X is SQUARED

VERTICAL PARABOLAS

$y = x^2$ parent function QUADRATIC

$y = -x^2$

Standard form: $y = \frac{1}{4p}(x-h)^2 + k$ ↑ (h, k)

Complete the table.

Equation of parabola	Does it open up or down?	vertex	p value
$y = -\frac{1}{28}(x-5)^2 - 8$	opens downward (negative LC) ↓	$(5,-8)$	$4p = 28$, $p = 7$
$y = \frac{1}{4}(x+3)^2 + 7$	↑ LC is positive	$(-3, 7)$	$4p = 4$, $p = 1$
$y = \frac{1}{8}x^2 + 1$ $\frac{1}{8}(x+0)^2+1$	↑	$(0, 1)$	$4p = 8$, $p = 2$
$y = -\frac{1}{20}(x-6)^2 - 11$	↓	$(6,-11)$	$4p = 20$, $p = 5$

distance from vertex to focus

Graph the following parabolas.

F
p
p
d

1. Determine the direction of opening
2. Determine the vertex
3. Calculate the value of p
4. Plot the vertex ✓
5. Use the p value to plot the focus and the directrix. ✓
6. ~~Use an x/y table to determine at least two more points on the graph~~. Use symmetry to draw the other two.
7. Sketch the curve

$(1 \div 12)(x+4)^2 - 1$

Analysis

EX 1 $y = \frac{1}{12}(x+4)^2 - 1$ ↑

V: $(-4,-1)$

$4p = 12$

$p = 3$

focus

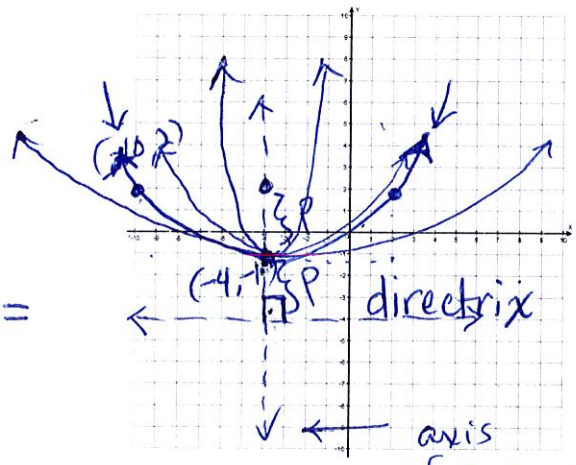
$(-4, -1+3)$

$(-4, 2)$

directrix

$(-4, -1-3)$

$y = -4$ is the directrix



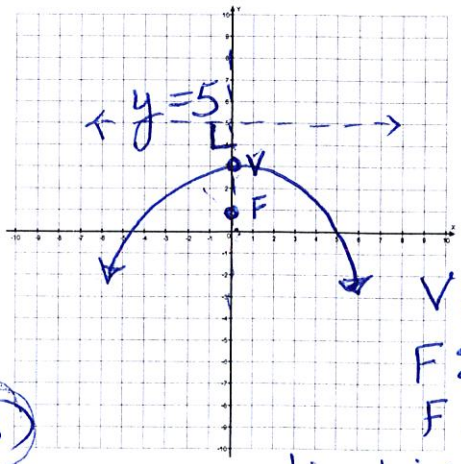
y=

EX 2 $y = -\frac{1}{8}x^2 + 3$

Vertex $(0,3)$ ↓

$4p = 8$

$p = 2$



V: $(0, 3+2)$

F: $(0, 3-2)$

F: $(0, 1)$

directrix: $y = 5$

HORIZONTAL PARABOLAS

Standard form: $x = \frac{1}{4p}(y-k)^2 + h$

If y is squared, it's horizontal

positive

$x = y^2$

LEFT.

Complete the table.

