# The Parabola
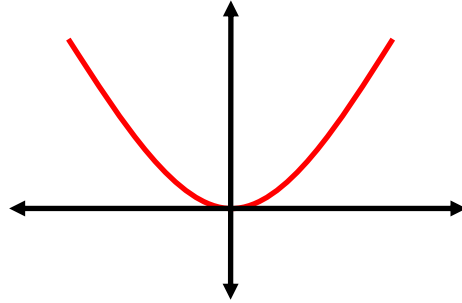
- Graph a parabola and identify its important parts.

- Write the equation of a parabola in standard form.

- Write the equation of a parabola in standard form given important parts.

# Vertical Axis of Symmetry

$$\left(x - h\right)^2 = 4p\left(y - k\right)$$
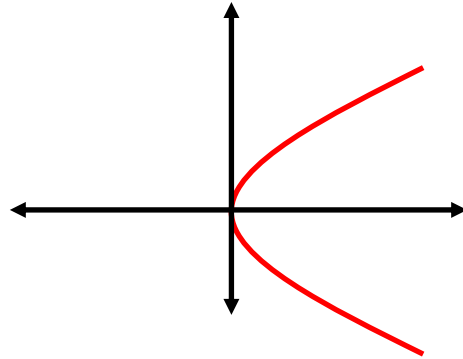
Vertex: (h, k)

P:

+ : opens up

− : opens down

**Focus:** p units away from the vertex, inside the parabola.

**Directrix:** the *horizontal* line -p units away from the vertex

# Horizontal Axis of Symmetry



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

Vertex: (h, k)

P:

+ : opens right

– : opens left

**Focus:** p units away from the vertex, inside the parabola.

**Directrix:** the *vertical* line -p units away from the vertex

# #1 Graph the parabola. Identify the vertex, focus, and directrix.

$$-2x^2 = 16y$$

Write in standard form:

