

NAME \_\_\_\_\_

STUDENT ID \_\_\_\_\_

RECITATION INSTRUCTOR \_\_\_\_\_

RECITATION TIME \_\_\_\_\_

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## DIRECTIONS

- Write your name, student ID number, recitation instructor's name and recitation time in the space provided above. Also write your name at the top of pages 2–6.
- The exam has six (6) pages, including this one.
- Circle the correct answer for problems 1–3. Write your answer in the box provided for problems 4–12.
- You must show sufficient work to justify your answers.
- Credit for each problem is given in parentheses in the left hand margin.
- No books, notes or calculators may be used on this exam.

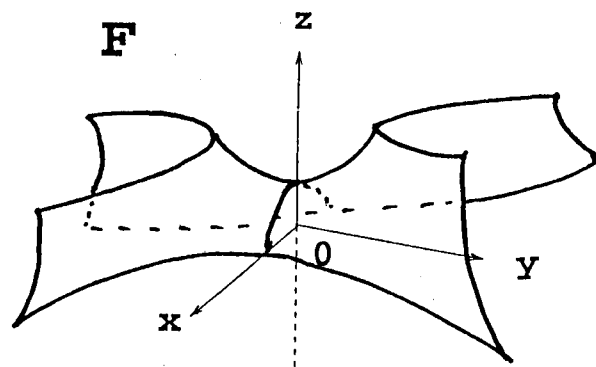
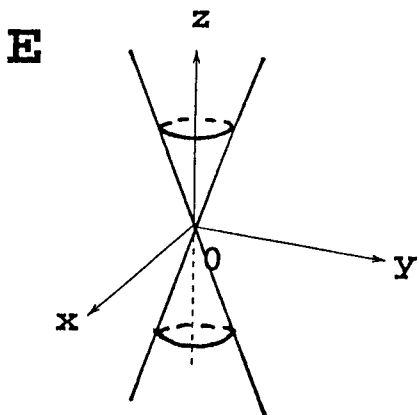
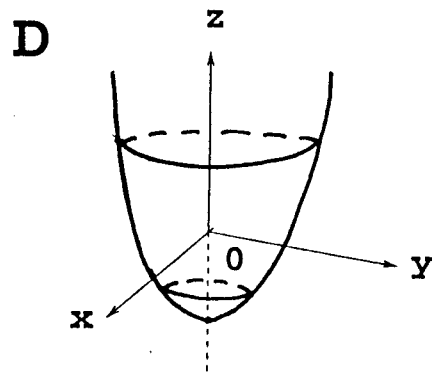
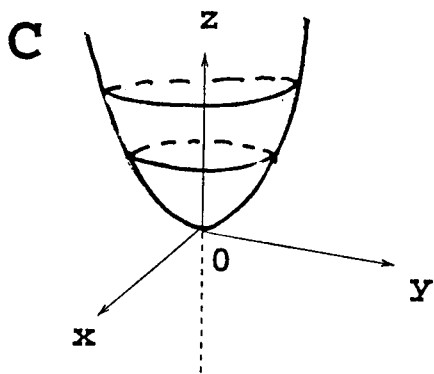
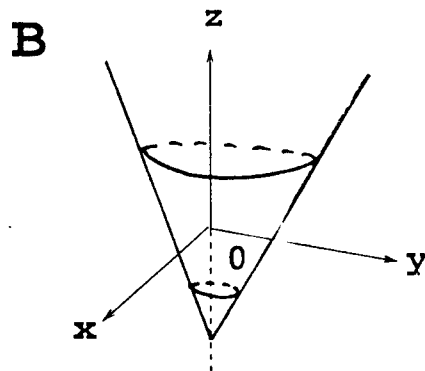
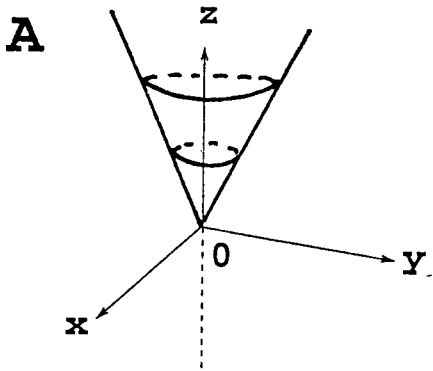
(5) 1. Let  $\vec{a} = \vec{i} - 2\vec{j} + 3\vec{k}$  and  $\vec{b} = 3\vec{i} + 4\vec{j} + 7\vec{k}$ . Then  $\frac{\vec{a} \cdot \vec{b}}{\|\vec{a}\|} =$

