**PreCalculus 10.2 Parabolas**

**Parabola -** the set of all points in a plane that are equidistant from a line (directrix) and a fixed point (focus).

Examples:

**Standard Equation of a Parabola** (with vertex at the point $(h, k)$

 $\left(x-h\right)^{2}=4p\left(y-k\right)$

 $p=directed distance from vertex to focus$

 $\left(y-k\right)^{2}=4p\left(x-h\right)$

When the vertex is at the origin these become:

 $x^{2}=4py$

 $y^{2}=4px$

Example: Find the standard equation of the parabola with vertex $(3, 2)$ and focus $(1, 2)$.

 $\left(y-k\right)^{2}=4p\left(x-h\right)$

 $\left(y-2\right)^{2}=4\left(-2\right)\left(x-3\right)$

 $\left(y-2\right)^{2}=-8\left(x-3\right)$

$$V\left(1, 2\right)$$

$$F\left(1, 2\right)$$

 $p=-2$

Example: Find the standard equation of the parabola with vertex at the origin and focus at $(0, 3)$.

Example: Find the vertex, focus and directrix of the parabola:

 $\left(x-4\right)^{2}=20\left(y+2\right)$

Find the vertex, focus and directrix of the parabola with the equation: $y=-\frac{1}{6}\left(x^{2}+4x-2\right)$

 $y=-\frac{1}{6}\left(x^{2}+4x-2\right)$

 $y=-\frac{1}{6}x^{2}-\frac{2}{3}x+\frac{1}{3}$

 $-6y=x^{2}+4x-2$

 $-6y+2=x^{2}+4x$

 $-6y+2+\\_\\_\\_\\_\\_=x^{2}+4x+ \\_\\_\\_\\_\\_$ (complete the square)

 $-6y+6=\left(x+2\right)^{2}$

 $-6\left(y-1\right)=\left(x+2\right)^{2}$

 $\left(x+2\right)^{2}=-6\left(y-1\right)$ Standard Form

 vertex = $\left(-2, 1\right)$

 $4p=-6$

 $p=-1.5$

 focus = $\left(-2, -0.5\right)$

 directrix: $y=2.5$

Find the standard form of the equation of the parabola with vertex $\left(1, 3\right)$ and focus $\left(1, 5\right)$. Then write the quadratic form of the equation.

 $\left(x-h\right)^{2}=4p\left(y-k\right)$

Find the standard form of the equation of the parabola graphed below.

$$\left(4.5, 4\right)$$

$$\left(5, 3\right)$$

Find the standard form of the equation of the parabola with: focus $\left(3, 1\right)$

 directrix: $y=-5$

$$F\left(3, 1\right)$$

$$y=-5$$

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 $\left(x-0\right)^{2}=4p\left(y-16\right)$

 $x^{2}=4p\left(y-16\right)$ $x^{2}=4\left(-0.1\right)\left(y-16\right)$

$(2, 6)$ $2^{2}=4p\left(6-16\right)$ $x^{2}=-0.4\left(y-16\right)$

 $4=4p\left(-10\right)$ $0=-0.4y+6.4$

 $4=-40p$ $0.4y=6.4$

 $-0.1=p$ $y=16$