

a.  $x^2 + 4x + y^2 - 6y - 23 = 0$   
 $(x^2 + 4x + 4) + (y^2 - 6y + 9) = 23 + 4 + 9$   
 $(x + 2)^2 + (y - 3)^2 = 36$   
 This is a circle with center at  $(-2, 3)$  and  $r = 6$ .

b.  $25x^2 - 150x + 4y^2 + 8y = -129$   
 $25(x^2 - 6x) + 4(y^2 + 2y) = -129$   
 $25(x^2 - 6x + 9) + 4(y^2 + 2y + 1) = -129 + 225 + 4$   
 $25(x - 3)^2 + 4(y + 1)^2 = 100$   
 $\frac{(x - 3)^2}{4} + \frac{(y + 1)^2}{25} = 1$   
 This is an ellipse with center at  $(3, -1)$ ,  $a = 2$ , and  $b = 5$ .  
 Vertices are  $(5, -1)$ ,  $(1, -1)$ ,  $(3, 4)$ , and  $(3, -6)$ .  
 $c = \sqrt{|a^2 - b^2|} = \sqrt{|4 - 25|} = \sqrt{|-21|} = \sqrt{21}$   
 Foci are  $(3, -1 + \sqrt{21})$  and  $(3, -1 - \sqrt{21})$ .  
 Major axis is a vertical axis with length 10, and minor axis is a horizontal axis with length 4.

c.  $25x^2 - 150x - 4y^2 - 8y = -121$   
 $25(x^2 - 6x) - 4(y^2 + 2y) = -121$   
 $25(x^2 - 6x + 9) - 4(y^2 + 2y + 1) = -121 + 225 - 4$   
 $25(x - 3)^2 - 4(y + 1)^2 = 100$   
 $\frac{(x - 3)^2}{4} - \frac{(y + 1)^2}{25} = 1$   
 This is a hyperbola that opens left and right with center at  $(3, -1)$ ,  $a = 2$ , and  $b = 5$ .  
 Vertices are:  $(1, -1)$  and  $(5, -1)$ .  
 $c = \sqrt{a^2 + b^2} = \sqrt{4 + 25} = \sqrt{29}$   
 Foci are  $(3 - \sqrt{29}, -1)$  and  $(3 + \sqrt{29}, -1)$ .  
 Equations of the asymptotes are  $y = -\frac{b}{a}(x - h) + k$  and  $y = \frac{b}{a}(x - h) + k$ . So,  
 $y = -\frac{5}{2}(x - 3) - 1 \rightarrow y = -\frac{5}{2}x + \frac{13}{2}$  and  $y = \frac{5}{2}(x - 3) - 1 \rightarrow y = \frac{5}{2}x - \frac{17}{2}$

d.  $x^2 - 6x + 2y + 11 = 0$   
 $x^2 - 6x = -2y - 11$   
 $x^2 - 6x + 9 = -2y - 11 + 9$   
 $x^2 - 6x + 9 = -2y - 2$   
 $(x - 3)^2 = -2(y + 1)$   
 $4p = -2 \rightarrow p = -\frac{1}{2}$   
 This is a parabola that opens down with vertex at  $(3, -1)$ , focus at  $(3, -\frac{3}{2})$ , and line of directrix at  $y = -\frac{1}{2}$ .