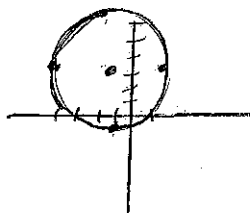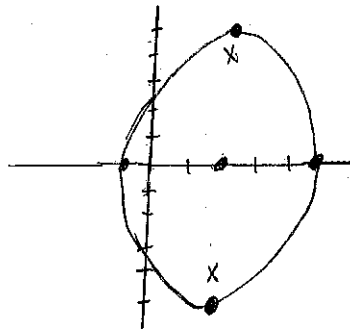**1.a.** $(x+1)^2 + (y-3)^2 = 10$

   center $= (-1, 3)$

   radius $= \sqrt{10} \approx 3.16$

Circle

1.b. $\dfrac{(x-2)^2}{9} + \dfrac{y^2}{25} = 1$

   Center: $(2, 0)$

   Co-Vertex: $(5,0)(-1,0)$

   Vertex: $(2,5)(2,-5)$

   foci: $(2,4)(-2,-4)$

   Major arc: 10

   Minor arc: 6
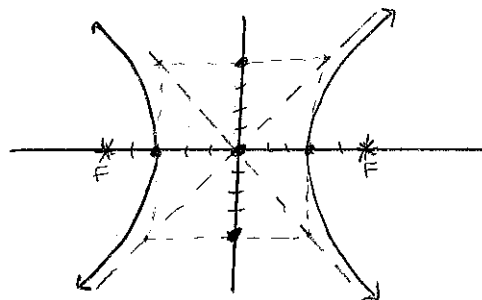

$c^2 = a^2 - b^2$

$c^2 = 25 - 9$

$c^2 = 16$

$c = 4$

1.c. $\dfrac{16x^2 - 9y^2 = 144}{144}$ $\boxed{\dfrac{x^2}{9} - \dfrac{y^2}{16} = 1}$

$c^2 = a^2 + b^2$ Center: $(0,0)$

$c^2 = 9 + 16$ Vertex: $(3,0)(-3,0)$

$c^2 = 25$ Foci: $(5,0)(-5,0)$

$c = 5$ asymptote: $y = \pm\dfrac{b}{a}x = \pm\dfrac{4}{3}x$

Horizontal Hyperbola

1.d. $\dfrac{(y-2)^2}{25} - \dfrac{(x+3)^2}{4} = 1$

$c^2 = a^2 + b^2$ Center: $(-3, 2)$

$c^2 = 25 + 4$ Vertex: $(-3,7)(-3,-3)$

$c^2 = 29$ Foci: $(-3, 2 \pm \sqrt{29})$

$c = \sqrt{29}$ asymptote:

$c \approx 5.39$ $y - 2 = \pm\dfrac{5}{2}(x+3)$
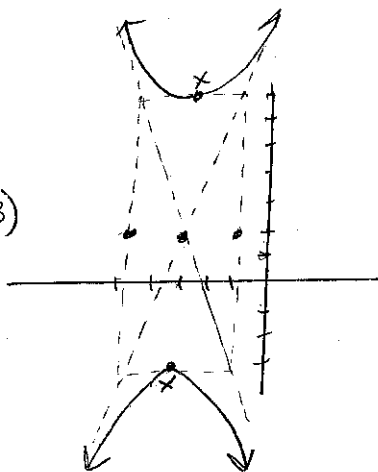
1.e. $(x+4) + (y-2)^2 = 0$ $\boxed{(y-2)^2 = -(x+4)}$

Latus Rectum $= |-1| = 1$

$4p = -1$

$p = -\frac{1}{4}$

Vertex: $(-4, 2)$
Foci: $(-4\frac{1}{4}, 2)$
Directrix: $x = -3\frac{3}{4}$
Ends: $(-4\frac{1}{4}, 1\frac{1}{2})(-4\frac{1}{4}, 2\frac{1}{2})$

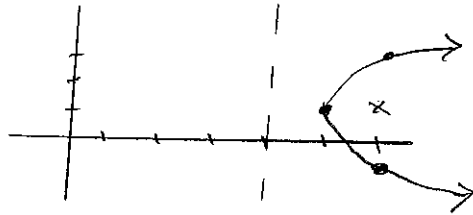1.f. $\frac{4(y-1)^2}{4} = \frac{16(x-5)}{4}$ $\boxed{(y-1)^2 = 4(x-5)}$

$4p = 4$

$p = 1$
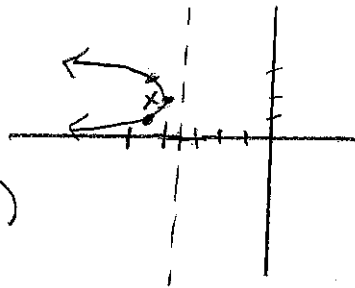
vertex: $(5, 1)$
Foci: $(6, 1)$
Directrix: $x = 4$
Ends: $(6, 3)(6, -1)$

