2.1 Linear & Quadratic Functions

Obj: 1. Recognize & graph linear & quad. fncs.
2. Use fncs. to solve problems.

Linear: $y = mx + b$

Quadratic: $y = ax^2 + bx + c$

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Polynomial Functions

Let n be a nonnegative integer and $a_0, a_1, a_2, \ldots\ldots, a_n$ be real #s with $a_n \neq 0$.

Then: $f(x) = \underline{a_n} x^{n} + a_{n-1}x^{n-1} + \ldots + a_2x^2 + a_1x^1 + a_0 \cdot x^0$

is a polynomial fnc. of degree $\underline{n}$

biggest exponent

and the <u>leading coefficient</u> is a_n.

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Which are polynomials?

$f(x) = 4x^3 - 5x - \frac{1}{2}$

Yes Deg: 3 Lead. coef: 4

$g(x) = 6x^{-4} + 7$

No

$h(x) = \sqrt{9x^4 + 16x^2}$

No : square root

$k(x) = 15x - 2x^4$

Yes Deg: 4

L.C: -2

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$f(x) = 3x^{-5} + 17$

No

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

Yes Deg: 2 LC: 2

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Polynomial Fncs of Low & No Degree:

1. Zero Fnc: $f(x)=0$ degree: undef
2. Constant Fnc: $f(x)=K\cdot x^0$ deg: 0
3. Linear Fnc: $f(x)=mx^1+b$ deg: 1
4. Quadratic: $f(x)=ax^2+bx+c$ deg: 2

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Linear Fncs

$y=mx+b$

* Vertical Lines = not a fnc.
* Horizontal Lines: graphs of constant fncs.

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Find an equation for the linear fnc f

if $f(-1)=2$, $f(3)=-2$ $\quad y=mx+b$

$(-1, 2) \quad (3, -2)$

$m: \frac{-2-2}{3+1} = \frac{-4}{4} = -1$

Slope intercept:

$y = mx+b$

$y = -x+b \qquad y=-x+1$

$2 = +1 + b$

$-1 \quad -1$

$b=1$

OR

point slope

$y - y_1 = m(x-x_1)$

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

$y-2 = -x-1$

$+2 \qquad +2$

$y = -x+1$

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Find the eq. for f if $f(-5)=-1$

and $f(2)=4$

$m: \frac{4+1}{2+5} = \frac{5}{7}$

$y+1 = \frac{5}{7}(x+5)$

$y+\cancel{1} = \frac{5}{7}x + \frac{25}{7}$

$-\cancel{1} \qquad -\frac{7}{7}$

$y = \frac{5}{7}x + \frac{18}{7}$

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Quadratics

Polynomials of deg 2

* parabola

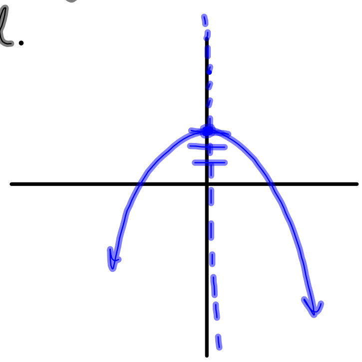
Describe the transformation of $f(x)=x^2$ into the given graph $g(x) = -\left(\frac{1}{2}\right)x^2+3$

Then sketch by hand.

refl. over x-axis

V. comp. by $\frac{1}{2}$

up 3



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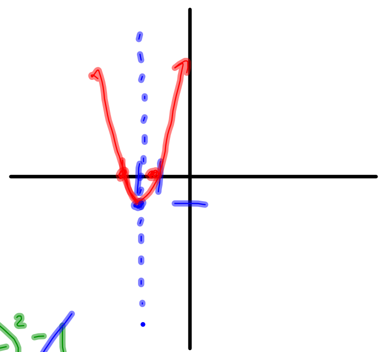
$$h(x) = 3(x+2)^2 - 1$$

v. str. by 3

left 2

down 1



Zeros:
x int

$$0 = 3(x+2)^2 - \cancel{1}$$
$$+1 \qquad\qquad\quad \cancel{+1}$$
$$\frac{1}{3} = \frac{\cancel{3}(x+2)^2}{\cancel{3}}$$
$$\sqrt{\frac{1}{3}} = \sqrt{(x+2)^2}$$
$$\pm\sqrt{\frac{1}{3}} = x+2$$
$$-2 \qquad\qquad -2$$
$$x = -2 \pm \sqrt{\frac{1}{3}}$$

