Mrs. R

BL3

Unit 3 Notes- Functions

$f(x)$ is the same as y

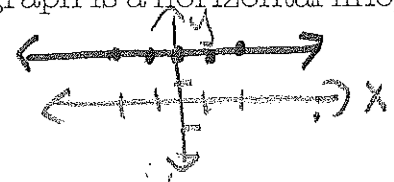
3.1 Parent Graphs

number

Constant function- $f(x) = b$ (when the graph is a horizontal line)

ex. $f(x) = 2$

$y = 2$



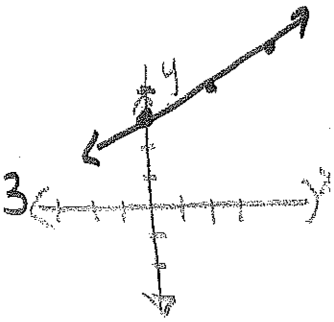
Linear Function- $f(x) = mx + b$

$y = mx + b$

$m = \text{slope} = \frac{\text{rise}}{\text{run}} = \frac{\text{change } y}{\text{change } x}$

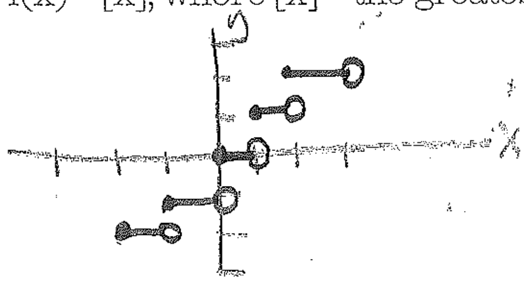
b = y intercept
(0, b)

ex.
$f(x) = \frac{1}{2}x + 3$

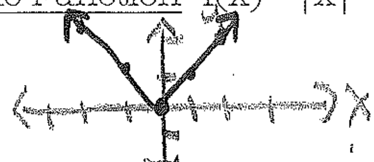


Greatest Integer Function- $f(x) = [x]$, where $[x]$ = the greatest integer less than or equal to x.

(step function)

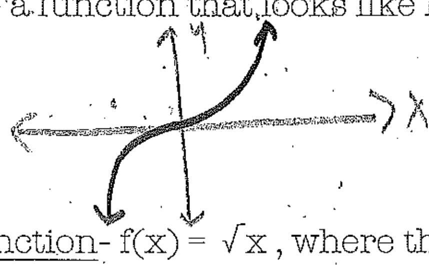


Absolute Value Function- $f(x) = |x|$



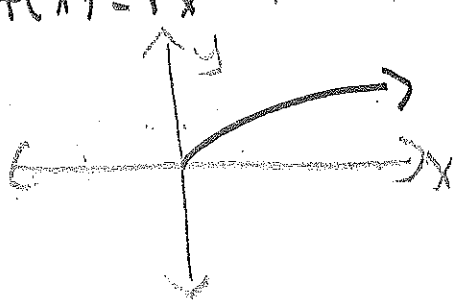
Quadratic Function- a function that is a parabola $f(x) = x^2 + bx + c$

Cubic Function- a function that looks like $f(x) = x^3$

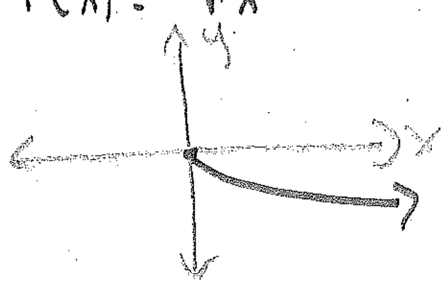


Square Root Function- $f(x) = \sqrt{x}$, where the graph is a curve going in one direction

$f(x) = \sqrt{x}$



$f(x) = -\sqrt{x}$



asymptote - line graph approaches

Rational Function- $f(x) = \frac{p(x)}{q(x)}$ where both are function. The graph will have one or more asymptotes/holes.

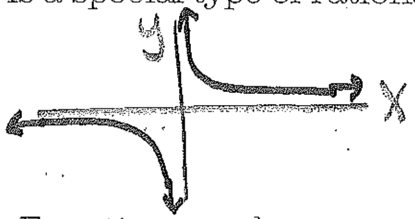
deg $p(x)$ < deg $q(x)$ $y = 0$

deg $p(x)$ = deg $q(x)$ $y = \frac{L.C.}{L.C.}$

vertical asym. V.A → set denominator = 0

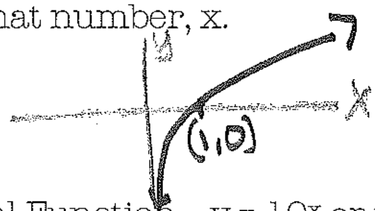
horizontal asym. H.A → look at degrees of $p(x)$ and $q(x)$

Inverse Variation Function – $y = k/x$ where the numerator is constant & the denominator is x. Has two asymptotes at $y = 0$ & $x = 0$ (this is a special type of rational function)

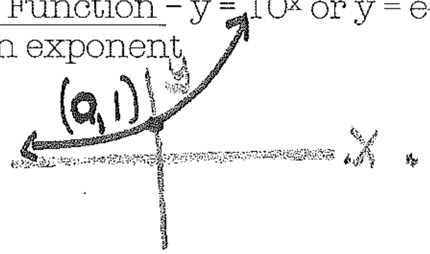


natural log

Logarithmic Function- $y = \log_a x$ or $y = \ln x$, where the log of a number, x, to a given base is the power that the base must be raised in order to produce that number, x.

