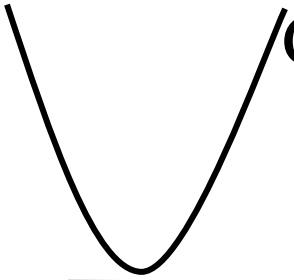
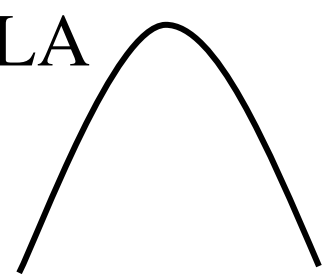


GRAPHING PARABOLA

$$f(x) = ax^2 + bx + c$$

$$a \neq 0$$



1) Write the function in standard form $f(x) = ax^2 + bx + c$

2) Identify $a, b,$ and c.

3) Opens upward when $a > 0$ or downward when $a < 0$.

4) Find the vertex (h, k) where $h = \dfrac{-b}{2a}$ and $k = f(h)$

5) $x-$intercepts, set $f(x) = 0,$ solve $ax^2 + bx + c = 0$ by factoring or quadratic formula. It is possible to have a parabola without any $x-$intercepts.

6) $y-$intercept, find $f(0)$. Any quadratic function must have only one $y-$intercept.

7) Find two additional points, one in each side of the vertex or $x-$intercepts.

8) The axis of symmetry $x = h$.

9) Graph the parabola by plotting these points on the rectangular coordinate system. Draw the axis of symmetry.

Example: Graph $f(x)=(x+5)(x+2)-5(x+4)+2$

1) We first need to use foil method and distribution to simplify our function:

$$f(x)=x^2+2x+5x+10-5x-20+2$$

which simplifies to $f(x)=x^2+2x-8$.

2) $a=1, b=2,$ and $c=-8$.

3) It opens upward since $a>0$

4) $h=\dfrac{-b}{2a}=\dfrac{-2}{2(1)}=\dfrac{-2}{2}=-1$

$k=f(h)=f(-1)=(-1)^2+2(-1)-8$, $k=-9$.

Therefore the vertex is $(-1,-9)$.

5) $x-$intercepts,

$y=0, f(x)=0, x^2+2x-8=0$

$(x-2)(x+4)=0;$

$x=2, x=-4$

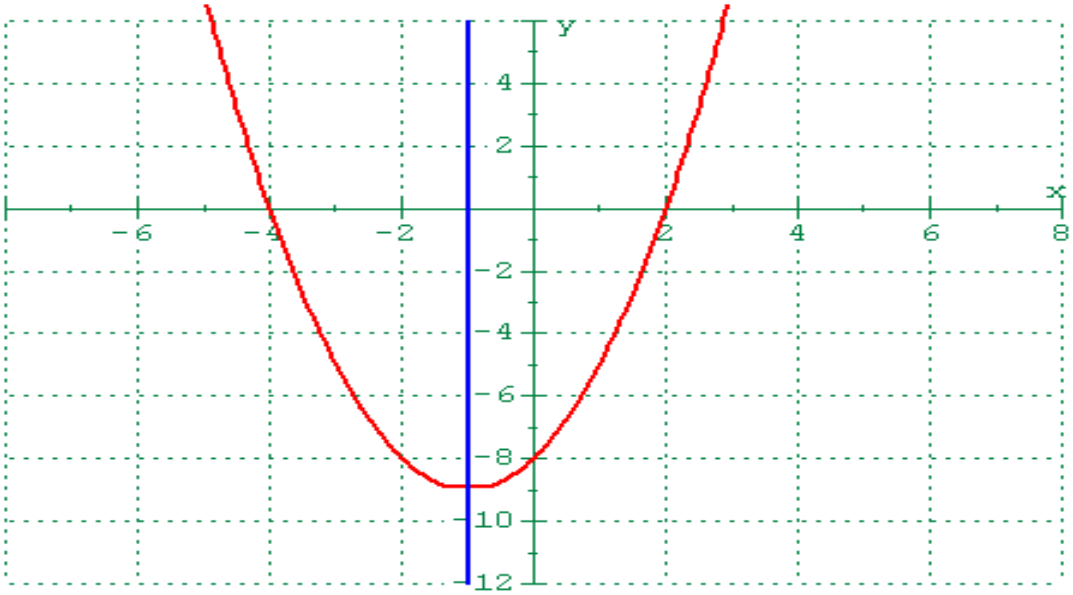
So the $x-$intercepts are $(2,0)$ & $(-4,0)$.

