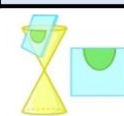
## TOPIC: PARABOLAS
## Parabolas as Conic Sections

| Circle | Ellipse | **Parabola** | Hyperbola |
| --- | --- | --- | --- |



- As conic sections, parabolas have a focus ( __________ ) & directrix ( __________ )
  - To find **focus**, start at vertex: if opens ↑, go **[ ↑ | ↓ ]** $|p|$ units; if opens ↓, go **[ ↑ | ↓ ]** $|p|$ units
  - To find **directrix**, start at vertex: if opens ↑, go **[ ↑ | ↓ ]** $|p|$ units; if opens ↓, go **[ ↑ | ↓ ]** $|p|$ units & draw line

$$y = a(x-h)^2 + k$$

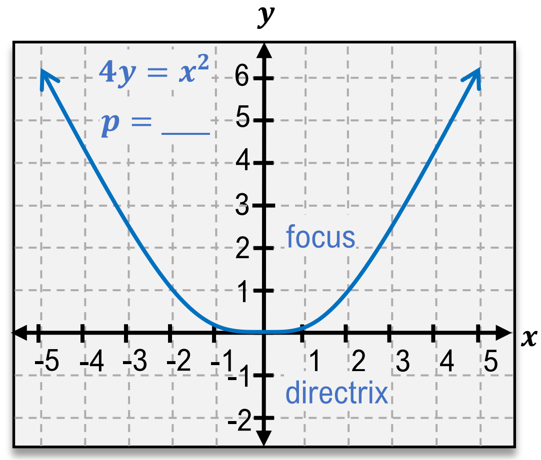
↓

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

↓

$$4py = x^2$$

*(Parabola At Origin)*




- When $p \rightarrow +$ the parabola opens **[ ↑ | ↓ ]** and when $p \rightarrow -$ the parabola opens **[ ↑ | ↓ ]**

EXAMPLE: Graph the following parabola.

$$8(y-2) = (x-1)^2$$

**TO GRAPH**

**1)** Find the vertex $(h, k)$: ( __ , __ )

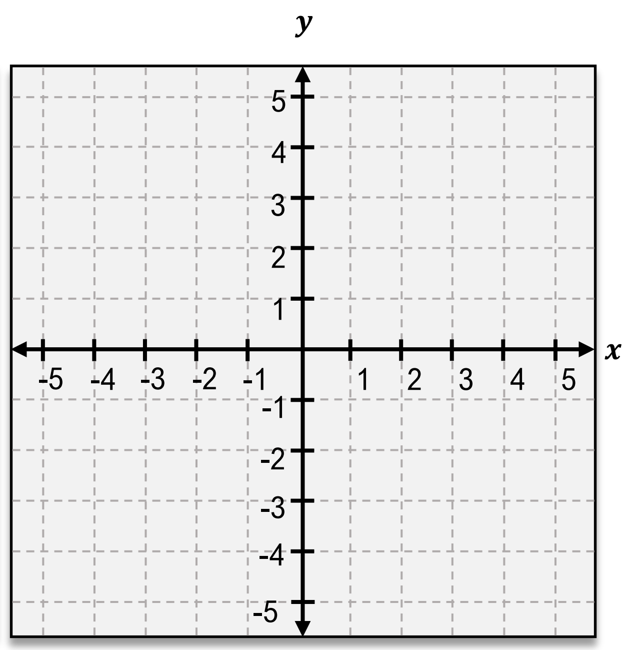
**2)** Calculate the $p$ value: $p =$ ___

