

King Fahd University of Petroleum and Minerals  
Department of Mathematical Sciences  
Semester II, 2006-2007(062)  
MATH 201 Sec. 7  
Major Exam I

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Student Name: \_\_\_\_\_

Student ID: \_\_\_\_\_

Section: \_\_\_\_\_

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**Note:**

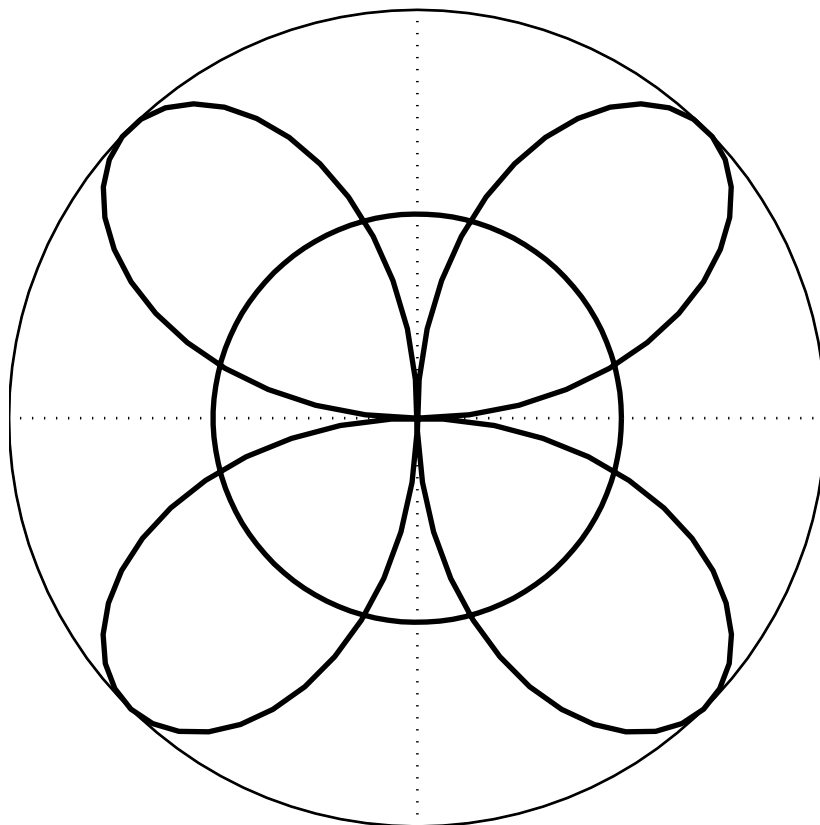
FOR ALL PROBLEMS, SHOW WORK. NO CREDIT FOR ANSWERS NOT SUPPORTED BY WORK.

1. Consider the parametric curve with equations

$$\begin{aligned}x &= t^2 + 1 \\y &= 3t - t^3.\end{aligned}$$

- (a) Find the points of intersection with this curve with (a) the  $x$ -axis, (b) the  $y$ -axis.
- (b) Find points on the curve where the tangent line is
- (i) horizontal
  - (ii) vertical.

2. Consider the polar curve  $r = 2 \sin 2\theta$ . A sketch is drawn for you.



Write as an integral the area of the region in the first quadrant outside the circle  $r = 1$  and inside the curve with polar equation  $r = 2 \sin 2\theta$ .

3. Consider the points  $P$  so that the distance of  $P$  from  $A(0, 0, 0)$  is twice the distance of  $P$  from  $B(1, 0, 0)$ . Show that the set of all such points is a sphere.

4. Use vectors to show that the line joining the mid-points of two sides of a triangle is parallel to the third side.

5. (a) Find the vector projection of  $\overrightarrow{DE}$  on  $\overrightarrow{DP}$  where  $D = (0, 1, 1)$ ,  
 $E = (-2, 4, 3)$  and  $F = (1, 2, -1)$ .
- (b) Find values of  $k$  so that the vectors  $\langle -6, k, 2 \rangle$  and  $\langle k, k^2, k \rangle$  are orthogonal.

6. (a) Find the angle between the diagonals of a square.
- (b) Find the cosine of the angle between a diagonal of a cube and a diagonal of one of its faces.