

# FINAL EXAM

Time: 180min

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1. Determine whether or not  $A = (6, 3, 3)$ ,  $B = (3, 1, -1)$ , and  $C = (-1, 10, 5/2)$  determine the vertices of a right angle triangle.
2. What is the distance between the plane  $x + y + z = 0$  and the point  $(3, 2, 5)$
3. Find the equation of the tangent line to the curve  $r(t) = (\cos t, \sin t, -t^2 + t - 1)$  at  $t = 0$ .
5. Sketch the level sets of the function  $f(x, y) = x^2 + 4y^2$ . What is the directional derivative of this function at the point  $(2, 3)$  in the direction  $(2, -1)$ ?
6. Find the maximum and minimum values of  $f(x, y) = xy$  over  $D = \{(x, y) : x^2 + y^2 \leq 1\}$ .
7. Evaluate  $\int \int_S (x^2 + y) dA$ , where  $S$  is the triangular region with vertices  $(0, 0)$ ,  $(0, 5)$ , and  $(3, 5)$ .
8. Find the center of mass of a half disk of radius 1. (*Bonus*: Find the center of mass of a half ball of radius 1).
9. Find the volume of the region in the first octant bounded by the surface  $z = 9 - x^2 - y^2$  and the coordinate planes.
10. For a ball of radius  $a$  find the average distance from the center. (*Bonus*: Find the average distance from a diameter).

*Each problem is worth 10 points, and the bonuses are also 10 points each.*