

Name: \_\_\_\_\_ Pseudonym: \_\_\_\_\_

Please show all work and box the answers.

1. (40 pts.) Let  $u = 4\hat{j} - 3\hat{k}$ ,  $v = \hat{i} + 2\hat{j} - 2\hat{k}$ ,  $\theta =$  the angle from  $u$  to  $v$ . Find  
 (a)  $\text{comp}_u v$ , (b)  $\text{proj}_u v$ , (c)  $\cos \theta$ , (d)  $w$  such that  $|w| = 1$ ,  $w \perp u$ ,  $w \perp v$ .
2. (40 pts.) Let  $u = (5, 1, 5)$ ,  $v = (7, 8, 9)$ ,  $w = (9, 9, 9)$ . Find an equation for  
 (a) the line through the point  $u$  in the direction of  $v$ ,  
 (b) the line through the points  $u$  and  $v$ ,  
 (c) the plane perpendicular to  $v$  through the point  $u$ ,  
 (d) the plane through the points  $u$ ,  $v$ , and  $w$ .
3. (20 pts.) Find the shortest distance from the point  $p = (2, 1, 2)$  to  
 (a) the line  $x = 2 + 2t$ ,  $y = t$ ,  $z = 1$ , (b) the plane  $3x + y - z = 2$ .
4. (20 pts.) Sketch: (a)  $(x+1)^2 + y^2 + (z-2)^2 = 4$  (b)  $x^2 + z^2 = 9$ ,  $-2 \leq y \leq 2$ .
5. (40 pts.) Compute all partial derivatives of  
 (a)  $f(x, y) = y \sin(xy)$ ,  
 (b)  $f(x, y) = x \cos y + ye^x$ ,  
 (c)  $f(x, y, z) = x \sin(y + 3z)$ ,  
 (d)  $f(x, y) = x^y$ .
6. (20 pts.) Find an equation for the plane tangent to  $z = x^2 + y^3$  at  $(3, 2, 17)$ .
7. (30 pts.) True/false questions. Circle your choice. No explanation necessary.  
 T F (a) If  $u \perp v$ , then  $u \cdot v = 0$ .  
 T F (b) If  $u = 2v$ , then  $u \times v = 0$ .  
 T F (c)  $|u \times v| =$  the area of the triangle formed by  $u$  and  $v$ .  
 T F (d) The dot product is commutative.  
 T F (e)  $(u \times v) \times w = u \times (v \times w)$  for all  $u, v, w$ .  
 T F (f) If  $\partial f / \partial x = 0$ , then  $f(x, y)$  is constant.

1	2	3	4	5	6	7	total (210)	%