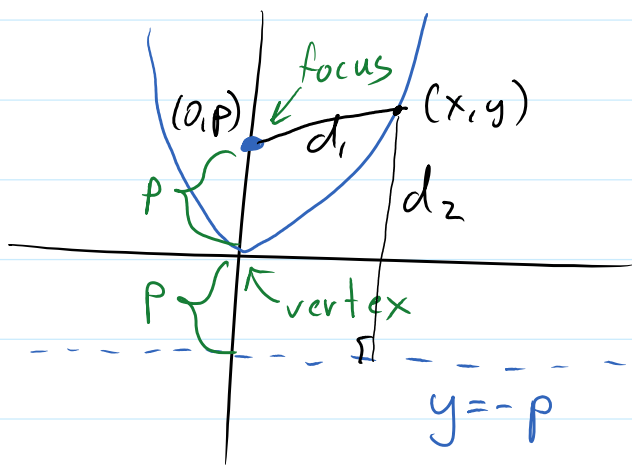


Section 10.3

Definition

A parabola is the set of all points in a plane that are equidistant from a fixed line, the directrix, and a fixed point, the focus, that is not on the line.



$$d_1 = d_2$$

$$\sqrt{(x-0)^2 + (y-p)^2} = y+p$$

$$\sqrt{x^2 + (y-p)^2} = y+p \quad // \dots^2$$

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

$$x^2 + y^2 - 2yp + p^2 = y^2 + 2yp + p^2$$

$$x^2 - 2yp = 2yp$$

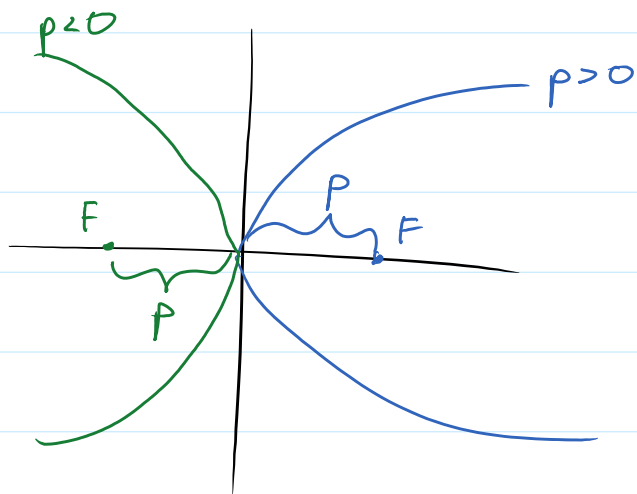
$$x^2 = 4py$$

Standard equation:

The standard equation of a parabola

The standard equation of a parabola with vertex at the origin is

$$y^2 = 4px$$



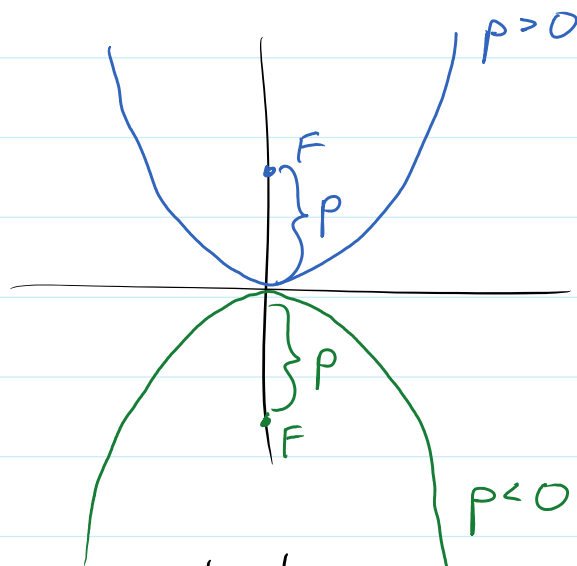
horizontal axis
of sym.

Focus: $(p, 0)$

directrix: $x = -p$

axis of sym: $y = 0$

$$x^2 = 4py$$



vertical axis
of sym.

Focus: $(0, p)$

directrix: $y = -p$

axis of sym: $x = 0$

Ex: Find the focus and directrix of the parabola: $y^2 = 12x$. Then graph the parabola.

$$y^2 = 4px$$

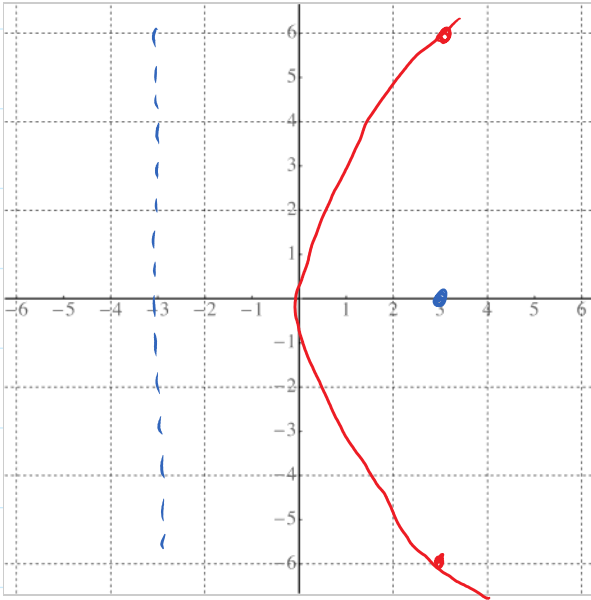
$$\frac{12}{4} = \frac{4p}{4}$$

- par. opens to right
- vertex: $(0, 0)$

$$\frac{12}{4} = \frac{12}{4}$$

$$p=3$$

- parabola opens to the right
- vertex: $(0,0)$
- focus: $(3,0)$
- directrix: $x=-3$



