

2.1 Vertex form of a Quadratic Function

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

 $(h, k) = \text{vertex}$

ex] Describe the transformations

a) $g(x) = -\frac{1}{2}(x+2)^2$
reflection, left 2

b) $g(x) = \frac{1}{2}(x-1)^2 + 2$
right 1, up 2

ex] what is the equation of a parabola with

$V = (1, -4)$ and point $(-2, -1)$

 (h, k) (x, y)

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

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

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

$-1 = 9a - 4$

$+4 \quad +4$

$\frac{3}{9} = \frac{9a}{9}$

$a = 1/3$

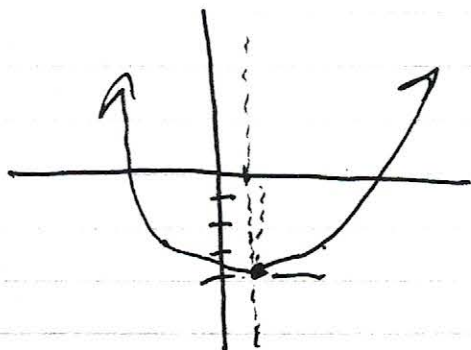
$y = 1/3(x-1)^2 - 4$

b) Find the axis of symmetry

$x-1=0$

$x=1$

c) Graph

max or min?

$d = (-\infty, \infty)$

$r = [-4, \infty)$

2.2 Standard Form of a Quadratic Function

$$y = ax^2 + bx + c \quad \text{Standard form}$$

$$h = \frac{-b}{2a} \quad \text{Axis of symmetry}$$

$b = \#$ with the x

$a = \#$ with the x^2

ex) Find the axis of symmetry

$$F(x) = x^2 - 6x + 10$$

$$a = 1 \quad b = -6$$

$$h = \frac{-(-6)}{2(1)} = \frac{6}{2} = \boxed{3}$$

b) Find K

$$y = x^2 - 6x + 10$$

$$y = 3^2 - 6(3) + 10$$

$$y = 9 - 18 + 10$$

$$y = 1 = K$$

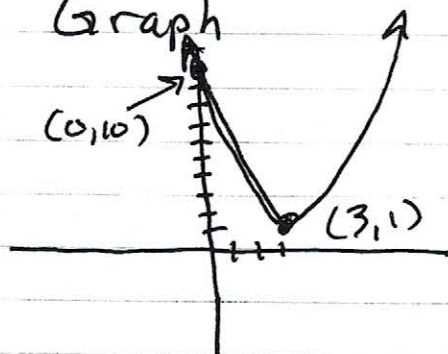
$$(h, K) = (3, 1)$$

c) Find the y-intercept

$$y = 0^2 - 6(0) + 10$$

$$y = 10 \quad (0, 10)$$

d) Graph



min or max?

2.3 Factored form of Quadratics

ex] Factor $x^2 + 7x + 12$
Factor chart

x^2	$+12$	$+7x$	
x	$+4$	$4x$	$(x+4)(x+3)$
x	$+3$	$3x$	
multiply	mult	Add	

b) $x^2 - x - 12$

x^2	-12	$-x$	
x	-4	$-4x$	$(x-4)(x+3)$
x	$+3$	$+3x$	

c) $3x^2 - 7x + 2$

$3x^2$	$+2$	$-7x$	
$3x$	-1	$-x$	$(3x-1)(x-2)$
x	-2	$-6x$	

ex] Solve by Zero Product Property
 $x^2 + x = 42$ (must = 0)

$$\begin{array}{r} -42 - 42 \\ x^2 + x - 42 = 0 \end{array}$$

x^2	-42	$+x$
x	$+7$	$7x$
x	-6	$-6x$

$(x+7)(x-6) = 0$

$$\begin{array}{r} x+7=0 \\ -7 -7 \\ \hline x=-7 \end{array}$$

$$\begin{array}{r} x-6=0 \\ +6 +6 \\ \hline x=6 \end{array}$$

b) $2x^2 = -9x + 5$

$$2x^2 + 9x - 5 = 0$$

$2x^2$	-5	$+9x$
$2x$	-1	$-x$
x	$+5$	$10x$

$(2x-1)(x+5) = 0$

$$2x-1=0$$

$$\begin{array}{r} +1 \\ 2x=1 \end{array} \quad x > 1/2$$

$$\begin{array}{r} x+5=0 \\ -5 -5 \\ \hline x=-5 \end{array}$$

2.4 Complex Numbers and Operations

* $\sqrt{-1} = i$ and $i^2 = -1$ *

ex] $\sqrt{x^2} = \sqrt{9}$ (square root)

$x = \pm 3$ * don't forget $\pm$ *

b) $\sqrt{x^2} = \sqrt{-9}$
 $x = \pm \sqrt{-1} \cdot \sqrt{9}$
 $x = i \cdot 3$
 $x = \pm 3i$

c) $\sqrt{x^2} = \sqrt{-27}$
 $x = \pm \sqrt{-1} \cdot \sqrt{27}$ $9 < 3$
 $x = \pm i \sqrt{3 \cdot 3 \cdot 3}$
 $x = \pm 3i \sqrt{3}$

Add or subtract

ex] $(4-7i) + (3-2i)$

$7-9i$

b) $(6+8i) - (2-5i)$

$4+13i$

Multiply

ex] $-2i(3+4i)$ distribute
 $-6i - 8i^2$ * $i^2 = -1$ *
 $-6i - 8(-1)$
 $-6i + 8$

b) $(3-2i)(3+2i)$ FOIL
 $9 + 6i - 6i - 4i^2$
 $9 - 4(-1)$
 $9 + 4 = 13$

Divide

ex] $\frac{5+3i}{5i} \left(\frac{5i}{5i} \right) = \frac{25i + 15i^2}{25i^2} = \frac{25i + 15(-1)}{25(-1)} = \frac{25i - 15}{-25}$

b) $\frac{10}{2-i} \left(\frac{2+i}{2+i} \right) = \frac{20+10i}{4+2i-2i-i^2} = \frac{20+10i}{4-(-1)} = \frac{20+10i}{5}$
 FOIL $\rightarrow$ $4+2i$
 * Change middle sign *