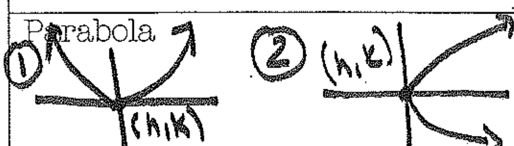
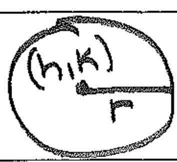
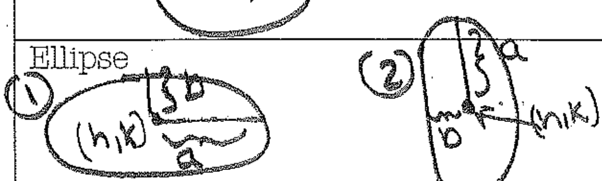
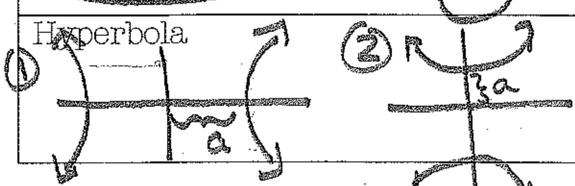


Exponential Function – $y = 10^x$ or $y = e^x$, where the independent variable is an exponent

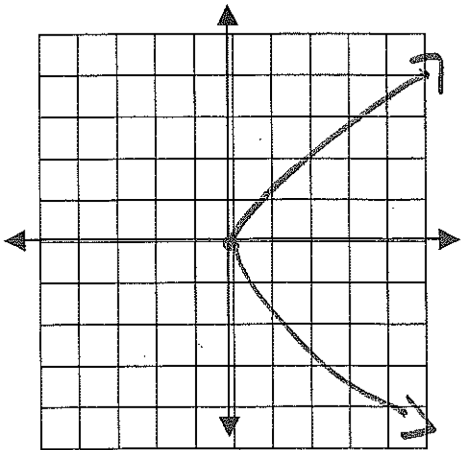


Conic Sections

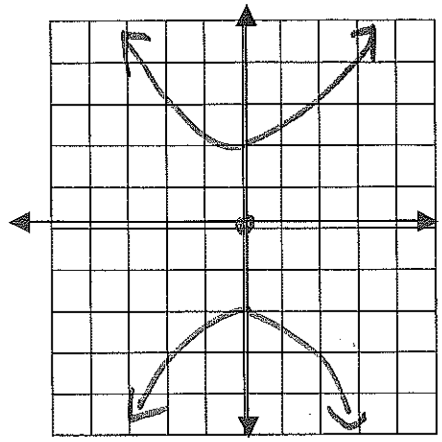
Standard form of Conic Sections

Conic Sections	Equations	
Parabola 	$y = ax^2 + bx + c$ vertex (h,k) ① $y = a(x-h)^2 + k$ ② $x = a(y-k)^2 + h$	only 1 squared either x or y
Circle 	$(x-h)^2 + (y-k)^2 = r^2$ center (h,k) radius $= r$	both x + y squared same sign same coefficients
Ellipse 	① $\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$ ② $\frac{(y-k)^2}{a^2} + \frac{(x-h)^2}{b^2} = 1$	both squared same sign different coefficients
Hyperbola 	① $\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$ ② $\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$	both squared different signs

Ex. 1 Identify the type of graph



parabola



hyperbola

Ex. 2 Identify a Function Given its Equation

a. $6x^2+6y^2=162$
circle

b. $4y^2-x^2+4=0$
hyperbola

c. $3x^2+4y^2+8y=8$
ellipse

d. $y+x^2=-(8x+23)$
parabola

e. $x^2=8y$
parabola

f $x^2-y^2+8x=16$
hyperbola

3.2 Relations and Functions

Relation- a set of ordered pairs $\{(4,2),(6,9),(8,11)(5,16)\}$

Domain- set of all first coordinates (typically x-values) $D = 4,5,6,8$

Range- set of all coordinates (typically y-values) $R = 2,9,11,16$

Function- a relation in which each element of the domain is paired with exactly one element of the range. (x-values cannot repeat themselves)

• no "y^2"
• pass vertical line test (draw ↕ anywhere & it touch graph only once.

• for every x there is exactly 1 y

Independent Variable- the domain (usually x)

Dependent Variable- the range (usually y)

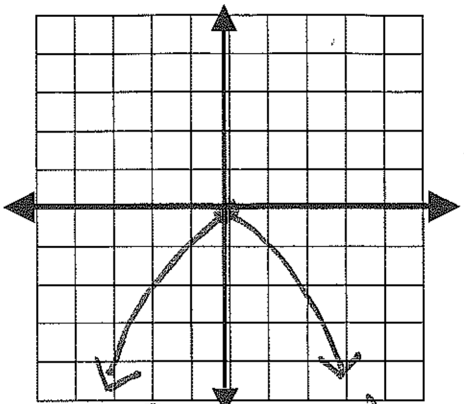
Functional Notation- Equations that are functions are written as f(x) =, instead of y =. It is read "f of x". Coordinates are written as (x, f(x))

(x, y)

are these functions? if so state domain and range

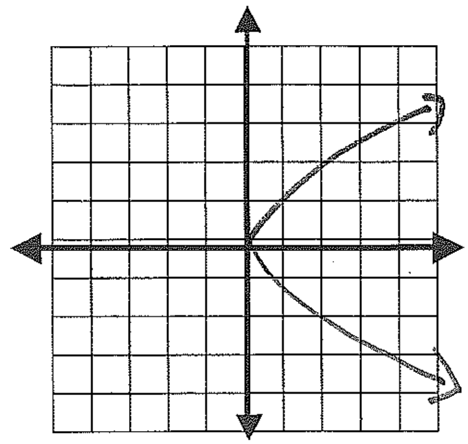
Ex. 1

a.



yes D: $(-\infty,\infty)$
R: $(-\infty,0]$

b.



no

Ex. 2

a. $f(x)=x^2+y^2$

no

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

yes
D: $(-\infty,\infty)$
R: $(-\infty,\infty)$

c. $f(x)=5$

yes
D: $(-\infty,\infty)$
R: 5

Classwork:
p101 section 2.1 #12, 14, 16 interval notation
p61 #23-27 odd, 29-32 all

3.3 Transformation of Functions

$\boxed{y=f(x)}$

Transformation - a change in the position, size, or shape of a figure.