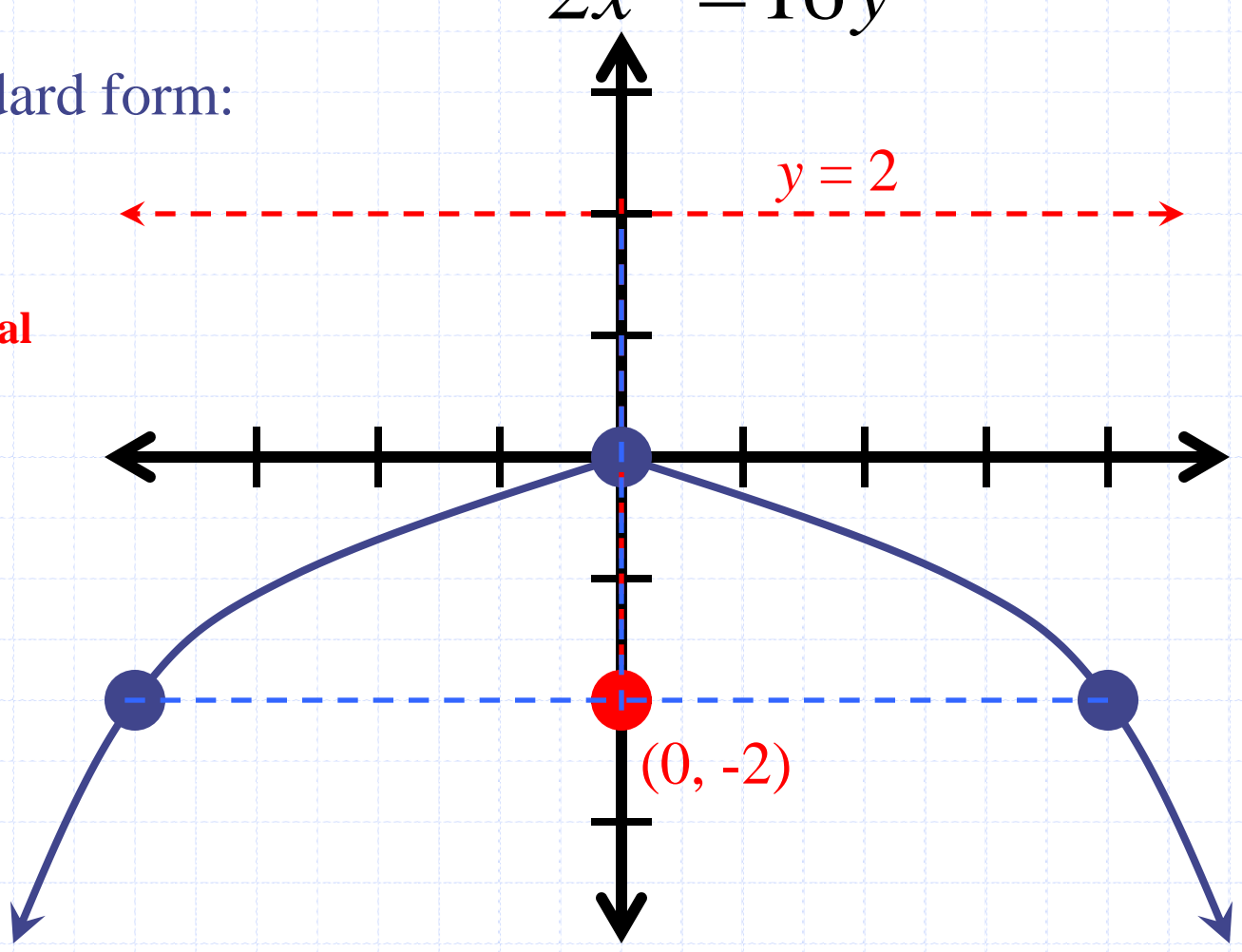$$-2x^2 = 16y$$

$$x^2 = -8y \quad \textbf{Vertical}$$

Vertex $(0,\ 0)$

$$4p = -8$$

$$p = -2$$

Focus $(0, -2)$

Directrix $y = 2$

$y = 2$

$(0, -2)$

# #2 Graph the parabola. Identify the vertex, focus, and directrix.

$$6x = y^2$$

Write in standard form:

