Column	Points	Score
1	10	
2	14	
3	12	
4	14	
Total	50	

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. $r = 3\cos 2q$ ____

c. $x = 2\sin q,\ y = 3\cos q$ ____

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

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

f. $x = 1 - t,\ y = 5t - 1$ ____

g. $x = \cos 5t,\ y = \sin 5t$ ____

h. $r = \dfrac{6}{1 - 2\sin q}$ ____

i. $x = q - \sin q,\ y = 1 - \cos q$ ____

j. $r = 4\sin q$ ____

_____

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

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 $t = \dfrac{1}{2}$?

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 $(r, q) = (2, -\dfrac{7p}{6})$ 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 $9r - 6r\cos q = 4$ in the general Cartesian form $Ax^2 + By^2 + Cx + Dy + E = 0.$

5. Polar Fun. (9 pts) Consider the curve $r = 2\sin 2q, \ 0 \le q \le 2p$.

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 $r = \dfrac{4}{9 - 6\cos q}$

a. What is the eccentricity?

b. Find the equation of the directrix.

c. What type of conic is it?