9.1 Intro to Conics: Parabolas

What will you learn?

- **Recognize a conic as an intersection of a plane and a double-napped cone**
- **Write equations of parabolas in standard form**
- **Use the reflective property of parabolas to solve real-life problems**

Conics

Intersection of a plane and a double-napped cone

Circle **Ellipse** **Parabola** **Hyperbola**

Degenerate Conic: When the intersecting plane passes through the vertex

Point **Line** **Two Intersecting Lines**

Parabolas

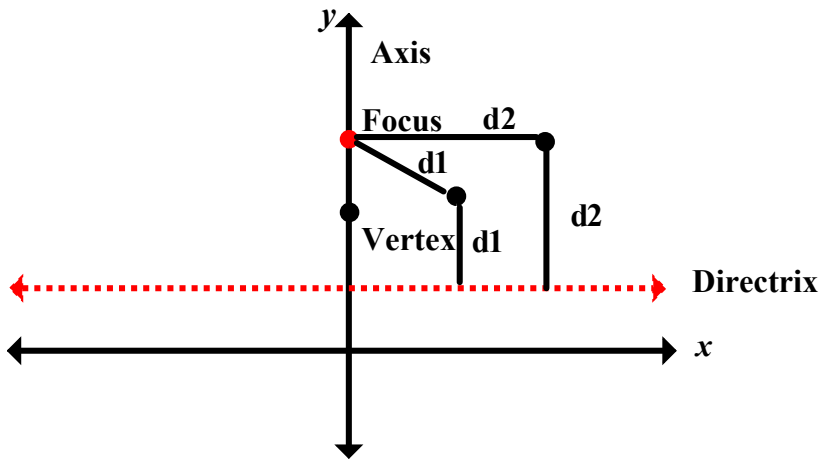
$$f(x) = ax2 + bx + c$$

Definition of a Parabola

A Parabola is the set of al points (x, y) in a plane that are equidistant from a fixed line, the directrix, and a fixed point, the focus, not on the line.

Vertex - the midpoint between the focus and the directrix
the axis of the parabola

A parabola is symmetric with respect to its axis



Standard Equation of a Parabola

Vertex (*h, k*)

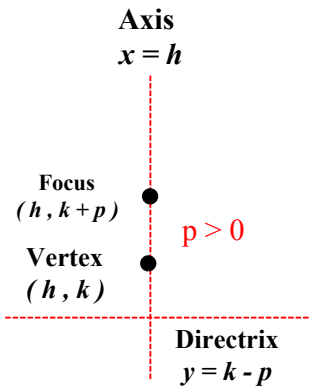
$(x - h)^2 = 4p(y - k), \quad p \neq 0$ — Vertical Axis; Directrix: $y = k - p$

$(y - k)^2 = 4p(x - h), \quad p \neq 0$ — Horizontal Axis; Directrix: $x = h - p$

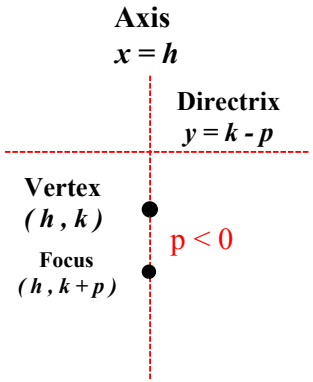
The focus lies on the axis *p* units(directed distance) form the vertex.
If the *vertex is at the origin*, the equation takes on of the following forms.

$x^2 = 4py$ — **Vertical Axis**

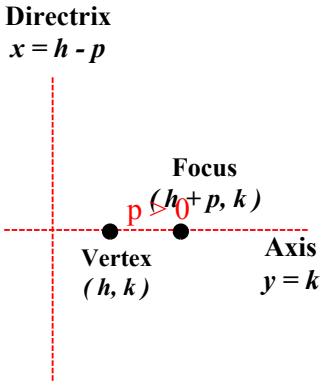
$y^2 = 4px$ — **Horizontal Axis**



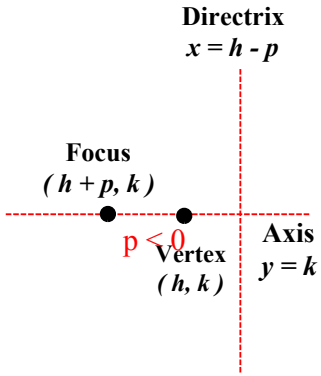
$(x - h)^2 = 4p(y - k)$,
Vertical Axis: $p > 0$



$(x - h)^2 = 4p(y - k)$,
Vertical Axis: $p < 0$



$(y - k)^2 = 4p(x - h)$,
Horizontal Axis: $p > 0$



$(y - k)^2 = 4p(x - h)$,
Horizontal Axis: $p < 0$

Example 1 - Finding the Standard Equation of a Parabola

Find the standard form of the equation of the parabola with:

Vertex : origin
Focus: (0, 4)

