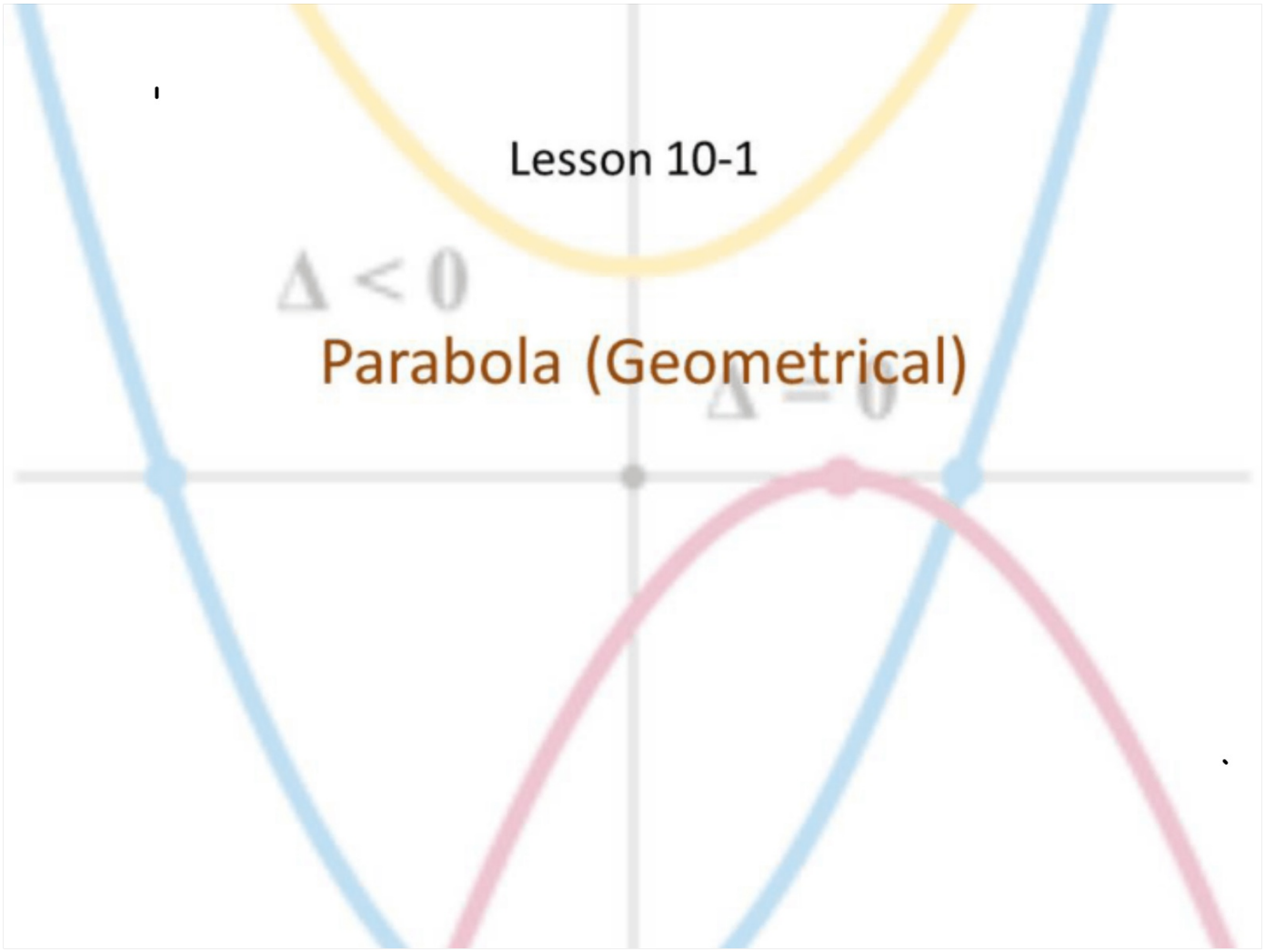

Lesson 10-1
$\Delta < 0$
Parabola (Geometrical)
$\Delta = 0$

Objective

Students will…

- Be able to give a geometric definition of a parabola.
- Be able to define focus (foci), directrix, axis of symmetry, and vertex.
- Be able to find the equation of a parabola.

Parabola within a Cone

As seen from yesterday's video, a parabola can be cut out from a cone. Parabolas are easily found in the real-world.

Parabola

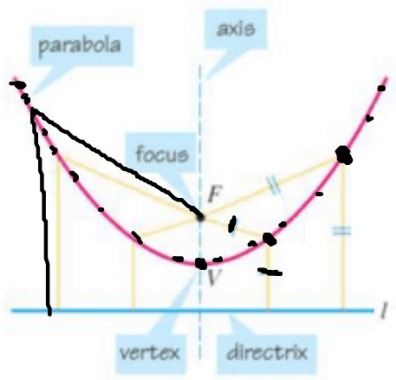
The trajectory of a basketball is a parabola.

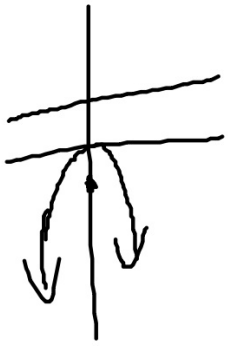
Geometric Parabola

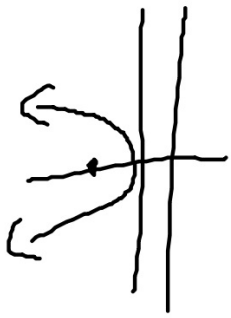
We worked extensively with parabolas **algebraically** back in chapters 2 and 3. Here in this chapter, we now look at parabolas **geometrically**.

