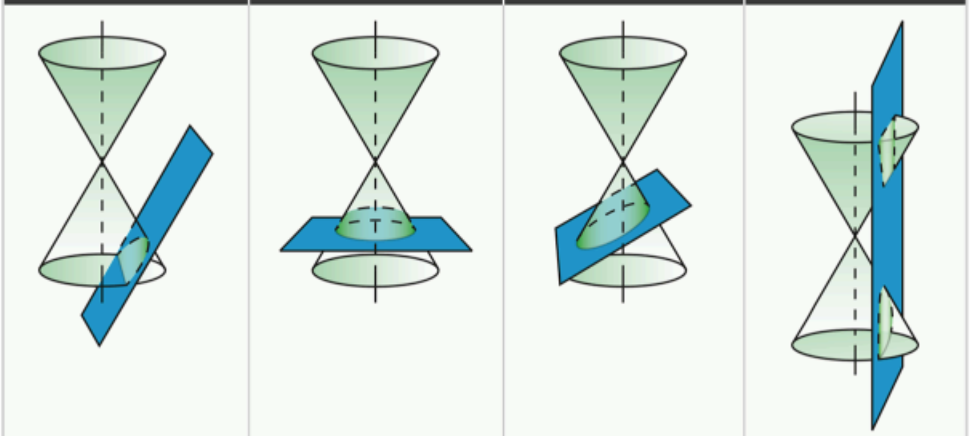
Topic 9.1 Parabolas

Essential Question:

How do the geometric properties of conic sections relate to their algebraic representations?

CONCEPT: CONIC SECTIONS

A **conic section** is a curve formed by the intersection of a plane and a double right cone.



Parabola	Circle	Ellipse	Hyperbola
The intersecting plane cuts through one side of one cone.	The intersecting plane is perpendicular to the axis.	The intersecting plane cuts through both sides of a cone.	The intersecting plane cuts through both cones.

Each conic section has a geometric definition that describes a property of every point on the curve. The conic sections covered in this topic can be graphed in a coordinate plane and can be represented by a second-degree equation in two variables.

The **general form of a second-degree equation** is

$Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0.$

All of the conic sections covered in this topic will have equations where the coefficient of the *xy*-term is zero. A nonzero *xy*-term results in conics with an axis of symmetry that is neither horizontal nor vertical.

Q: Describe what is created by the intersection of a plane and a cone.

Q: How can you relate the cross sections to shapes created on a coordinate plane?

Q: If two-dimensional figures are created on a coordinate plane by an infinite number of points that look like lines or curves, what can you say about 3-D figures?

Q: If these conic sections can be represented by second-degree equations, what can you predict about their graphs?

CONCEPT Summary

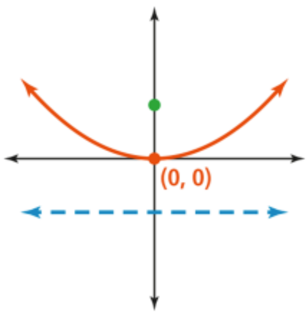
Parabolas

DEFINITION A parabola is the set of points on a plane that are equidistant from a given point, the *focus*, and a given line, the *directrix*.

GRAPHS The parabolas below have vertex (0, 0). Parabolas can also be translated anywhere in the coordinate plane.

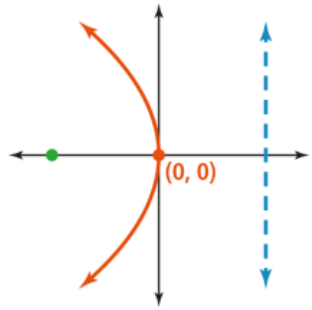
Vertical

Axis of symmetry: $x = 0$
Focus $(0, c)$
Directrix $y = -c$



Horizontal

Axis of symmetry: $y = 0$
Focus $(c, 0)$
Directrix $x = -c$



EQUATIONS For a parabola with vertex at the origin and focal length $|c|$,

$$y = \frac{1}{4c}x^2$$

$$x = \frac{1}{4c}y^2$$

Q: What causes the parabola to have its curve on each side of the vertex? Explain in terms of distance.

Notes:

Examples & Questions

Examples 1

Q: How can you define point *P* in the equation for the parabola?
Q: Why do you use the variables *x* and *y* for *P* instead of its actual coordinates when writing the equation?
Q: What indicates that the parabola opens vertically or horizontally?

Examples 2

Q: How does a parabola change as the distance between the focus and the vertex of the parabola decreases?
Q: For a vertical parabola, how do you identify the focus and the directrix to use when setting up the distance formula?
Q: Why does the value of *c* affect the width of the parabola?

Examples 3

Q: The equation for any parabola is $y = \frac{1}{4c}x$. If you are given the value of *c* for a specific parabola, how do you write its equation?
Q: How do you know when to use $y = \frac{1}{4c}x^2$ vs $y = \frac{1}{4c}y^2$?

Examples 4

Q: How can you relate the given equation to the equation for any parabola in terms of *c*?
Q: Since the equations are exactly the same except for the denominator, how can you solve for *c*?

Examples 5

Q: How do you know if you need to solve for *x* or *y*?
Q: Why is it important to complete the square first in order to find the focus and directrix?
Q: After you write the equation in vertex form, how do you find the value of *c*?
Q: How can the value of *c* define the focus and the directrix?

Practice and Problem Solving

Complete MathXL for School: Practice and Problem Solving (online)
Complete MathXL for School: Enrichment (online)

Challenge: #15, 23, 24, 27 – key will be posted in Power School Learning.

Lesson Quiz 9.1/Notes