6) $y-$intercept, $y=f(0)=-8$,

So the $y-$intercepts is $(0,-8)$.

7) Two additional points: I choose -5 & 3 for the x value in either side of the $x-$intercepts, plug them into the function to obtain my additional order pairs $(-5,7)$ & $(3,7)$.

7) The axis of symmetry $x=-1$.



Graph:

1) $f(x) = x^2 - 10x + 9$

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

3) $f(x) = x^2 + 6x + 9$

4) $f(x) = x^2 + 5x + 2$

5) $f(x) = x^2 - 9$

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

7) $f(x) = x^2 - 10x + 25$

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

9) $f(x) = (4x - 1)(x - 4) - 4$

10) $f(x) = (x - 2)(x + 3) - 6$

11) $f(x) = x^2 - 3x - 18$

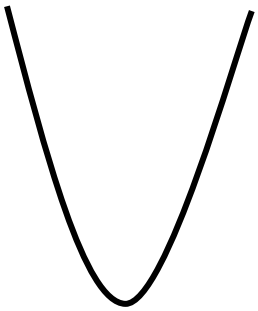
12) $f(x) = x^2 + 6x$

13) $f(x) = 16x^2 - 24x + 9$

14) $f(x) = -x^2 + 8x - 16$

15) $f(x) = (x - 4)^2 - 1$

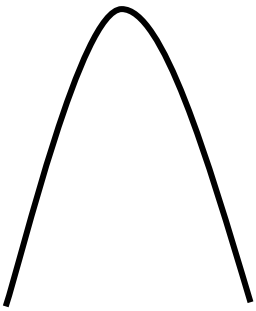
16) $f(x) = -(x + 3)^2 + 4$



GRAPHING PARABOLA

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

$$a \neq 0$$



1) Identify $a, h,$ and k.

2) Opens upward when $a > 0$ or downward when $a < 0$.

3) Find the vertex (h,k).

4) $x-$intercepts, set $f(x)=0,$ solve $a(x-h)^2+k=0$.

5) $y-$intercept, find $f(0)$.

6) The axis of symmetry $x=h$.

8) Graph the parabola by plotting these points on the rectangular coordinate system. Draw the axis of symmetry.

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

1) $a = -\frac{1}{2}, h = -4,$ and $k = -2$.

2) Opens downward since $a < 0$

3) The vertex is $(-4,-2)$.

4) $x-$intercepts,

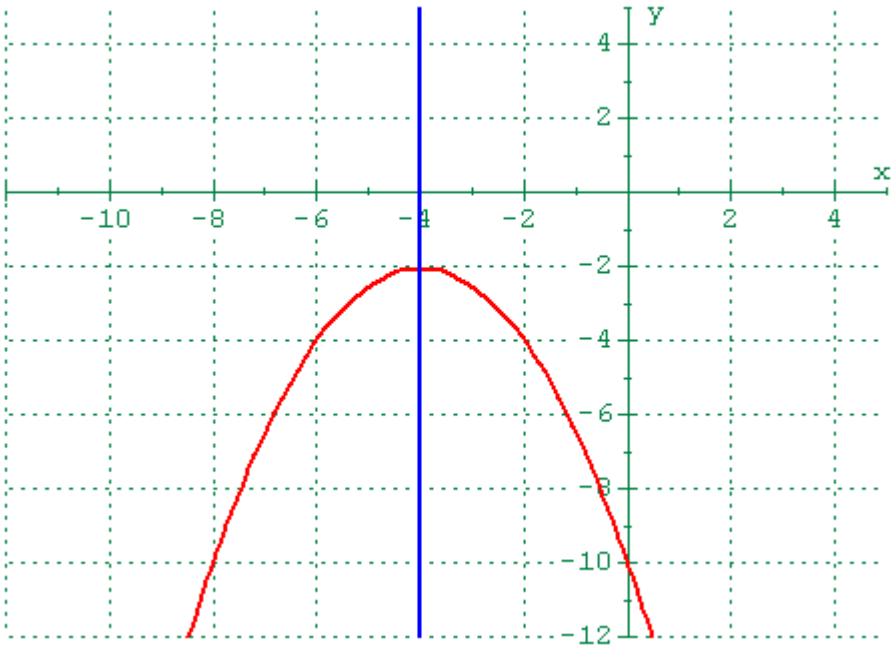
$y = 0, f(x) = 0, -\frac{1}{2}(x+4)^2 - 2 = 0$