Translation - or slide, is a transformation that moves each point in a figure the same distance in the same direction

Horizontal: $y=f(x-h)$ right h units $y=f(x+h)$ left h units * opposite of what you think

Vertical: $y=f(x)-k$ down k units $y=f(x)+k$ up k units * same as you think

Reflection - a transformation that flips a figure across a line called the line of reflection. Each reflection point is the same distance from the line of reflection, but on the opposite side of the line.

Across the y-axis $y=f(-x)$ substitute $(-x)$ in for all x's

Across the x-axis $y=-f(x)$ (make the whole function negative)

Stretch - pulling the points away from an axis

Horizontal (wider) multiply all x values by a factor between 0 & 1

Vertical taller.

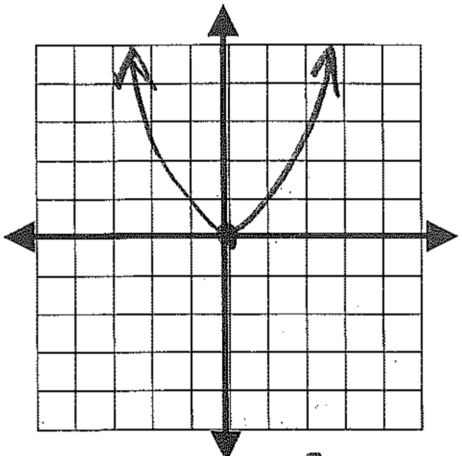
multiply all y values (whole function) by a number greater than 1

Compression – pushing the points toward an axis

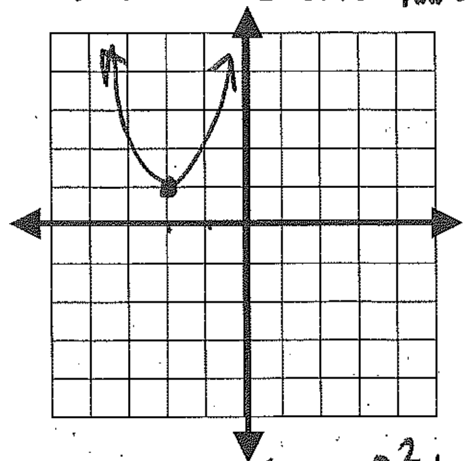
Horizontal (narrower) multiply all x values by a factor greater than 1

Vertical (shorter) multiply all y values (whole function) by a factor between 0 + 1

Ex. 1 Graph original + transformed function. State transformations.



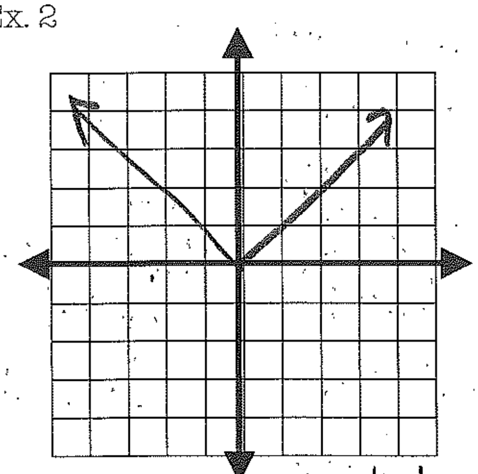
$y = x^2$



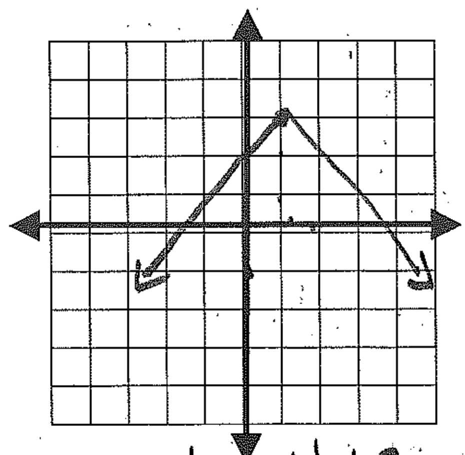
$y = (x+2)^2 + 1$

left 2
up 1

Ex. 2



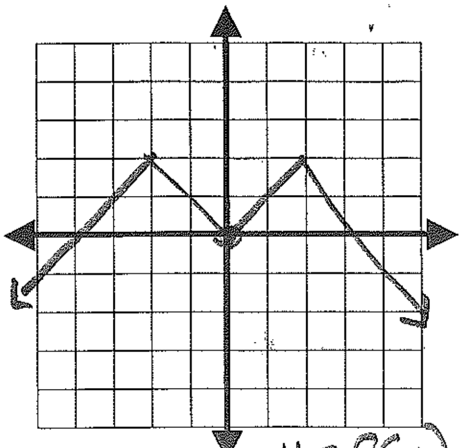
$y = |x|$



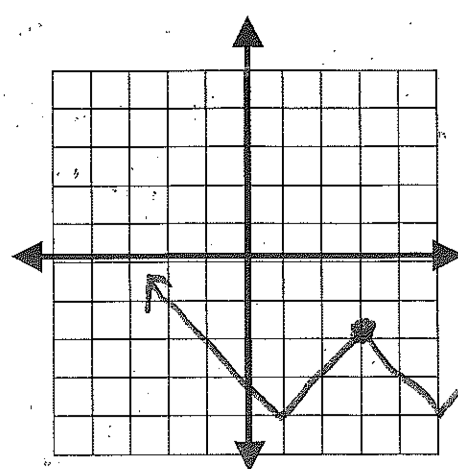
$y = -|x-1| + 3$

right 1
up 3
refl. across x axis

Ex. 3.



