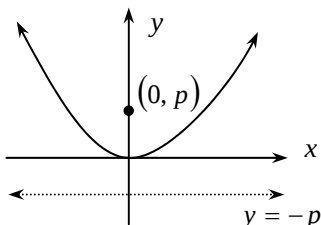


Conic Sections

1. Parabolas:

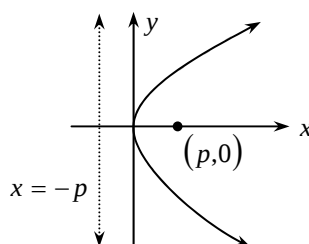
$$x^2 = 4py$$

- opens vertically
- focus: $(0, p)$
- directrix: $y = -p$
- focal diameter: $|4p|$



$$y^2 = 4px$$

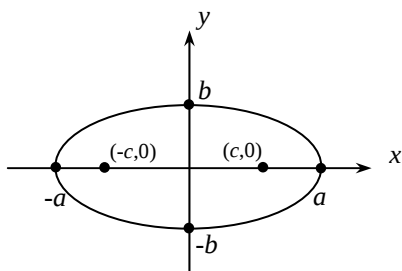
- opens horizontally
- focus: $(p, 0)$
- directrix: $x = -p$
- focal diameter: $|4p|$



2. Ellipses:

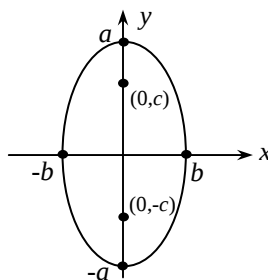
$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \quad a > b > 0$$

- vertices: $(\pm a, 0)$
- foci: $(\pm c, 0)$, $c^2 = a^2 - b^2$



$$\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1 \quad a > b > 0$$

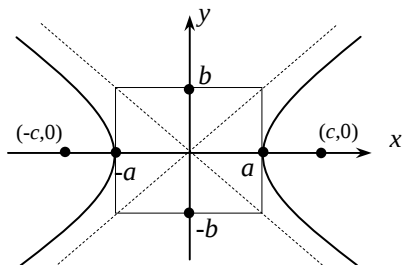
- vertices: $(0, \pm a)$
- foci: $(0, \pm c)$, $c^2 = a^2 - b^2$



3. Hyperbolas:

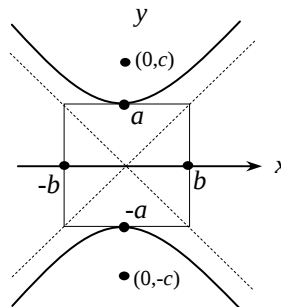
$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

- vertices: $(\pm a, 0)$
- foci: $(\pm c, 0)$, $c^2 = a^2 + b^2$



$$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$$

- vertices: $(0, \pm a)$
- foci: $(0, \pm c)$, $c^2 = a^2 + b^2$



4. Shifting:

- replacing x with $(x - h)$ shifts h units to the right
- replacing y with $(y - k)$ shifts k units up