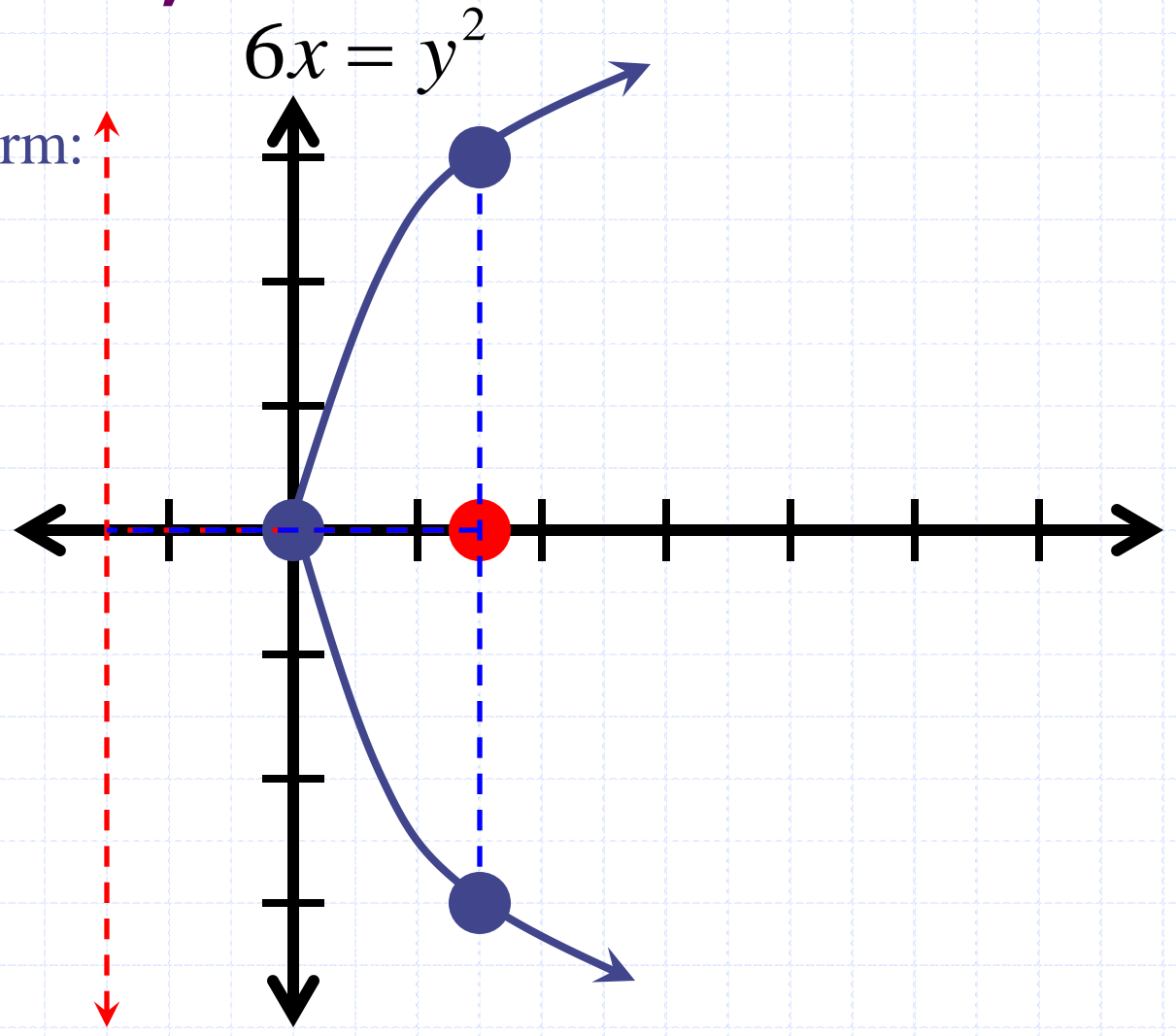$$6x = y^2$$

$$y^2 = 6x \quad \textbf{Horizontal}$$

Vertex $(0, 0)$

$$4p = 6$$

$$p = \frac{3}{2}$$

Focus $\left(\frac{3}{2}, 0\right)$

Directrix: $x = -\frac{3}{2}$