See p. 637; exercise 27

Example 2 - Finding the Focus of a Parabola

Find the focus of the parabola given by $y = -\frac{1}{2}x^2 - x + \frac{1}{2}$

See p. 637; exercise 15

Example 3 - Finding the Standarrd Equation of a Parabola

Find the standard form of the equation of the parabola with:

Vertex (1, 0)
Focus: (2, 0)

See p. 638; exercise 41

Reflective Property of Parabolas

Focal Chord → **The line segment that passes through the focus of a parabola and has endpoints on the parabola**

Latus Rectum → **The specific chord perpendicular to the axis of the parabola**

Tangent → **A line that touchs a single point on the parabola but does not cross the parabola**

Parabolic Reflector → **Light is reflected in parallel rays**

Reflective Property of Parabolas

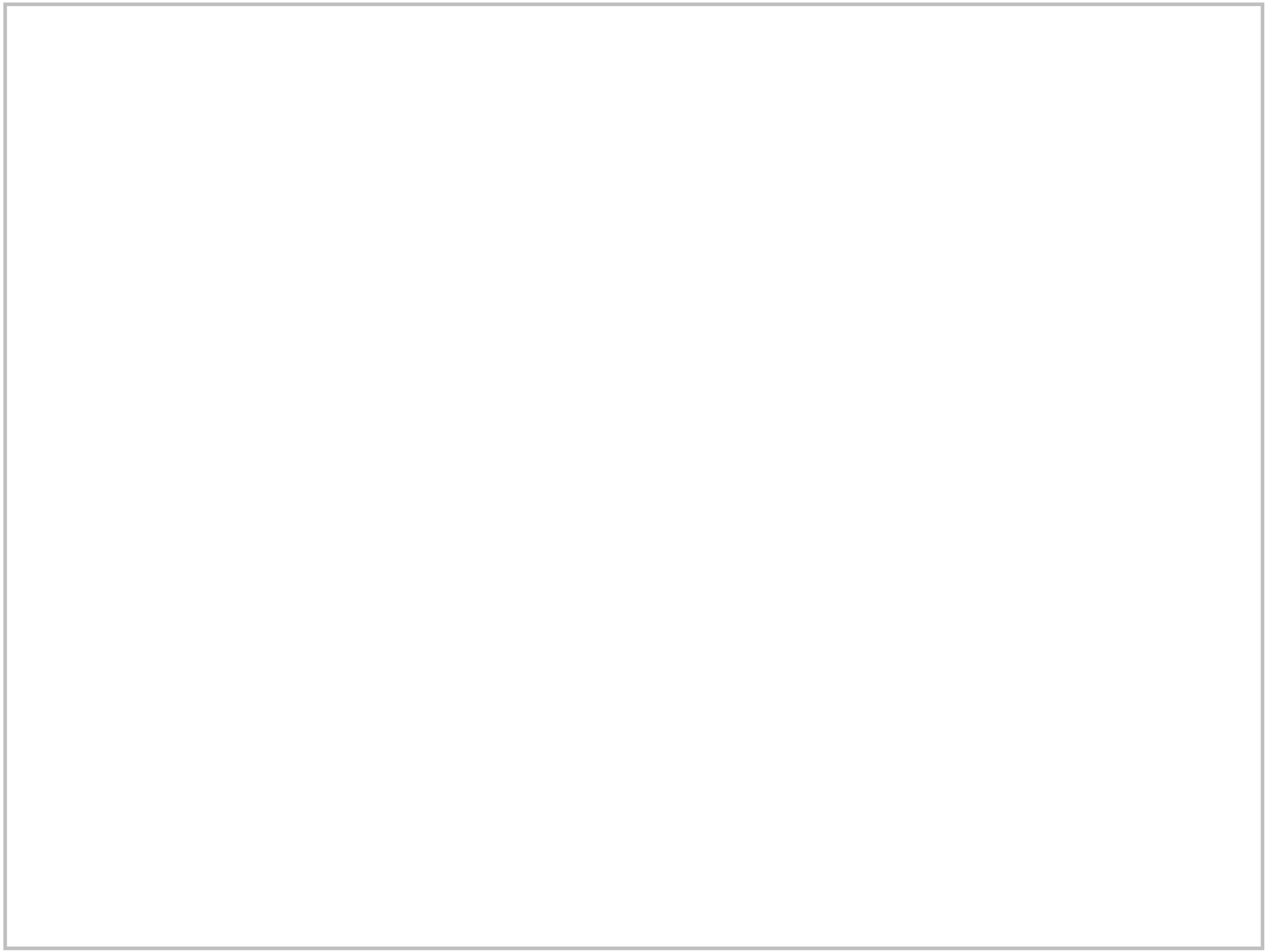
The tangent line to a parabola at a point P makes equal angles with the following two lines:

1. The line passing through P and the focus

2. The axis of the parabola

Example 4 - Finding the Tangent Line at a Point on a Parabola

Find the equation of the tangent line to the parabola $y = x2$ **at the point** $(1, 1)$



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