

Linear Equation: equations with an exponent of one. Graphs are lines.

Standard Form $y = mx + b$

Quadratic Equations: equations with an exponent of two (squared). Graphs are parabolas.

Standard Form $y = ax^2 + bx + c$

(U-shaped)



Opening up

positive a



Opening down (flipped)

negative a

Write the quadratic equation in standard form and determine if the graph opens up or down.

1.) $y = 2x^2 + x - 1$

UP

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

$y = -x^2 - x - 3$

DOWN

3.) $y = -3x^2 + 1 - 4x$

$y = -3x^2 - 4x + 1$

DOWN

4.) $y = 4 - 3x^2$

$y = -3x^2 + 4$

DOWN

5.) $y = x + 9x^2$

$y = 9x^2 + x$

UP

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

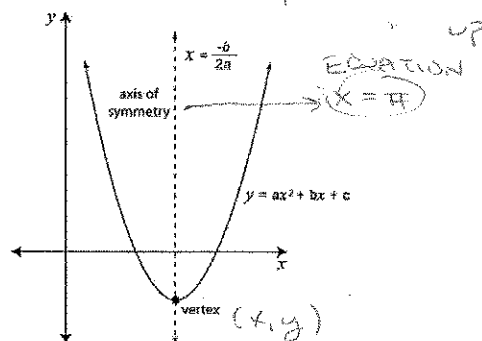
$y = 8x^2 - 3x + 2$

UP

Vertex: the lowest or the highest point of the graph

(end of U-shape)

Axis of Symmetry: the vertical line through the vertex



Axis of Symmetry and x-coordinate of the vertex

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

$-\frac{b}{2a}$

Find the axis of symmetry of the parabola.

7.) $y = 2x^2 + 4x - 1$

$x = -\frac{b}{2a} = -\frac{4}{2 \cdot 2} = -1$

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

$x = -\frac{b}{2a} = -\frac{2}{2 \cdot (-1)} = -\frac{2}{-2} = 1$

9.) $y = 3x^2 - 5$

$y = 3x^2 + 0x - 5$

$x = -\frac{b}{2a} = -\frac{0}{2 \cdot 3} = -\frac{0}{6} = 0$

$x = -1$

$x = 1$

$x = 0$

Find the vertex of the parabola. Find x using formula and then plug it back into equation to find y.

10.) $y = x^2 + 2x - 1$

$x = -\frac{b}{2a} = -\frac{2}{2 \cdot 1} = -\frac{2}{2} = -1$

$y = (-1)^2 + 2(-1) - 1$

$y = 1 - 2 - 1$

$y = -2$ $(-1, -2)$

11.) $y = -x^2 + 4$

$y = -x^2 + 0x + 4$

$x = -\frac{b}{2a} = -\frac{0}{2 \cdot (-1)} = -\frac{0}{-2} = 0$

$y = -(0)^2 + 4$

$y = 4$ $(0, 4)$

12.) $y = 2x^2 + 4x$

$x = -\frac{b}{2a} = -\frac{4}{2 \cdot 2} = -\frac{4}{4} = -1$

$y = 2(-1)^2 + 4(-1)$

$y = 2 - 4$

$(-1, -2)$

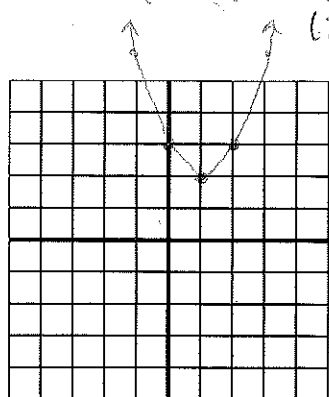
Graph the following quadratic equations. Find the axis of symmetry and the vertex.