**3)** Find focus (go **[ ↑ | ↓ ]** $|p|$ units from vertex):
( __ , __ )

**4)** From focus, go **left** & **right** $2|p|$ units:
( __ , __ ) & ( __ , __ )

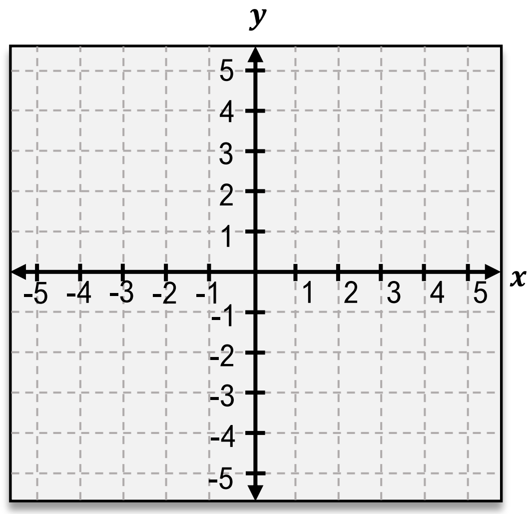
**5)** Connect outer points with smooth curve

**6)** Find directrix (go **[ ↑ | ↓ ]** $|p|$ units from vertex):
$y =$ ___

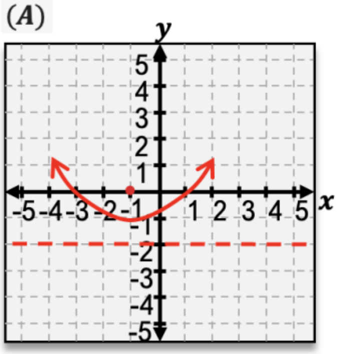


**TOPIC: PARABOLAS**

PRACTICE: Graph the parabola $-4(y+1) = (x+1)^2$, and find the focus point and directrix line.

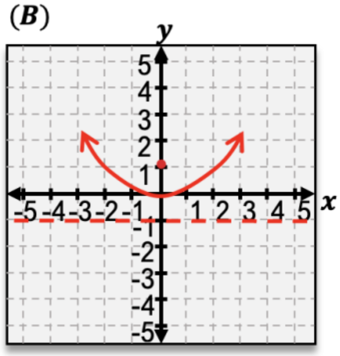



**(A)**



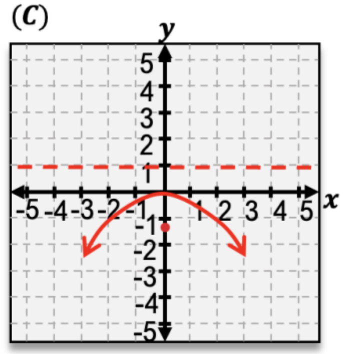
Focus: $(-1,0)$
Directrix: $y = -2$

**(B)**



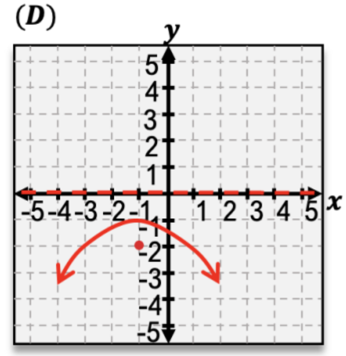
Focus: $(0,1)$
Directrix: $y = -1$

**(C)**



Focus: $(0,-1)$
Directrix: $y = 1$

**(D)**



Focus: $(-1,-2)$
Directrix: $y = 0$

PRACTICE: If a parabola has the focus at $(0,-1)$ and a directrix line $y = 1$, find the standard equation for the parabola.

(**A**) $4y = x^2$
(**B**) $4(y-1) = x^2$
(**C**) $-4y = x^2$
(**D**) $-4(y+1) = x^2$

| Circle | Ellipse | **Parabola** | Hyperbola |
|---|---|---|---|

## TOPIC: PARABOLAS

EXAMPLE**:** Identify the vertex, focus, & directrix of the parabola.

