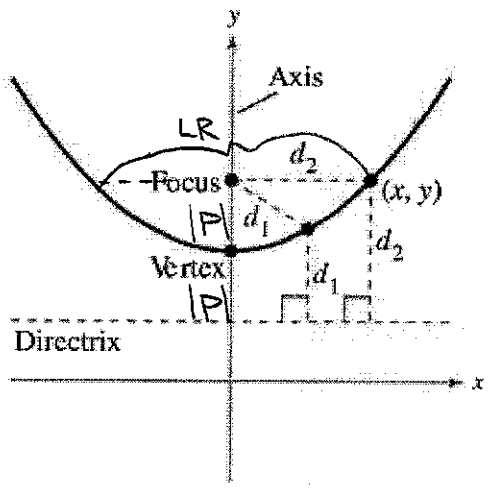
Precalculus **Name** Key

9.1 Notes: Parabolas

Parabola: The set of all points (x, y) in a plane that are equidistant from a fixed line called the directrix, and a fixed point called the focus.

Info about Parabolas

Standard Equation	$(x-h)^2 = 4p(y-k)$	$(y-k)^2 = 4p(x-h)$
Axis of Symmetry (AOS)	$x = h$	$y = k$
Vertex	(h,k)	(h,k)
Focus	$(h, k+p)$	$(h+p, k)$
Directrix	$y = k-p$	$x = h-p$
Direction of Opening	Upward if $p>0$ Downward if $p<0$	Right if $p>0$ Left if $p<0$
Latus Rectum (LR)	$\lvert 4p \rvert$	$\lvert 4p \rvert$



- The midpoint between the **focus** and the **directrix** is the vertex.
- The line passing through the **focus** and the **vertex** is the axis of symmetry.
- The directrix and the **axis of symmetry** are always perpendicular.
- The latus rectum is a line segment perpendicular to the **axis of symmetry** that passes through the focus and has endpoints on the parabola.
- To *recognize* that the equation of a conic is a **parabola**, notice that there is only one squared term.

Write the standard form of the equation for each parabola. Find and graph all of the requested information.

1. $y = x^2 - 12x + 30$

$y - 30 = x^2 - 12x$

$36 + y - 30 = x^2 - 12x + 36$

$y + 6 = (x-6)^2$

$(x-6)^2 = 1(y+6)$

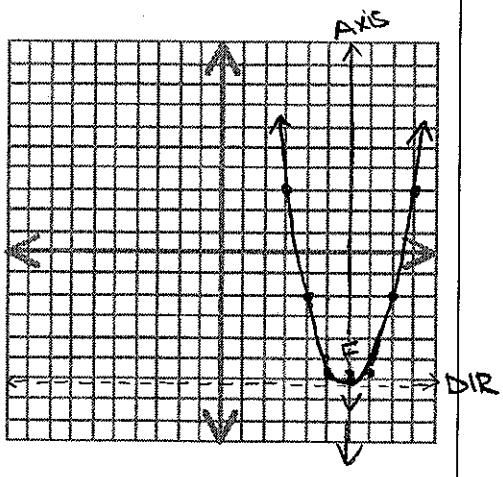
$4p = 1$

$p = \frac{1}{4}$

Focus: $(6, -6+\frac{1}{4})$

Directrix: $y = -6 - \frac{1}{4} = -6.25$

Opens:	up
Vertex:	(6, -6)
AOS:	$x = 6$
Focus:	(6, -5.75)
Directrix:	$y = -6.25$
LR:	1