13. $y = x^2 - 2x + 3$

$x = 1$

Vertex: $(1, 2)$

Point: $(0, 3)$ $(2, 3)$

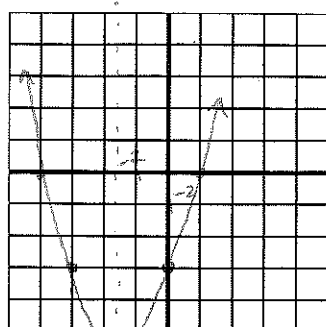


~~14.~~ $y = x^2 + 5x - 6$

$x = -2.5$

Vertex: $(-2.5, -12.25)$

Point: $(0, -6)$
 $(1, 0)$

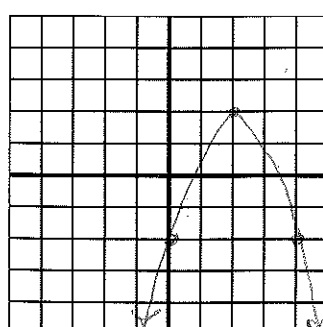


15. $y = -x^2 + 4x - 2$

$x = 2$

Vertex: $(2, 2)$

Point: $(0, -2)$
 $(1, 1)$ $(3, 1)$



Standard Form: Practice Problems: pg 253 #20-25 #17-19

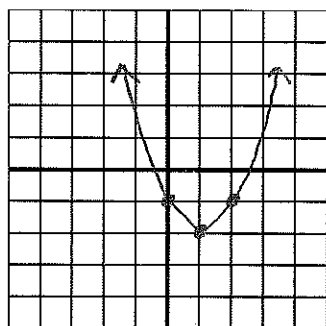
(17)C (18)A (19)B

20.) $y = x^2 - 2x - 1$

$x = 1$

Vertex: $(1, -2)$

Point: $(0, -1)$ $(2, -1)$

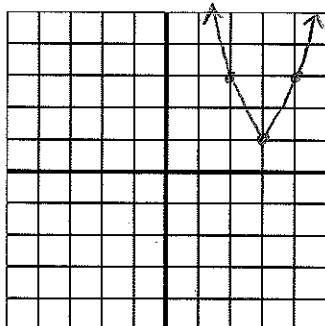


21.) $y = 2x^2 - 12x + 19$

$x = 3$

Vertex: $(3, 1)$

Point: $(2, 3)$ $(4, 3)$

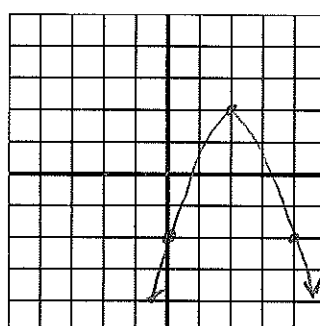


22.) $y = -x^2 + 4x - 2$

$x = 2$

Vertex: $(2, 2)$

Point: $(0, -2)$

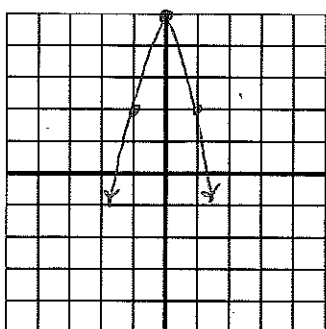


23.) $y = -3x^2 + 5$

$x = 0$

Vertex: $(0, 5)$

Point: $(1, 2)$ $(-1, 2)$

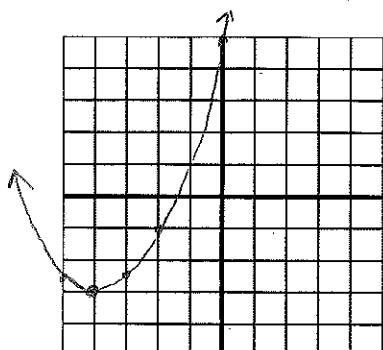


24.) $y = \frac{1}{2}x^2 + 4x + 5$

$x = -4$

Vertex: $(-4, -3)$

Point: $(-3, -2.5)$
 $(-5, -2.5)$

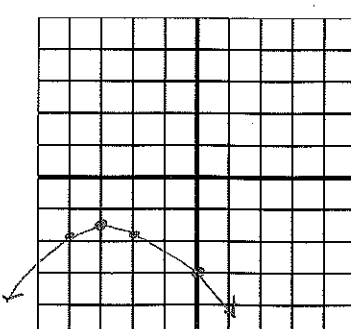


25.) $y = -\frac{1}{6}x^2 - x - 3$

$x = -3$

Vertex: $(-3, -1.5)$

Point: $(-4, -1\frac{2}{3})$
 $(-2, -1\frac{2}{3})$



Vertex Form

$$y = a(x - h)^2 + k$$



Opening up

positive a

Opening down (flipped)

negative a

Determine if the graph opens up or down.

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

 $a = 1$ UP

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

UP

3.) $y = -2(x - 1)^2$

DOWN

Axis of Symmetry and x-coordinate of the vertex

$x = h$

Intercept Form Vertex: (h, k)

Find the axis of symmetry of the parabola.

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

$x = 5$

5.) $y = -4(x)^2 - 5$

$y = -4(x - 0)^2 - 5$

$x = 0$

6.) $y = 7(x + 9)^2 + 2$

$y = 7(x - (-9))^2 + 2$

$x = -9$

Find the vertex of the parabola (h, k) .

