

MATH 152  
Exam 3  
Fall 1997  
Version A

Student (Print)	_____	_____
	Last, First Middle	
Student (Sign)	_____	1-11   _____
Student ID	_____	12   _____
Instructor	_____	13   _____
Section	_____	14   _____
		15   _____
		TOTAL   _____

Part I is multiple choice. There is no partial credit. You may not use a calculator.

Part II is work out. Show all your work. Partial credit will be given. You may use your calculator.

Part I: Multiple Choice (5 points each)

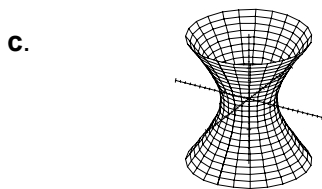
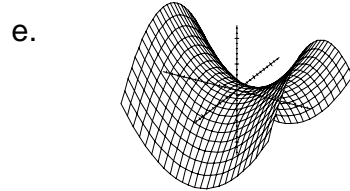
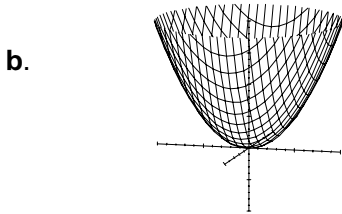
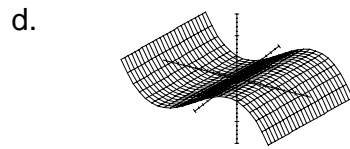
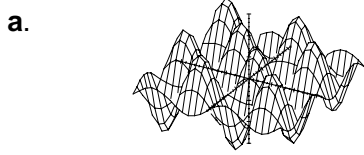
There is no partial credit. You may not use a calculator. You have 1 hour.

1. If  $f(x,y,z) = x^2y\sin z$ , then  $\frac{\partial^2 f}{\partial x \partial z} =$ 
  - a.  $\frac{xy}{z} \sin z$
  - b.  $x^2 \sin z$
  - c.  $2xy \sin z + x^2y \cos z$
  - d.  $2x^3y^2 \sin z \cos z$
  - e.  $2xy \cos z$
2. Which pair of vectors is NOT perpendicular?
  - a.  $\mathbf{a} = \langle 1, 2, 3 \rangle$  and  $\mathbf{b} = \langle 3, 0, -1 \rangle$
  - b.  $\mathbf{p} = 2\mathbf{i} - 4\mathbf{j} + 2\mathbf{k}$  and  $\mathbf{q} = -\mathbf{i} + \mathbf{j} + \mathbf{k}$
  - c.  $\mathbf{A} = -3\mathbf{i} + 2\mathbf{j}$  and  $\mathbf{B} = 4\mathbf{i} + 6\mathbf{j}$
  - d.  $\mathbf{F} = \mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$  and  $\mathbf{G} = \mathbf{i} + \mathbf{j} + \mathbf{k}$
  - e.  $\mathbf{u} = \langle 3, 4 \rangle$  and  $\mathbf{v} = \langle 8, -6 \rangle$
3. A parallelepiped has adjacent edges  $\mathbf{u} = \langle 2, -1, 4 \rangle$ ,  $\mathbf{v} = \langle 1, -3, 0 \rangle$  and  $\mathbf{w} = \langle 3, 1, -2 \rangle$ . Find its volume.
  - a.  $\langle 12, 4, -8 \rangle$
  - b.  $-12$
  - c.  $12$
  - d.  $50$
  - e.  $54$
4. The radius of a cylindrical tin can is 5 cm and the height is 10 cm. The sides are .01 cm thick while the top and bottom are .02 cm thick each. Estimate the volume of metal used to make the can.
  - a.  $.004\pi \text{ cm}^3$
  - b.  $.01\pi \text{ cm}^3$
  - c.  $.02\pi \text{ cm}^3$
  - d.  $2\pi \text{ cm}^3$
  - e.  $250\pi \text{ cm}^3$

