MTH 264, Homework #11, Summer 2022 Name ____

Instructions: Write your work up neatly and attach to this page. Record your final answers (only) directly on this page if they are short; if too long indicate which page of the work the answer is on and mark it clearly. Use exact values unless specifically asked to round.

Note: In this homework, some of the integrals can be calculated with various calculus and algebraic techniques learned in class. Find exact values for these integrals. If they cannot be calculated by techniques learned in this course, then you may calculate the integrals numerically: use $n = 6$ if you use Simpson's Rule, or $n = 10$ if you use the Trapezoidal rule. You may confirm your result with a numerical integration program in your calculator or MatLab, but you must show work by hand for all problems.

1. Identity the type of graph the equation represents: ellipse, hyperbola or parabola; and then graph the equation by finding the equation in standard form, the focus(foci), vertex(vertices), directrix, center, and eccentricity.
   a. $4x^2 - y^2 - 4x - 3 = 0$
   b. $y^2 - 4y = x + 5$
   c. $9(x+3)^2 = 36 - 4(y-2)^2$
   d. $25x^2 - 10x - 200y - 119 = 0$
   e. $9x^2 + 9y^2 - 36x + 6y + 34 = 0$

2. Find an equation of conic with the given properties.
   a. Parabola, focus $(3,6)$, vertex $(3,2)$
   b. Ellipse, center $(-1,4)$, vertex $(-1,0)$, focus $(-1,6)$
   c. Hyperbola, vertices $(-3,-4)$, $(-3,6)$, foci $(-3,-7)$, $(-3,9)$

3. Find the length of the curve in polar coordinates. You may need to calculate the value numerically.
   a. $r = 2\cos\theta$, $[0,\pi]$
   b. $r = \theta^2$, $[0,2\pi]$
   c. $r = 2(1+\cos\theta)$, $[0,2\pi]$
   d. $r = \sin(6\sin\theta)$, $\left[0,\frac{\pi}{2}\right]$
   e. $r = 5^\theta$, $[0,2\pi]$
   f. $r = \frac{1}{\theta}$, $[\pi, 2\pi]$
   g. $r = \tan\theta$, $\left[0,\frac{\pi}{4}\right]$

4. Convert the rectangular equation to polar form, or the polar form to rectangular form and sketch the graph. In some cases, it will be easier to graph in polar form than in rectangular form. To create the sketch in polar form, it may help to first graph in a rectangular θr-plane, and transfer that data to the polar plane.
   a. $y = 4$
   b. $y^2 = 9x$
   c. $r = \theta$
   d. $r = \dfrac{2}{1+\cos\theta}$
   e. $xy = 4$
   f. $r = 3$
   g. $r = 5(1 - 2\sin\theta)$
   h. $r^2 = \sin 2\theta$

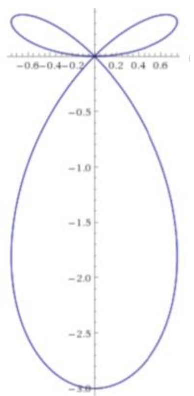
5. Find the area of the region.
   a. One petal of $r = 2\cos 3\theta$
   d. Interior of $r = 1 - \sin\theta$

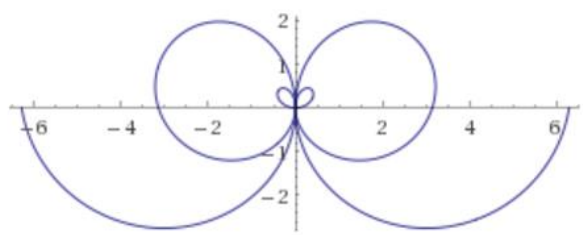
b. Inner loop of $r = 4 - 6\sin\theta$

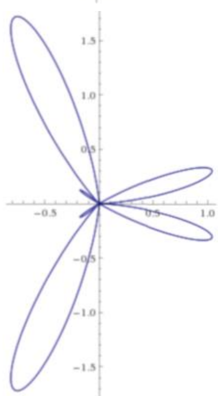
c. Inside $r = 3\sin\theta$ and outside $r = 2 - \sin\theta$

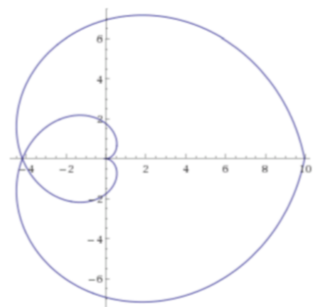
e. Common interior of $r = 4\sin 2\theta, r = 2$

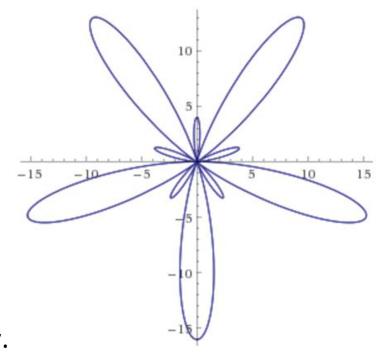
6. Match the graph of the polar equation to its graph.
   a. $r = 3\cos(2\theta)\sin\theta$
   b. $r = \theta\cos\theta$
   c. $r = |\theta|^{5/4}$
   d. $r = (1 - 3\sin 5\theta)^2$
   e. $r = 2\sin^2 4\theta\cos 3\theta$

i. 

iii. 

ii. 

iv. 

v. 

7. Convert the points from polar to rectangular. Plot all points on the same graph and label each point.
   a. $\left(2, \frac{\pi}{3}\right)$
   b. $\left(-\sqrt{2}, \frac{5\pi}{4}\right)$
   c. $\left(-3, \frac{\pi}{6}\right)$
   d. $\left(1, \frac{7\pi}{4}\right)$
   e. $\left(2, -\frac{2\pi}{3}\right)$

8. Convert each rectangular point to polar. Give two equivalent representations for each.
   a. $(2, -2)$
   b. $(1, -2)$
   c. $\left(-1, \sqrt{3}\right)$

9. Find all points of intersection between the curves on $[0, 2\pi]$.
   a. $r = 1 + \sin\theta, r = 3\sin\theta$
   b. $r^2 = \sin 2\theta, r^2 = \cos 2\theta$
   c. $r = 1 - \cos\theta, r = 1 + \sin\theta$
   d. $r = 2\sin 2\theta, r = 1$
   e. $r = \cos 3\theta, r = \sin 3\theta$

10. Identify the rotated conic. You can graph them in desmos.com implicitly. For the 3D functions graph the two variables with the cross-term.
    a. $13x^2 - 8xy + 7y^2 - 45 = 0$
    b. $2x^2 - 4xy + 5y^2 - 36 = 0$
    c. $8x^2 + 8xy + 8y^2 + 10\sqrt{2}x + 26\sqrt{2}y + 31 = 0$
    d. $xy + x - 2y + 3 = 0$
    e. $3x^2 - 2xy + 3y^2 + 8z^2 - 16 = 0$
    f. $x^2 + 2y^2 + 2z^2 + 2yz - 1 = 0$