Equation of parabola	Does it open left or right?	vertex	p value
$x = \frac{1}{8}y^2 + 5$	→	(5, 0)	$4p = 8$ $p = 2$
$x = \frac{1}{32}(y+2)^2 + 0$	→	(0, -2)	$4p = 32$ $p = 8$
$x = -\frac{1}{16}(y-9)^2 - 7$	←	(-7, 9)	$4p = 16$ $p = 4$
$x + 3 = -\frac{1}{4}(y+1)^2$ $x = -\frac{1}{4}(y+1)^2 - 3$		(-3, -1)	$4p = 4$ $p = 1$

Graph the following parabolas.

1. Determine the direction of opening
2. Determine the vertex
3. Calculate the value of p
4. Plot the vertex
5. Use the p value to plot the focus and the directrix.
6. Use an x/y table to determine at least two more points on the graph. Use symmetry to draw the other two.
7. Sketch the curve

HORIZONTAL

EX 1 $x = \frac{1}{12}(y+3)^2 - 1$

V: (-1, -3)

$4p = 12$

$p = 3$

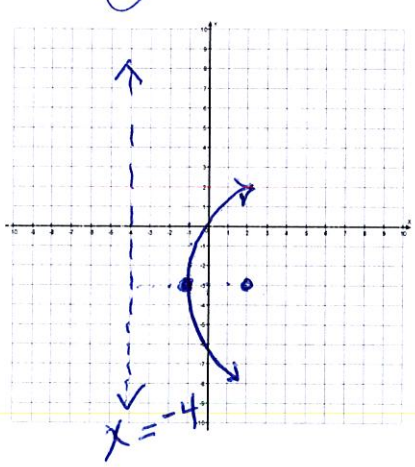
(+3 (right)

(-1, -3)

-3

focus: (2, -3)

directrix: $x = -4$



EX 2 $x = -\frac{1}{16}y^2 + 2$

←

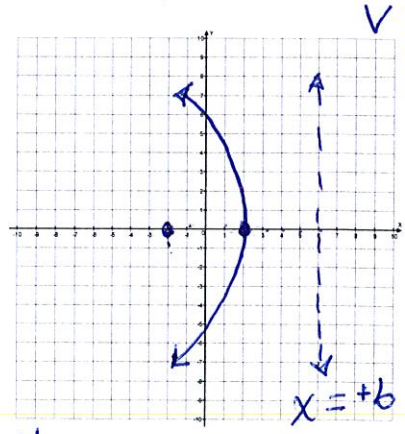
V: (+4, 0)

-4

$4p = 16$

$p = 4$

focus (-2, 0)

