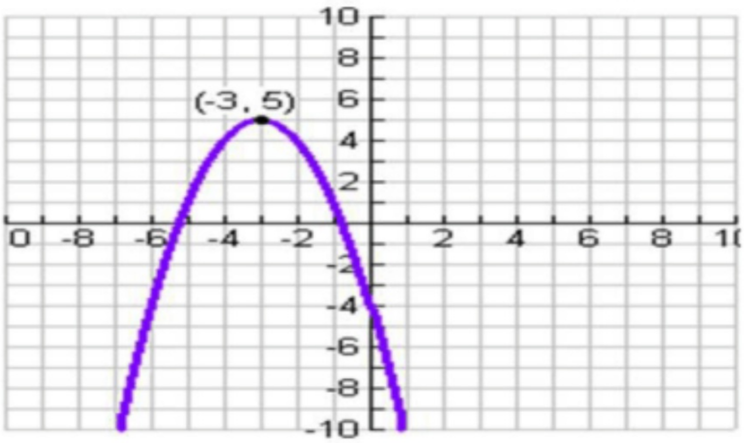
Warm Up 9/17

1. State the interval in which the function is increasing. Decreasing?

$(-\infty, -3]$

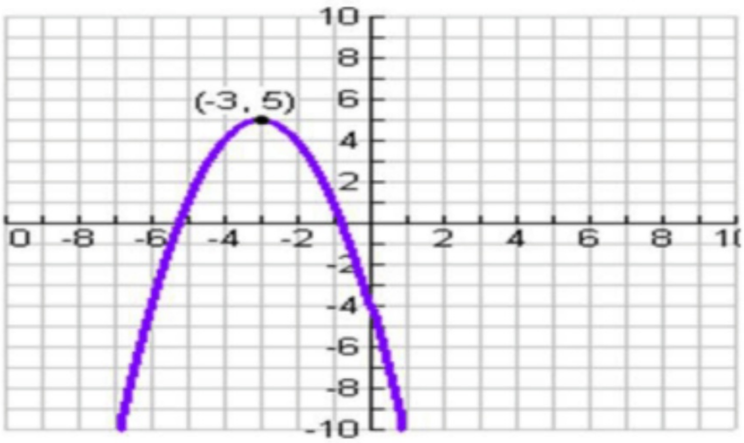
$) : [-3, \infty)$



2. Complete the square: $2x^2 - 12x + 23$

Warm Up Solutions

1. State the interval in which the function is increasing. Decreasing?



Warm Up Solutions

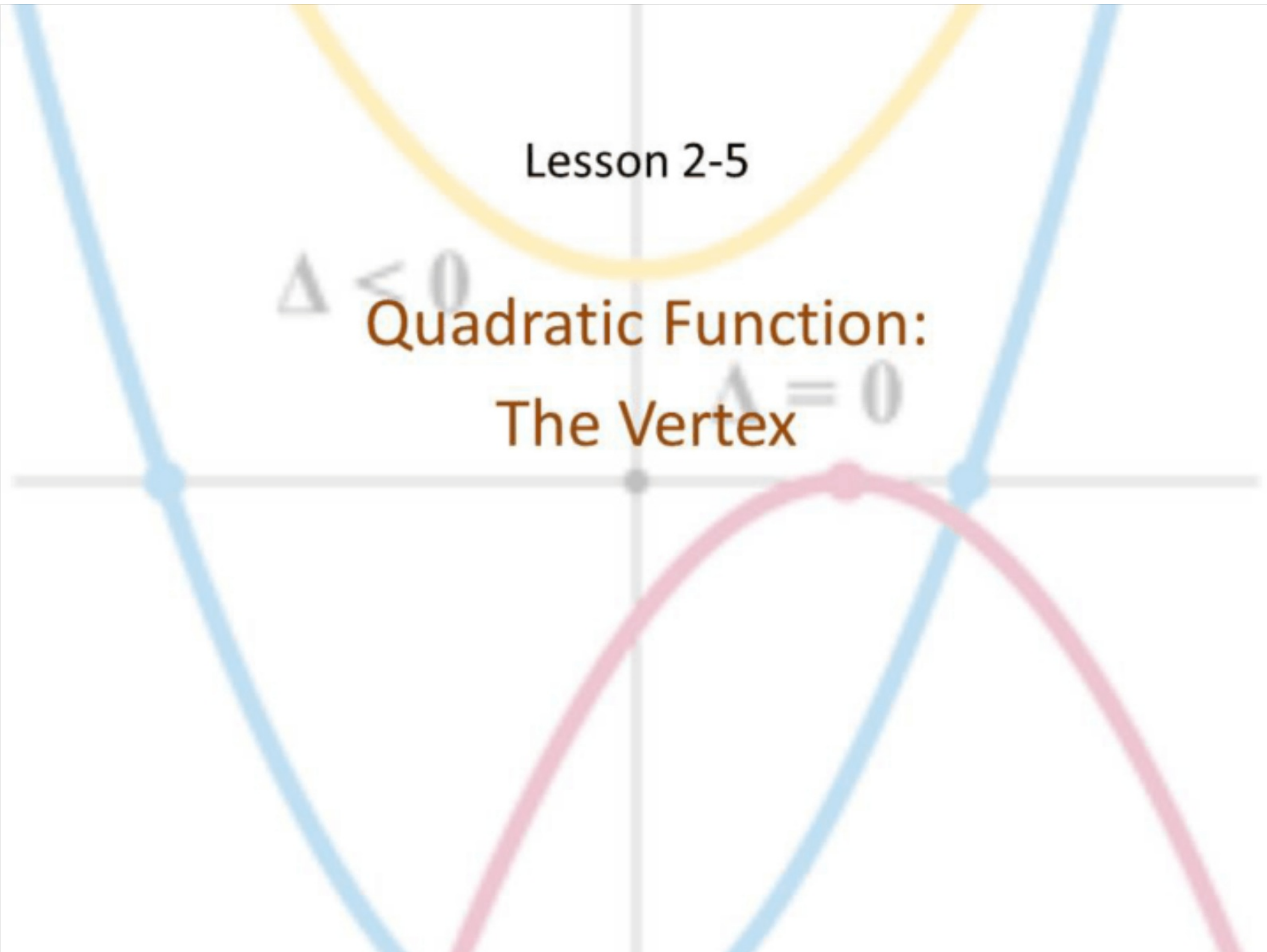
2. Complete the square: $2x^2 - 12x + 23$

