

## Math 2313, Test II

Name \_\_\_\_\_

1. If  $f(x, y, z) = \ln(x^2y^3z^4)$ ,
  - a. Find the gradient of  $f$  at  $(2, 3, 4)$ .  
answer:  $(1, 1, 1)$
  - b. Find the derivative of  $f$  at  $(2, 3, 4)$  in the direction of the vector  $\langle 0, 1, 1 \rangle$ .  
answer:  $\frac{2}{\sqrt{2}}$
  - c. In what direction is the directional derivative smallest (most negative), at the point  $(2, 3, 4)$ ?  
answer:  $(-1, -1, -1)$
  - d. Find the equation of the tangent plane to the surface  $f(x, y, z) = \ln(27648)$  at  $(2, 3, 4)$ .  
answer:  $x + y + z = 9$
2. If the temperature in a flat area is given by  $T = x^3 + 2y^2$  and at the point  $(2, 5)$  the velocity of your car is  $r' = \langle 3, -4 \rangle$ , what is the rate of change of temperature inside your car with respect to time at this point?

answer:  $\frac{dT}{dt} = \frac{\partial T}{\partial x} \frac{dx}{dt} + \frac{\partial T}{\partial y} \frac{dy}{dt} = 3x^2(3) + 4y(-4) = -44$

3. Find the point on the plane  $3x + 2y + z = 1$  which is closest to the origin  $(0, 0, 0)$ .

answer:  $(\frac{3}{14}, \frac{2}{14}, \frac{1}{14})$

4. A cylinder initially has radius  $r = 5$  and height  $h = 10$ , then the radius is decreased to 4.8 and the height is increased to 10.1. Given that the surface area is  $A = 2\pi(r^2 + rh)$ , calculate both
- The exact change in surface area,  $\Delta A$ , and

answer:  $-21.87$

- The approximate change in surface area,  $dA$ .

answer:  $-21.99$