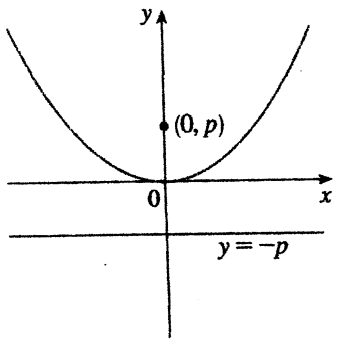
CONIC SECTIONS

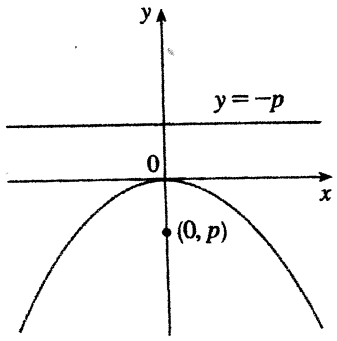
PARABOLAS

1 An equation of the parabola with focus $(0, p)$ and directrix $y = -p$ is

$$x^2 = 4py$$

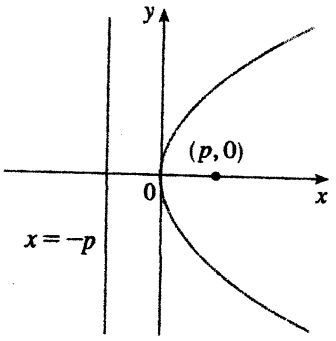


(a) $x^2 = 4py$, $p > 0$

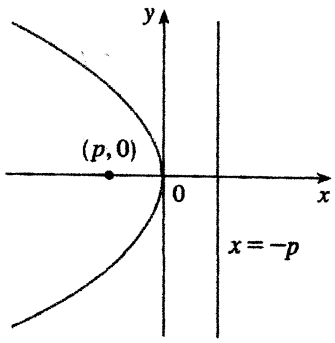


(b) $x^2 = 4py$, $p < 0$

$$y^2 = 4px$$



(c) $y^2 = 4px$, $p > 0$



(d) $y^2 = 4px$, $p < 0$

Ellipses

4 The ellipse

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

has foci $(\pm c, 0)$, where $c^2 = a^2 - b^2$, and vertices $(\pm a, 0)$.

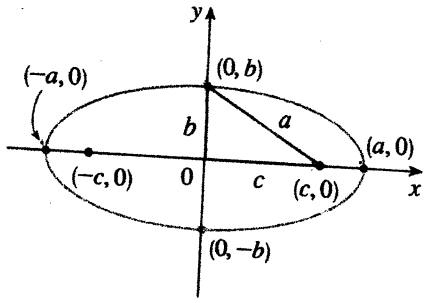


FIGURE 8
$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1,\ a \geqslant b$

5 The ellipse

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

has foci $(0, \pm c)$, where $c^2 = a^2 - b^2$, and vertices $(0, \pm a)$.

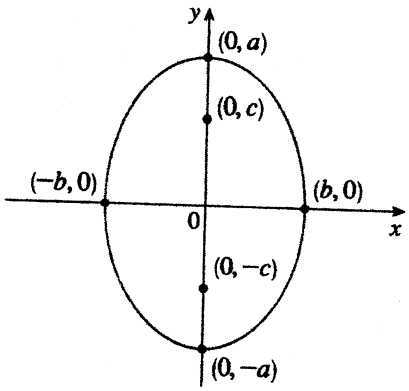


FIGURE 9
$\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1,\ a \geqslant b$

Hyperbolas

7 The hyperbola

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

has foci $(\pm c, 0)$, where $c^2 = a^2 + b^2$, vertices $(\pm a, 0)$, and asymptotes $y = \pm(b/a)x$.

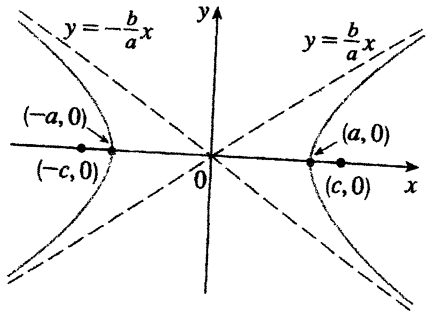


FIGURE 12
$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

8 The hyperbola

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

has foci $(0, \pm c)$, where $c^2 = a^2 + b^2$, vertices $(0, \pm a)$, and asymptotes $y = \pm(a/b)x$.

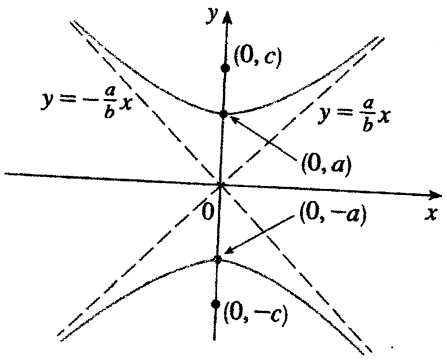


FIGURE 13
$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$