U2D3a_T Quadratic Function Properties MCR 3UI

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U2D3a_T Quadratic...

U2D3a MCR 3UI **QUADRATIC FUNCTIONS**

Summary Of Quadratic Functions
(Everything you should know but may have forgotten)

1. **Vertex Form** **Example** $g(x) = -\frac{1}{2}(x+1)^2 - 10$

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

direction of opening $a>0 \Rightarrow$ UP ü
$a<0 \Rightarrow$ DOWN ⌢̈

$\boxed{\text{DOWN}}$

vertex $V(h,k)$

$\boxed{(-1,-10)}$

Axis of Symmetry $x=h$

$\boxed{x=-1}$

Max/Min $y=k$ ü min ⌢̈ max

$\boxed{y=-10}$

When the optimal value occurs $x=h$

$\boxed{x=-1}$

y-int $g(0)$

$g(0) = -\frac{1}{2}(0+1)^2 - 10$

$g(0) = -10.5$

$\boxed{y=-10.5}$

Range: ü $\{y \geq k\}$
⌢̈ $\{y \leq k\}$

$\boxed{\{y \leq -10\}}$

2. **Standard Form** **Example** $f(x) = -3x^2 - 18x + 11$

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

direction of opening

$\boxed{\text{DOWN}}$

y-int $y=c$

$\boxed{y=11}$

$(0,11)$

$f(0)=11$

3. **Factored Form**

Example $y = 3(x-4)(x+2)$

State: $h = \frac{s+t}{2}$ $k = f(h)$

$y = a(x-s)(x-t)$

direction of opening $a = 3$

So, $\boxed{\text{UP}}$

roots/x-intercepts/zeros

$\boxed{x = s,\ x = t}$

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

Axis of Symmetry $x = \frac{s+t}{2}$

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

$\boxed{x = 1}$ $\leftarrow h = 1$

Max/$\boxed{\text{Min}}$

$\ddot{\cup} \Rightarrow$ MIN $\boxed{-27}$

When the optimal value occurs

$\boxed{x = 1}$

vertex $(h, f(h))$ k

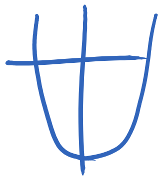
$\boxed{(1, -27)}$

$f(1)$
$= 3(-3)(3)$
$= -27$

y-intercept $f(0)$

$y = 3(0-4)(0+2)$

$= \boxed{-24}$



Range:

$\boxed{\{y \geq -27\}}$

Difference Tables

Calculate the first and second differences for the following table.

X	Y	First Diff.	Second Diff.
-2	22	-10	4
-1	12	-6	4
0	6	-2	4
1	4	2	4
2	6	6	
3	12		

$\uparrow$ 2a

Is this relation linear? Why?

No. First Differences are not constant.

Is this relation quadratic? Why?

Yes. Second Differences are constant.

What is the direction of opening?
Why?

Since $a > 0$, opens up.

NOTE: $a = \text{second diff.} \div 2$

OR $2a = \text{second diff.}$

when graph is quadratic.

Graphing: **Graph the following.**

a) $y=(x-3)(x+1)$

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

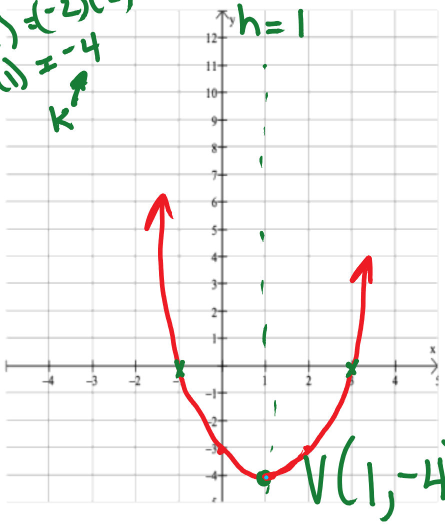
$h=1$

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

$f(1)=(-2)(2)$

$f(1)=-4$

k



$V(1,-4)$

b) $y=-2x^2+6x+8$

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

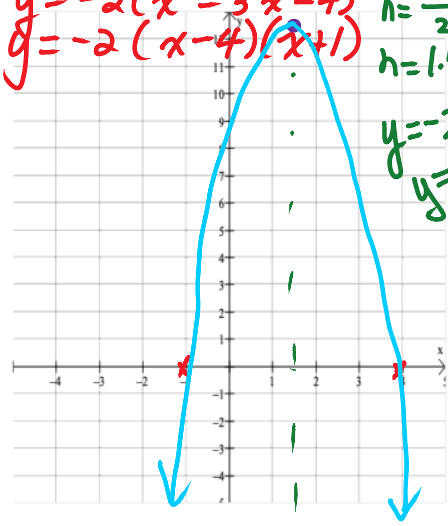
$y=-2(x-4)(x+1)$

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

$h=1.5$

$y=-2(-2.5)(2.5)$

$y=12.5$



U2D3b_T
Partial Fa...