$$y^2 = 12x$$
$$x=3$$
$$y^2 = 12 \cdot 3$$
$$y^2 = 36 \rightarrow y = \pm 6$$

Ex: sketch: $x^2 = -8y$

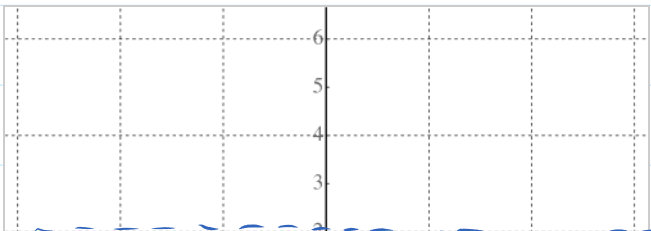
$$x^2 = 4py$$

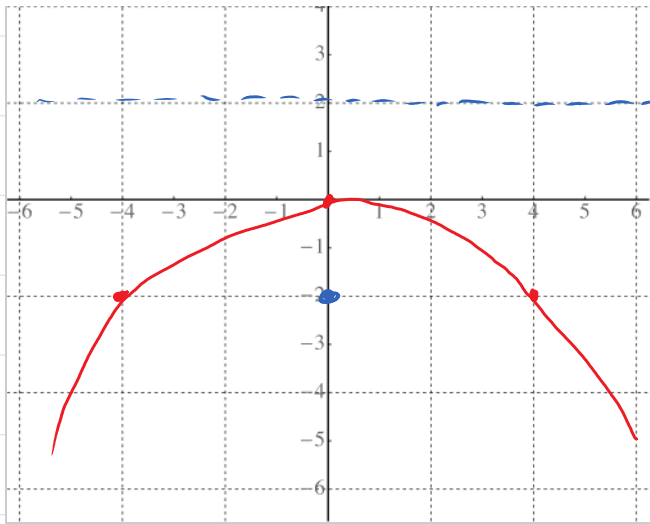
$$-8 = 4p$$

$$p = -2$$

- opens down
- focus $(0, 0 + (-2))$ $(h, k+p)$
 $(0, -2)$

• directrix: $y = -(-2)$
 $y = 2$





$$x^2 = -8y$$

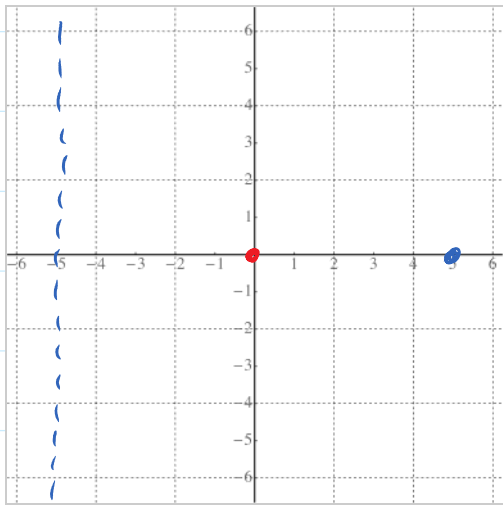
$$y = -2$$

$$x^2 = -8 \cdot (-2)$$

$$x^2 = 16$$

$$x = \pm 4$$

Ex: Find the equation of the parabola with focus $(5, 0)$ and directrix $x = -5$.



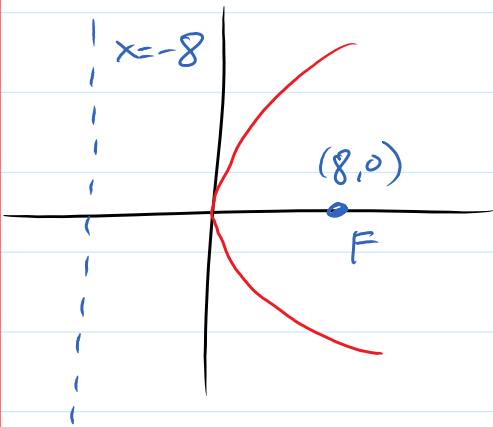
$$p = 5$$

$$\text{st. eq: } y^2 = 4px$$

$$y^2 = 4 \cdot 5x$$

$$\boxed{y^2 = 20x}$$

Ex: find the equation of the parabola with focus $(8, 0)$ and directrix $x = -8$.



$$p = 8$$

$$y^2 = 4 \cdot 8x$$

$$\boxed{y^2 = 32x}$$

focus $(-8, 0)$, direct: $x = 8$

$$p = -8$$

$$\boxed{y^2 = -32x}$$