**(A)** $16y = x^2$

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

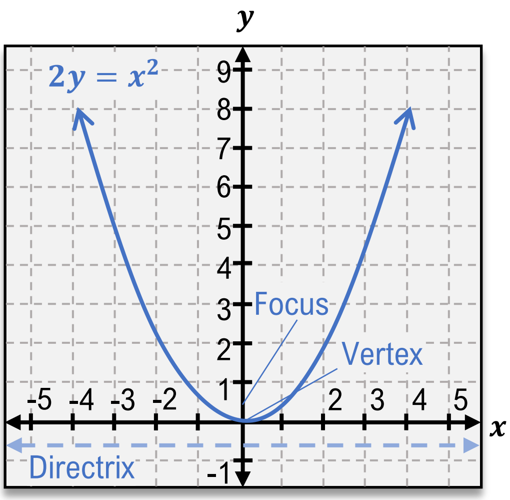
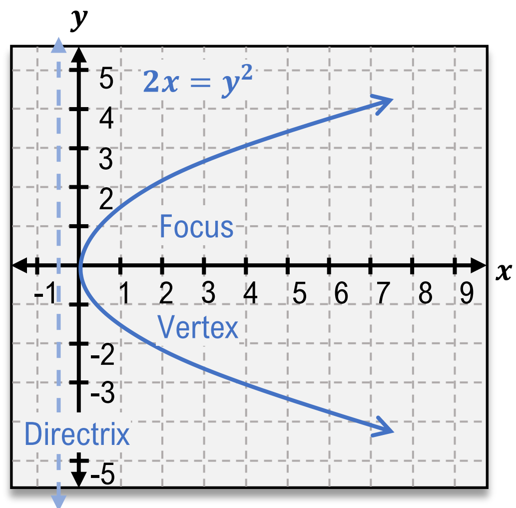
**(C)** $8(y-1) = (x-2)^2$

**(D)** $-12y = (x+1)^2$

**TOPIC: PARABOLAS**

**Horizontal Parabolas**

- Horizontal parabolas are just like vertical ones, but with ___ & ___ switched (so they are ___________)
  - The directrix is always _____________ to the axis of symmetry

| Vertical Parabola | Horizontal Parabola |
|---|---|
|  |  |
| $4py = x^2$ | $4px = y^2$ |
| If $p$ is **pos**: parabola opens **[ ↑ \| ↓ \| → \| ← ]** | If $p$ is **pos**: parabola opens **[ ↑ \| ↓ \| → \| ← ]** |
| If $p$ is **neg**: parabola opens **[ ↑ \| ↓ \| → \| ← ]** | If $p$ is **neg**: parabola opens **[ ↑ \| ↓ \| → \| ← ]** |
| Directrix is **[ HORIZONTAL \| VERTICAL ]** | Directrix is **[ HORIZONTAL \| VERTICAL ]** |



EXAMPLE: Graph the parabola

$8x = y^2$

**TO GRAPH**

**1)** Find the vertex $(h, k)$: ( __ , __ )

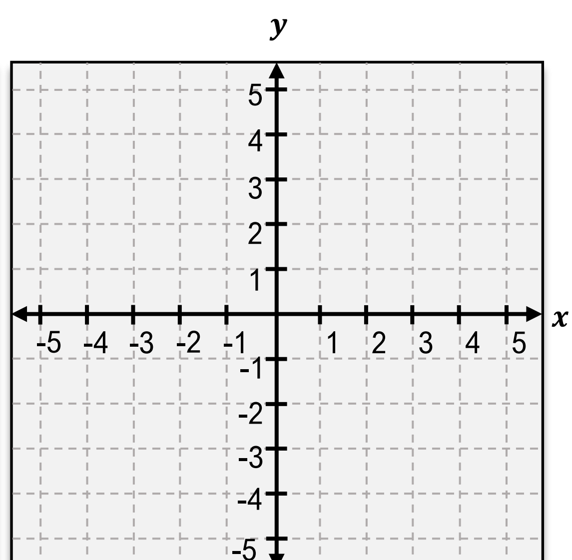
**2)** Calculate the $p$ value: $|p| =$ ___