# #3 Graph the parabola. Identify the vertex, focus, and directrix.

$$(y - 2)^2 = 4(x - 3)$$ <span style="color:red">**Horizontal**</span>

<span style="color:red">Vertex</span> $(3, 2)$
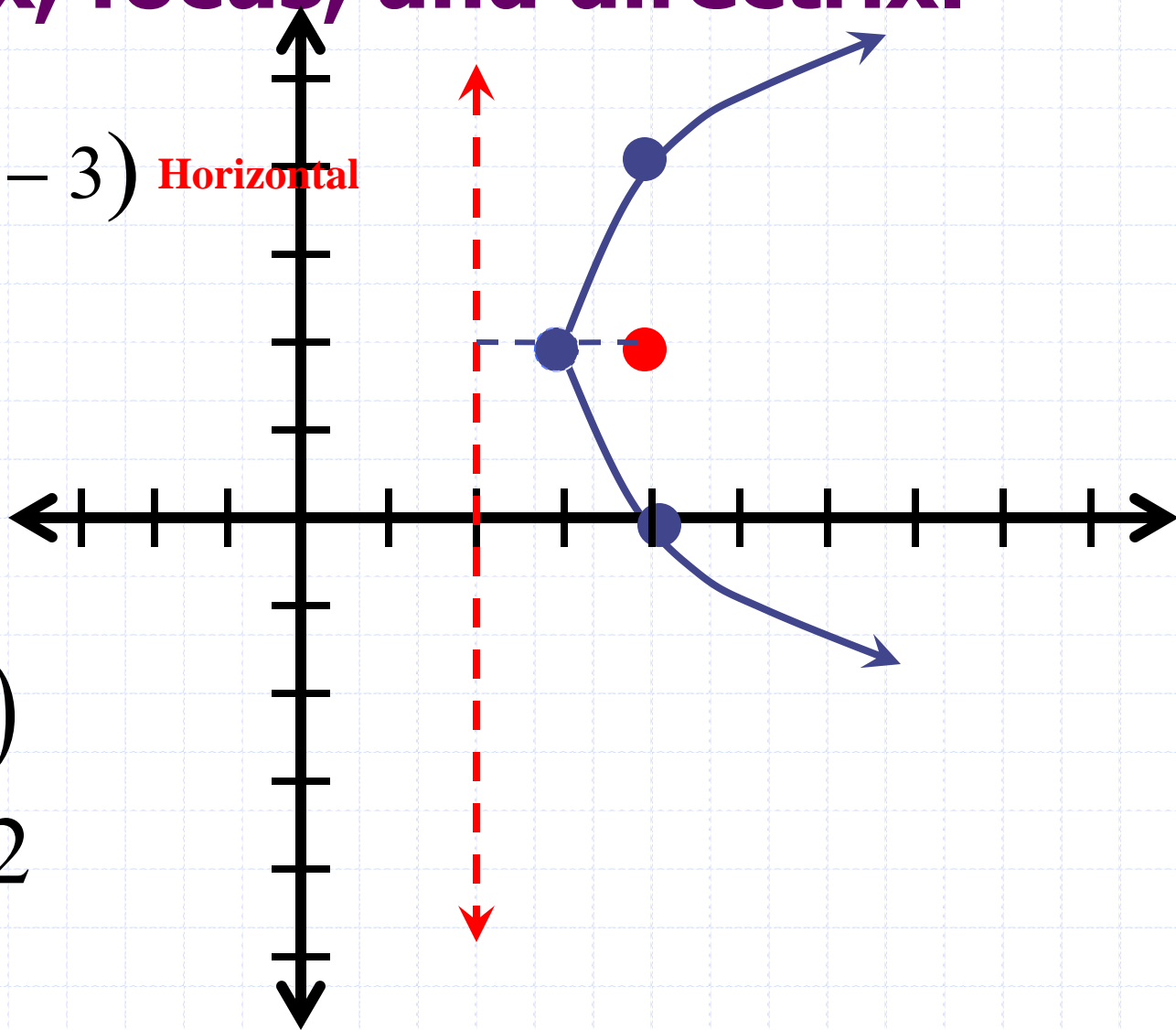
$4p = 4$