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

There is no real solutions, therefore no $x-$intercepts.

5) $y-$intercept, $y = f(0) = -\frac{1}{2}(0+4)^2 - 2 = -10$.

6) The axis of symmetry $x = -4$.



Graph:

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

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

3) $f(x) = 4(x-1)^2 - 4$

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

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

6) $f(x) = \frac{1}{10}(x+3)^2 - 5$

7) $f(x) = \frac{1}{3}x^2 - 3$

8) $f(x) = -2(x+5)^2$

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

10) $f(x) = -\frac{2}{3}(x+1)^2 + \frac{2}{3}$

GRAPHING SIDEWAYS PARABOLA

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

$$a \neq 0$$

1) Identify $a, h,$ and k.

2) Opens right when $a > 0$ or left when $a < 0$.

3) Find the vertex (h,k).

4) $y-$intercepts, set $x = 0,$ solve $a(y-k)^2 + h = 0$.

5) $x-$intercept, let $y = 0$ and compute x.

6) Find two additional points, one in each side of the vertex

BELOW	VERTEX	ABOVE
$(?, k-d)$	(h,k)	$(?, k+d)$

where $d > 0$.

7) The axis of symmetry $y = k$.

8) Graph the parabola by plotting these points on the rectangular coordinate system. Draw the axis of symmetry.

Example: Graph $x = \frac{1}{2}(y-4)^2 - 2$

1) $a = \frac{1}{2}, h = -2,$ and $k = 4$.

2) Opens right since $a > 0$

3) The vertex is $(-2, 4)$.

4) $y-$intercepts,

$x = 0, \frac{1}{2}(y-4)^2 - 2 = 0$

$(y-4)^2 = 4; y = 6 \;\&\; y = 2$

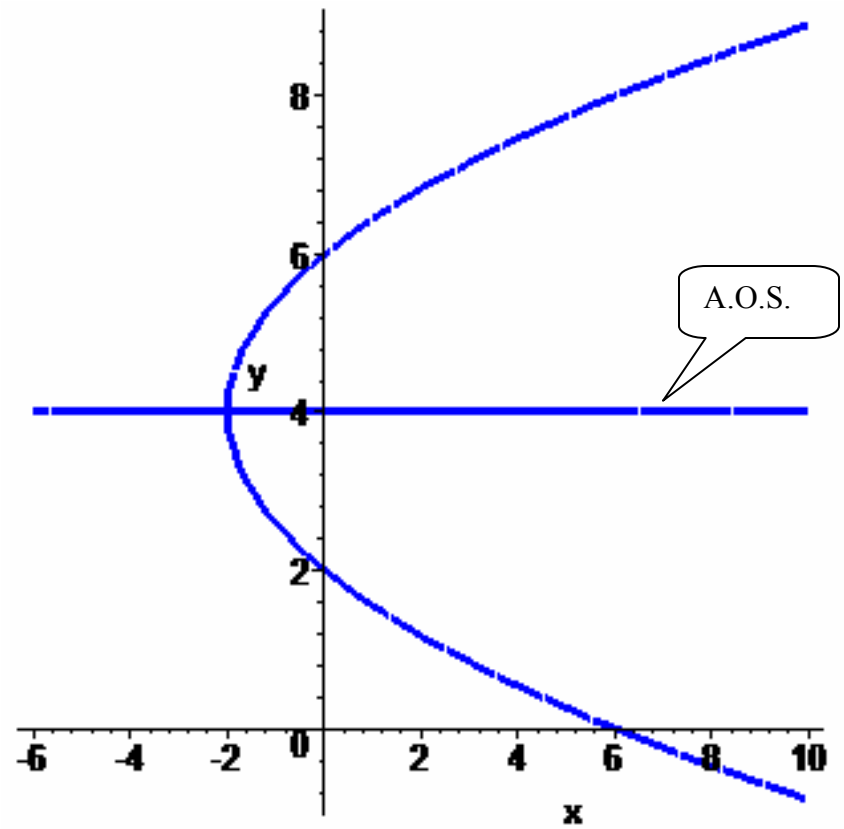
5) $x-$intercept, $y = 0, x = \frac{1}{2}(0-4)^2 - 2 = 6$.

