3.4 Graphing: Vertex Form

It turns out - the transformed version that we have been seeing has a special name:
VERTEX FORM

vertex (h,k)

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

Steps:
1. Plot the vertex.
2. Up or down?
3. Step pattern
   Count over & up/downs to get 4 more points.
4. Draw a smooth curve.

$a > 0$, opens up (has min)
$a < 0$, opens down (has max)

axis of symmetry is $x = h$

if $a > 1$, then there is a stretch by a factor of a

if $0 < a < 1$, then there is a compression by a factor of $\frac{1}{a}$

step pattern from the vertex:

1	1 x a
2	4 x a
3	9 x a

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Ex 1: Complete the table.

values that y can be ↘

Equation	Direction of Opening	Vertex (h,k)	Equation of Axis of Symmetry x=h	Stretch Factor a	Range
$y=3(x-5)^2+9$	UP	(5, 9)	$x=5$	3	$y \geq 9$
$y=-\frac{3}{4}(x+4)^2-7$	DOWN	(-4, -7)	$x=-4$	$\frac{3}{4}$	$y \leq -7$
$y=-2x^2-3$	DOWN	(0, -3)	$x=0$	2	$y \leq -3$
$y=7(x+2)^2+5$	up	$(-2,5)$	$x=-2$	7	$y \geq 5$
$y=-4(x-4)^2$	down	(4, -2)	$x=4$	4	$y \leq -2$

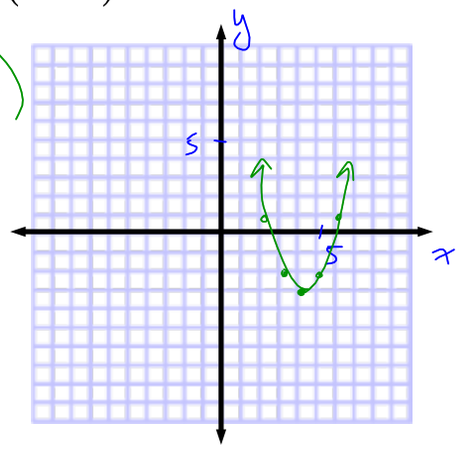
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Ex 2: Graph (show at least 5 points)

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

V (4, -3)

a = 1

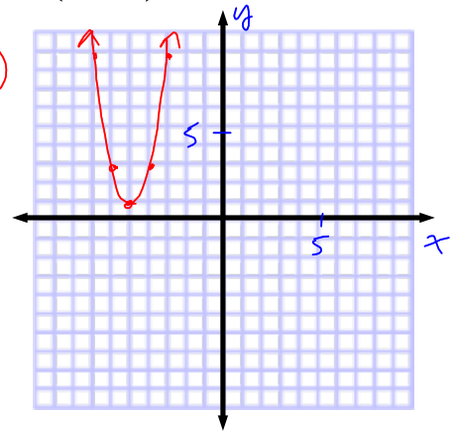


b) $y=2(x+5)^2+1$

V (-5, 1)

a = 2

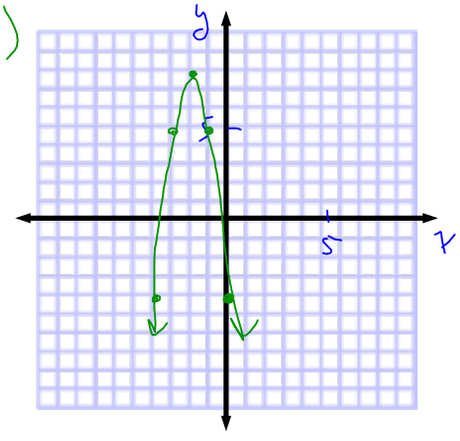
pattern x 2



c) $y=-3(x+2)^2+8$

V (-2, 8)