$y = f(x)$



$y = -f(x-3) - 2$

right 3
down 2
refl across x axis

parallel lines → same slope

3.4 Linear Functions

$\perp$ lines → opposite sign reciprocal (flip it)

Linear Equation- has no operations other than addition, subtraction, and multiplication of a variable by a constant. Ex. $y = mx + b$ (slope intercept form)

Linear Function- a function that has ordered pairs that will make a linear equation. Can be written as $f(x) = mx + b$

Standard Form- $AX + BY = C$, where A is greater than 0, and A and B aren't both 0 (no fractions) +

X-Intercept- The x-coordinate of the point that crosses the x-axis $(x, 0)$

Y-Intercept- The y-coordinate of the point that crosses the y-axis $(0, y)$

Ex. 1 write equation of a line in $y=mx+b$ form given:

A. $m = \frac{1}{2}$ point $(0, 3)$ b

$\boxed{y = \frac{1}{2}x + 3}$

B. $m = 0$ point $(0, -2)$

$y = 0x + -2$

$\boxed{y = -2}$

C. $m = 7$ point $(0, 5)$

$\boxed{y = 7x + 5}$

Ex. 2 write in $y=mx+b$ form + find x + y intercepts

A. $5x + y = 4$

$-5x \quad -5x$

$\boxed{y = -5x + 4}$

yint $(0, 4)$

xint $\frac{5x}{5} + 0 = \frac{4}{5}$ $\left(\frac{4}{5}, 0\right)$

$x = \frac{4}{5}$

B) $9x - 2y = 18$

$-9x \quad -9x$

$\frac{-2y}{-2} = \frac{-9x}{-2} + \frac{18}{-2}$

$y = \frac{9}{2}x - 9$

yint $(0, -9)$

xint

$9x - 2(0) = 18$

$\frac{9x}{9} = \frac{18}{9}$

$x = 2$ $(2, 0)$

Ex. 3 write in standard form using integer coefficients

A. $y = -3x + 1$

$+3x \quad +3x$

$\boxed{3x + y = 1}$

B. $y = \frac{1}{2}x + 2$

$-\frac{1}{2}x \quad -\frac{1}{2}x$

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

$\boxed{x - 2y = -4}$

C. $\left(\frac{-4}{1}\right) -\frac{1}{2}x - y\left(\frac{-4}{1}\right) = \frac{3}{4}\left(\frac{-4}{1}\right)$

$\boxed{2x + 4y = -3}$

Ex. 4 Graph the line

$2x + 4y = 8$

xint

$2x + 4(0) = 8$

$\frac{2x}{2} = \frac{8}{2}$

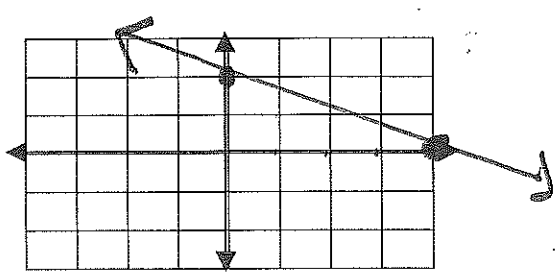
$x = 4$ $(4, 0)$

yint

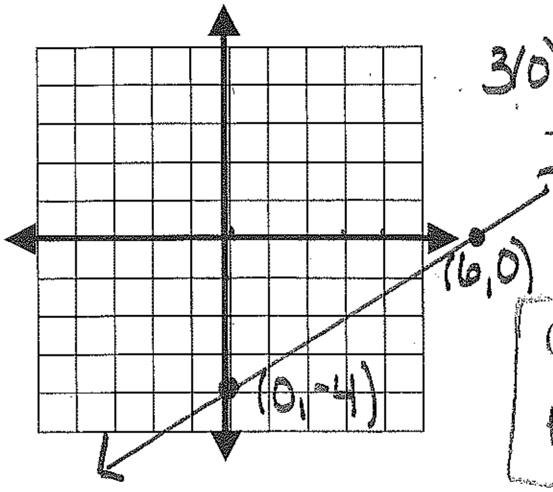
$2(0) + 4y = 8$

$\frac{4y}{4} = \frac{8}{4}$

$y = 2$ $(0, 2)$



Ex. 5 $3y-2x=12$ Graph the line label x + y intercepts



x int

$3(0)-2x=-12$

$\frac{-2x}{-2}=\frac{-12}{-2}$

$x=6$

y int

$3y-2(0)=-12$

$\frac{3y}{3}=\frac{-12}{3}$

$y=-4$

Classwork
p 66 # 15-23 odd, 27-49 odd

3.5 Writing Linear Equations

$\boxed{m=\frac{y_2-y_1}{x_2-x_1}}$ slope

Slope-Intercept Form- $y=mx+b$; m = slope, b= y-intercept

Point-Slope Form- $y-y_1=m(x-x_1)$; m = slope x_1 & y_1 are a coordinate (x_1, y_1) point

Write equations in slope intercept form

Ex. 1 $m=2$ point $(3,-5)$ x_1 y_1

$y - -5 = 2(x-3)$

$y+5=2x-6$

$-5 \quad -5$

$\boxed{y=2x-11}$

Ex. 2 passing through points $(3,2)$ and $(5,8)$
$x_1\ y_1 \quad x_2\ y_2$

$m=\frac{8-2}{5-3}=\frac{6}{2}=\boxed{3}$

$y-2=3(x-3)$

$y-2=3x-9$

$+2 \quad +2$

$\boxed{y=3x-7}$

Ex. 3 x intercept = 2 $(2,0)$ $x_1\ y_1$ y intercept = -1 $(0,-1)$ $x_2\ y_2$

$m=\frac{-1-0}{0-2}=\frac{-1}{-2}=\boxed{\frac{1}{2}}$

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

$\boxed{y=\frac{1}{2}x-1}$

Ex. 4 A fair entrance ticket costs \$10. Each ride costs \$3. Write an equation to represent how much it will cost you (y) to go to the fair riding X number of rides.

