

### Parabolas with vertex (h,k)

Opening up/down  $(x-h)^2 = \pm 4p(y-k)$

Vertical Focus  $(h, k+p)$

Directrix  $y=k-p$

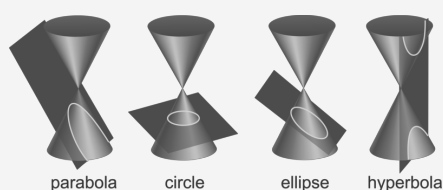
Opening right/left  $(y-k)^2 = \pm 4p(x-h)$

Horizontal Focus  $(h+p, k)$

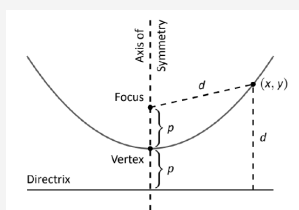
Directrix  $x = h-p$

Any point on a parabola is equidistant from the parabola's focus and directrix

### Conic Cross-Sections Diagram



### Parabola opening upwards



### Circles/Ellipses with center (h,k)

Circle  $(x-h)^2 + (y-k)^2 = r^2$

Circle Focus  $(h,k)$

Circle Vertices None

Wide Ellipse  $(x-h)^2/a^2 + (y-k)^2/b^2 = 1$

Wide Foci  $(h \pm c, k)$

Wide Vertices  $(h \pm a, k \pm b)$

Tall Ellipse  $(x-h)^2/b^2 + (y-k)^2/a^2 = 1$

Tall Foci  $(h, k \pm c)$

### Circles/Ellipses with center (h,k) (cont)

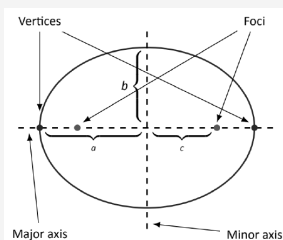
Tall Vertices  $(h \pm b, k \pm a)$

$c^2 = a^2 - b^2$  and  $a > b > 0$

Formulas for foci generate two different points (+c and -c), and formulas for vertices generate four different vertices: (h+a, k) (h-a, k) (h, k+b) and (h, k-b)

Distances between a focal point to any point on the ellipse, plus the distance of the other focal point to that same point on the ellipse, gives a sum of distances that is constant for any point on the ellipse

### Wide Ellipse



### Hyperbolas with center (h,k)

Branches opening horizontally  $(x-h)^2/a^2 - (y-k)^2/b^2 = 1$

Horizontal Foci  $(h \pm c, k)$

Horizontal Vertices  $(h \pm a, k)$

Asymptotes  $y-k = \pm(b/a)(x-h)$

Branches opening vertically  $(y-k)^2/a^2 - (x-h)^2/b^2 = 1$

Vertical Foci  $(h, k \pm c)$

Vertical Vertices  $(h, k \pm a)$

### Hyperbolas with center (h,k) (cont)

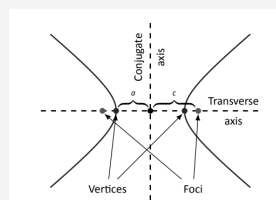
Asymptotes  $y-k = \pm(b/a)(x-h)$

$c^2 = a^2 + b^2$  and  $a, b \neq 0$

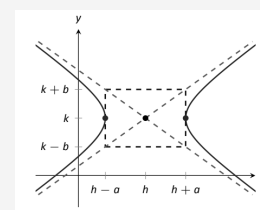
Formulas for foci generate two different points (+c and -c), formulas for vertices generate two different points (+a and -a), and formulas for asymptotes generate two different asymptotes (+a/b and -a/b) or + (b/a) and -(b/a))

Distance of a focal point to a point on either hyperbola branch, minus distance of the other focal point to that same point on that same hyperbola branch, gives a value whose magnitude is constant for any point on either hyperbola branch

### Horizontal Hyperbola



### Horizontal Hyperbola Asymptotes



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