$$\frac{f(x)}{2} = \frac{\cancel{2}x^2}{\cancel{2}} - \frac{12x}{2} + \frac{23}{2} \Rightarrow \frac{f(x)}{2} = \left(x^2 - 6x\right) + \frac{23}{2}$$

$$\Rightarrow \frac{f(x)}{2} + 9 = \left(x^2 - 6x + 9\right) + \frac{23}{2} = (x-3)^2 + \frac{23}{2} - \frac{18}{2}$$

$$\left(\frac{f(x)}{2} = (x-3)^2 + \frac{5}{2}\right) \Rightarrow f(x) = \boxed{2(x-3)^2 + 5}$$

$$\left(\frac{b}{2}\right)^2 \quad \frac{-6}{2} = (-$$


Lesson 2-5
$\Delta < 0$
Quadratic Function:
$\Delta = 0$
The Vertex

Objective

Students will…

- Be able to write standard form of a quadratic function into its vertex form by completing the square, and identify the vertex.
- Be able to solve to find the vertex of a quadratic from its standard form by using $\mathrm{x} = \frac{-b}{2a}$

Standard form of a Quadratic Function

Recall that the standard form of a quadratic function is:

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

where *a, b,* and *c* are real numbers and $a \neq 0$

$y = mx + b$

Vertex Form

Also, recall that the standard vertex form of a quadratic function is

$f(x) = (x - h)^2 + k$, with the vertex being (h, k).

Ex. $f(x) = (x - 2)^2 - 4$

$V: (2, -4)$

Completing the Square

$\left(\frac{b}{2}\right)^2 = \left(\frac{4}{2}\right.$

$= ($

We can always write the standard form into the vertex form by completing the square.

Ex. $\frac{f(x)}{2} = \frac{2x^2}{2} + \frac{8x}{2} + \frac{10}{2} \Rightarrow \frac{f(x)}{2} = (x^2+4x)+5$

$\cancel{4} + \frac{f(x)}{2} = (x^2+4x+4)+5 = (x+2)^2+5-4$

$2\cdot\frac{f(x)}{2} = 2((x+2)^2+1) \Rightarrow \boxed{f(x) = 2(x+2)^2+2}$

$V: (-2, 2)$

The reason why this can be useful is because we can more easily and quickly identify the vertex of the quadratic functions when we see them in their vertex form. The point of learning how to identify the vertex will be explored more in detail during the next lesson.

Vertex from the Standard Form?

$$\left(\frac{b}{2}\right)^2 = \left(\frac{\frac{b}{a}}{2}\right)^2 = \left(\frac{b}{a}\cdot\frac{1}{2}\right)^2 = \left(\frac{b}{2a}\right)^2 =$$

Question arises, is there a way to derive the vertex directly from the standard form? Well, there is. You may recall the formula from before, but it can be rather easily derived by completing the square of the general standard form. Consider,

$$\frac{f(x)}{a} = \frac{ax^2}{a} + \frac{bx}{a} + \frac{c}{a} \Rightarrow \frac{f(x)}{a} = \left(x^2 + \frac{b}{a}x\right) + \frac{c}{a}$$

$$\frac{f(x)}{a} = \left(x^2 + \frac{b}{a}x + \frac{b^2}{4a^2}\right) + \frac{c}{a} = \left(x + \frac{b}{2a}\right)^2 + \frac{4ac}{4a^2} - \frac{b^2}{4a^2}$$

$$a\,\frac{f(x)}{a} = a\left(\left(x + \frac{b}{2a}\right)^2 + \frac{4ac - b^2}{4a^2}\right) \Rightarrow \boxed{f(x) = a\left(x + \boxed{\frac{b}{2a}}\right)^2 + \frac{4ac - b^2}{4a}}$$

$$V: \left(\frac{-b}{2a},\ f\left(\frac{-b}{2a}\right)\right)$$

Vertex from the Standard Form?

So, the general form of vertex from the standard form turns out to be $\left(\frac{-b}{2a}, f\left(\frac{-b}{2a}\right)\right)$.

Ex. Find the vertex of the following quadratic functions.

1. $f(x) = x^2 + 6x + 3$

$V: \left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$

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

$f(-3) = (-3)^2 + 6(-3) + 3$

$= 9 - 18 + 3 = -6$

$\boxed{V: (-3, -6)}$

2. $f(x) = 3x^2 - 2x + 4$

$x = \frac{2}{2(3)} = \frac{2}{6} = 1/3$

$f(1/3) = 3(1/3)^2 - 2(1/3) + 4$

$= 1/3 - 2/3 + 12/3 = 11/3$

$\boxed{V: (1/3, 11/3)}$

Homework 9/17

Every other odd.

TB pg. 200-201 #1-17 (E.O.O)

Only find the vertex.