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

$(3, 3)$

8.) $y = \frac{1}{2}(x - 6)^2 + 0$

$(6, 0)$

9.) $y = (x + 1)^2 - 7$

$(-1, -7)$

Graph the following quadratic equations. Find the axis of symmetry and the vertex.

10. $y = (x - 2)^2 + 1$

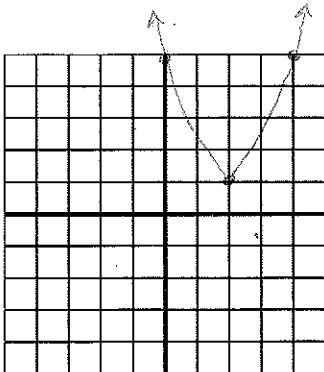
$x = 2$

Vertex: $(2, 1)$

Point: $(0, 5)$ $(1, 2)$

$(3, 2)$

$y = (0 - 2)^2 + 1$
 $y = 4 + 1$
 $y = 5$



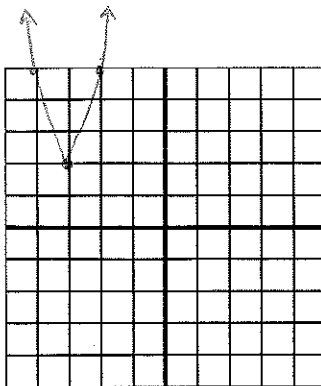
11. $y = 3(x + 3)^2 + 2$

$x = -3$

Vertex: $(-3, 2)$

Point: $(-1, 5)$ $(-2, 5)$

$(-4, 5)$



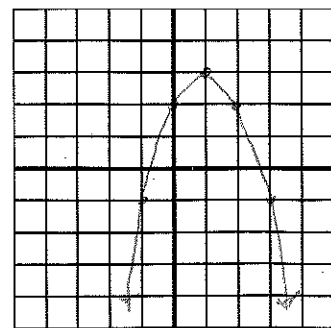
12. $y = -(x - 1)^2 + 3$

$x = 1$

Vertex: $(1, 3)$

Point: $(0, 2)$ $(2, 2)$

$(1, 4)$



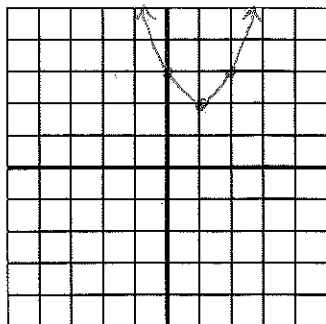
Vertex Form: Practice Problems: pg 253 #26-31

