Analyzing Quadratic Functions in the form $y=a(x-p)^2+q$

Monday, October 21, 2019 11:42 AM

Function	Vertex
$y=(x-2)^2+3$	$(2,3)$
$y=-3(x+1)^2-4$	$(-1,-4)$
$y=2x^2+5$	$(0,5)$
$y=\frac{2}{3}(x+4)^2$	$(-4,0)$

$y=a(x-p)^2+q$ is called the <u>standard form</u> of the equation of a quadratic function

a affects the shape + size of the parabola and whether it opens up or down.
- if a is +ve, parabola opens up.
- if a is -ve " " down
- if $a>1$ or $a<-1$ the parabola is compressed (skinnier)
- if $-1<a<1$ $a\neq 0$ the parabola is expanded (fatter or wider)

p moves the parabola left or right
- if p is +ve, moves right
- if p is -ve, moves left.

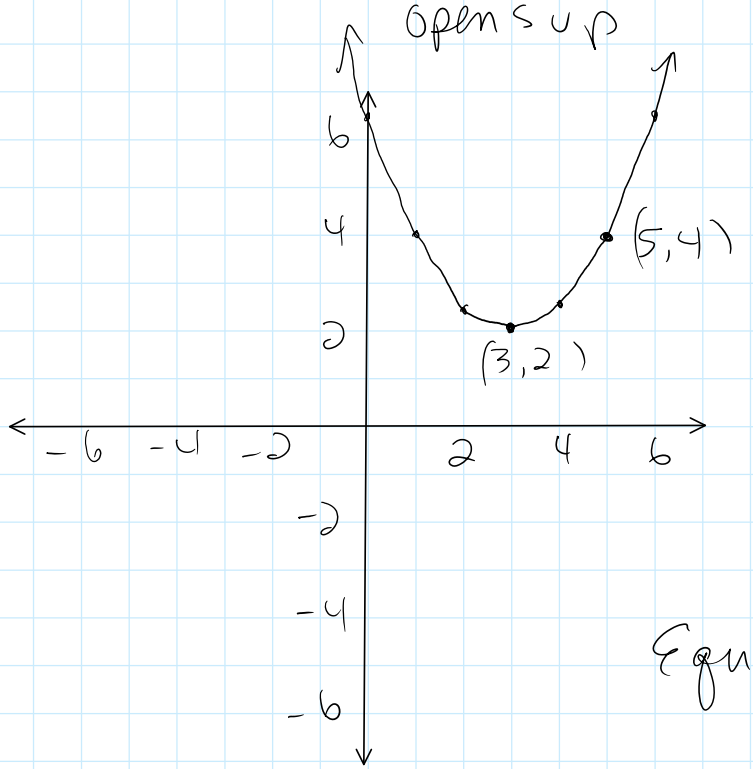
q moves the parabola up or down
- if q is +ve, moves up

∴ if q is -ve, moves down.

$y = a(x-p)^2 + q$ vertex (p, q)

axis of symmetry: $x = p$

range: $y \geq q$ or $y \leq q$



opens down

$y = a(x-p)^2 + q$

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

$4 = a(5-3)^2 + 2$

$4 = a(4) + 2$

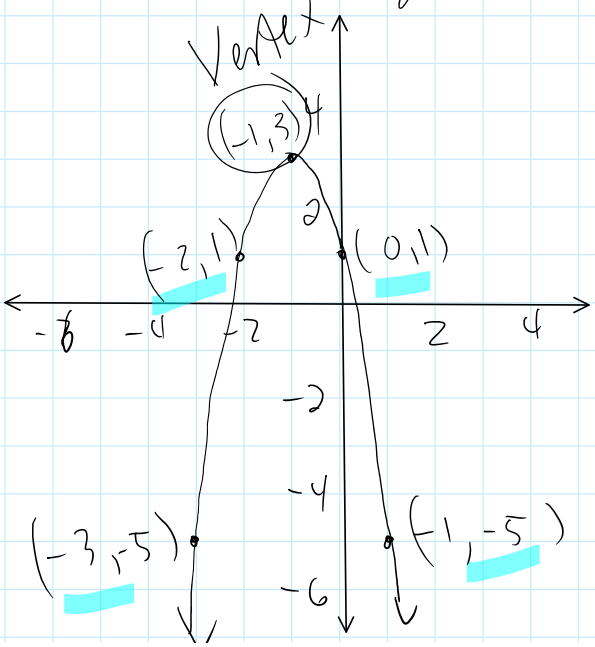
$-2 \quad\quad -2$

$\frac{2}{4} = \frac{4a}{4}$

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

Equation: $y = \frac{1}{2}(x-3)^2 + 2$

Try: Write the equation for:



