Concepts
Introduction to Conic Sections - Parabola

Based on power point presentations by Pearson Education, Inc.
Revised by Ingrid Stewart, Ph.D.

Learning Objectives

1. Memorize which standard equation pertains to what graphs of conic parabolas (open up/down, open right/left).
2. Memorize the characteristics of the vertex, the focus, the directrix, and the latus rectum.
3. Change given equations of conic parabolas to their standard form.

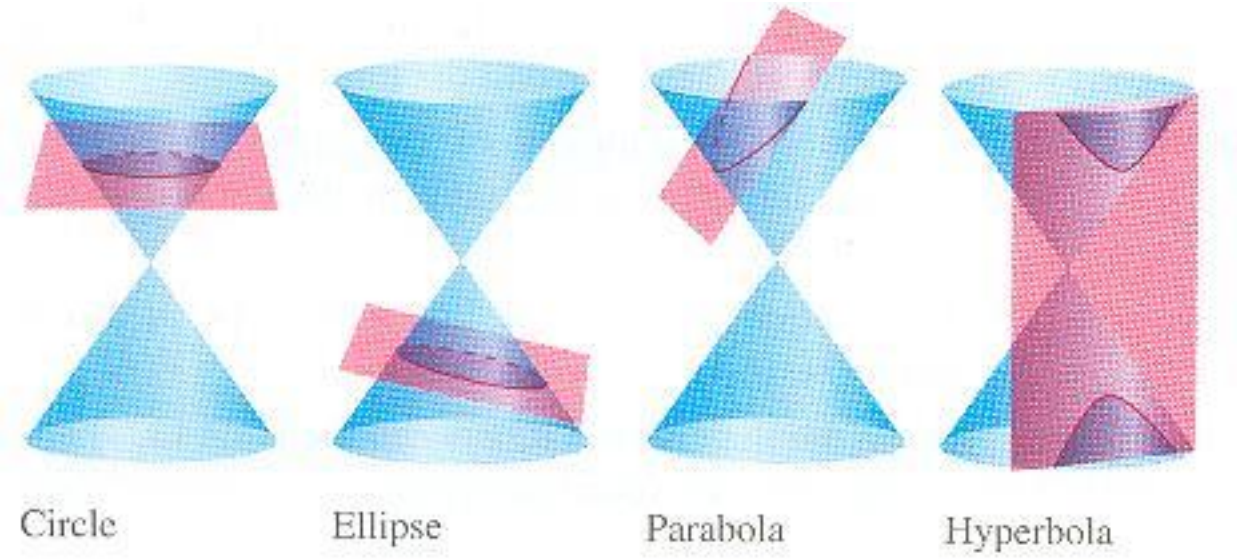
NOTE: This lesson only contains pictures standard equations of geometric parabolas. It contains NO examples.

Our task will be to change given equations of geometric parabolas to standard form.

You can find examples in the “Examples” document also located in the appropriate MOM Learning Materials folder.

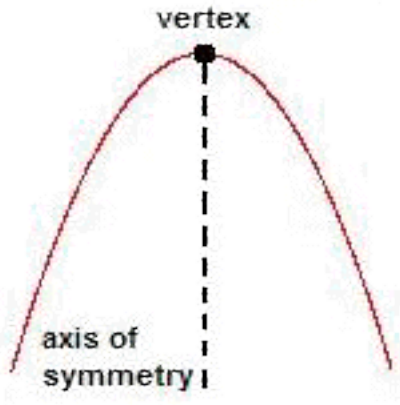
In the next three lessons, we are getting away entirely from trigonometry, and very briefly investigate a few concepts in analytic geometry. Namely, we will introduce conic sections.

A conic section (or simply a conic) can be described as the intersection of a plane with two cones stacked tip to tip. The most common intersections are the circle, the ellipse, the parabola, and the hyperbola.

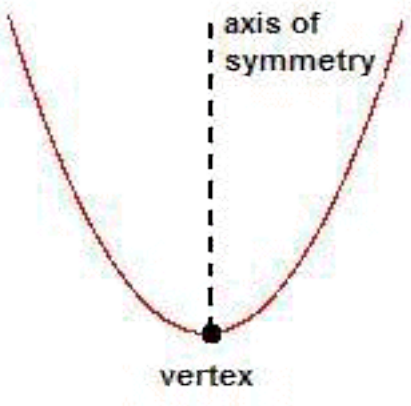


The Parabola (1 of 5)

In algebra, we discussed quadratic functions and their graphs which we called parabolas. Their general equation is $\mathbf{f(x) = ax^2 + bx + c}$ and their standard equation is $\mathbf{f(x) = a(x - h)^2 + k}$. Following are pictures of the parabola.