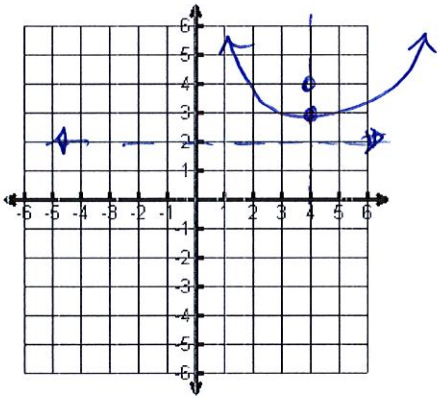


Extra practice on parabolas

Give the direction, vertex, p, focus, directrix, and graph

Analysis

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



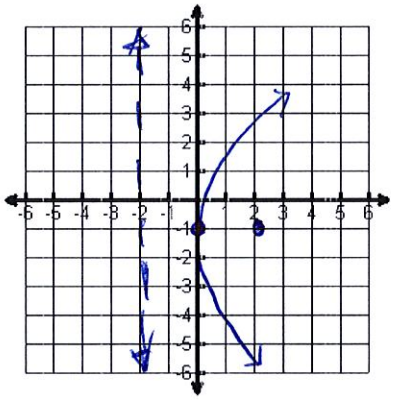
↑

V: $(4, \overset{+1}{\underset{-1}{3}})$ $p = 1$

focus $(4,4)$

directrix: $y = 2$

2. $x = \frac{1}{8}(y+1)^2$



→

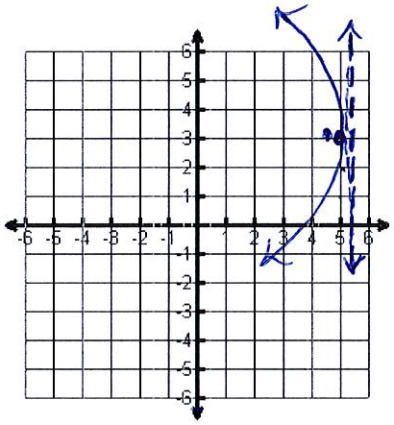
V: $(\overset{+2}{\underset{-2}{0}}, -1)$

$p = 2$

focus $(2,-1)$

directrix: $x = -2$

3. $x = -(y-3)^2 + 5$



←

V $(\overset{+1/4}{\underset{-1/4}{5}}, 3)$

$4p = 1$

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

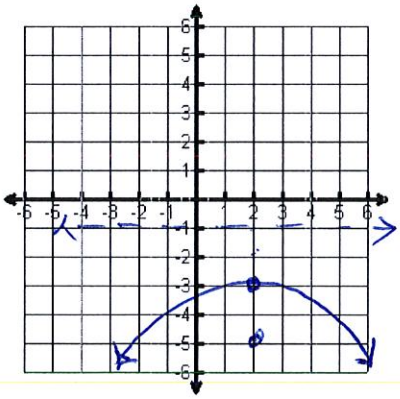
focus $(4.75, 3)$

directrix: $x = 5.25$

4. $y = -\frac{1}{8}(x-2)^2 - 3$

$y = x^2$ $y = x^2$

$y = -x^2$



↓

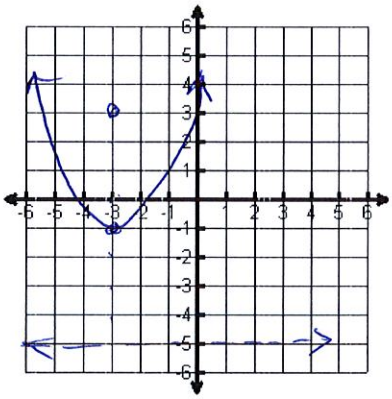
$(\overset{+2}{\underset{-2}{2}}, -3)$ is vertex

$p = 2$

Focus $(2,-5)$

directrix: $y = -1$

5. $y+1=\frac{1}{16}(x+3)^2$



$y=\frac{1}{16}(x+3)^2-1$

$\uparrow$ $(-3,-1)$ Vertex

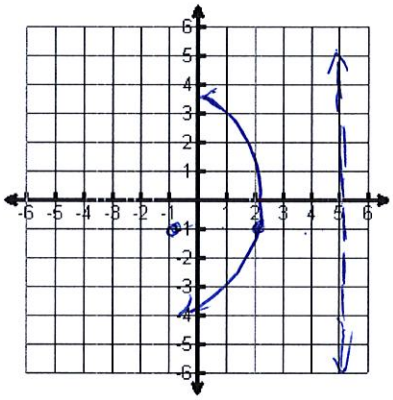
$4p=16$

$p=4$

focus : $(-3,3)$

directrix : $y=-5$

6. $x-2=-\frac{1}{12}(y+1)^2$



$x=-\frac{1}{12}(y+1)^2+2$

$\leftarrow$ vertex $(2,-1)$

$4p=12$

$p=3$

focus $(-1,-1)$

directrix : $x=5$

Put into standard form. Then do all the stuff from 1st page.