$x = -2+\sqrt{\frac{1}{3}}$ ≈ -1.4

$x = -2-\sqrt{\frac{1}{3}}$ ≈ -2.6

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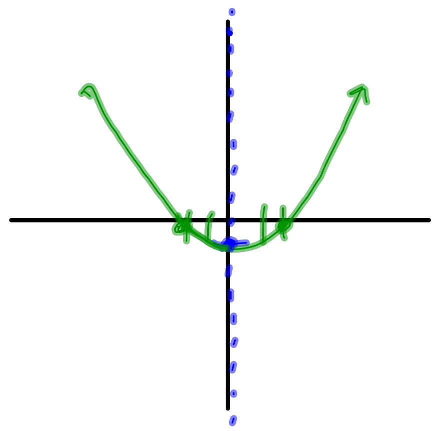
$h(x) = \frac{1}{4}x^2 - 1$

V. comp. by $\frac{1}{4}$

down 1



Zeros: $0 = \frac{1}{4}x^2 - 1$

$+1 \qquad\qquad +1$

$4(1) = (\cancel{\tfrac{1}{4}}x^2)\cancel{4}$

$\sqrt{4} = \sqrt{x^2}$

$x = \pm 2$

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All parabolas are symmetric.
on their line/axis of symmetry.

If $y = \underline{a}x^2 + \underline{b}x + \underline{c}$

then the line of symmetry is:

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

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Vertex Form:

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

can be written in Vertex form:

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

Vertex: (h, K)

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Find the vertex & axis of symmetry of

* $f(x) = 6x - 3x^2 - 5$ & Rewrite in vertex form.

$f(x) = -3x^2 + 6x - 5$ vertex: $\left(\frac{-b}{2a}, f(x)\right)$

$a = -3$ $b = 6$ $c = -5$

axis: $x = \frac{-6}{2(-3)} = \frac{-6}{-6} = 1$

$x = 1$ $f(1) = 6 - 3 - 5 = -2$

Vertex: $(1, -2)$

Vertex form: $f(x) = a(x-h)^2 + K$

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

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$f(x) = -2x^2 + 7x - 3$

Find the vertex, axis of symmetry & vertex form.

axis: $x = \frac{-7}{2(-2)} = \frac{7}{4}$

$f\left(\frac{7}{4}\right) = -2\left(\frac{7}{4}\right)^2 + 7\left(\frac{7}{4}\right) - 3$

$-2\left(\frac{49}{16}\right) + \frac{49}{4} - 3$

$= -\frac{98}{16} + \frac{4}{4}\cdot\frac{49}{4} - 3\frac{16}{16}$

$= -\frac{98}{16} + \frac{196}{16} - \frac{48}{16}$

$= \frac{50}{16} = \frac{25}{8}$

V: $\left(\frac{7}{4}, \frac{25}{8}\right)$

$f(x) = -2\left(x - \frac{7}{4}\right)^2 + \frac{25}{8}$

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Use completing the square to describe:

$f(x) = 3x^2 + 12x + 11 = 0$

$-11 \quad -11$

$3x^2 + 12x = -11$

$3(x^2 + 4x) = -11$

$3(x^2 + 4x + 2^2) = -11 + 3(2^2)$

$3(x+2)^2 = 1$

$-1 \quad -1$

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

axis: $x = -2$

V: $(-2, -1)$

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