

The Ellipse

1) Definition of an Ellipse

1) _____

- An ellipse is the set of all points, P, in a plane the sum of whose distances from two fixed points, F_1 and F_2 is constant.
- These two fixed points are called the *Foci* (plural of focus).
- The midpoint of the segment connecting the foci is the *center* of the ellipse.
- The line through the foci intersects the ellipse at two points, called the *vertices* (plural of vertex).
- The line segment that joins the vertices is the *major axis*.
- The line segment whose endpoints are on the ellipse and that is perpendicular to the major axis at the center is called the *minor axis* of the ellipse.

2) Standard Forms of Equations of Ellipses Centered at (0, 0)

2) _____

Form I: $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, a^2 > b^2$ The characteristics of form I are:

1. The vertices are $(-a, 0)$ and $(a, 0)$.
2. The major axis is horizontal with length of $2a$.
3. The endpoints of the minor axis are $(0, -b)$ and $(0, b)$.
4. The minor axis is vertical with length of $2b$.
5. The foci are $(-c, 0)$ and $(c, 0)$ where $c^2 = a^2 - b^2$.

3) Standard Forms of Equations of Ellipses Centered at (0, 0)

3) _____

Form II: $\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1, a^2 > b^2$ The characteristics of form II are:

1. The vertices are $(0, -a)$ and $(0, a)$.
2. The major axis is vertical with length of $2a$.
3. The endpoints of the minor axis are $(-b, 0)$ and $(b, 0)$.
4. The minor axis is horizontal with length of $2b$.
5. The foci are $(0, -c)$ and $(0, c)$ where $c^2 = a^2 - b^2$.

4) Standard Forms of Equations of Ellipses Centered at (h, k)

4) _____

Form I: $\frac{(x - h)^2}{a^2} + \frac{(y - k)^2}{b^2} = 1, a^2 > b^2$ The characteristics of form I are:

1. The vertices are $(h - a, k)$ and $(h + a, k)$.
2. The major axis is horizontal.
3. The endpoints of the minor axis: $(h, k + b)$ and $(h, k - b)$.
4. The minor axis is vertical.
5. The foci are $(h - c, k)$ and $(h + c, k)$ where $c^2 = a^2 - b^2$.

5) Standard Forms of Equations of Ellipses Centered at (h, k)

5) _____

Form II: $\frac{(x - h)^2}{b^2} + \frac{(y - k)^2}{a^2} = 1, a^2 > b^2$ The characteristics of form II

are:

1. The vertices are $(h, k - a)$ and $(h, k + a)$.
2. The major axis is vertical.
3. The endpoints of the minor axis: $(h - b, k)$ and $(h + b, k)$.
4. The minor axis is horizontal.
5. The foci are $(h, k - c)$ and $(h, k + c)$ where $c^2 = a^2 - b^2$.

The Hyperbola

6) Definition of a Hyperbola

6) _____

- The hyperbola is the set of points in a plane the difference of whose distances from two fixed points, called *foci*, is constant.
- The line through the foci intersects the hyperbola at two points, called the *vertices*. The line is called the *transverse axis*.
- The midpoint of the transverse axis is the *center* of the hyperbola.
- The graph of the hyperbola consists of two disjoint parts, called *branches*.
- The two branches approach a pair of intersecting straight lines, called *asymptotes*.

7) Standard Forms of Equations of Hyperbolas Centered at (0, 0)

7) _____

Form I: $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ The characteristics of form I are:

a^2 is the denominator of the term preceded by a plus sign;
 b^2 is the denominator of the term preceded by a minus sign.

1. The vertices are $(-a, 0)$ and $(a, 0)$.
2. The transverse axis lies on the x -axis.
3. The foci are $(-c, 0)$ and $(c, 0)$, where $c^2 = a^2 + b^2$.
4. The equations of the asymptotes are $y = \pm \frac{b}{a} x$.

8) Standard Forms of Equations of Hyperbolas Centered at (0, 0)

8) _____

Form II: $\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$ The characteristics of form II are:

a^2 is the denominator of the term preceded by a plus sign;
 b^2 is the denominator of the term preceded by a minus sign.

1. The vertices are $(0, -a)$ and $(0, a)$.
2. The transverse axis lies on the y -axis.
3. The foci are $(0, c)$ and $(0, -c)$, where $c^2 = a^2 + b^2$.
4. The equations of the asymptotes are $y = \pm \frac{a}{b} x$.

9) Standard Forms of Equations of Hyperbolas Centered at (h, k)

9) _____

Form I: $\frac{(x - h)^2}{a^2} - \frac{(y - k)^2}{b^2} = 1$ The characteristics of form I are:

a^2 is the denominator of the term preceded by a plus sign;
 b^2 is the denominator of the term preceded by a minus sign

1. The vertices are $(h - a, k)$ and $(h + a, k)$.
2. The transverse axis is horizontal.
3. The foci are $(h - c, k)$ and $(h + c, k)$, where $c^2 = a^2 + b^2$.
4. The equations of the asymptotes are $y - k = \pm \frac{b}{a}(x - h)$.

10) Standard Forms of Equations of Hyperbolas Centered at (h, k) 10) _____

Form II: $\frac{(y - k)^2}{a^2} - \frac{(x - h)^2}{b^2} = 1$ The characteristics of form II are:

- a^2 is the denominator of the term preceded by a plus sign;
- b^2 is the denominator of the term preceded by a minus sign.
- 1. The vertices are $(h, k - a)$ and $(h, k + a)$.
- 2. The transverse axis is vertical.
- 3. The foci are $(h, k - c)$ and $(h, k + c)$, where $c^2 = a^2 + b^2$
- 4. The equations of the asymptotes are $y - k = \pm \frac{a}{b}(x - h)$.

The Parabola

11) Definition of a Parabola 11) _____

- A parabola is the set of all points in a plane that are equidistant from a fixed line, the *directrix*, and a fixed point, the *focus*, that is not on the line.
- The line through the focus and perpendicular to the directrix is called the *axis of symmetry* of the parabola.
- The point of intersection of the parabola with its axis of symmetry is called the *vertex*.

12) Standard Forms of Equations of Parabolas with vertex at(0, 0) 12) _____

Form I: $y^2 = 4px$ The characteristics of form I are:

- 1. The axis of symmetry is horizontal.
- 2. The focus is $(p, 0)$, and the directrix is $x = -p$.
- 3. If $p > 0$, the parabola opens to the right;
if $p < 0$, it opens to the left.

13) Standard Forms of Equations of Parabolas with vertex at(0, 0) 13) _____

Form II: $x^2 = 4py$ The characteristics of form II are:

- 1. The axis of symmetry is vertical.
- 2. The focus is $(0, p)$, and the directrix is $y = -p$.
- 3. If $p > 0$, the parabola opens upward;
if $p < 0$, it opens downward.

14) Standard Forms of Equations of Parabolas with vertex at (h, k) 14) _____

Form I: $(y - k)^2 = 4p(x - h)$ The characteristics of form II are:

- 1. The axis of symmetry is horizontal.
- 2. The focus is $(h + p, k)$, and the directrix is $x = h - p$.
- 3. If $p > 0$, the parabola opens to the right;
if $p < 0$, it opens to the left.

15) Standard Forms of Equations of Parabolas with vertex at (h, k)

15) _____

Form II: $(x - h)^2 = 4p(y - k)$ The characteristics of form I are:

1. The axis of symmetry is vertical.
2. The focus is $(h, k + p)$, and the directrix is $y = k - p$.
3. If $p > 0$, the parabola opens upward;
if $p < 0$, it opens downward.