**Lesson 10.01 Note Taking Study Guide**

**Parabolas – Honors Only!**

Important parts of a parabola include:

1. The turning point of the parabola is called the ________.
2. A line that splits a parabola in half so that each side is symmetrical to each other is the ______ of _____________.
3. A line perpendicular to the axis of symmetry on the opposite side of the vertex from the focus is the _________.
4. A point on the axis of symmetry which is also inside the opening of the parabola is the ________.
5. The _____________ of a parabola is always equal to 1.

Parabolas with a vertex at the origin (0, 0).

Parabolas with a Vertex at the Origin (0, 0)

Fill in the chart below with a summary of information concerning parabolas with a vertex at the origin.

\[ a = \frac{1}{?} \]

<table>
<thead>
<tr>
<th>Equation (standard form):</th>
<th>y=</th>
<th>x=</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opens:</td>
<td></td>
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<tr>
<td>Focus:</td>
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<tr>
<td>Directrix:</td>
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<td>Axis of Symmetry:</td>
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<tr>
<td>Eccentricity:</td>
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How do I use the chart?

Example 1: Identify the vertex, focus, directrix, axis of symmetry and eccentricity of the parabola given by the equation $y = -\frac{1}{12}x^2$

- Vertex: (0, 0)
- Focus: (0, c)
- $a = \frac{1}{4c}$
- $\frac{1}{12} = \frac{1}{4c}$
- $\frac{1}{4(-3)} = \frac{1}{4c}$
- $c = -3$
- Focus: (0, -3)
- Directrix: $y = -c$
- $y = -(-3)$
- Directrix: $y = 3$
- Axis of Symmetry: $x = 0$
- Eccentricity: 1
Example 2: Write the equation of the parabola with vertex at the origin and with a directrix equation of $x = -5$ in standard form.

When the vertex is at the origin and the directrix equation is $x = -c$ ($x = -5$), then the focus would be $(c, 0)$. In this case $(5, 0)$. The standard form of the equation must take the form $x = \frac{1}{4c}y^2$.

Substitute the value of $c$ into the equation and simplify:

$$x = \frac{1}{4(5)}y^2$$

$$x = \frac{1}{20}y^2$$
Parabolas with a vertex away from the Origin.

Fill in the chart below with a summary of information concerning parabolas with a vertex away from the origin.

\[ a = \frac{1}{?} \]

<table>
<thead>
<tr>
<th>Equation (General Form)</th>
<th>[ y = _{(x - _)^2 + _} ]</th>
<th>[ x = _{(y - _)^2 + _} ]</th>
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</table>

How do I use the chart?

Example 1: Identify the vertex, axis of symmetry, focus, directrix, and eccentricity of the parabola given by the equation by \[ y = -2(x - 1)^2 + 3. \]
\[ y = -2(x - 1)^2 + 3 \]
Vertex: \((h, k)\)
\((1, 3)\)
Axis of symmetry: \(x-1=0\)
\(x = 1\)
Focus: \(\frac{1}{4c}\)
\[-2 = \frac{1}{4c}\]
\[4c(-2) = \frac{1}{4c}(4c)\]
\[-8c = 1\]
\[c = -\frac{1}{8}\]
Focus: \((h, k + c)\)
\((1, 3 - \frac{1}{8})\)
\[(1, 2\frac{7}{8})\]
\[y = k - c\]
Directrix: \(y = 3 - (-\frac{1}{8})\)
\[y = 3\frac{1}{8}\]
Eccentricity: \(1\)
Example 2: Write the equation of the parabola with a vertex at $(2, 3)$ and a directrix equation of $x=\frac{11}{12}$.

Because the directrix equation is $x=\frac{11}{12}$, the general form of this parabola would be $x = a(y-k)^2 + h$.

We can plug in the $h$ and $k$ values from the vertex $(h, k)$.

$x = a(y-3)^2 + 2$

Now to find the value of $a$ we can use $a = \frac{1}{4c}$

We must first determine the value of $c$, we can use the directrix equation $x = h - c$.

Since $x = \frac{11}{12}$ and $h = 2$

$\frac{11}{12} = 2 - c$

$\frac{1}{12} = -c$

$c = -\frac{1}{12}$

$a = \frac{1}{(4)(-\frac{1}{12})}$

$a = \frac{1}{\frac{4}{12}} = \frac{1}{\frac{1}{3}}$

$a = \frac{1}{3}$

Our equation in general form is $x = -3(y-3)^2 + 2$. 
Example 3: Identify the vertex, axis of symmetry, focus, directrix, and eccentricity of the parabola given by the equation \( y = 3x^2 + 18x + 32 \).

1. Write the equation in general form by completing the square. (Review steps for completing the square in lesson 5.04).

\[
y = 3x^2 + 18x + 32
\]
\[
y - 32 = 3(x^2 + 6x)
\]
\[
6 \times \frac{1}{2} = 3^2 = 9
\]
\[
y - 32 + 27 = 3(x^2 + 6x + 9)
\]
\[
y - 5 = 3(x + 3)^2
\]
\[
y = 3(x + 3)^2 + 5
\]

**Vertex:** \((h, k)\)

\((-3, 5)\)

**Axis of symmetry:** \(x + 3 = 0\)

\(x = -3\)

**Focus:**

\[
a = \frac{1}{4c}
\]
\[
3 = \frac{1}{4c}
\]
\[
4c(3) = \left(\frac{1}{4c}\right)4c
\]
\[
12c = 1
\]
\[
c = \frac{1}{12}
\]

\((h, k+c)\)

\((-3, 5 + \frac{1}{12}) = (-3, 5 \frac{1}{12})\)

**Directrix:** \(y = k-c\)

\[
y = 5 - \frac{1}{12}
\]
\[
y = 4 \frac{11}{12}
\]

**Eccentricity:** 1