

# Polytechnic University

MA 2112

MIDTERM

NOVEMBER 19, 2007

Print Name:

Signature:

ID #:

Instructor/Section:

**Directions:** You have **90 minutes** to answer the following questions. ***You must show all your work*** as neatly and clearly as possible and indicate the final answer clearly. You may use only a approved calculator. The last page contains formulas that you may find helpful. You may tear that page out.

If you are feeling ill you should inform the proctor. The proctor will note your name, Poly ID and accept any written statement(s) that you may wish to make regarding your illness.

Problem	Possible	Points
1	10	
2	15	
3	30	
4	30	
5	10	
6	5	
Total	100	

YOUR SIGNATURE:

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(1) Find the center and radius of the sphere.

$$3x^2 + 3y^2 + 3z^2 + 18x - 5z + 12 = 0$$

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(2) Let  $f(x, y) = x^2 + y^2 + 1$

(a) Draw a contour diagram of  $f$  indicating the level curves for  $z = 1, 2, 3$ .

(b) Sketch the cross section (in two dimensions) of  $z = f(x, y)$  on the  $yz$ -plane.

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(3) Let  $\vec{v} = \vec{i} - 8\vec{j} + 4\vec{k}$ ,  $\vec{w} = 4\vec{i} - 3\vec{j}$ ,  $\vec{p} = 5\vec{i} + x\vec{j} - 7\vec{k}$

(a) Find a vector of length 6 in the direction of  $\vec{v}$ .

(b) Find the cosine of the angle between  $\vec{v}$  and  $\vec{w}$ .

(c) Express  $\vec{w}$  as the sum of two vectors, one parallel and the other perpendicular to  $\vec{v}$ .

(d) Find  $x$  so that  $\vec{p}$  is perpendicular to  $\vec{v}$ .

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(4) Let  $A = (1, -2, 3)$ ,  $B = (-1, 4, 5)$ ,  $C = (0, -3, 6)$ ,  $D = (3, -1, 4)$  be four points in 3-space.

(a) Find the area of the triangle with vertices  $A$ ,  $B$ , and  $C$ .

(b) Find an equation of the plane containing  $A$ ,  $B$ , and  $C$ .

(c) Find the volume of the parallelepiped (i.e. box), three of whose edges are  $\vec{AB}$ ,  $\vec{AC}$ ,  $\vec{AD}$ .

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(5) Show that the following limit does not exist.

$$\lim_{(x,y) \rightarrow (0,0)} \frac{x^2 - xy^2 + y^4}{x^2 + y^4}$$

Hint: Check the  $x$ -axis and the curve  $x = y^2$ .

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(6) Let  $f(x, y) = x^4 - xy^2 + \sin(y) + 5$ . Find  $f_x(-1, 3)$ .