$p = 1$

<span style="color:red">Focus</span> $(4, 2)$

<span style="color:red">Directrix</span> $x = 2$

# #4 Graph the parabola. Identify the vertex, focus, and directrix.
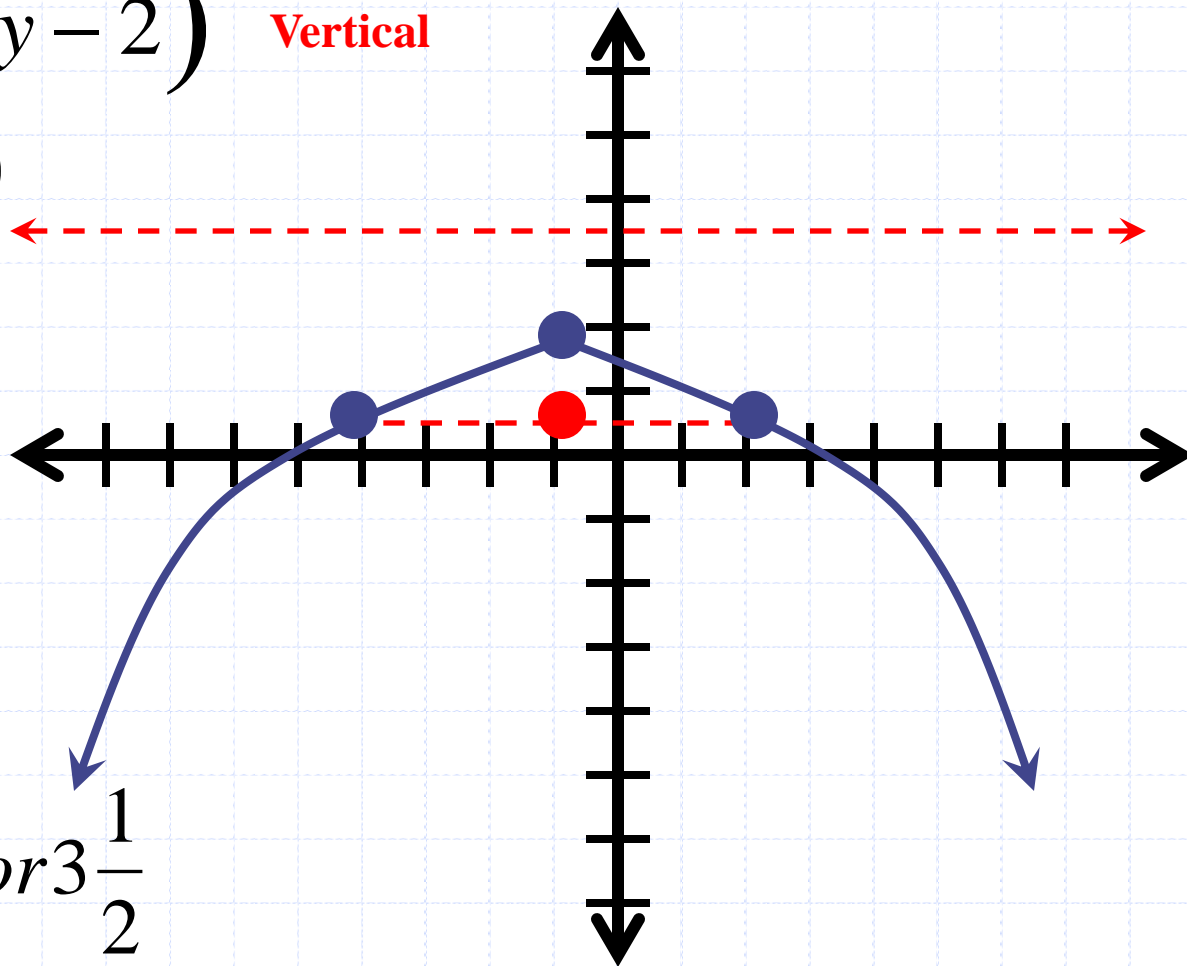
$$(x+1)^2 = -6(y-2)$$

