

(1) 12 Points. Let  $\mathbf{v} = 3\mathbf{i} + 2\mathbf{j}$  and  $\mathbf{w} = -\mathbf{i} + 4\mathbf{j}$ .

(a) Find  $2\mathbf{v} - 5\mathbf{w}$ .

(b) Find  $\|\mathbf{v}\|$ .

(c) Find  $\mathbf{v} \cdot \mathbf{w}$ .

(2) 10 Points. Evaluate the following product and quotient. Express your answers in polar form with  $0^\circ \leq \theta < 360^\circ$  or  $0 \leq \theta < 2\pi$ . You may use cis notation.

(a)  $\left[4\left(\cos\left(\frac{\pi}{4}\right) + i\sin\left(\frac{\pi}{4}\right)\right)\right]\left[5\left(\cos\left(\frac{\pi}{8}\right) + i\sin\left(\frac{\pi}{8}\right)\right)\right]$

(b)  $\frac{[36(\cos 280^\circ + i\sin 280^\circ)]}{[9(\cos 20^\circ + i\sin 20^\circ)]}$

(3) 10 Points.

(a) Find **exact** rectangular coordinates for the point which has polar coordinates  $(8, 5\pi/6)$ .

(b) Use your calculator to approximate the polar coordinates for the point which has rectangular coordinates  $(-4.03, 2.17)$ . Choose  $r > 0$  and compute  $\theta$  in radians with  $0 < \theta < 2\pi$ .

(4) 15 Points. For each of the following equations, identify by name the conic section which the equation describes. (You are not expected to complete squares or rotate axes for these problems.)

(a)  $x^2 + 4y^2 = 4x$

(b)  $x^2 + 4x = 4y^2$

(c)  $y^2 = 4x$

(d)  $x^2 + 4xy + 5y^2 = 4$

(e)  $x^2 + 4xy + 3y^2 = 4$

(5) 12 Points. Identify the following polar curves by name. (You are not expected to graph the equations.)

(a)  $r = 3$

(b)  $r = 4 \sin(3\theta)$

(c)  $r = 2 \csc \theta$

(6) 10 Points. Find an equation for the hyperbola which has vertices at  $(3, 2)$  and  $(3, -2)$  and has foci at  $(3, 5)$  and  $(3, -5)$ .

(7) 15 Points. On the graph paper below, sketch a graph of the equation

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

Find coordinates for the center:

Find coordinates for all of the vertices:

Find coordinates for both foci:

Find the eccentricity:

Find equations for both directrices:

(8) For all parts of this problem use the conic section which has polar equation

$$r = \frac{5}{2 - 2\sin\theta}.$$

(a) 4 Points. Find the eccentricity of this conic section and identify the conic section by name.

(b) 4 Points. Find a cartesian equation for the curve.

(c) 8 Points. Sketch the graph of the conic. Find cartesian coordinates for all vertices and foci.