- A. 8  
 B.  $\frac{33}{14}$   
 C.  $\frac{33}{\sqrt{14}}$   
 D.  $\frac{16}{\sqrt{14}}$   
 E.  $\frac{8}{7}$

(7) 2. Symmetric equations for the tangent line to the curve  $\vec{r}(t) = e^t\vec{i} + (2t + 3)\vec{j} - \sin t\vec{k}$  at the point (1, 3, 0) are:

- A.  $\frac{x-1}{1} = \frac{y-3}{2} = \frac{z}{-1}$   
 B.  $\frac{x-1}{1} = \frac{y-3}{3} = \frac{z}{5}$   
 C.  $\frac{x-1}{e^t} = \frac{y-3}{2} = \frac{z}{-\cos t}$   
 D.  $x = 1 + t, y = 3 + 2t, z = -t$

(7) 3. Which of the following surfaces represents the graph of  $f(x, y) = 4x^2 + y^2 - 4$ ?



- (9) 4. Find an equation of the plane through the points  $(1, 2, -3)$ ,  $(4, 1, 1)$ , and  $(5, 0, 2)$ .

- (9) 5. If a particle has velocity  $\vec{v}(t) = 2\vec{i} + 3t^2\vec{j} + e^t\vec{k}$  and initial position  $\vec{r}(0) = \vec{i} + 2\vec{k}$ , find the position  $\vec{r}(t)$  of the particle at time  $t$ .

$$\vec{r}(t) = \input{text}$$

- (9) 6. If  $w = f(t^2, 2t^3)$ , where  $f(x, y)$  is differentiable,  $f_x(1, 2) = 5$  and  $f_y(1, 2) = 8$ , compute  $\frac{dw}{dt}$  at  $t = 1$ .

$$\frac{dw}{dt} \Big|_{t=1} = \boxed{\phantom{000000}}$$

- (9) 7. Find the directional derivative of  $f(x, y) = \frac{1}{3}x^3 + x \ln y$  at the point  $(2, 1)$  in the direction from  $(2, 1)$  to  $(5, 5)$ .

$$D_{\vec{u}}f(2, 1) = \boxed{\phantom{000000}}$$

(9) 8. Find the length,  $L$ , of the curve  $\vec{r}(t) = 2t\vec{i} + t^2\vec{j} + \ln t\vec{k}$  for  $1 \leq t \leq 2$ .

$L =$

(9) 9. Find an equation of the plane tangent to the graph of  $f(x, y) = \frac{x+1}{y-1}$  at the point  $(3, 2, 4)$ .

tangent plane:

(9) 10. Find the critical point(s) of  $f(x, y) = (\sin x)(\cos y)$  in the square,  $0 \leq x \leq \pi$ ,  $0 \leq y \leq \pi$ .

critical point(s):

- (9) 11. Apply the second partial derivative test to determine whether

$$f(x, y) = x^3 + y^3 - xy - 2x - 2y$$

has a relative maximum, a relative minimum, or a saddle point at its critical point  $(1, 1)$ . Circle the correct answer. (Give reasons for your answer.)

Relative Maximum

Relative Minimum

Saddle Point

- (9) 12. Find the maximum value of  $f(x, y) = x^2 - 6y$  on the circle  $x^2 + y^2 = 25$ . (Give reasons for your answer.)

Maximum Value: