### Graphs and Equations of Conic Sections

<table>
<thead>
<tr>
<th>Graph</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circle</td>
<td>( x^2 + y^2 = r^2 )</td>
</tr>
<tr>
<td>Decentered Circle</td>
<td>((x-h)^2 + (y-k)^2 = r^2)</td>
</tr>
</tbody>
</table>

\[ x^2 + y^2 - 2hx - 2ky + \left( h^2 + k^2 - r^2 \right) = 0 \]

Note: The equations below are for centered conics. Decentered conics have:
- \( x \rightarrow x - h \)
- \( y \rightarrow y - k \)

#### Horizontal Ellipse
- Equation: \( \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \)
- Note: \(|x| \leq a, |y| \leq b\)
- \(a > b\)
- \(a^2 = b^2 + c^2\)
- Vertices: \((\pm a, 0)\)
- Foci: \((\pm c, 0)\)

#### Vertical Ellipse
- Equation: \( \frac{x^2}{b^2} + \frac{y^2}{a^2} = 1 \)
- Note: \(|x| \leq b, |y| \leq a\)
- \(a > b\)
- \(a^2 = b^2 + c^2\)
- Vertices: \((0, \pm a)\)
- Foci: \((0, \pm c)\)

#### Horizontal Parabola
- Standard Form: \( y^2 = 4px \)
- Focus: \((p, 0)\)
- Directrix: \(x = -p\)

#### Vertical Parabola
- Standard Form: \( x^2 = 4py \)
- Focus: \((0, p)\)
- Directrix: \(y = -p\)

#### Horizontal Hyperbola
- Equation: \( \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1 \)
- \(c^2 = a^2 + b^2\)
- Vertices: \((\pm a, 0)\)
- Foci: \((\pm c, 0)\)
- Asymptotes: \( y = \pm \frac{b}{a}x \)

#### Vertical Hyperbola
- Equation: \( \frac{y^2}{a^2} - \frac{x^2}{b^2} = 1 \)
- Vertices: \((0, \pm a)\)
- Foci: \((0, \pm c)\)
- Asymptotes: \( y = \pm \frac{a}{b}x \)