5. $x^2+2x-4y+9=0$

Isolate x or y

$x^2+2x+9=4y$

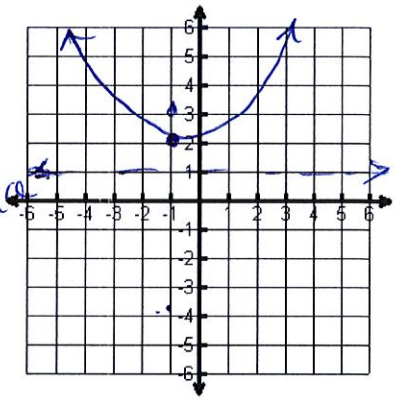
$4y=x^2+2x+9$

$4y=(x^2+2x+1)+9-1$

$\frac{4y}{4}=\frac{(x+1)^2}{4}+\frac{8}{4}$

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

Keep balance



V : $(-1,2)$

$p=1$

focus $(-1,3)$

directrix

$y=1$

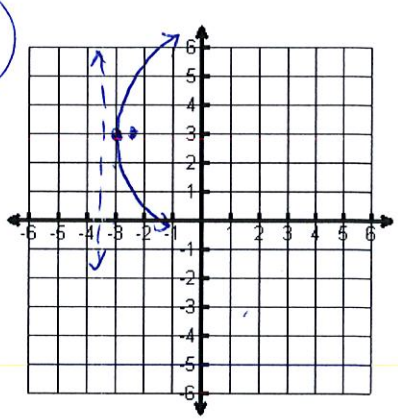
6. $y^2-6y-2x+3=0$

$y^2-6y+3=2x$

$2x=(y^2-6y+9)+3-9$

$\frac{2x}{2}=\frac{(y-3)^2}{2}-\frac{6}{2}$

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



V : $(-3,3)$ $+\frac{1}{2}$ $-\frac{1}{2}$

$4p=2$

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

focus $(-2.5,3)$

directrix :