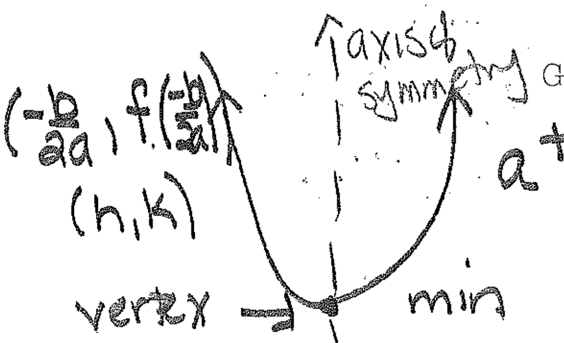
$y=10+3x \longrightarrow \boxed{y=3x+10}$

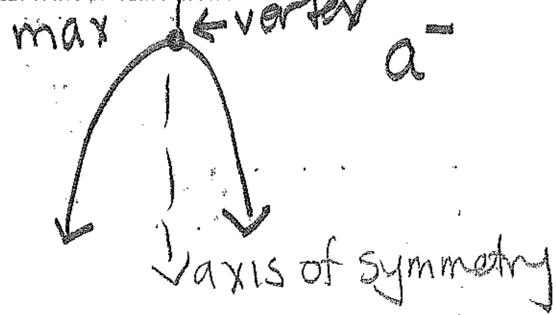
Classwork:
p78 13-17 all, 23-31 odd

3.6 Graphing Quadratic Functions

Quadratic Equation Standard Form- $\boxed{f(x) = ax^2 + bx + c}$ $y = a(x-h)^2 + k$

Graph of a Quadratic Function





What affects the parabola

- If a > 0 the graph will open upwards
- If a < 0 the graph will open downwards
- |a| > 1 stretches away from the axes
- 0<|a|<1 compresses toward the axes
- If k is > 0 the graph will shift up that many points
- If k is < 0 the graph will shift down that many points

- If h is >0 the graph will shift right that many points
- If h is <0 the graph will shift left that many points

Roots- the solutions of a quadratic equation (the x-intercepts found by solving the zeros) (where graph crosses x axis)

0, 1, 2

Solutions of a Quadratic Equation

One Real Two Real No Real

Ex. 1 Graph a Quadratic Function $a=1\ b=-4\ c=4$

$y = x^2 - 4x + 4$

x	y
0	4
1	1
2	0
3	1
4	4

$y = 0^2 - 4(0) + 4 = 0 - 0 + 4$

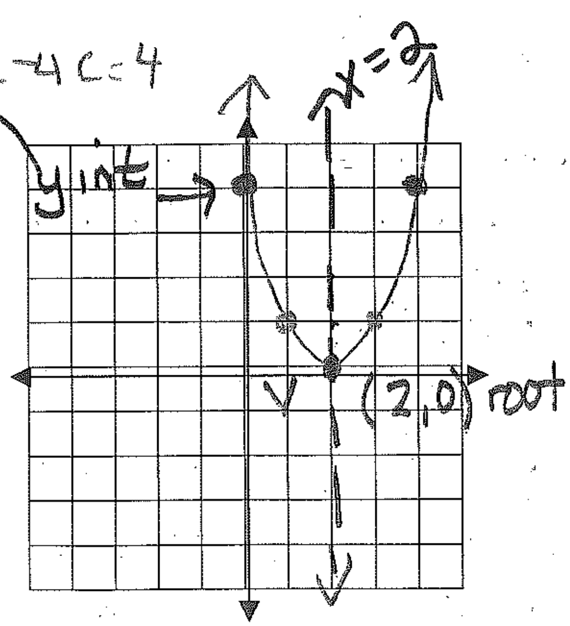
$y = 1^2 - 4(1) + 4 = 1 - 4 + 4$

$y = 2^2 - 4(2) + 4 = 4 - 8 + 4 = -4 + 4$

$y = 3^2 - 4(3) + 4 = 9 - 12 + 4$

$y = 4^2 - 4(4) + 4 = 16 - 16 + 4$

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



$a=2$
$b=-8$
$c=3$

Ex. 2 Axis of Symmetry, y-Intercept, and Vertex

Given $y=2x^2-8x+3$

a. Find the y-intercept, the equation of the axis of symmetry, and the x-coordinate of the vertex. (same)

y int set $x=0$
$y=2(0)^2-8(0)+3$
$\boxed{y=3}$

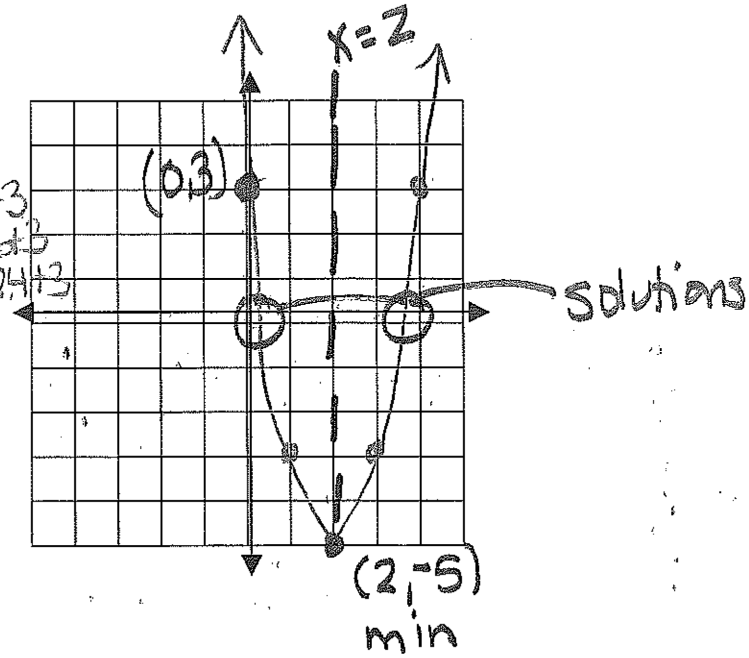
$x=\frac{-b}{2a}=\frac{-(-8)}{2(2)}=\frac{8}{4}=2$

axis of sym $x=2$ x coor. vertex $=2$

b. make a table of values that includes the vertex and graph

x	y
0	3
1	-3
2	-5
3	-3
4	3

$y=2(0)^2-8(0)+3$
$y=2(1)^2-8(1)+3=2-8+3$
$y=2(2)^2-8(2)+3=8-16+3$
$y=2(3)^2-8(3)+3=18-24+3$
$y=2(4)^2-8(4)+3$
$=32-32+3$



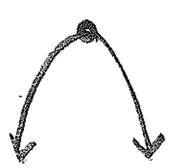
Ex. 3 Maximum or Minimum Value

Given $y=-x^2+13x-12$

$a=-1$
$b=13$
$c=-12$

a. Determine whether the function has a maximum or a minimum value.

