MAT 162 Exam #3

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Instructions:
1. Do all of your work in this booklet.
2. Show all of your steps in problems for full credit.
3. Be clear and neat in your work. Any illegible work, or scribbling in the margins, will not be graded.
4. Place your answers in a box.
5. If you need more space, you may use the back of the page and write On back Page # in the problem space.

1. Special Curves. (10 pts) for each equation indicate the type of graph you would expect from the list:

(A) Line       (B) Parabola       (C) Rose
(D) Circle     (E) Ellipse        (F) Hyperbola
(G) Cardiod    (H) Cycloid

a. $4x^2 - 9y^2 = 36$ ______

b. $r = 3\cos 2\theta$ ______

c. $x = 2\sin \theta, y = 3\cos \theta$ ______

d. $x = 2t - 1, y = 3 - t^2$ ______

e. $r = 1 + \cos t$ ______

f. $x = 1 - t, y = 5t - 1$ ______

g. $x = \cos 3\theta, y = \sin 5\theta$ ______

h. $r = \frac{6}{1 - 2\sin \theta}$ ______

i. $x = \theta - \sin \theta, y = 1 - \cos \theta$ ______

j. $r = 4\sin \theta$ ______

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Bonus – Give the exact equation for the length of the curve $r = f(\theta), a \leq \theta \leq b$. 

2. Slippery Slopes. (8 pts) Consider the curve $x = 1 + 3t^2, y = 4 + 2t^3$ with $0 \leq t \leq 1$.

a. What point $(x, y)$ corresponds to $t = \frac{1}{2}$?

b. Find the slope of the tangent line at this point.

c. What is the length of this curve?

3. Conversions. (6 pts)

a. Convert $(r, \theta) = (2, -\frac{7\pi}{6})$ to Cartesian coordinates.

b. Convert $(x, y) = (3, -3\sqrt{3})$ to polar coordinates.
4. Conics. (12 pts)
   a. Put the conic \(4x^2 - 16x + y^2 + 2y + 5 = 0\) into standard form. Describe the type and orientation of the conic.
   b. Sketch the conic \(25(x-2)^2 - 4y^2 = 100\).
   c. Rewrite the conic equation \(9r - 6r \cos \theta = 4\) in the general Cartesian form \(Ax^2 + By^2 + Cx + Dy + E = 0\).

5. Polar Fun. (9 pts)
   Consider the curve \(r = 2\sin 2\theta, \ 0 \leq \theta \leq 2\pi\).
   a. Where does the curve cross itself?
   b. Sketch the curve (neatly).
   c. Find the area of one of the loops in the curve

6. Polar Conic. (5 pts)
   Consider the conic \(r = \frac{4}{9 - 6\cos \theta}\)
   a. What is the eccentricity?
   b. Find the equation of the directrix.
   c. What type of conic is it?