$x=-3.5$

Puzzle worksheet writing equations

1. $y = x^2 - 2x - 2$

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

$y = (x^2 - 2x + 1) \quad -2 \quad -1$

balance by adding opposites on some side of equation

$$\boxed{y = (x-1)^2 - 3}$$

2. $y = x^2 + 12x \quad + 17$

$y = (x^2 + 12x + 36) \quad + 17 - 36$

$$\boxed{y = (x+6)^2 - 19}$$

3. $y = 2x^2 - 8x - 3$

$y = 2(x^2 - 4x + 4) \quad - 3 - 8$

$$\boxed{y = 2(x-2)^2 - 11}$$

4. $y = -5x^2 + 10x \quad + 23$

$y = -5(x^2 - 2x + 1) \quad + 23 + 5$

$$\boxed{y = -5(x-1)^2 + 28}$$

5. $2y = x^2 - 6x + 13$

$2y = (x^2 - 6x + 9) + 13 - 9$

$2y = (x-3)^2 + 4$

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

6. $x^2 - 4x - 3y + 1 = 0$

$x^2 - 4x + 1 = 3y$

$3y = x^2 - 4x + 1$

$3y = (x^2 - 4x + 4) + 1 - 4$

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

$\boxed{y = \frac{1}{3}(x-2)^2 - 1}$

7. $x^2 + 10x + 2y - 3 = 0$

$2y = -x^2 - 10x + 3$

$2y = -(x^2 + 10x + 25) + 3 + 25$

$2y = -(x+5)^2 + 28$

$\boxed{y = -\frac{1}{2}(x+5)^2 + 14}$

8. $5y + 4 = 6x^2 - 12x$

$5y = 6x^2 - 12x \quad -4$

$5y = 6(x^2 - 2x + 1) - 4 - 6$

$5y = 6(x-1)^2 - 10$

$$\boxed{y = \frac{6}{5}(x-1)^2 - 2}$$

9. $6x^2 + 5y - 25 = 0$

$5y = -6x^2 + 25$

$$\boxed{y = \frac{-6}{5}x^2 + 5}$$

Use the information to write the equation of the parabola

7. Vertex (9,1), Focus (8,1)

8. Vertex (-4,3) Focus (-5,3)

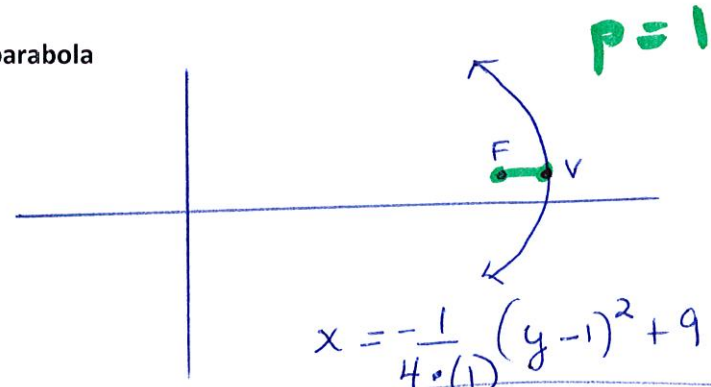
9. Vertex (9,0) Directrix x = 7

10. Vertex (-3,3) Directrix x = 1

11. Focus (4,2) Directrix y=6

12. Focus (3,2) Directrix y = 0

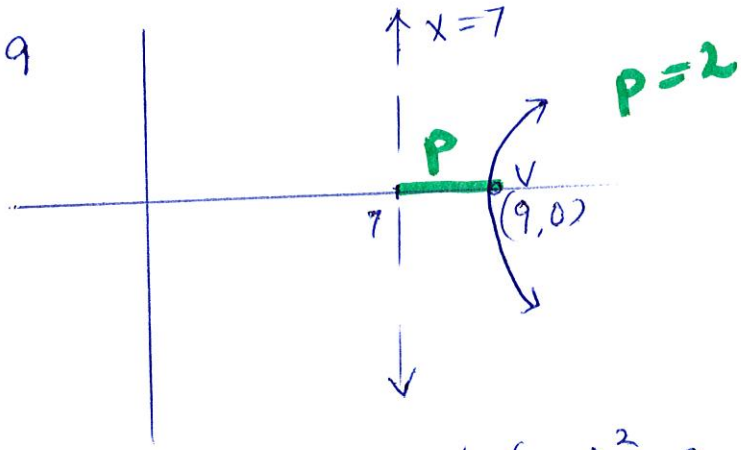
7.



$$x = -\frac{1}{4\cdot(1)}(y-1)^2+9$$

$$\boxed{y = -\frac{1}{4}(y-1)^2+9}$$

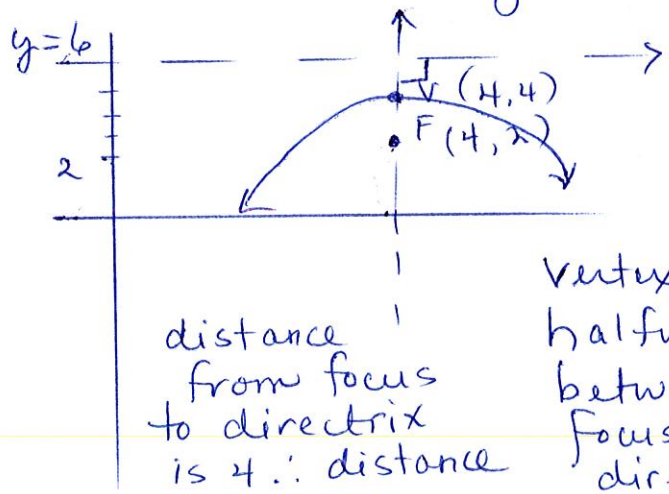
8. 9



$$x = \frac{1}{4\cdot 2}(y-0)^2+9$$

$$\boxed{x = \frac{1}{8}y^2+9}$$

11. focus (4,2)
directrix: y=6



distance from focus to directrix is 4 ∴ distance p = 2

vertex lies halfway between focus + directrix

$$\boxed{y = -\frac{1}{8}(x-4)^2+4}$$