**PreCalculus 10.4 Hyperbolas**

**Hyperbola –** all points where the difference of the distances from two fixed points (foci) is a constant.

**Standard Form of a Hyperbola** (with center at the point $(h, k)$)

 $\frac{\left(x-h\right)^{2}}{a^{2}}-\frac{\left(y-k\right)^{2}}{b^{2}}=1$

 foci are *c* units from center

 where $c^{2}=a^{2}+b^{2}$

 $\frac{\left(y-k\right)^{2}}{a^{2}}-\frac{\left(x-h\right)^{2}}{b^{2}}=1$

**Graphing a Hyperbola**

 $\frac{\left(x-3\right)^{2}}{25}-\frac{\left(y+2\right)^{2}}{16}=1$

Example: $6y^{2}-3x^{2}=18$

Example: $x^{2}-9y^{2}+36y-72=0$

Example: Find the standard form of the hyperbola with center at the origin, vertices $\left(\pm 4, 0\right)$ and foci $\left(\pm 6, 0\right)$.

Example: Find the standard form of the hyperbola with: foci $\left(0, 0\right)$ and $\left(8, 0\right)$

 vertices $\left(3, 0\right)$ and $\left(5, 0\right)$

Example: Find the standard form of the hyperbola with: vertices $\left(-2, 1\right)$ and $\left(2, 1\right)$

 passes through $\left(5, 4\right)$

**Classifying a Conic Section from its General Equation**

 $Ax^{2}+Cy^{2}+Dx+Ey+F=0$

 Circle $A=C$

 Parabola $AC=0$ (*A* or *C* is 0)

 Ellipse $AC>0$ (*A* and *C* are the same sign)

 Hyperbola $AC<0$ (*A* and *C* are the different signs)

Examples: $x^{2}+y^{2}-10x+2y+12=0$

 $x^{2}-3y^{2}-4x+1=0$

 $x^{2}-4y^{2}+24y+16=0$

 $2x^{2}+3y^{2}-16x+6y+15=0$