

Parabolas (up and Down)

$$y = a(x-h)^2 + k \quad (\text{equation: vertex form})$$

Vertex (h, k)

axis of
Symmetry: $x = h$

Focus: $(h, k + \frac{1}{4a})$

Directrix: $y = k - \frac{1}{4a}$

Direction: $a > 0$ $\uparrow\uparrow$

$a < 0$ $\downarrow\downarrow$

Notes Parabolas (Opening up and down)

Use the information provided to write the vertex form equation of each parabola.

1) Vertex: $(-8, -9)$, Focus: $(-8, -10)$

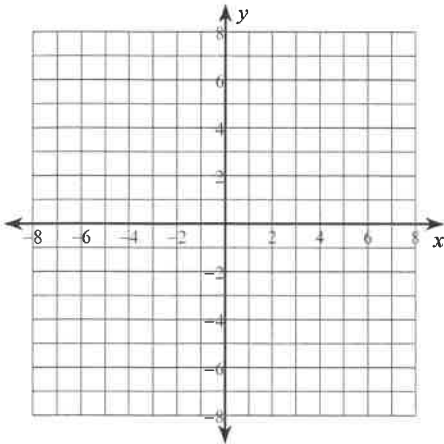
2) Vertex: $(8, -1)$, Focus: $(8, -\frac{5}{4})$

3) Vertex: $(-1, 4)$, Focus: $(-1, 5)$

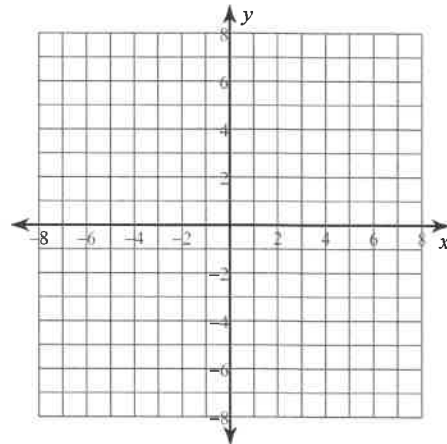
4) Vertex: $(8, 7)$, Focus: $(8, \frac{57}{8})$

Identify the vertex, focus, axis of symmetry, and directrix of each. Then sketch the graph.

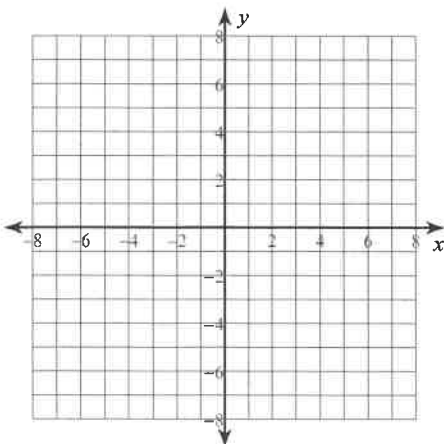
5) $x^2 + 6x + 3y + 9 = 0$



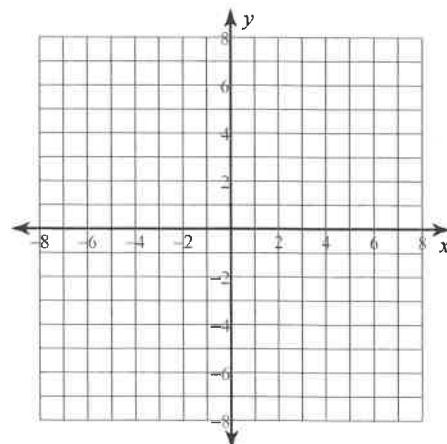
6) $x^2 - 4x + y + 8 = 0$



7) $-x^2 - 8x + y - 11 = 0$



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



Notes Parabolas (Opening up and down)

Use the information provided to write the vertex form equation of each parabola.