Geometric Definition of a Parabola- A parabola is a set of points in the plane **equidistant** from a fixed point F (called the **focus**) and a fixed line l (called the **directrix**). We define the vertex as the point that lies **halfway** between the **focus** and the **directrix**, and the **axis of symmetry** is the line that runs through the focus **perpendicular** to the directrix.

Ex.







Equations and Graphs of Parabolas $y = x^2$

Using the distance formula, we can see that parabolas have the following equations:

Vertical

Opening up or down

$x^2 = 4py$

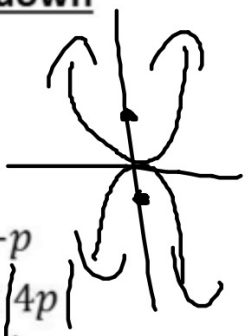
Vertex: $V(0,0)$

Focus: $F(0,p)$

Directrix: $y = -p$

Focal Diameter: $|4p|$

(the number in front of y)



Horizontal.

Opening left or right

$y^2 = 4px$

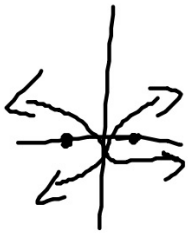
$V(0,0)$

$F(p,0)$

$x = -p$

$|4p|$

(the number in front of x)



Opens...

Up: $p > 0$

Down: $p < 0$

Right: $p > 0$

Left: $p < 0$

Example

Vertical.

Find the equation of the parabola with vertex $V(0,0)$ and focus $F(0,2)$, and sketch its graph.

$F(0,p)$.

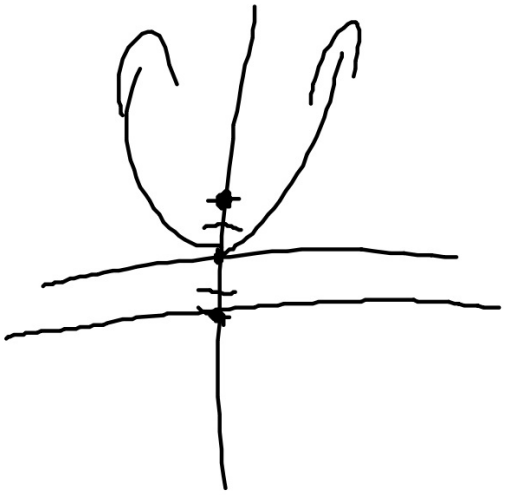
$p=2$

directrix: $y=$

$$x^2 = 4py$$

$$\Rightarrow x^2 = 4(2)y$$

$$\Rightarrow \boxed{x^2 = 8y}$$



Example

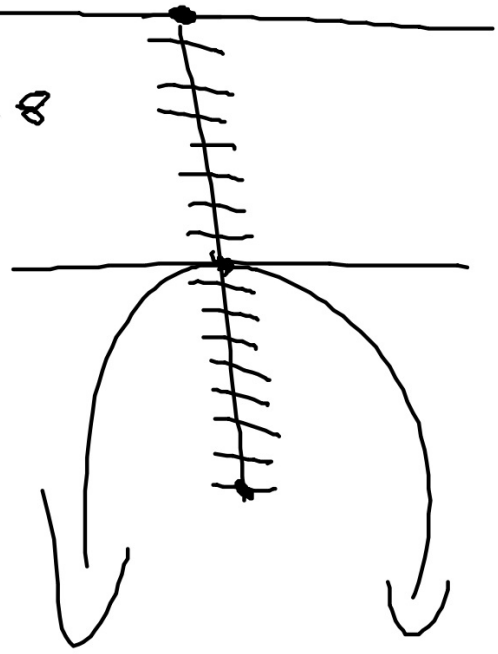
Find the equation of the parabola with vertex $V(0,0)$ and focus $F(0,-8)$, and sketch its graph.

Vertical.

$p = -8$

$-p = 8$

Direct: $y = 8$



$x^2 = -32y$

Example

A parabola has the equation $6x + y^2 = 0$. Find its focus, directrix, and the focal diameter, and sketch its graph.

$y^2 = -6x$ (horiz.).

$y^2 = \boxed{4p}x$

$\Rightarrow \frac{4p}{4} = \frac{-6}{4}$

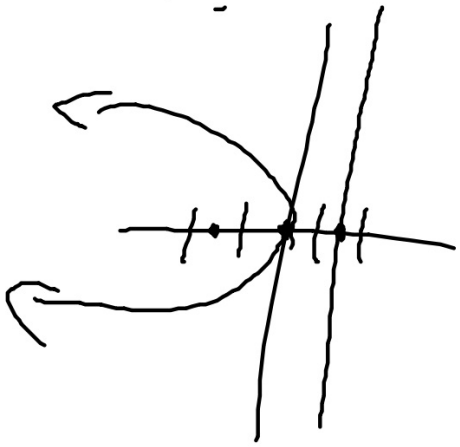
$p = -6/4 = -3/2 = -1.5$

Focus: $F(p, 0)$

$= F(-1.5, 0)$

Direct.: $x = 1.5$

F. D.: $|4p| = |-6| = \boxed{6}$



Homework Problems

Find the focus, directrix, and focal diameter of the parabola, and sketch its graph.

7. $y^2 = 4x$

16. $x - 7y^2 = 0$

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

$$\frac{-7}{-7}$$

$$y^2 = \frac{x}{7} = \frac{1}{7}x$$

Homework Problems

Find an equation for the parabola that has its vertex at the origin and satisfies the given condition(s).

29. Directrix $x = 2$

horiz.

$x = -p$

$\Rightarrow -p = 2$

$\Rightarrow p = -2$

$y^2 = 4px$

35. Opens upward with focus 5 units from the vertex.

Homework 4/6

TB pg. 751 #1-6, 7-17 (odd), 25, 27, 29, 33, 35