$a=-1$ max



b. State the maximum or minimum value of the function. y value $f\left(\frac{-b}{2a}\right)$

$\frac{-b}{2a}=\frac{-13}{2(-1)}=\frac{-13}{-2}=\frac{13}{2}=6.5$

$y=-(6.5)^2+13(6.5)-12=\boxed{30.25}$ max. value

Ex. 4 Find a Maximum Value

Four hundred people came to last year's winter play at Sunnybrook High School. The ticket price was \$5. This year, the Drama Club is hoping to earn enough money to take a trip to a Broadway play. They estimate that for each \$.50 increase in the price, 10 fewer people will attend their play.

a.

b. What is the maximum income the Drama Club can expect to make?

Ex. 5 Two Real Solutions

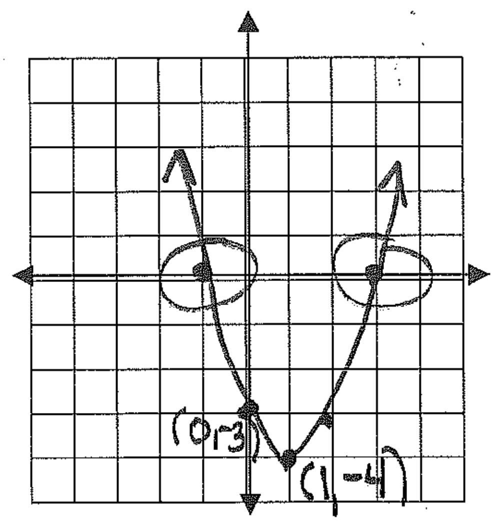
$a=1 \quad b=-2 \quad c=-3$

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

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

x	y
-1	0
0	-3
1	-4
2	-3
3	0

Solutions $\boxed{x=-1 \quad x=3}$



Ex. 6 One Real Solution (double root)

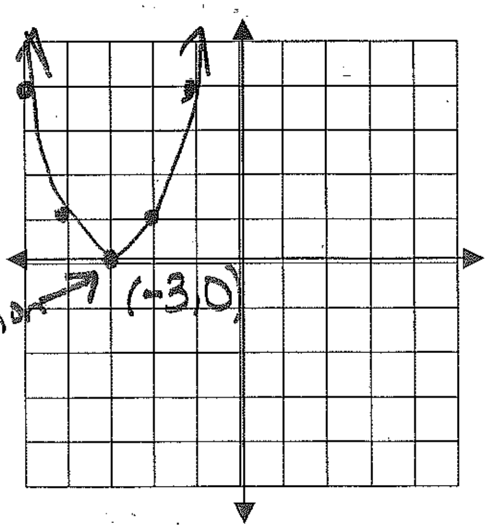
$y = x^2 + 6x + 9$

$a=1 \quad b=6 \quad c=9$

$x = \frac{-b}{2a} = \frac{-6}{2(1)} = \frac{-6}{2} = -3$

x	y
-5	4
-4	1
-3	0
-2	1
-1	4

Solution



$\boxed{x=-3}$

Solution

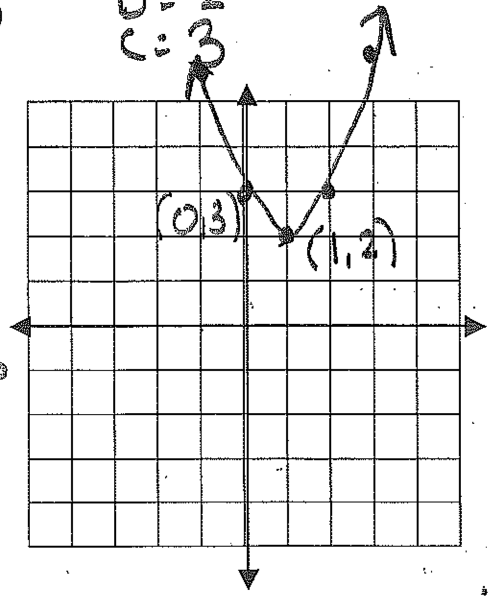
Ex. 3 No Real Solutions $y = x^2 - 2x + 3$

$a = 1$
$b = -2$
$c = 3$

x	y
-1	6
0	3
1	2
2	3
3	6

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

no real solutions

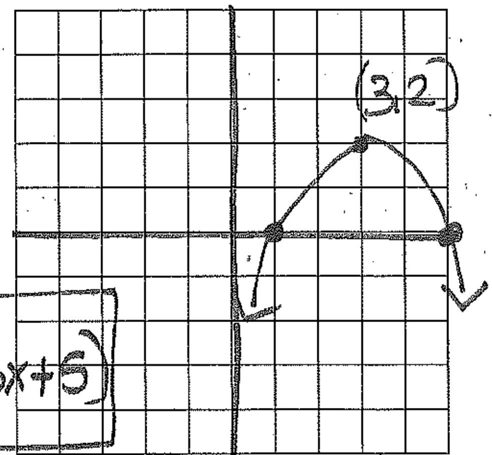


Ex. 4 Write an Equation Given the Graph

$x = 1 \quad x = 5$
$-1 \quad -1$
$x - 1 = 0 \quad x - 5 = 0$
$y = a(x-1)(x-5)$
$y = a(x^2 - 5x - 1x + 5)$
$y = a(x^2 - 6x + 5)$
$(3, 2)$ $2 = a(3^2 - 6(3) + 5)$
$x \ y$ $2 = a(9 - 18 + 5)$