1) Vertex: $(-8, -9)$, Focus: $(-8, -10)$

$$y = -\frac{1}{4}(x + 8)^2 - 9$$

2) Vertex: $(8, -1)$, Focus: $(8, -\frac{5}{4})$

$$y = -(x - 8)^2 - 1$$

3) Vertex: $(-1, 4)$, Focus: $(-1, 5)$

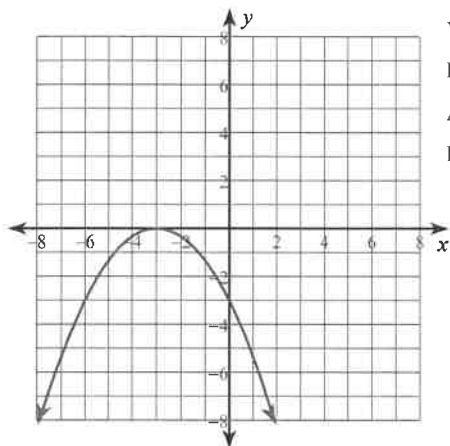
$$y = \frac{1}{4}(x + 1)^2 + 4$$

4) Vertex: $(8, 7)$, Focus: $(8, \frac{57}{8})$

$$y = 2(x - 8)^2 + 7$$

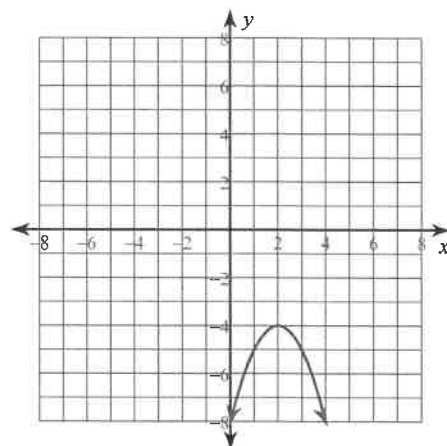
Identify the vertex, focus, axis of symmetry, and directrix of each. Then sketch the graph.

5) $x^2 + 6x + 3y + 9 = 0$



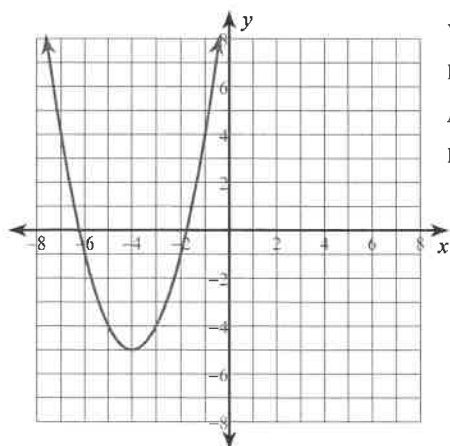
Vertex: $(-3, 0)$
 Focus: $(-3, -\frac{3}{4})$
 Axis of Sym.: $x = -3$
 Directrix: $y = \frac{3}{4}$

6) $x^2 - 4x + y + 8 = 0$



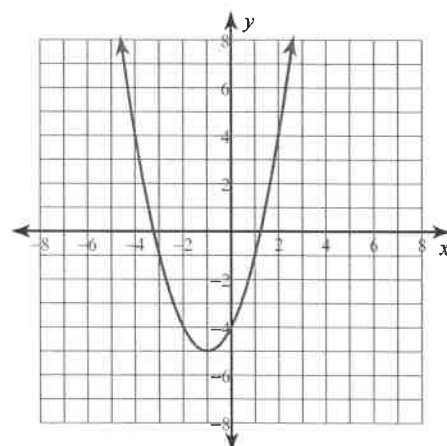
Vertex: $(2, -4)$
 Focus: $(2, -\frac{17}{4})$
 Axis of Sym.: $x = 2$
 Directrix: $y = -\frac{15}{4}$

7) $-x^2 - 8x + y - 11 = 0$



Vertex: $(-4, -5)$
 Focus: $(-4, -\frac{19}{4})$
 Axis of Sym.: $x = -4$
 Directrix: $y = -\frac{21}{4}$

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



Vertex: $(-1, -5)$
 Focus: $(-1, -\frac{19}{4})$
 Axis of Sym.: $x = -1$
 Directrix: $y = -\frac{21}{4}$

Notes: Parabola (Opens Up and Down)