2.5 Completing The Square

ex) Solve by Square roots

$$81 = x^2 + 12x + 36 \quad (\text{Factor})$$

$$\sqrt{81} = \sqrt{(x+6)^2}$$

$$\pm 9 = x+6$$

$$9 = x+6$$

$$3 = x$$

$$-9 = x+6$$

$$-15 = x$$

$$b) \quad 18 = 2x^2 - 32x + 128 \quad (\text{Divide by 2})$$

$$9 = x^2 - 16x + 64 \quad (\text{Factor})$$

$$\sqrt{9} = \sqrt{(x-8)^2}$$

$$\pm 3 = x-8$$

$$3 = x-8$$

$$11 = x$$

$$-3 = x-8$$

$$5 = x$$

ex) Solve by Completing The Square

$$0 = x^2 - 2x + 3$$

$$\begin{array}{r} -3 \qquad -3 \\ \hline \end{array}$$

$$+1 \quad -3 = x^2 - 2x + 1 \quad \left(\left(\frac{-2}{2} \right)^2 = -1^2 = 1 \right)$$

$$-2 = x^2 - 2x + 1 \quad (\text{Factor})$$

$$\sqrt{-2} = \sqrt{(x-1)^2}$$

$$\pm \sqrt{-2} = x-1$$

$$\pm \sqrt{-1} \cdot \sqrt{2} = x-1$$

$$\pm i \cdot \sqrt{2} = x-1$$

$$\begin{array}{r} +1 \qquad \qquad +1 \\ \hline 1 \pm i\sqrt{2} = x \end{array}$$

2.6 Quadratic Formula

$$X = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

a = number with x^2

b = number with x

c = Constant, no x

$$\text{Discriminant} = b^2 - 4ac$$

if > 0 then 2 real solution (root)

if $= 0$ then 1 real solution (root)

if < 0 then 2 non-real solution (root)

ex] Solve using Quadratic Formula

$$2x^2 + 6x + 3 = 0$$

$$a=2 \quad b=6 \quad c=3$$

$$\frac{-6 \pm \sqrt{6^2 - 4(2)(3)}}{2(2)} = \frac{-6 \pm \sqrt{36 - 24}}{4} = \frac{-6 \pm \sqrt{12}}{4}$$

reduce

$$\frac{-6 \pm 2\sqrt{3}}{4} = \frac{-3 \pm \sqrt{3}}{2}$$

$$b) x^2 - 9x + 27$$

$$a=1 \quad b=-9 \quad c=27$$

$$\frac{-(-9) \pm \sqrt{(-9)^2 - 4(1)(27)}}{2(1)}$$

$$\frac{+9 \pm \sqrt{81 - 108}}{2}$$

$$\frac{9 \pm \sqrt{-27}}{2} \quad \# \text{ use } i \#$$

$$\frac{9 \pm \sqrt{-1} \cdot \sqrt{27}}{2}$$

$$\frac{9 \pm i3\sqrt{3}}{2}$$

$$\frac{9 \pm 3i\sqrt{3}}{2}$$

over $\rightarrow$

ex] Using the discriminant find how many solutions the equation has

a) $16x^2 + 8x + 1 = 0$

$a=16$ $b=8$ $c=1$

$$b^2 - 4ac$$

$$8^2 - 4(16)(1)$$

$$64 - 64 = 0 \quad \text{1 real root}$$

b) $2x^2 - 5x = -6$ (must $= 0$)

$$\begin{array}{r} +6 \quad +6 \\ \hline 2x^2 - 5x + 6 = 0 \end{array}$$

$a=2$ $b=-5$ $c=6$

$$(-5)^2 - 4(2)(6)$$

$$25 - 48 = -23 \quad \text{2 non real roots}$$

Pg 121

3-7 all

11, 12, 16, 17, 19, 20

-not in 5 factors

2.7 Linear Quadratic Systems

ex] Find how many solutions $\begin{cases} y = x^2 \\ y = 2x \end{cases}$

$$x^2 = 2x \quad (\text{set } = 0)$$

$$x^2 - 2x = 0 \quad (\text{use } b^2 - 4ac)$$

$$a=1 \quad b=-2 \quad c=0$$

$$(-2)^2 - 4(1)(0)$$

$$4 - 0 = 4 \quad \text{2 real solutions}$$

ex] Solve using Substitution

$$a) \quad y = 2x^2 - 6x - 8$$

$$2x - y = -16$$

$$2x - (2x^2 - 6x - 8) = -16$$

$$2x - 2x^2 + 6x + 8 = -16$$

$$-2x^2 + 8x + 8 = -16 \quad (\text{set } = 0)$$

$$\frac{-2x^2}{-2} + \frac{8x}{-2} + \frac{24}{-2} = 0 \quad (\text{better to keep } x^2 \text{ positive})$$

$$x^2 - 4x - 12 = 0 \quad (\text{Factor}) \text{ or } (\text{Quad Formula})$$

x^2	-12	$-4x$
x	-6	$-6x$
x	$+2$	$+2x$

$$(x-6)(x+2) = 0$$

$$x-6=0 \quad x+2=0$$

$$x=6 \quad x=-2$$

b) $y = -3x^2 + x + 4$
 $4x - y = 2$ } Have students try