Bell Work
Write the standard equation of a parabola with vertex at (1,1) and directrix at y = -1/2

Definition of a Hyperbola
A Hyperbola is a smooth curve graph in which the difference of the distance from a single point "P" to the two Foci, $F_1$ & $F_2$, is a constant $k$.

Foci of a Hyperbola are $F_1$ & $F_2$.

$PF_1$ minus $PF_2$ equals the constant $k$.

Hyperbola - consists of two smooth branches
- turning point of each branch is a vertex

Traverse axis - segment connecting the two vertices
- also the axis of symmetry

$F_1$ & $F_2$ lie on the axis of symmetry

Center of the hyperbola
- midpoint of the two vertices
- midpoint of the two foci

Horizontal Hyperbola

Standard Equation $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

Traverse Axis: $x = \frac{b}{a} \cdot y$

Vertices: $(a,0)$, $(-a,0)$

Foci $(\pm c,0)$ where $c^2 = a^2 + b^2$

Asymptotes $y = \pm \frac{b}{a} \cdot x$
Write the standard equation for a hyperbola with vertices \((0,4)\) \((0,-4)\) and a focus at \((0,5)\)?

**Sketch the graph.**

step 1) Traverse axis: ___________

step 2) Identify a, b and c.

step 3) Use \(c^2 = a^2 + b^2\) to find the missing part.

step 4) Write the equation

Write the standard equation for a hyperbola with vertices \((2,0)\) \((-2,0)\) and a focus at \((3,0)\)?

**Sketch the graph.**

step 1) Traverse axis: ___________

step 2) Identify a, b and c.

step 3) Use \(c^2 = a^2 + b^2\) to find the missing part.

\[
\begin{align*}
a & = 2 \\ c & = 3 \\ a^2 & = 4 \\ b & = \sqrt{5} \\ x & = 2y
\end{align*}
\]

step 4) Write the equation
Write the following equations in Standard Form.

\[ 36x^2 - 4y^2 = 144 \]

\[ 4y^2 - 9x^2 = 9 \]

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Given the following equation find the vertices, foci, and asymptotes. \[ 9x^2 - 7y^2 = 63 \]

\begin{align*}
\text{step 1) rewrite the equation} & \quad \frac{y^2}{9} - \frac{x^2}{7} = 1 \\
\text{step 2) vertical or horizontal hyperbola} & \quad \sqrt{9} = 3, \quad \sqrt{7} = \sqrt{7} \\
\text{step 3) Use } c^2 = a^2 + b^2 \text{ to find the missing part.} & \quad a^2 = 9, \quad b^2 = 7, \quad c^2 = 9 + 7 = 16 \\
\text{step 4) Vertices:} & \quad (\pm \sqrt{9}, \pm \sqrt{7}) \\
\text{Foci:} & \quad (0, \pm \sqrt{16}) \\
\text{Asymptotes:} y = \pm \frac{\sqrt{9}}{\sqrt{7}}x
\end{align*}

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Given the following equation find the vertices, foci, and asymptotes. \[ 9x^2 - 4y^2 = 36 \]

\begin{align*}
\text{step 1) rewrite the equation} & \\
\text{step 2) vertical or horizontal hyperbola} & \\
\text{step 3) Use } c^2 = a^2 + b^2 \text{ to find the missing part.} & \\
\text{step 4) Vertices:} \quad (\pm a, 0) \\
\text{Foci:} \quad (h \pm c, 0) \\
\text{Asymptotes:} \quad y = \pm \frac{b}{a}x
\end{align*}

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Translating Horizontal Hyperbolas

<table>
<thead>
<tr>
<th>Center (0,0)</th>
<th>Center (h,k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1 )</td>
<td>( \frac{(x - h)^2}{a^2} - \frac{(y - k)^2}{b^2} = 1 )</td>
</tr>
<tr>
<td>Vertices: ( (\pm a, 0) )</td>
<td>Vertices: ( (h \pm a, k) )</td>
</tr>
<tr>
<td>Foci: ( (\pm c, 0) )</td>
<td>Foci: ( (h \pm c, k) )</td>
</tr>
<tr>
<td>Asymptotes: ( y = \pm \frac{b}{a}x )</td>
<td>Asymptotes: ( y - k = \pm \frac{b}{a} (x - h) )</td>
</tr>
<tr>
<td>( c^2 = a^2 + b^2 )</td>
<td>( c^2 = a^2 + b^2 )</td>
</tr>
</tbody>
</table>
### Translating Vertical Hyperbolas

<table>
<thead>
<tr>
<th>Center (0,0)</th>
<th>Center (h,k)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y^2 - x^2 = 1$</td>
<td>$\frac{(y - k)^2}{a^2} - \frac{(x - h)^2}{b^2} = 1$</td>
</tr>
<tr>
<td>Vertices: $(0, \pm a)$</td>
<td>Vertices: $(h, k \pm a)$</td>
</tr>
<tr>
<td>Foci: $(0, \pm c)$</td>
<td>Foci: $(h, k \pm c)$</td>
</tr>
<tr>
<td>Asymptotes: $y = \pm \frac{a}{b}x$</td>
<td>Asymptotes: $y - k = \pm \frac{a}{b}(x - h)$</td>
</tr>
<tr>
<td>$c^2 = a^2 + b^2$</td>
<td>$c^2 = a^2 + b^2$</td>
</tr>
</tbody>
</table>

What are the center, vertices, foci, and asymptotes of the hyperbola with equation:

$$\frac{(y - 4)^2}{25} - \frac{(x - 3)^2}{144} = 1$$

**Sketch the graph.**

- **Center**: $(3, 4)$
- **Vertices**: $(3, 4+5) \quad (3, 4-5)$
- **Foci**: $(3, 4+5) \quad (3, 4-5)$
- **Asymptotes**: $y - 4 = \pm \frac{5}{12}(x - 3)$

### Homework

**Practice Workbook page**

- 271 9-18, 24, 25
- 275 5-7

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### Bell Work

Identify any equations of a circle or a parabola from the following list.

1) $10y + x^2 = 0$ (Parabola)
   - $\frac{\partial y}{\partial x} = -\frac{x}{20}$
   - $y = \frac{1}{10} x^2$
   - $c = \sqrt{10}$, center $(0, 0)$

2) $12x^2 - 25y^2 = 40$
   - $r = 8$

3) $5(y - 2) = \frac{x^2}{5}$ (Parabola)
   - $y = \frac{1}{5} x^2 + 2$
   - $\gamma = \frac{x^2}{5}$

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**May 11-11:00 AM**