How to get the answers on the Notes

1. Vertex $(-8, -9)$ (h, k)

Focus $(-8, -10)$ $(h, k + \frac{1}{4}a)$

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

$$y = a(x - -8)^2 - 9$$

$$y = -\frac{1}{4}(x+8)^2 - 9$$

$$k + \frac{1}{4}a = -10$$

$$-9 + \frac{1}{4}a = -10$$

$$+9 \quad +9$$
$$\frac{1}{4}a = -1$$

$$\frac{1}{4a} = \frac{-1}{1} \quad \text{cross multiply}$$

$$-4a = 1$$

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

2. V $(8, -1)$ (h, k)

F $(8, -\frac{5}{4})$ $(h, k + \frac{1}{4}a)$

$$y = a(x-8)^2 - 1$$

$$y = -1(x-8)^2 - 1$$

$$k + \frac{1}{4}a = -\frac{5}{4}$$

$$-1 + \frac{1}{4}a = -\frac{5}{4}$$

$$+1 \quad +1$$

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

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

$$-4a = 4$$

$$a = -1$$

3. V $(-1, 4)$ (h, k)

F $(-1, 5)$ $(h, k + \frac{1}{4}a)$

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

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

$$k + \frac{1}{4}a = 5$$

$$4 + \frac{1}{4}a = 5$$

$$-4 \quad -4$$

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

$$\frac{1}{4a} = \frac{1}{1} \quad \text{cross multiply}$$

$$4a = 1$$

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

$$4. \quad V(8, 7)$$

$$F(8, \frac{57}{8})$$

$$y = a(x-8)^2 + 7$$

$$y = 2(x-8)^2 + 7$$

$$k + \frac{1}{4a} = \frac{57}{8}$$

$$7 + \frac{1}{4a} = \frac{57}{8}$$

$$\frac{1}{4a} = \frac{1}{8}$$

$$4a = 8$$

$$a = 2$$

$$\frac{57}{8} - 7$$

$$\frac{57}{8} - \frac{56}{8}$$

$$= \frac{1}{8}$$

cross multiply

$$5) \quad x^2 + 6x + 3y + 9 = 0$$

$$3y = -x^2 - 6x - 9$$

$$3y = -1(x^2 + 6x) - 9$$

$$3y = -1(x^2 + 6x + 9) - 9$$

$$+ -1(9)$$

$$3y - 9 = -1(x+3)(x+3) - 9$$

$$3y - 9 = -1(x+3)^2 - 9$$

$$3y = -1(x+3)^2 + 0$$

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

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

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

must complete the square!