5. Which line is perpendicular to the plane  $3x + 4y + 5z = 6$ ?

- a.  $\frac{x-3}{2} = \frac{y-4}{3} = \frac{z-5}{4}$
- b.  $x = 3 + 2t, y = 4 + 3t, z = 5 + 4t$
- c.  $x = 2 + 3t, y = 3 + 4t, z = 4 + 5t$
- d.  $\frac{x-2}{20} = \frac{y-3}{15} = \frac{z-4}{12}$
- e.  $x = 2 + 20t, y = 3 + 15t, z = 4 + 12t$

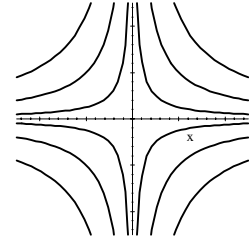
6. Which of the following is the graph of  $f = y^2 - x^2$ ?



7. Find the intersection of the line  $x = 3 + 2t, y = 2 + t, z = 1 - t$  and the plane  $x - y + 2z = 4$ .

- a. (3, 1, 1)
- b. (1, 1, 2)
- c. (2, -2, 0)
- d. (-1, 1, 3)
- e. (0, 2, 3)

8. For which function are the level curves (or contour plot) shown at the right?



- a.  $f = x^2 + y^2 - 2x$   
b.  $f = \cos x \cos y$   
c.  $f = xy$   
d.  $f = (x + y)^2$   
e.  $f = (x - y)^2$
9. An object moves in the  $xy$ -plane along the curve  $y = x^2$  from  $(-2, 4)$  to  $(2, 4)$ . In what direction does the (principal) normal  $\mathbf{N}$  point when the object is at  $(0, 0)$ ?
- a.  $\mathbf{j}$   
b.  $\mathbf{i} + \mathbf{j}$   
c.  $\mathbf{j} - \mathbf{i}$   
d.  $-\mathbf{j}$   
e.  $\mathbf{i}$
10. A triangle has vertices  $A = (1, 1, -1)$ ,  $B = (2, 0, -1)$  and  $C = (1, -1, 1)$ . Find a vector perpendicular to the plane of the triangle.
- a.  $\langle 1, 1, 1 \rangle$   
b.  $\langle -2, 2, 2 \rangle$   
c.  $\langle 1, -1, 1 \rangle$   
d.  $\langle 2, 2, -2 \rangle$   
e.  $\langle 2, 2, 0 \rangle$
11. A wagon is pulled a distance of 100m along a horizontal path by a constant force of 50N exerted along the handle which is at  $30^\circ$  above the horizontal. How much work is done?
- a. 5000J  
b. 2500J  
c.  $2500\sqrt{3}$  J  
d.  $\frac{10000}{\sqrt{3}}$  J  
e. 10000J

Part II: Work Out

Show all your work. Partial credit will be given.  
You may use your calculator but only after 1 hour.

12. (12 points) Consider the curve  $r(t) = (t, \sin(2t), \cos(2t))$ .

Compute each of the following:

a. velocity

$$\mathbf{v} = \underline{\hspace{10em}}$$

b. speed

$$|\mathbf{v}| = \underline{\hspace{10em}}$$

c. arclength between  $t = 1$  and  $t = 3$

$$L = \underline{\hspace{10em}}$$

d. acceleration

$$\mathbf{a} = \underline{\hspace{10em}}$$

e. unit tangent

$$\mathbf{T} = \underline{\hspace{10em}}$$

f. curvature

$$\kappa = \underline{\hspace{10em}}$$

13. (11 points) Find the plane tangent to the hyperbolic paraboloid  $z = 2x^2 - y^2$  at the point  $(1, 2, -2)$ . Then identify its  $z$ -intercept.

14. (11 points) A particle has initial position  $\mathbf{r}(t) = \langle 0, 0 \rangle$  and initial velocity  $\mathbf{v}(t) = \langle 1, -1 \rangle$ . If its acceleration is  $\mathbf{a}(t) = \langle 4\cos(2t), 12t^2 \rangle$ , find its position at  $t = \pi$ .

15. (11 points) Find the line of intersection of the planes  $x + y + z = 3$  and  $3x + y - z = 1$ .