2. $y^2 - 4x + 2y + 5 = 0$

x	y
5	3
5	-5

$y^2 + 2y = 4x - 5$

$y^2 + 2y + 1 = 4x - 5 + 1$

$(y+1)^2 = 4x - 4$

$(y+1)^2 = 4(x-1)$

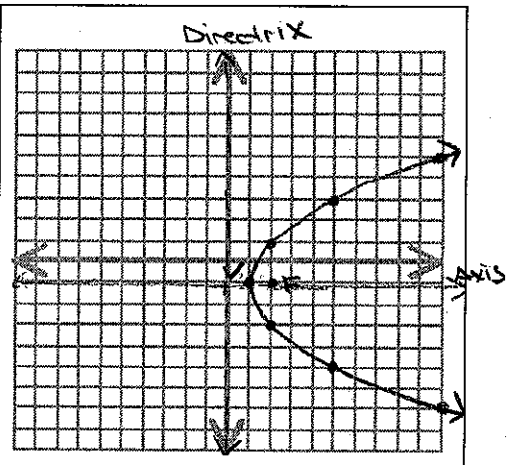
Focus: $(1+1, -1)$ $(2,-1)$

$4p = 4$

$p = 1$

Directrix: $x = h - p$ $x = 1 - 1 = 0$

Opens:	Right
Vertex: (h,k)	$(1,-1)$
AOS: $y = k$	$y = -1$
Focus: $(h+p, k)$	$(2,-1)$
Directrix: $x = h - p$	$x = 0$
LR:	4



x	y
5	8.32
5	-4.32

3. The focus is at $(2,2)$ and the equation of the directrix is $x = -2$.

$(y-k)^2 = 4p(x-h)$

$(y-2)^2 = 4p(x-0)$

$(y-2)^2 = 4p(x)$

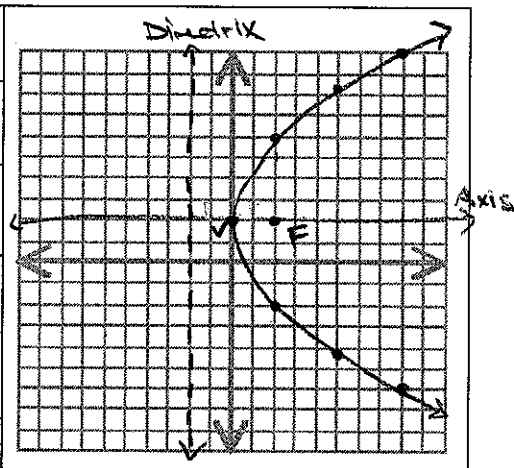
$h + p = 2$

$0 + p = 2$

$p = 2$

$(y-2)^2 = 8x$

Opens:	Right
Vertex:	$(0,2)$ h k
AOS:	$y = 2$
Focus:	$(2,2)$ $(h+p, k)$
Directrix: $x = h - p$	$x = -2$
LR:	8



x	y
-2	0
-6	-8
-4	2
0	2
2	8

4. The vertex is at $(-2,0)$ and the coordinates of the focus are $\left(-2, \frac{1}{2}\right)$.

$(x-h)^2 = 4p(y-k)$

$(x+2)^2 = 4p(y-0)$

$(x+2)^2 = 4p(y)$

$(x+2)^2 = 2y$

$k + p = \frac{1}{2}$

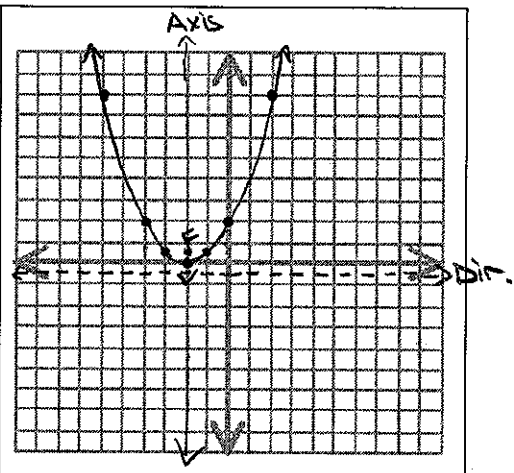
$0 + p = \frac{1}{2}$

$p = 1/2$

Directrix: $y = k - p$

$y = 0 - 1/2 = -\frac{1}{2}$

Opens:	up
Vertex:	$(-2,0)$ (h,k)
AOS:	$x = -2$
Focus: $(h, k+p)$	$\left(-2, \frac{1}{2}\right)$
Directrix: $y = k - p$	$y = -\frac{1}{2}$
LR:	2



Find the standard equation of the parabola; then find the coordinates of the vertex. Determine if the graph of the parabola will be a function.

5. $y^2 + 2y - x + 6 = 0$

$(y^2 + 2y \quad) = x - 6$

$(y^2 + 2y + 1) = x - 6 + 1$

$(y+1)^2 = x - 5$

$(y+1)^2 = 1(x-5)$

* opens to the right

Vertex: $(5,-1)$

Not a Function