26.) $y = (x - 1)^2 + 2$

$x = 1$

Vertex: $(1, 2)$

Point: $(0, 3)$ $(2, 3)$

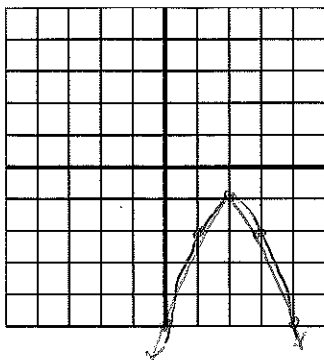


27.) $y = -(x - 2)^2 - 1$

$x = 2$

Vertex: $(2, -1)$

Point: $(0, -5)$
 $(1, -2)$ $(3, -2)$

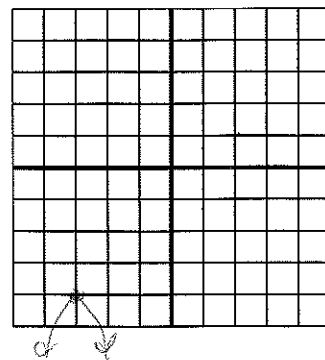


28.) $y = -2(x + 3)^2 - 4$

$x = -3$

Vertex: $(-3, -4)$

Point: $(-2, -6)$
 $(-4, -6)$

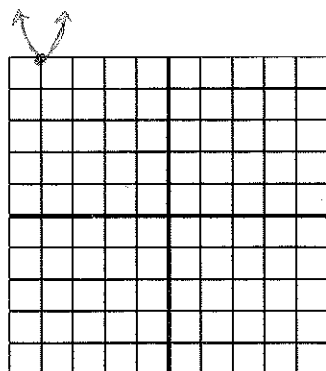


29.) $y = 3(x + 4)^2 + 5$

$x = -4$

Vertex: $(-4, 5)$

Point: $(-3, 8)$, $(-5, 8)$

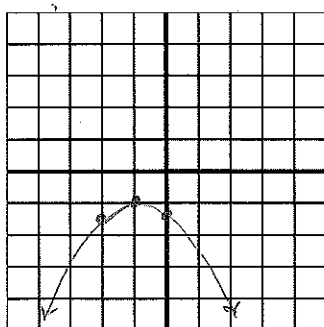


30.) $y = -1/3(x + 1)^2 - 1$

$x = -1$

Vertex: $(-1, -1)$

Point: $(0, -1 1/3)$
 $(-2, -1 1/3)$

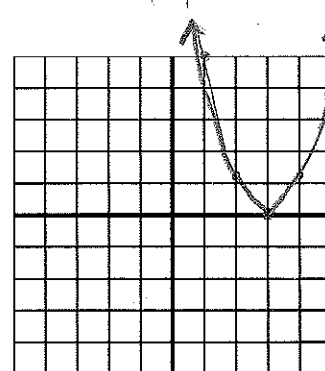


31.) $y = 5/4(x - 3)^2 + 0$

$x = 3$

Vertex: $(3, 0)$

Point: $(2, 1 1/4)$
 $(4, 1 1/4)$



Intercept Form $y = a(x - p)(x - q)$ $\rightarrow p$ and q are the x -intercepts

Opening up positive a

Opening down (flipped) negative a

Determine if the graph opens up or down.

1.) $y = (x - 2)(x + 3)$

$a = 1$
up

$(p = 2, q = -3)$

2.) $y = -2(x - 1)(x - 4)$

down

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

up

$$y = a(x-p)(x-q)$$

Axis of Symmetry and x-coordinate of the vertex

x is half way between p and q

$$x = \frac{p+q}{2} \rightarrow \text{write on flipchart}$$

Find the axis of symmetry of the parabola.

4.) $y = -2(x-1)(x-5)$

$p = 1 \quad q = 5$

$$x = \frac{1+5}{2} = \frac{6}{2} = 3$$

$x = 3$

5.) $y = 3(x+2)(x-4)$

$p = -2 \quad q = 4$

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

$x = 1$

6.) $y = -x(x+5)$

$y = (-x-0)(x+5)$

$p = 0 \quad q = 5$

$$x = \frac{0+5}{2} = \frac{5}{2}$$

$x = \frac{5}{2}$

Find the vertex of the parabola. Find x by counting half way between p and q. Find y by plugging x into the given equation.

7.) $y = (x+5)(x-3)$

$p = -5 \quad q = 3$

$$x = \frac{-5+3}{2} = \frac{-2}{2} = -1$$

$x = -1$

$y: (-1, -16)$

8.) $y = -4(x+1)(x-1)$

$p = -1 \quad q = 1$

$$x = \frac{-1+1}{2} = \frac{0}{2} = 0$$

$x = 0$

$y: (0, 4)$

9.) $y = 3(x-6)(x-4)$

$p = 6 \quad q = 4$

$$x = \frac{6+4}{2} = \frac{10}{2} = 5$$

$x = 5$

$y: (5, -3)$

Graph the following quadratic equations. Find the axis of symmetry and the vertex.