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

$\boxed{y = -\frac{1}{2}(x^2 - 6x + 5)}$



3.7 Solving Quadratic Equations by Factoring

① set equation = 0
② factor
③ set each factor = 0
solve

Ex. 1 Two Roots

a. $x^2 = 6x$
$-6x \ -6x$
$x^2 - 6x = 0$
$x(x - 6) = 0$
$\boxed{x = 0}$ $\quad x - 6 = 0$
$+6 \ +6$
$\boxed{x = 6}$

b. $x^2 + 7x + 12 = 0$
$(x + 3)(x + 4) = 0$
$+3x \quad +4x$
$x + 3 = 0 \qquad x + 4 = 0$
$-3 \ -3 \qquad -4 \ -4$
$x = -3 \qquad x = -4$

Ex. 2 Double Root

$x^2 - 8x + 16 = 0$
$(x - 4)(x - 4) = 0$
$-4x \ -4x$
$x - 4 = 0$
$+4 \ +4$

$x = 4$

Ex. 3 Greatest Common Factor

1, 20
2, 10
4, 5

$3x^2 - 3x - 60 = 0$
$3(x^2 - x - 20) = 0$
$\frac{3}{3} \quad x^2 - x - 20 = \frac{0}{3}$
$(x + 4)(x - 5) = 0$
$+4x \ -5x$

$x + 4 = 0 \qquad x - 5 = 0$
$-4 \ -4 \qquad +5 \ +5$
$x = -4 \qquad x = 5$

Ex. 4 Write an Equation Given Roots

xint $(-2,0)$ $(-6,0)$

a.

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

$+2\ +2 \quad +6\ +6$

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

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

$x^2+6x+2x+12=0$

$\boxed{x^2+8x+12=0}$

b.

$x=\frac{1}{2} \quad x=\frac{3}{4}$

$2x=1 \quad 4x=3$

$-1\ -1 \quad -3\ -3$

$2x-1=0 \quad 4x-3=0$

$(2x-1)(4x-3)=0$

$8x^2-6x-4x+3=0$

$8x^2-10x+3=0$

3.8 Complete the Square

For and real number n, $\boxed{x^2 = n,}$ then $\boxed{x = \pm\sqrt{n}}$

Ex. 1 Equation with Rational Roots

$x^2+10x+25=49$

$(x+5)(x+5)$

$(x+5)^2=49$

$\sqrt{(x+5)^2}=\sqrt{49}$

$x+5=\pm 7$

$-5\ -5$

$x=-5\pm 7$

$x=-5+7 \quad \boxed{x=2}$

$x=-5-7 \quad \boxed{x=-12}$

Ex. 2 Equation with Irrational Roots

$x^2-6x+9=32$

$(x-3)(x-3)$

$\sqrt{(x-3)^2}=\sqrt{32}$

$x-3=\pm\sqrt{32}$

$+3\ +3$

$x=3\pm\sqrt{32}$

$x=3\pm\sqrt{32}$

2 16

4 4

$\boxed{x=3\pm 4\sqrt{2}}$

Completing the Square

1. Find ½ of b (the number in front of x)
2. Square the answer to step one
3. Add the answer to step two to x^2 + bx

Ex. 3 Complete the Square find C

a) $x^2+12x+C$

$b=12$

$\frac{1}{2}b=6$

$(\frac{1}{2}b)^2=36$

$\boxed{x^2+12x+36}$

$(x+6)(x+6)$

b) x^2+8x+C

$b=8$

$\frac{1}{2}b=4$

$(\frac{1}{2}b)^2=16$

$\boxed{x^2+8x+16}$

$(x+4)(x+4)$

c) x^2-6x+C

$b=-6$

$\frac{1}{2}b=-3$

$(\frac{1}{2}b)^2=9$

$\boxed{x^2-6x+9}$

$(x-3)(x-3)$

d) x^2-5x+C

$b=-5$

$\frac{1}{2}b=-\frac{5}{2}$

$(\frac{1}{2}b)^2=\frac{25}{4}$

$x^2-5x+\frac{25}{4}$

$(x-\frac{5}{2})(x-\frac{5}{2})$

Ex. 4 Solve an Equation by Completing the Square

a) $x^2+8x-20=0$

$+20\ +20$

$x^2+8x+\boxed{16}=20+\boxed{16}$

$b=8$

$\frac{1}{2}b=4$

$(\frac{1}{2}b)^2=16$

$(x+4)(x+4)=36$

$\sqrt{(x+4)^2}=\sqrt{36}$

$x+4=\pm 6$

$-4\ -4$

$x=-4\pm 6$

$x=-4+6 \quad x=2$

$x=-4-6 \quad x=-10$

b) $x^2-8x+15=0$

$-15\ -15$

$x^2-8x+\boxed{16}=-15+\boxed{16}$

$b=-8$

$\frac{1}{2}b=-4$

$(\frac{1}{2}b)^2=16$

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

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

$x-4=\pm 1$

$+4\ +4$

$x=4\pm 1$

$x=4+1 \quad x=5$

$x=4-1 \quad x=3$

Ex. 5 Equation with a ≠ 1

$$\frac{2x^2}{2} - \frac{5}{2}x + \frac{3}{2} = \frac{0}{2}$$

$$x^2 - \frac{5}{2}x + \frac{3}{2} = 0$$

$$-\frac{3}{2} \quad -\frac{3}{2}$$

$b = -\frac{5}{2}$

$\frac{1}{2}b = -\frac{5}{2} \cdot \frac{1}{2} = -\frac{5}{4}$

$(\frac{1}{2}b)^2 = \frac{25}{16}$

$$x^2 - \frac{5}{2}x + \boxed{\frac{25}{16}} = -\frac{3}{2}\left(\frac{8}{8}\right) + \boxed{\frac{25}{16}}$$

$$\left(x - \frac{5}{4}\right)\left(x - \frac{5}{4}\right) = -\frac{24}{16} + \frac{25}{16}$$

$$\sqrt{\left(x - \frac{5}{4}\right)^2} = \sqrt{\frac{1}{16}}$$

$$x - \frac{5}{4} = \pm\frac{1}{4}$$

$$+\frac{5}{4} \quad +\frac{5}{4}$$

$$x = \frac{5}{4} \pm \frac{1}{4}$$

$x = \frac{5}{4} + \frac{1}{4} = \frac{6}{4}$ $x = \frac{5}{4} - \frac{1}{4} = \frac{4}{4}$