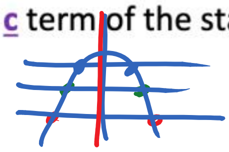
U2D3b MCR 3UI **QUADRATIC FUNCTIONS**

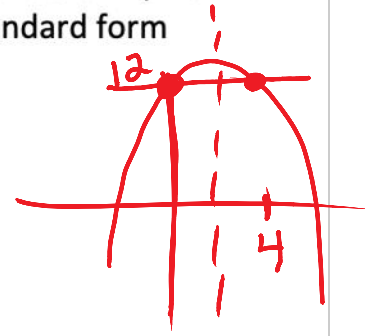
Partial Factored Form $y = ax(x - d) + c$

- Used to find two points that are **equidistant** to the axis of symmetry, which then can be used to find the **vertex**

Steps:

1. **Common factor** only the first two terms of the standard form expression $y = ax^2 + bx + c$.
2. Determine the two values of x that will make the factored part of the expression equal to **zero**.
   Note: the y value will be **the same** for these two values of x (and actually, they will be **equal** to the **c** term of the standard form expression.





Example $y = -3x^2 + 12x + 12$

$y = -3x(x-4)+12$

$\frac{b}{a}$ $d = -\frac{b}{a}$

State:

direction of opening DOWN **y-int** c

2 points equidistant to the axis of symmetry $(0,c),(d,c)$

$\boxed{(0, 12),(4,12)}$

Axis of Symmetry $x = \frac{d}{2}$

$x = \frac{4}{2} \Rightarrow \boxed{x = 2} \leftarrow h$

Max/Min $f\left(\frac{d}{2}\right)$

$f(2) = -3(2)(-2)+12$

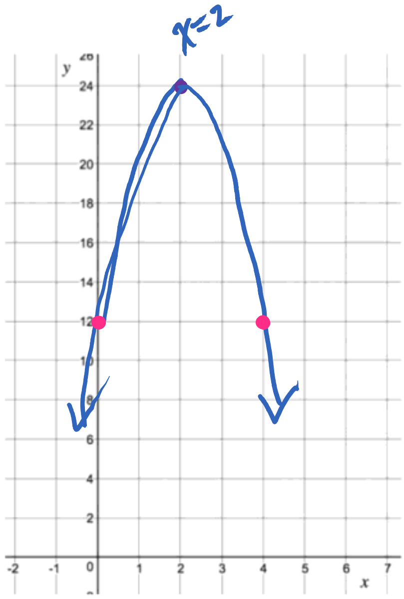
$f(2) = \boxed{24}$

When the optimal value occurs

$\boxed{x = 2}$

vertex $\boxed{(2,24)}$

Range: $\boxed{\{y \leq 24\}}$

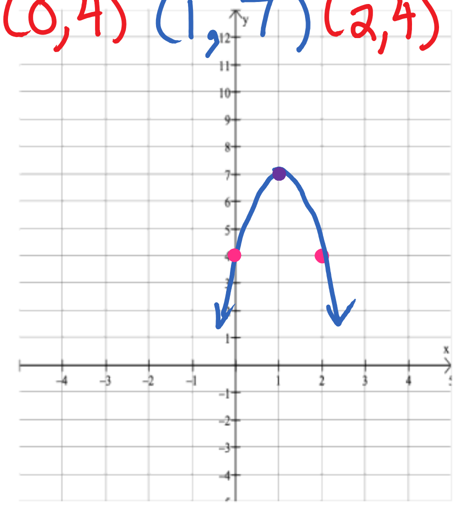


<u>Graphing:</u> Graph the following.

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

$f(1) = -3(1)(1-2)+4$
$= -3(1)(-1)+4$
$= 7$

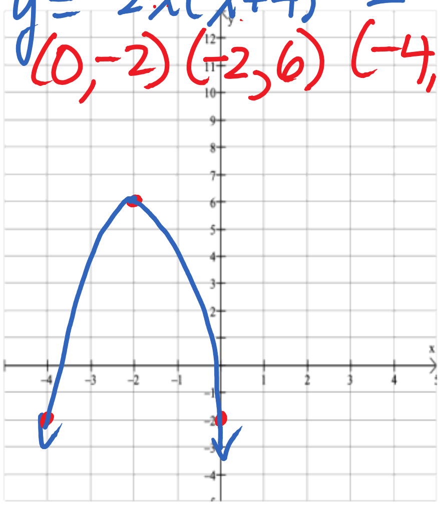
(0,4) (1, 7) (2,4)



b) $y = -2x^2 - 8x - 2$

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

(0,-2) (-2,6) (-4,-2)



In General

Vertex Form

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

Standard Form

$y = ax^2 + bx + c$

Partial Factored Form

$y = ax(x-d) + c$

Factored Form

$y = a(x-s)(x-t)$