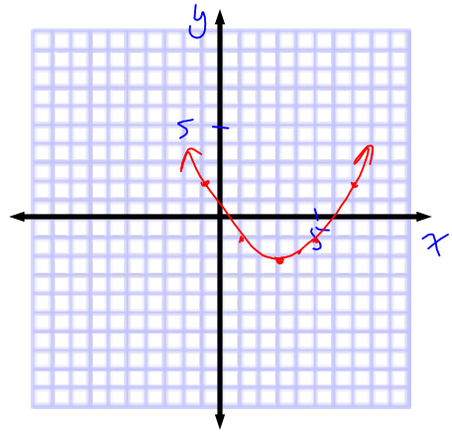
a = -3



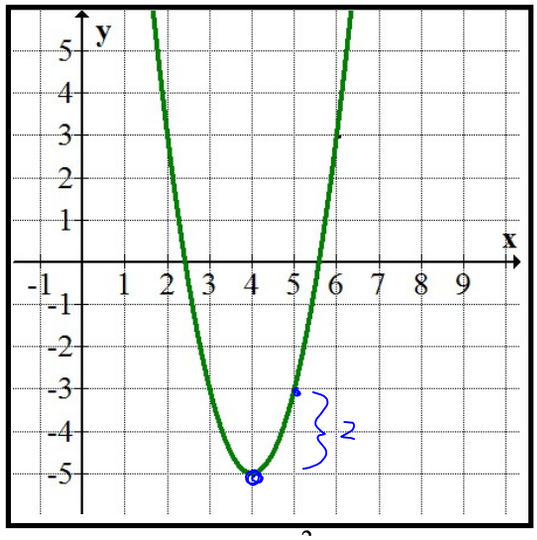
d) $y=\frac{1}{4}(x-3)^2-2$

V (3, -2)

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

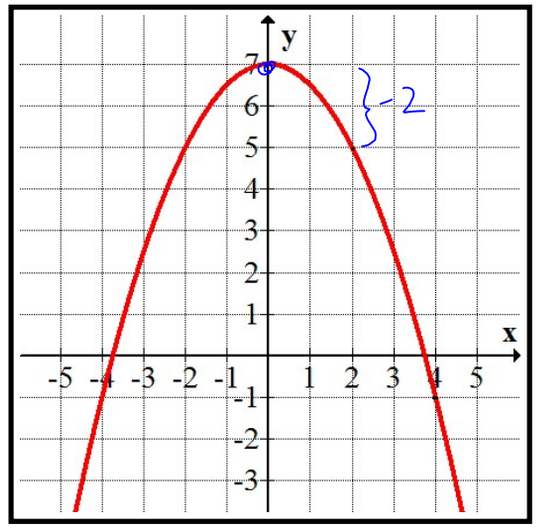


e.g.3: Write an equation for each parabola. $y = a(x-h)^2 + k$



V(4,-5)

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



V(0,7)

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

$y = -\frac{1}{2}x^2 + 7$

Normal pattern?
over 2 up 4
Now
over 2 down 2
...? $a = -\frac{1}{2}$

OR

$4a = -2$

$a = -\frac{2}{4}$

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

Ex. 4 Determine an equation for each quadratic.

a) vertex at (-3,4) through the point (-1, -2)

- Construct, using a as placeholder
- Sub in other point & solve for a

$y = a(x+3)^2 + 4$

Sub in $(-1, -2)$

$-2 = a(-1+3)^2 + 4$

$-6 = a(2)^2$

$-6 = 4a$

$-\frac{6}{4} = a$

$-\frac{3}{2} = a$

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

b) stretch by 4, reflection in x-axis ($a = -4$), axis of symmetry at x=-3 (h), through the point (5,1)

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

Sub in $(5, 1)$

$1 = -4(5+3)^2 + k$

$1 = -4(8)^2 + k$

$1 = -4(64) + k$

$1 = -256 + k$

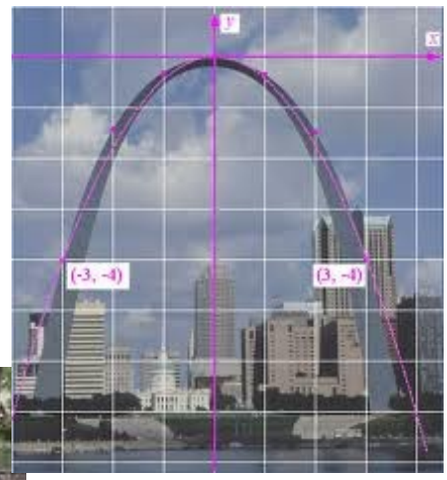
$257 = k$

$\therefore y = -4(x+3)^2 + 257$

Homework

Set 1: p. 185 #C3,1adh, 2bdfg, 3, 4, 6

Set 2: p. 185 #C3,1adh, 2bdfg, 3, 4, 6, 7









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