**Vertical**

Vertex $(-1, 2)$

$$4p = -6$$

$$p = -\frac{3}{2}$$

Focus $\left(-1, \frac{1}{2}\right)$

Directrix $y = \frac{7}{2} \; or \; 3\frac{1}{2}$

# Writing an equation of a parabola in standard form

**5.** $y^2 - 2y + 16x - 31 = 0$
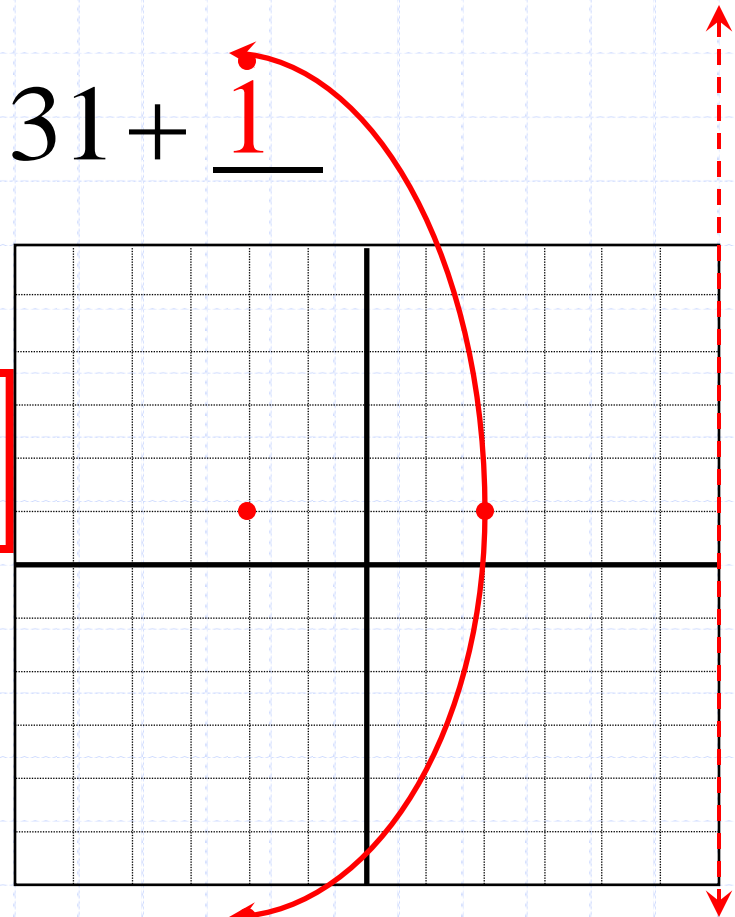
$y^2 - 2y = -16x + 31$

$y^2 - 2y + \underline{1} = -16x + 31 + \underline{1}$

$(y - 1)^2 = -16x + 32$

$(y - 1)^2 = -16(x - 2)$

**Horizontal**

**Vertex: (2, 1)**

# Writing an equation of a parabola in standard form
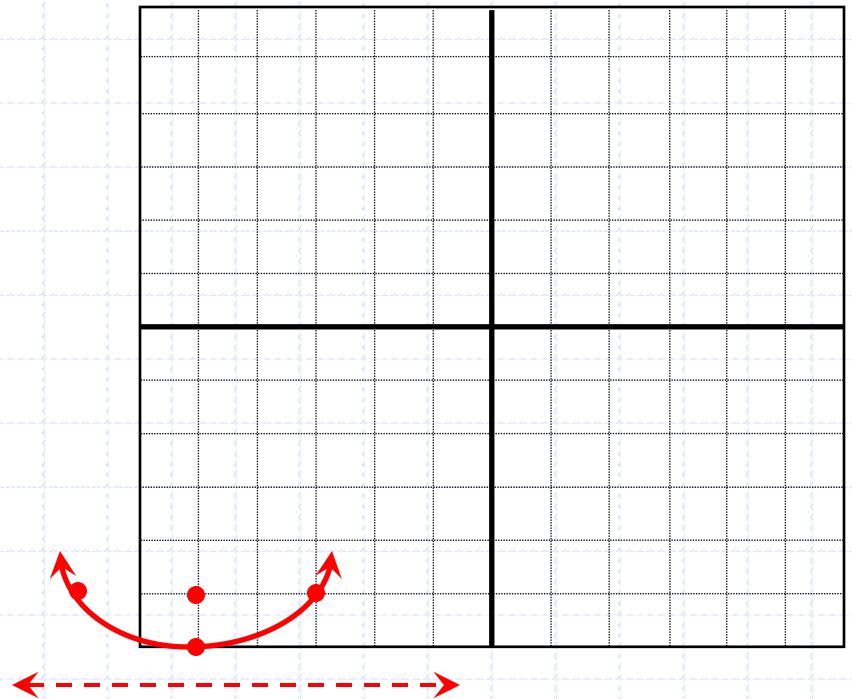
6. $x^2 + 10x - 4y + 1 = 0$