10.) $y = -2(x+2)(x-4)$

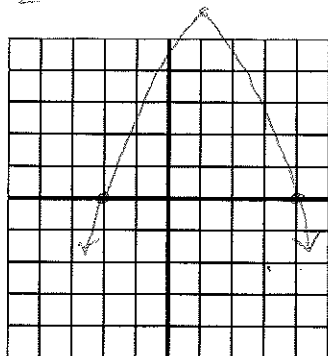
$x = 1$

Vertex: $(1, 18)$

Point: $(-2, 0) (4, 0)$

$p = -2 \quad q = 4$

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



11.) $y = -x(x+2) \quad y = -(x-0)(x+2)$

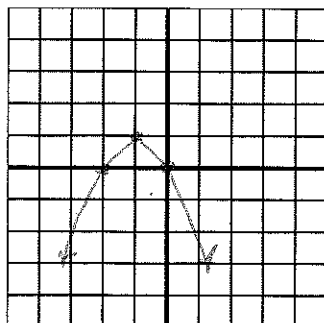
$x = -1$

Vertex: $(-1, 1)$

Point: $(0, 0) (-2, 0)$

$p = 0 \quad q = -2$

$$x = \frac{0-2}{2} = \frac{-2}{2} = -1$$



12.) $y = (x+3)(x-3)$

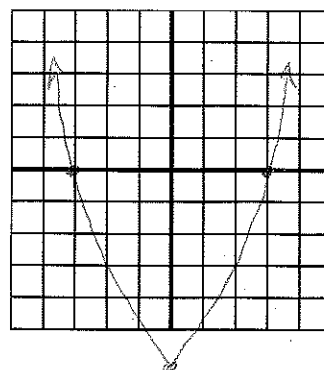
$x = 0$

Vertex: $(0, -9)$

Point: $(-3, 0) (3, 0)$

$p = -3 \quad q = 3$

$$x = \frac{-3+3}{2} = \frac{0}{2} = 0$$



Intercept Form: Practice Problems: pg 254 #32 - 37

$$\frac{-3 \pm -5}{2} = \frac{-8}{2} = -4$$

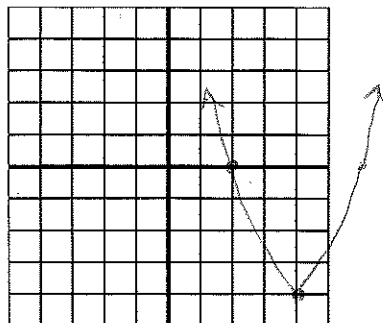
32.) $y = (x - 2)(x - 6)$

$x = 4$

Vertex: $(4, -4)$

Point: $(2, 0)$ $(6, 0)$

$p = 2 \quad q = 6$



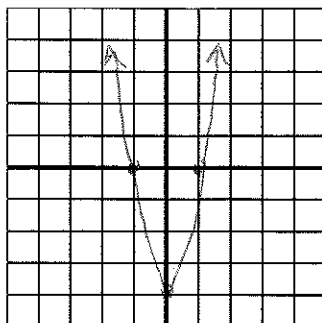
33.) $y = 4(x + 1)(x - 1)$

$x = 0$

Vertex: $(0, -4)$

Point: $(-1, 0)$ $(1, 0)$

$p = -1 \quad q = 1$

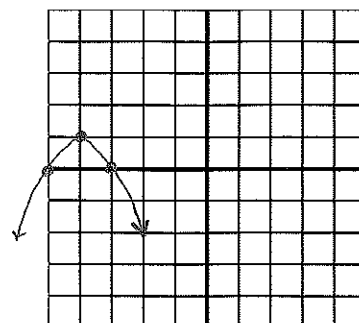


34.) $y = -(x + 3)(x + 5)$

$x = -4$

Vertex: $(-4, 1)$

Point: $(-3, 0)$ $(-5, 0)$



$$\frac{-4 \pm -1}{2}$$

35.) $y = 1/3(x + 4)(x + 1)$

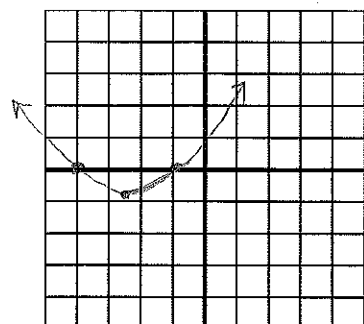
$x = -5/2$

Vertex: $(-5/2, -3/4)$

Point: $(-4, 0)$ $(-1, 0)$

$$\frac{1}{3}(-2.5 \pm -1)(-2.5 \pm -1)$$

$$\frac{1}{3}(1.5)(-1.5) = \frac{1}{3} \cdot \frac{3}{2} \cdot \frac{3}{2} = \frac{1 \cdot 9}{12} = -\frac{3}{4}$$



$$\frac{3 \pm -2}{2} = \frac{1}{2}$$

36.) $y = -1/2(x - 3)(x + 2)$

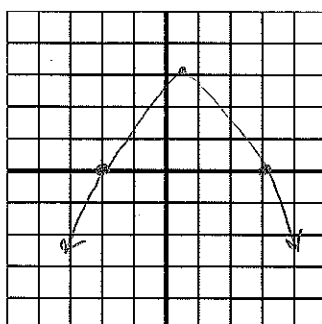
$x = 1/2$

Vertex: $(1/2, 3/8)$

Point: $(3, 0)$ $(-2, 0)$

$$-\frac{1}{2}(\frac{1}{2} - 3)(\frac{1}{2} + 2)$$

$$-\frac{1}{2}(-2.5)(2.5) = -\frac{1}{2} \cdot -\frac{5}{2} \cdot \frac{5}{2} = \frac{25}{8}$$



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

37.) $y = -3x(x - 2)$

$x = 1$

Vertex: $(1, 3)$

Point: $(0, 0)$ $(2, 0)$