$$(1) \quad \frac{1}{2}(6) = 3$$

$$(2) \quad 3^2 = 9$$

(3) add to both sides

$$a = -\frac{1}{3}$$

vertex: $(3, 0)$

axis of symmetry: $x = 3$

Focus $(3, 0 + \frac{1}{4(-\frac{1}{3})})$

$$= (3, 0 + \frac{1}{-\frac{4}{3}})$$

$$= (3, 0 + \frac{-3}{4})$$

$$= (3, -\frac{3}{4})$$

Directrix: $y = 0 - \frac{1}{4(-\frac{1}{3})}$

$$y = 0 + \frac{3}{4} = \frac{3}{4}$$

$$6. \quad x^2 - 4x + y + 8 = 0$$

$$y = -x^2 + 4x - 8$$

$$y = -1(x^2 - 4x) - 8$$

$$y + 1(4) = -1(x^2 - 4x + 4) - 8$$

$$y + 4 = -1(x - 2)(x - 2) - 8$$

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

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

$$(1) \quad \frac{1}{2}(-4) = -2$$

$$(2) \quad (-2)^2 = 4$$

(3) Add to both sides

Vertex $(2, -4)$

axis of symmetry
 $x = 2$

Focus $(2, -4 + \frac{1}{4(-1)})$

$$(2, -4 + (-\frac{1}{4}))$$

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

Directrix

$$y = -4 - (-\frac{1}{4})$$

$$y = -4 + \frac{1}{4}$$

$$y = -3\frac{3}{4}$$

$$7. -x^2 - 8x + y - 11 = 0$$

$$y = x^2 + 8x + 11$$

$$y + 16 = (x^2 + 8x + 16) + 11$$

$$y + 16 = (x + 4)(x + 4) + 11$$

$$y + 16 = (x + 4)^2 + 11$$

$$\begin{array}{ccc} -16 & & -16 \\ \hline y & & \end{array}$$

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

Vertex $(-4, -5)$

a. of s. $x = -4$

focus $(-4, -5 + \frac{1}{4(1)})$

$$-4, -5 + \frac{1}{4}$$

$$(-4, -4\frac{3}{4})$$

Directrix $y = -5 - \frac{1}{4}$

$$y = -5\frac{1}{4} = -\frac{21}{4}$$

$$8. -x^2 - 2x + y + 4 = 0$$

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

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

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

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

$$\begin{array}{ccc} -1 & & -1 \\ \hline y & & \end{array}$$

$$y = (x + 1)^2 - 5$$

vertex $(-1, -5)$

a. of s. $x = -1$

focus $(-1, -5 + \frac{1}{4(1)})$

$$(-1, -5 + \frac{1}{4})$$

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

Directrix

$$y = -5 - \frac{1}{4}$$

$$y = -5\frac{1}{4} = -\frac{21}{4}$$

HW Parabolas (Opening up and down)

Use the information provided to write the vertex form equation of each parabola.

1) Vertex: $(-8, 2)$, Focus: $(-8, 1)$

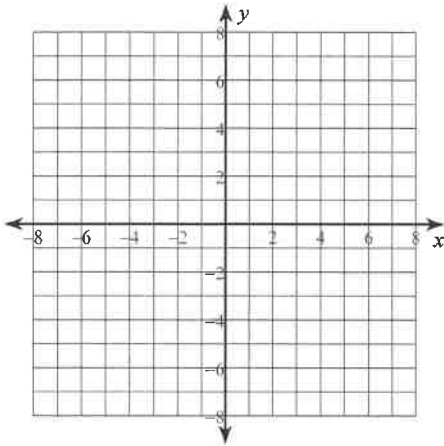
2) Vertex: $(4, 4)$, Focus: $\left(4, \frac{9}{2}\right)$

3) Vertex: $(-4, 1)$, Focus: $\left(-4, \frac{7}{8}\right)$

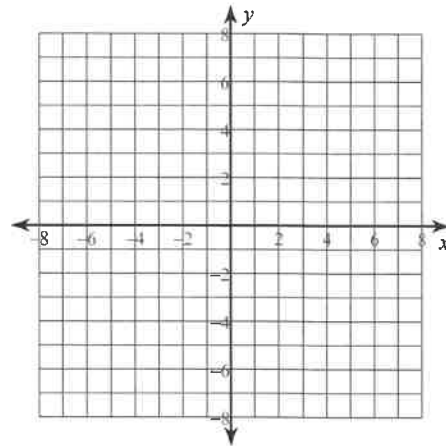
4) Vertex: $(-4, 0)$, Focus: $\left(-4, -\frac{1}{4}\right)$

Identify the vertex, focus, axis of symmetry, and directrix of each. Then sketch the graph.

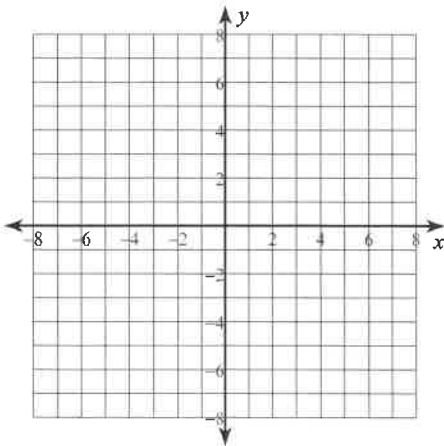
5) $-5x^2 + 6y + 12 = 0$



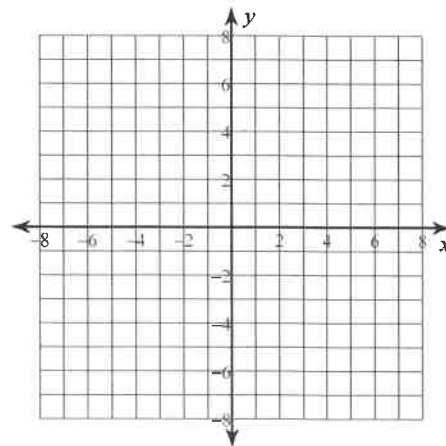
6) $-x^2 - 12x + y - 34 = 0$



7) $x^2 - 6x + 3y + 9 = 0$



8) $x^2 + y - 3 = 0$



HW Parabolas (Opening up and down)

Use the information provided to write the vertex form equation of each parabola.