**3)** Find focus (go **[ ↑ | ↓ | → | ← ]** $|p|$ units from vertex): ( __ , __ )

**4)** From focus, go **[Left & Right | Up & Down]** $|2p|$ units: ( __ , __ ) & ( __ , __ )

**5)** Connect outer points with smooth curve

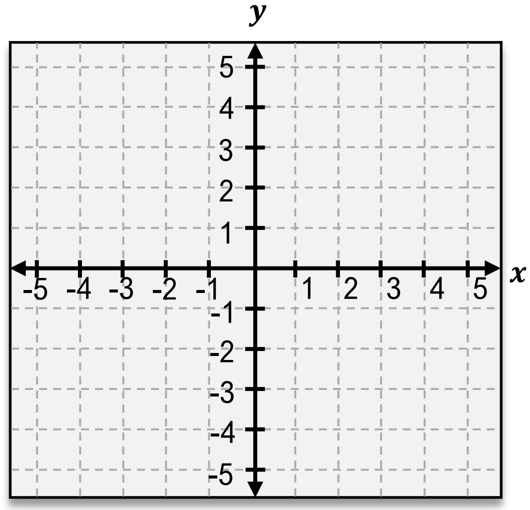
**6)** Find directrix (go **[ ↑ | ↓ | → | ← ]** $|p|$ units from vertex): **[x | y] =** ________



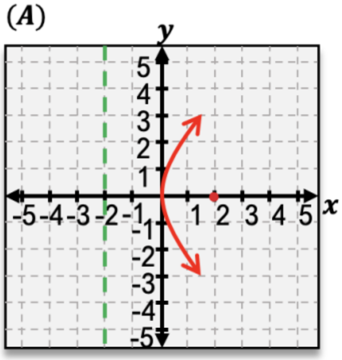
| Circle | Ellipse | **Parabola** | Hyperbola |
|---|---|---|---|

## TOPIC: PARABOLAS

PRACTICE: Graph the parabola $8(x+1)=(y-2)^2$, and find the focus point and directrix line.

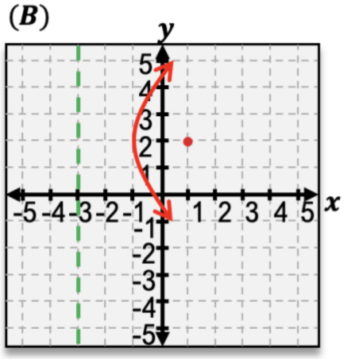



$(A)$



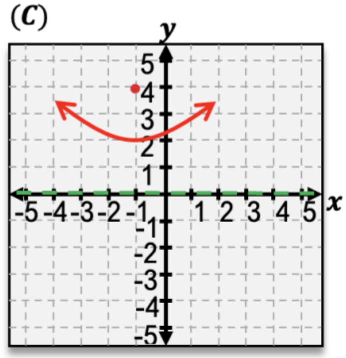
Focus: $(2,0)$
Directrix: $x=-2$

$(B)$



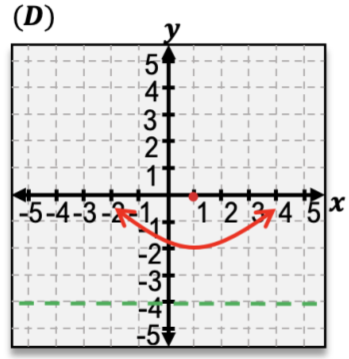
Focus: $(1,2)$
Directrix: $x=-3$

$(C)$



Focus: $(-1,4)$
Directrix: $y=0$

$(D)$



Focus: $(1,0)$
Directrix: $y=-4$

| Circle | Ellipse | Parabola | Hyperbola |
|---|---|---|---|

**TOPIC: PARABOLAS**

PRACTICE**:** If a parabola has the focus at $(2,4)$ and a directrix line $x = -4$, find the standard equation for the parabola.
$(\boldsymbol{A})$ $12(x + 1) = (y - 4)^2$
$(\boldsymbol{B})$ $-(x + 1) = (y - 4)^2$
$(\boldsymbol{C})$ $12x = y^2$
$(\boldsymbol{D})$ $4(x - 1) = (y + 4)^2$

EXAMPLE**:** Identify the vertex, focus, & directrix of the parabola.

$(\boldsymbol{A})$ $4x = y^2$

$(\boldsymbol{B})$ $9x = (y - 2)^2$

$(\boldsymbol{C})$ $16(x - 4) = (y + 2)^2$

$(\boldsymbol{D})$ $-2(x - 1) = y^2$