2a. $x^2 + y^2 - 6x - 2y + 1 = 0$

$x^2 - 6x + \underline{9} + y^2 - 2y + \underline{1} = -1 + 9 + 1$

$\boxed{(x-3)^2 + (y-1)^2 = 9}$ $\boxed{\text{Circle}}$

2.b. $6x^2 - 12 = 6y^2$ $\frac{6x^2 - 6y^2}{12} = \frac{12}{12}$ $\boxed{\frac{x^2}{2} - \frac{y^2}{2} = 1}$

$\boxed{\text{Hyperbola}}$

2.c. $9x^2 + 4y^2 + 54x - 16y + 61 = 0$

$9x^2 + 54x + 4y^2 - 16y = -61$

$9(x^2 + 6x + \underline{9}) + 4(y^2 - 4y + \underline{4}) = -61 + 81 + 16$

$\frac{9(x+3)^2}{36} + \frac{4(y-2)^2}{36} = \frac{36}{36}$

$\boxed{\frac{(x+3)^2}{4} + \frac{(y-2)^2}{9} = 1}$ $\boxed{\text{Ellipse}}$

2.d. $9x^2 - 4y^2 + 36x - 8y - 40 = 0$

$9x^2 + 36x - 4y^2 - 8y = 40$

$9(x^2 + 4x + \underline{4}) - 4(y^2 + 2y + \underline{1}) = 40 + 36 - 4$

$\dfrac{9(x+2)^2}{72} - \dfrac{4(y+1)^2}{72} = \dfrac{72}{72}$

$\boxed{\dfrac{(x-2)^2}{8} - \dfrac{(y+1)^2}{18} = 1}$ $\boxed{\text{Hyperbola}}$

2.e. $x^2 + x - y = 5$ $\left(\dfrac{1}{2}\right)^2 = \dfrac{1}{4}$

$x^2 + x + \dfrac{1}{4} = y + 5 + \dfrac{1}{4}$

$\boxed{\left(x + \dfrac{1}{2}\right)^2 = y + \dfrac{21}{4}}$ $\boxed{\text{Parabola}}$
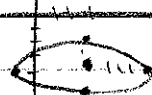
3a. $(x-h)^2 + (y-k)^2 = r^2$

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

$(x+2)^2 + (y-3)^2 = 16$

3b $\dfrac{(x-h)^2}{a^2} + \dfrac{(y-k)^2}{b^2} = 1$ $a = 4$ $b = 2$

$\boxed{\dfrac{(x-3)^2}{16} + \dfrac{(y+4)^2}{4} = 1}$

3c $(x-h)^2 + (y-k)^2 = r^2$

$(2-1)^2 + (-1-4)^2 = r^2$

$1^2 + (-5)^2 = r^2$

$1 + 25 = r^2$

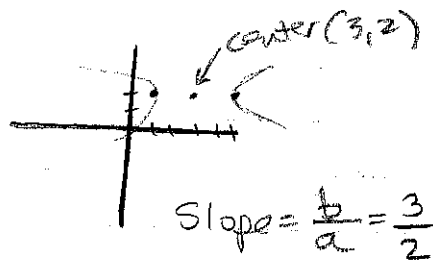$26 = r^2$

$\boxed{(x-1)^2 + (y-4)^2 = 26}$

$\bullet (1,4)$

$\bullet (2,-1)$

3d.

$$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$$

$$\frac{(x-3)^2}{2^2} - \frac{(y-2)^2}{3^2} = 1$$

$$\boxed{\frac{(x-3)^2}{4} - \frac{(y-2)^2}{9} = 1}$$

center $(3,2)$

Slope $= \frac{b}{a} = \frac{3}{2}$

3e.

$$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$$

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

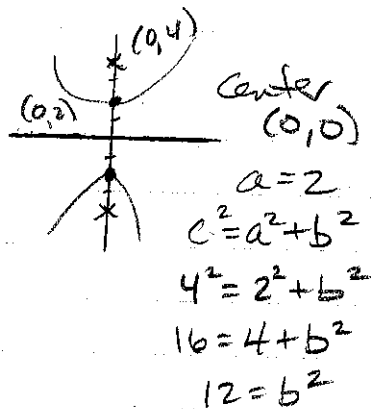$$\boxed{\frac{(x-4)^2}{4} + (y-1)^2 = 1}$$

center $(4,1)$

$a = 2$
$b = 1$
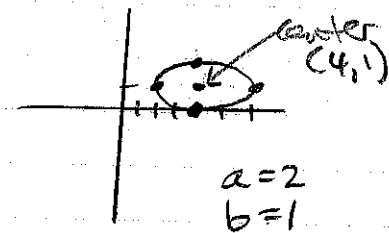
3f.

