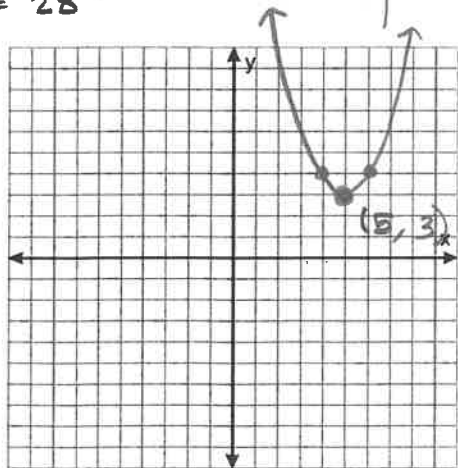
$(5, 3)$

y-int:

$y = (0 - 5)^2 + 3$

$= 28$

x	y
4	4



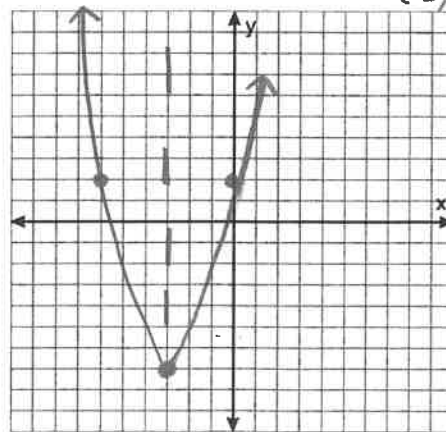
d. $y = x^2 + 6x + 2$

$y = (x^2 + 6x) + 2$

$y = (x^2 + 6x + 9) + 2 - 9$

$y = (x + 3)^2 - 7$

$(-3, -7)$



y-int = 2

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e. $y = -2x^2 + 8x - 5$

$$x = \frac{-b}{2a} = \frac{-8}{2(-2)} = \frac{-8}{-4} = 2$$

$f(2) = -2(2)^2 + 8(2) - 5$
 $= -8 + 16 - 5$
 $= 3$

vertex $(2, 3)$
 y -int $= -5$

f. $y = -3(x-5)^2 - 2$

vertex $(5, -2)$

y -int

$$y = -3(0-5)^2 - 2$$

$$= -75 - 2$$

$$= -77$$

x	y
4	-5

6. What is the equation of the graph shown:

$y = a(x-3)^2 + 2$

plug in $(-1, -2)$

$$-2 = a(-1-3)^2 + 2$$

$$-2 = 16a + 2$$

$$-4 = 16a$$

$$-\frac{4}{16} = a$$

7. What is the equation of the graph shown:

$y = a(x+3)^2 + 6$

$$2 = a(-5+3)^2 + 6$$

$$-4 = 4a$$

$$-1 = a$$

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

$- \frac{1}{4} = a$

$$y = -\frac{1}{4}(x-3)^2 + 2$$