when $a < 0$

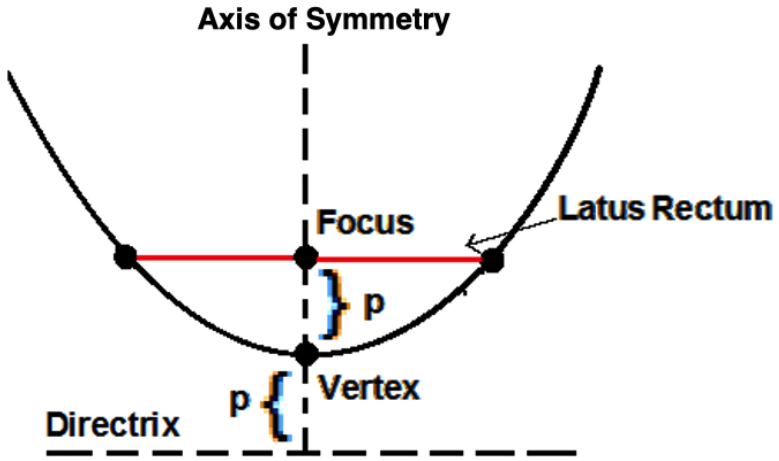


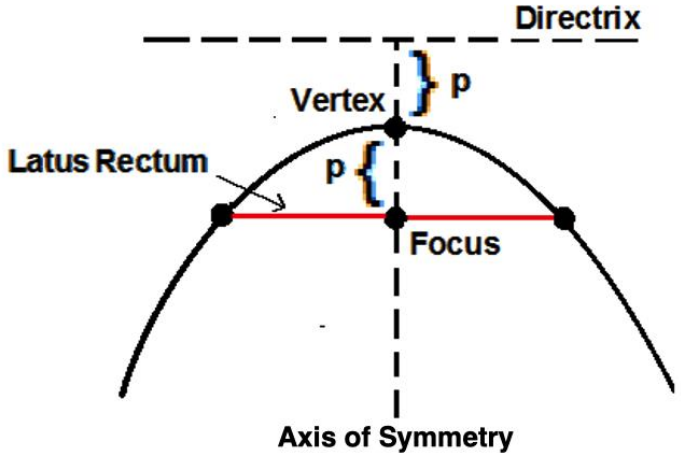
when $a > 0$

- The axis of symmetry is an invisible vertical line parallel to the *y*-axis that divides the parabola into two identical halves! Since it is invisible, we draw a dashed line! The vertex is either the lowest or highest point on the graph. Sometimes the vertices are called "minimum" or "maximum", respectively.

The Parabola (2 of 5)

Parabolas resulting from conic sectioning can be open up, open down, open right or open left. Following are pictures of parabolas **open up and open down**.



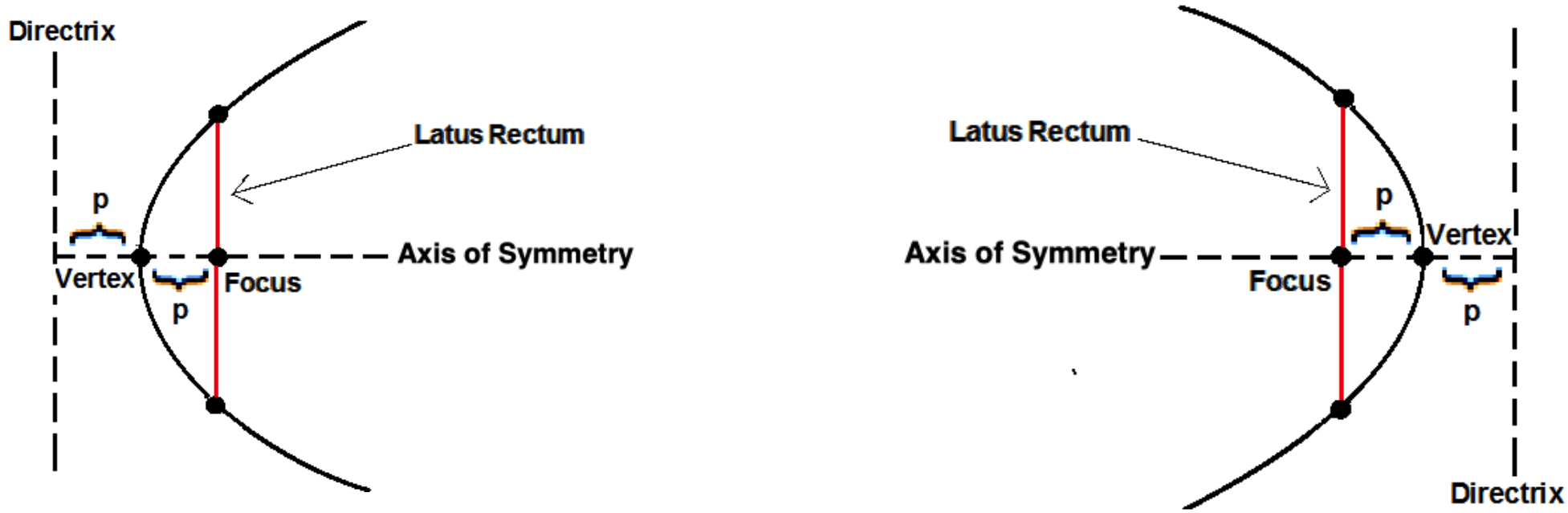


Geometrically, the standard equation of a parabola open up or open down is $\mathbf{(x - h)^2 = 4p\,(y - k)}$. When $\boldsymbol{p} < 0$ the parabola is open down. When $\boldsymbol{p} > 0$ the parabola is open up. This equation must be memorized.

The coordinates of the Vertex are (h, k).

The Parabola (4 of 5)

Following are pictures of parabolas open right and open left



Geometrically, the standard equation of a parabola open right or open left is $\mathbf{(y - k)^2 = 4p\,(x - h)}$. When $\boldsymbol{p} < 0$ the parabola is open left. When $\boldsymbol{p} > 0$ the parabola is open right. This equation must be memorized.

The coordinates of the Vertex are (h, k).

The Parabola (5 of 5)

Some Vocabulary

Please refer to the pictures in the previous two slides!

Vertex – It is either the lowest, highest, right-most, or left-most point on the graph of a geometric parabola.

Focus – It is a point that lies on the (invisible) axis of symmetry above, below, to the right, or to the left of the vertex.

Directrix – It an invisible line perpendicular to the (invisible) axis of symmetry and lies below the vertex.

NOTE: The focus and the directrix are the same distance, often called ***p***, away from the vertex.

Latus Rectum – It is an invisible line that is often helpful when graphing a parabola. It passes through the focus, is parallel to the directrix, and has its endpoints on the parabola.