$x = \frac{3}{2}$ $x = 1$

Ex. 6 Equation with Complex Solutions

$$x^2 + 4x + 11 = 0$$

$$-11 \quad -11$$

$b = 4$

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

$(\frac{1}{2}b)^2 = 4$

$$x^2 + 4x + \boxed{4} = -11 + \boxed{4}$$

$$(x+2)(x+2) = -7$$

$$\sqrt{(x+2)^2} = \sqrt{-7}$$

$$x + 2 = \pm\sqrt{-7}$$

$$-2 \quad -2$$

$$x = -2 \pm \sqrt{-7}$$

$$x = -2 \pm i\sqrt{7}$$

discriminant

$b^2 - 4ac > 0$ (+) – 2 rational roots or 2 irrational roots

$b^2 - 4ac = 0$ 1 rational root

$b^2 - 4ac < 0$ (−) 2 imagnary roots

3.9 The Quadratic Formula

Quadratic Formula : $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Ex. 1 Two Rational Roots

$a = 1$

$b = -12$

$c = -28$

$$x^2 - 12x = 28$$

$$-28 \quad -28$$

$$x^2 - 12x - 28 = 0$$

$$b^2 - 4ac = (-12)^2 - 4(1)(-28) = 144 + 112 = 256$$

$$x = \frac{-(-12) \pm \sqrt{256}}{2(1)}$$

$$x = \frac{-12}{2} \pm \frac{16}{2}$$

$$x = -6 \pm 8$$

$x = -6+8 = 2 =$

$x = -6-8 = -14 =$

Ex. 2 One Rational Root

$$x^2 + 22x + 121 = 0$$

$a = 1$

$b = 22$

$c = 121$

$$b^2 - 4ac = (22)^2 - 4(1)(121) = 484 - 484 = 0$$

$$x = \frac{-22 \pm \sqrt{0}}{2(1)} = \frac{-22}{2} = \boxed{-11 = x}$$

Ex. 3 Irrational Roots

$$2x^2 + 4x - 5 = 0$$

$a = 2$

$b = 4$

$c = -5$

$$b^2 - 4ac = (4)^2 - 4(2)(-5) = 16 + 40 = 56$$

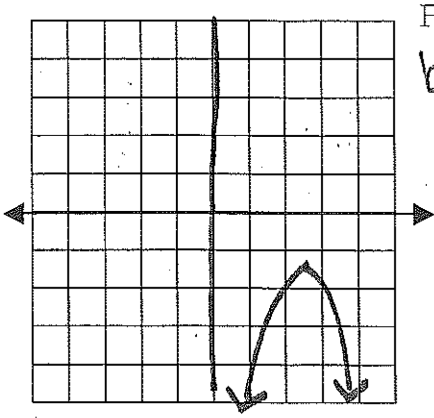
$56 = 2 \cdot 28$, $28 = 2 \cdot 14$

$$x = \frac{-4 \pm \sqrt{56}}{2(2)} = \frac{-4}{4} \pm \frac{2\sqrt{14}}{4}$$

$$x = -1 \pm \frac{\sqrt{14}}{2}$$

Ex. 4 Complex Roots

$a = -1$
$b = 7$
$c = -14$



$-x^2 + 7x - 14 = 0$

$b^2 - 4ac = (7)^2 - 4(-1)(-14)$
$= 49 - 56 = -7$

$\sqrt{-7}$

$x = \dfrac{-7 \pm \sqrt{-7}}{2(-1)}$

$x = \dfrac{-7}{-2} \pm \dfrac{i\sqrt{7}}{-2}$

$\boxed{x = \dfrac{7}{2} \pm \dfrac{i\sqrt{7}}{2}}$

3.10 Analyzing Graphs of Quadratic Functions

Vertex form= $y = a(x - h)^2 + k$, where (h,k) is the vertex of the parabola, and $x = h$ is the axis of symmetry.

opposite same

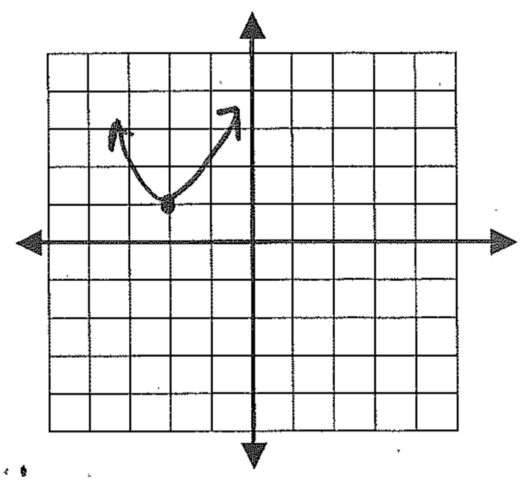
Ex. 1 ~~Graph~~ Sketch a Quadratic Function in Vertex Form

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

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

$V(-2, 1)$

$a = 1^+$



Ex. 2 Write $y = x^2 + bx + c$ in Vertex Form

$y = x^2 + 8x - 5$

$y = (x^2 + 8x + \boxed{16}) - 5 - \boxed{16}$

$y = (x+4)(x+4) - 21$

$b = 8$
$\frac{1}{2}b = 4$
$(\frac{1}{2}b)^2 = 16$

$y = (x+4)^2 - 21$

$V(-4, -21)$

Ex. 3 Write $y = ax^2 + bx + c$ in Vertex Form if ~~a≠1~~.

$y = x^2 - 12x + 7$

$y = (x^2 - 12x + \square) + 7 - \square$

$y = (x^2 - 12x + \boxed{36}) + 7 - \boxed{36}$

$y = (x-6)(x-6) - 29$

$y = (x-6)^2 - 29$

$b = -12$
$\frac{1}{2}b = -6$
$(\frac{1}{2}b)^2 = 36$

$V(6, -29)$