6) Two additional points:

BELOW	VERTEX	ABOVE
$(?, 4-d)$	$(-2, 4)$	$(?, 4+d)$

Where $d > 0$.

7) The axis of symmetry $y = 4$.



Graph:

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

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

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

4) $x = y^2 + 3$

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

6) $x = \frac{1}{3}(y+3)^2 - 12$

GRAPHING SIDEWAYS PARABOLA

$$x = ay^2 + by + c$$

$$a \neq 0$$

1) Identify $a, b,$ and c.

2) Opens right when $a > 0$ or left when $a < 0$.

3) Find the vertex (h,k) where $k = \dfrac{-b}{2a}$ and h can be computed by evaluating the right hand side when $y = k$.

4) $x-$intercepts, set $y = 0,$ compute x.

5) $y-$intercept, set $x = 0,$ solve for y.

6) Find two additional points, one in each side of the vertex

BELOW	VERTEX	ABOVE
$(?, k-d)$	(h,k)	$(?, k+d)$

where $d > 0$.

7) The axis of symmetry $y = k$.

8) Graph the parabola by plotting these points on the rectangular coordinate system. Draw the axis of symmetry.

Example: Graph $x = y^2 - 2x - 8$

1) $a = 1, b = -2,$ and $c = -8$.

2) Opens right since $a > 0$

3) $k = \frac{-b}{2a} = \frac{-(-2)}{2(1)} = \frac{2}{2} = 1$

$h = (1)^2 - 2(1) - 8$

$h = -9$.

Therefore the vertex is $(-9,1)$.

4) $x-$intercepts,

$y = 0,$

$x = 0^2 + 2(0) - 8 = -8$

5) $y-$intercept, $x = 0$.

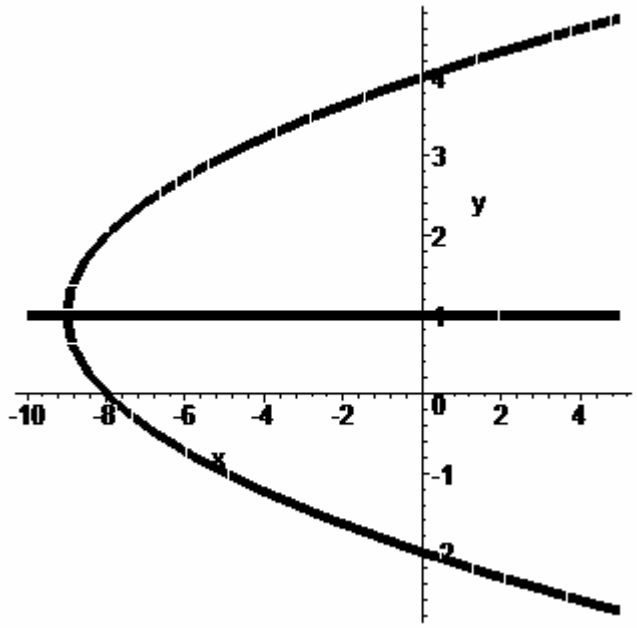
$$y^2 - 2x - 8 = 0, (y-4)(y+2) = 0$$

$y - 4 = 0, y = 4$ and $y + 2 = 0, y = -2$.

6) Two additional points:

BELOW	VERTEX	ABOVE
$(?,1-d)$	$(-9,1)$	$(?,1+d)$

7) The axis of symmetry $y = 1$.



Graph:

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

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

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

4) $x = y^2 + 6y + 12$

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

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