$y = a(x-p)^2 + q$

$y = a(x-(-1))^2 + 3$

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

$1 = a(0+1)^2 + 3$

$1 = a + 3$

$-3 \quad\quad -3$

$-2 = a$

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

Eg For $y = -(x+3)^2 + 2$

a) direction of opening: down

b) vertex: $(-3, 2)$

c) axis of symmetry: $x = -3$

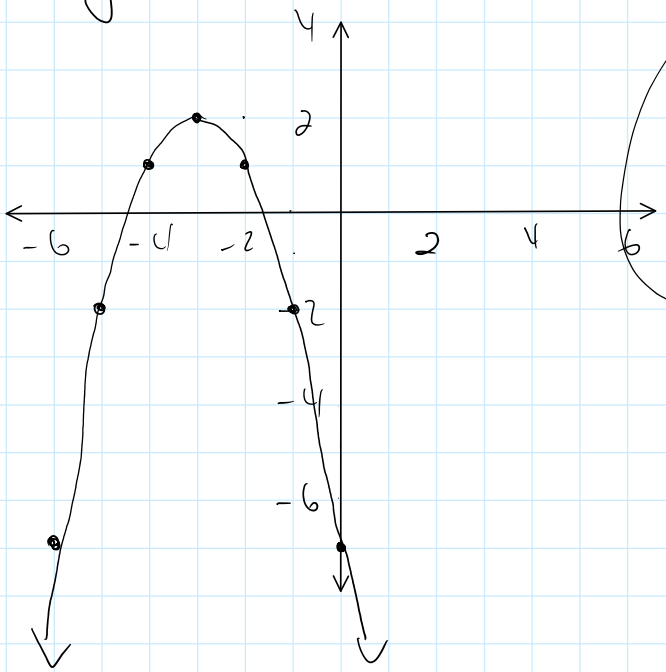
d) y-intercept: $y = -(0+3)^2 + 2$
$= -9 + 2$
$= -7$ $(0, -7)$

e) x-intercepts: $0 = -(x+3)^2 + 2$
$-2 = -(x+3)^2$
$\sqrt{2} = \sqrt{(x+3)^2}$
$\pm\sqrt{2} = x + 3$
$x = -3 \pm \sqrt{2}$ $(-3+\sqrt{2}, 0)$ $(-3-\sqrt{2}, 0)$

f) domain: $x \in R$.

g) range: $y \leq 2$

Graph $y = -(x+3)^2 + 2$.



① graph vertex
② from vertex
over 1 up a
over 1 up 3a
over 1 up 5a
over 1 up 7a.

over 1 down -1
" " " -3
" " " -5
" " " -7

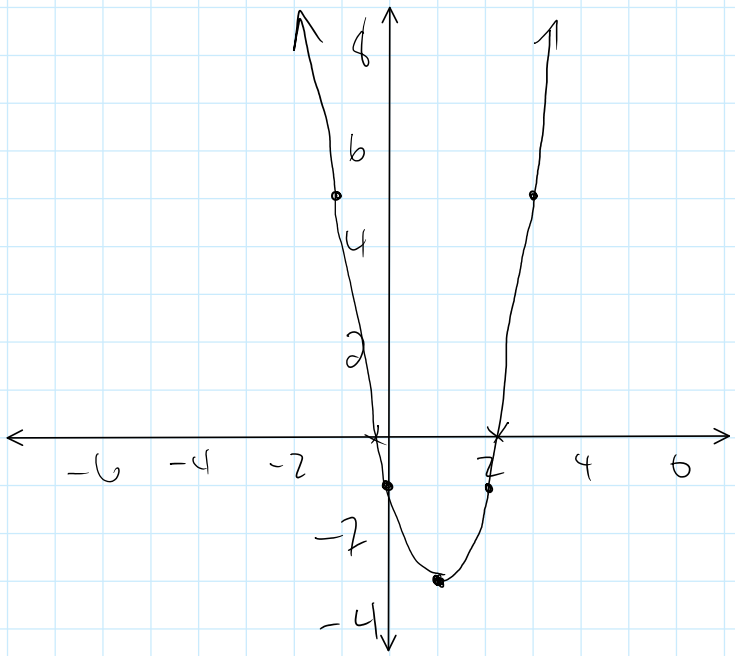
For $y = 2(x-1)^2 - 3$ find:

a) direction of opening up $y = 2(0-1)^2 - 3$

a) direction of opening up
b) vertex $(1, -3)$
c) axis of symmetry $x = 1$
d) y-intercept $(0, -1)$
e) x-intercepts $(1+\sqrt{\frac{3}{2}}, 0)$ $(1-\sqrt{\frac{3}{2}}, 0)$
f) domain $x \in R$.
g) range $y \geq -3$.
h) graph it.

$y = 2(0-1)^2 - 3$
$y = 2 - 3$
$y = -1$

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



$a = 2$

over 1 up a (2)
" 1 up 3a (6)
over 1 up 5a (10)

Pg 304-09 # 3-12.