$x^2 + 10x = 4y - 1$

$x^2 + 10x + \underline{25} = 4y - 1 + \underline{25}$
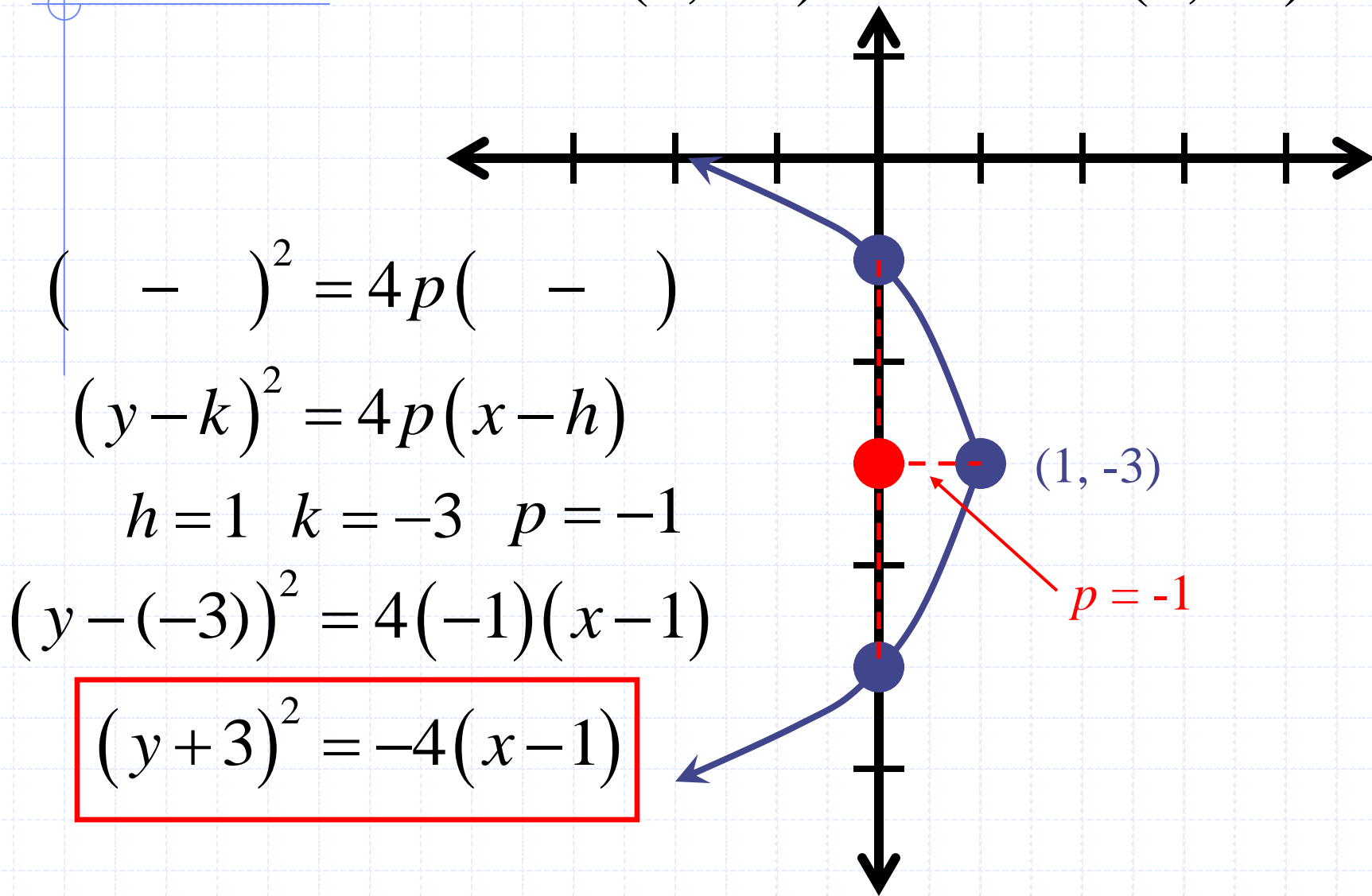
$(x + 5)^2 = 4y + 24$