1) Vertex: $(-8, 2)$, Focus: $(-8, 1)$

$$y = -\frac{1}{4}(x + 8)^2 + 2$$

2) Vertex: $(4, 4)$, Focus: $(4, \frac{9}{2})$

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

3) Vertex: $(-4, 1)$, Focus: $(-4, \frac{7}{8})$

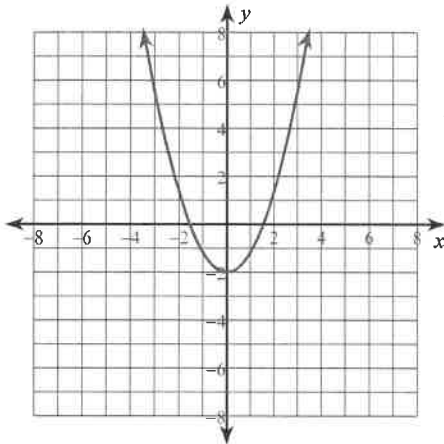
$$y = -2(x + 4)^2 + 1$$

4) Vertex: $(-4, 0)$, Focus: $(-4, -\frac{1}{4})$

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

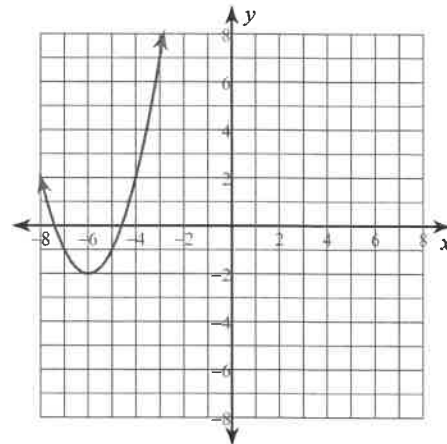
Identify the vertex, focus, axis of symmetry, and directrix of each. Then sketch the graph.

5) $-5x^2 + 6y + 12 = 0$



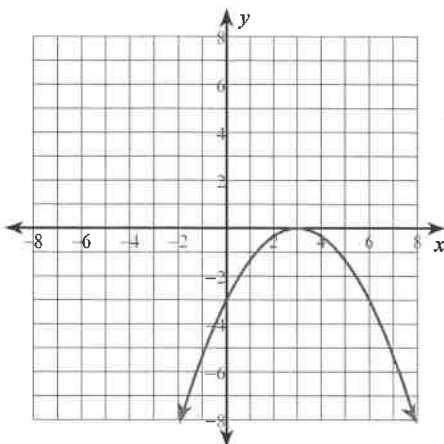
Vertex: $(0, -2)$
 Focus: $(0, -\frac{17}{10})$
 Axis of Sym.: $x = 0$
 Directrix: $y = -\frac{23}{10}$

6) $-x^2 - 12x + y - 34 = 0$



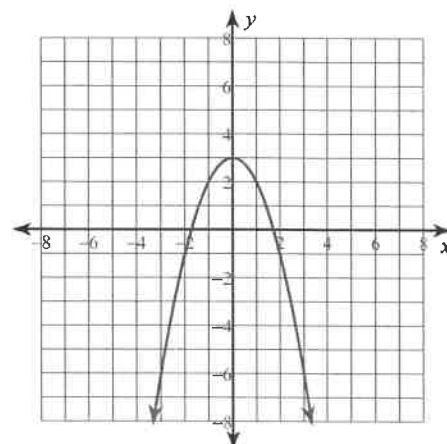
Vertex: $(-6, -2)$
 Focus: $(-6, -\frac{7}{4})$
 Axis of Sym.: $x = -6$
 Directrix: $y = -\frac{9}{4}$

7) $x^2 - 6x + 3y + 9 = 0$



Vertex: $(3, 0)$
 Focus: $(3, -\frac{3}{4})$
 Axis of Sym.: $x = 3$
 Directrix: $y = \frac{3}{4}$

8) $x^2 + y - 3 = 0$



Vertex: $(0, 3)$
 Focus: $(0, \frac{11}{4})$
 Axis of Sym.: $x = 0$
 Directrix: $y = \frac{13}{4}$