$$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$$

$$\frac{(y-0)^2}{2^2} - \frac{(x-0)^2}{12} = 1$$

$$\boxed{\frac{y^2}{4} - \frac{x^2}{12} = 1}$$

$(0,4)$

$(0,2)$

Center $(0,0)$

$a = 2$
$c^2 = a^2 + b^2$
$4^2 = 2^2 + b^2$
$16 = 4 + b^2$
$12 = b^2$

3g. $(x-h)^2 = 4p(y-k)$

$(x-5)^2 = 4(4)(y-1)$

$$\boxed{(x-5)^2 = 16(y-1)}$$

Vertex $(5,1)$

$-y = -3$

$P = 4$
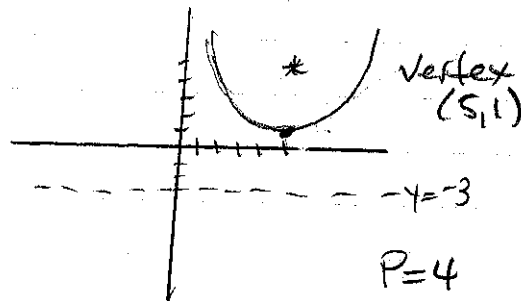
3h. $(x-h)^2 = 4p(y-k)$

$(4-2)^2 = 4p(2--1)$

$2^2 = 4p(3)$

$4 = 4p(3)$

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

$\boxed{P = \tfrac{1}{3}}$

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

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

4a. $x^2 + y^2 = 16$ $\begin{cases} \text{Center }(0,0) \\ \quad r=4 \end{cases}$

$x - y = 4$

$-y = -x + 4$

$y = x - 4$

Answer:

$\boxed{\begin{array}{c}(4,0) \\ (0,-4)\end{array}}$
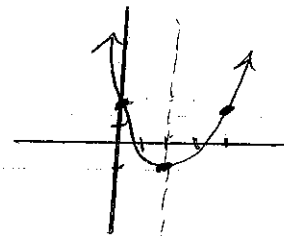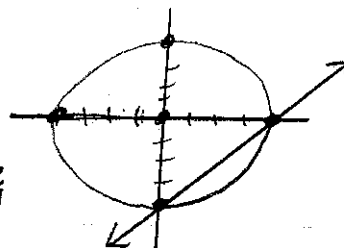
4b. $(x+1)^2 + (y-3)^2 = 1$

Center $(-1,3)$ $r=1$

$x^2 + y^2 - 4x - 5 = 0$

$x^2 - 4x + \underline{4} + y^2 = 5 + 4$

$(x-2)^2 + y^2 = 9$

center: $(2,0)$ $r=3$
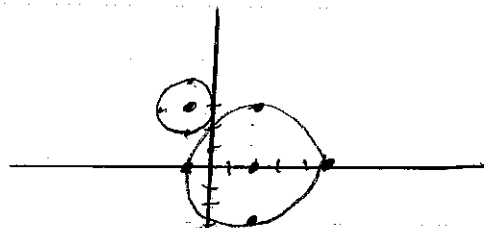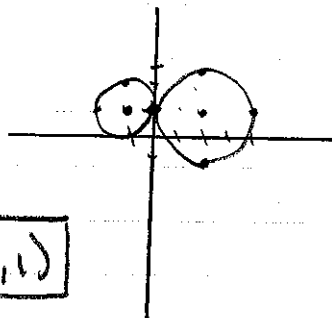

$\boxed{\text{No Solution}}$

4c. $(x+1)^2 + (y-1)^2 = 1$

Center $(-1,1)$ $r=1$

$(x-2)^2 + (y-1)^2 = 4$

Center $(2,1)$ $r=2$

Answer $\boxed{(0,1)}$

5a $x^2 + y^2 = 5$ $y = \boxed{-x+3}$

$x^2 + (-x+3)^2 = 5$

$x^2 + (-x+3)(-x+3) = 5$

$x^2 + x^2 - 3x - 3x + 9 = 5$

$2x^2 - 6x + 9 = 5$

$2x^2 - 6x + 4 = 0$

$2(x^2 - 3x + 2) = 0$

$2(x-2)(x-1) = 0$

$x - 2 = 0 \qquad x - 1 = 0$

$x = 2$	$x = 1$
$y = -2+3$	$y = -1+3$
$y = 1$	$y = 2$
$(2, 1)$	$(1, 2)$

5b. $x^2 + y^2 - 9 = 0$

$x^2 + y^2 - 4x + 3 = 0$

$4x - 12 = 0$

$4x = 12 \qquad x = 3$

$3^2 + y^2 = 9$

$9 + y^2 = 9$ Answer $(3, 0)$

$y^2 = 0$

$y = 0$

5c. $4x^2 + 9y^2 - 36y = 0$ $x^2 = \boxed{-9y + 27}$

$4(-9y + 27) + 9y^2 - 36y = 0$

$-36y + 108 + 9y^2 - 36y = 0$

$9y^2 - 72y + 108 = 0$

$y = 6$	$y = 2$
$x^2 = -9(6) + 27$	$x^2 = -9(2) + 27$
$x^2 = -27$	$x^2 = 9$