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

**Vertical**

**Vertex: (-5, -6)**

# #7 Write an equation of the parabola

$$\text{Vertex} = (1, -3) \quad \text{Focus} = (0, -3)$$

$$(\quad - \quad)^2 = 4p(\quad - \quad)$$

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

$$h = 1 \quad k = -3 \quad p = -1$$
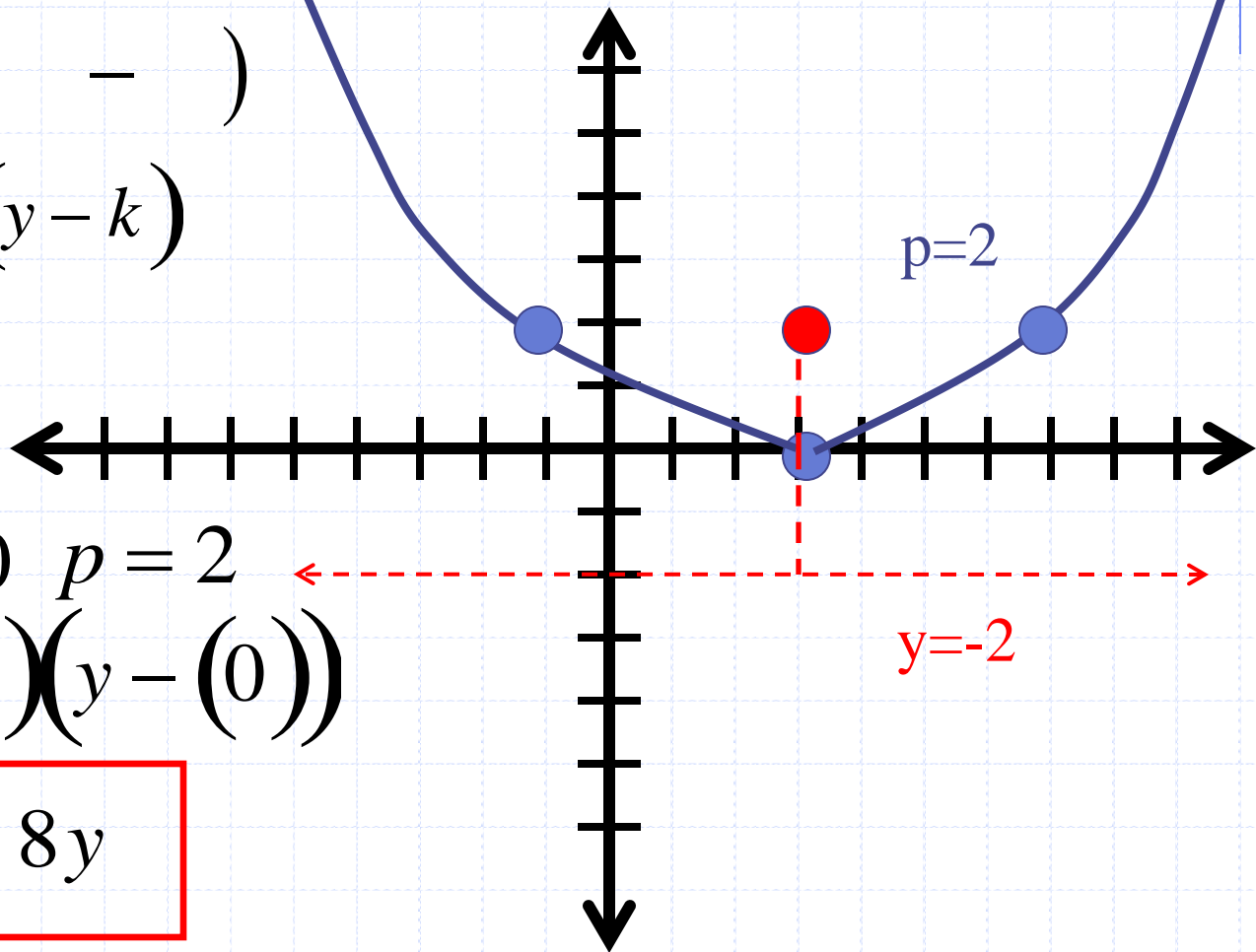
$$(y - (-3))^2 = 4(-1)(x - 1)$$

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

(1, -3)

$p = -1$

# #8 Write an equation of the parabola

$$\text{Vertex} = (3,0) \quad \text{Directrix} \; y = -2$$

$$(\quad - \quad)^2 = 4p(\quad - \quad)$$

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

p=2

y=-2

$$h = 3 \quad k = 0 \quad p = 2$$

$$(x - (3))^2 = 4(2)(y - (0))$$

$$(x - 3)^2 = 8y$$