

MA 2112

Polytechnic University  
MIDTERM

OCTOBER 6 , 2006

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.

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	20	
2	15	
3	10	
4	10	
5	20	
6	15	
7	10	
Total	100	

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- (1)
  - (a) Find the center and radius of the sphere  $x^2 + y^2 + z^2 + 4x + 2y - 6z + 10 = 0$ .
  - (b) Find a vector of length 5 which is perpendicular to the vector  $i - j + k$ .
  - (c) Sketch the level surface of  $w = x^2 + z^2$  when  $w = 9$ .
  - (d) Find the area of the triangle ABC where  $A = (-2, 3, 1)$ ,  $B = (1, 2, 3)$  and  $C = (3, -1, 2)$ .

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(2) Consider the surface  $h(x, y) = \begin{cases} \sqrt{x^2 + y^2} & \text{if } x \geq 0 \\ |y| & \text{if } x < 0 \end{cases}$

- (a) Sketch the level curves when  $z = 0, 1, 2, 3$  on a contour map.
- (b) Sketch the cross section of  $h$  with the plane  $x = 0$ .

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(3) Consider the function  $f(x, y) = \begin{cases} \frac{3xy}{x^2 + y^2} & \text{if } (x, y) \neq (0, 0) \\ 0 & \text{if } (x, y) = (0, 0) \end{cases}$

(a) Does  $\lim_{(x,y) \rightarrow (0,0)} f(x, y)$  exist? Explain.

(b) Does  $\lim_{(x,y) \rightarrow (2,3)} f(x, y)$  exist? Explain.

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- (4) (a) Find all numbers  $x$  for which the angle between the vectors  $\vec{a} = xi + j + k$  and  $\vec{b} = i + xj + k$  is  $\frac{\pi}{3}$ .
- (b) Find the volume of the box with edges  $\vec{a} = 3j + k$ ,  $\vec{b} = 2i - k$  and  $\vec{c} = i + j$ .

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- (5) (a) Find an equation of the plane containing the points  $(3, 4, 1)$ ,  $(1, 7, 1)$  and  $(-1, -2, 5)$ .
- (b) Find an equation of the plane parallel to the plane  $4x - 2y + z - 1 = 0$  and containing the point  $(2, 6, -1)$ .
- (c) Show that the planes in parts *a* and *b* are not perpendicular and are not parallel.
- (d) What is the angle between the planes in parts *a* and *b*?

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- (6) Consider the plane  $5x + 11y - 2z - 30 = 0$ .
- (a) Where does the plane intersect the  $x$ -,  $y$ - and  $z$ -axes?
  - (b) Is the point  $(-3, 1, 20)$  on the plane? Explain.
  - (c) Find the distance from the point  $(-2, 6, 3)$  to the plane.

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(7) Show that  $u = \sin\left(\frac{r}{t}\right) + \ln\left(\frac{t}{r}\right)$  satisfies the equation

$$t \frac{\partial u}{\partial t} + r \frac{\partial u}{\partial r} = 0$$