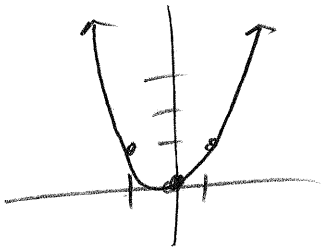
Sec 9.5 cont.

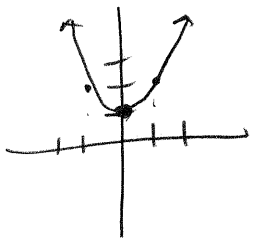
Parent function

$y = x^2$



$y = x^2 + 1$

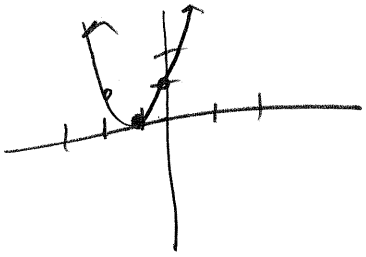
$\uparrow 1$



$y = (x+1)^2$

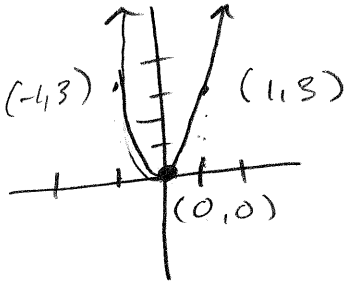
moves -1

$\leftarrow$



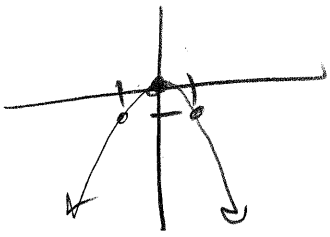
$y = 3x^2$

Stretches by a factor of 3



$y = -x^2$

flips upside down

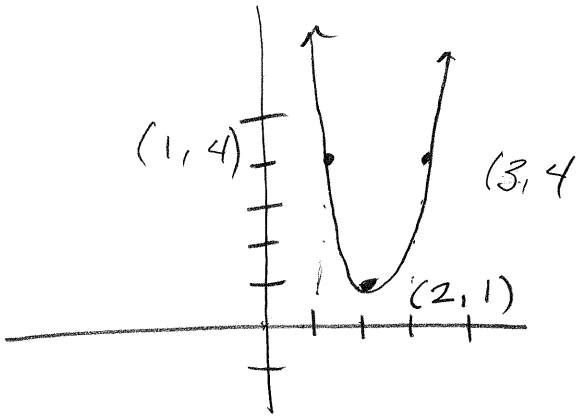


#32 $f(x) = 3(x-2)^2 + 1$

Stretches by factor of 3

→ 2 units

↑ 1 unit



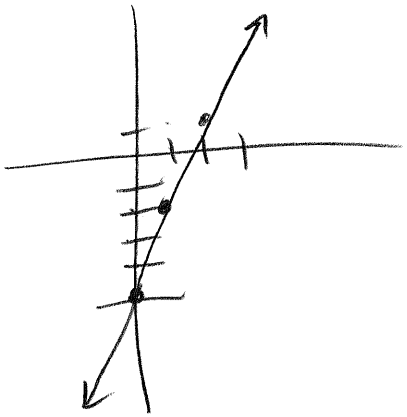
No Square

$f(x) = 3(x-2) + 1$

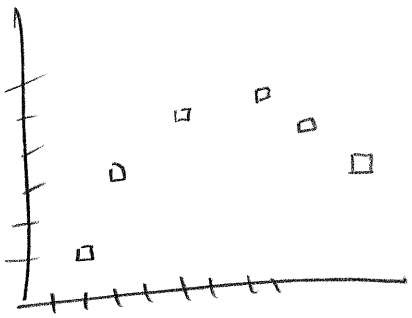
$= 3x - 6 + 1$

$= 3x - 5$

Slope y-int

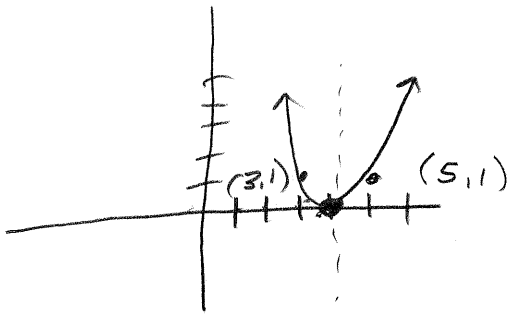


Scatter plots



#27 $f(x) = (x-4)^2$

→ 4



Vertex: (4,0)

axis of symmetry: $x = 4$

Domain: $(-\infty, \infty)$ ← inputs (x-values)

Range: $[0, \infty)$ ← outputs (y-values)

(4,0)

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

-2 ← ↓ -3

(-2,-3)

#12 $f(x) = -(x-2)^2 + 1$

$+2$ → ↑ $+1$

Vertex (2, 1)

Sec 9.6 More about Parabolas and their Applications

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

Vertex: (h, k)

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

how do we find Vertex

Option 1: Completing the Square

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

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

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

Vertex: $(-2, -4)$

find Vertex of

$g(x) = x^2 + 8x + 11$

$= (x^2 + 8x + 16) - 16 + 11$ $\quad \frac{8}{2} = 4$, $(4)^2 = 16$

$(x+4)^2 - 5$

Vertex: $(-4, -5)$

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

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

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

$(-1)^2 = 1$

$2[(x-1)^2 - 1] + 1$

$2(x-1)^2 - 1(2) + 1$

$= 2(x-1)^2 - 1$ ←

Vertex: $(1, -1)$

$(x-1)^2 - 1$

$x^2 - x - x + 1 - 1$

$x^2 - 2x + 1 - 1$

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

$= a\left(x^2 + \frac{b}{a}x + \frac{b^2}{4a^2} - \frac{b^2}{4a^2}\right) + c$

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

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

$a\left[\left(x + \frac{b}{2a}\right)^2 - \frac{b^2}{4a^2}\right] + c$

$a\left(x + \frac{b}{2a}\right)^2 - \frac{ab^2}{4a^2} + c$

Stuff

$a\left(x + \frac{b}{2a}\right)^2 + \text{stuff}$

Vertex: $\left(-\frac{b}{2a}, \text{stuff}\right) = \left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$

✓ $f(x) = 2x^2 - 4x + 1$ ($a=2$, $b=-4$) found Vertex: $(1,-1)$

$$x = \frac{-b}{2a} = \frac{-(-4)}{2(2)} = \frac{4}{4} = 1 \leftarrow x$$

$$f(1) = 2(1)^2 - 4(1) + 1.$$
$$= 2 - 4 + 1$$
$$= -1 \leftarrow y \text{ output}$$

2 ways to find Vertex

Option 1: Complete the Square

Option 2: Vertex Short cut

$$x = \frac{-b}{2a} \quad y = f\left(\frac{-b}{2a}\right)$$