Honor Statement: By signing below you confirm that you have neither given nor received any unauthorized assistance on this exam. This includes any use of a graphing calculator beyond those authorized by the School of Mathematics and your instructor. Furthermore, you agree not to discuss this exam with anyone until the exam testing period is over and all tests have been returned. In addition, your calculator’s program memory and menus may be checked at any time and cleared by any testing center proctor or instructor. NEITHER LECTURE NOTES NOR BOOKS ARE ALLOWED TO USE DURING THE TEST. It is acceptable to use one and/or two pages of hand written notes with formulas prepared specially for the test.

NAME: ______________________________________(PRINT!)

Signed: ______________________________________

DIRECTIONS

1. This exam consists of 3 pages and 9 problems. Make sure your exam is complete before you begin.

2. NO BOOK OR NOTES ARE ALLOWED.

3. It is acceptable to use one or two pages of hand written notes with the formulas specifically prepared for the test. No time limit.

4. SHOW ALL WORK in detail or your answer will not receive any credit.

No Calculators that do symbolic algebra (e.g. TI-89, TI-92, CASIO FX2 or 9970Gs are allowed.
1. Find an equation of the tangent plane to the graph of the given function at the specified point.
   
   (a) 
   \[ z = 4x^2 - y^2 + 2 \cdot y, \quad (-1, 2, 4) \]
   
   (b) 
   \[ z = \sqrt{4 - x^2 - 2 \cdot y^2}, \quad (1, -1, 1) \]

2. Use the Chain Rule to find the indicated partial derivatives.
   
   (a) Calculate 
   \[ \frac{\partial R}{\partial x}, \frac{\partial R}{\partial y} \] when \( x = y = 1 \)
   for 
   \[ R = \ln(u^2 + v^2 + w^2) \]
   where 
   \[ u = x + 2 \cdot y, \quad v = 2 \cdot x - y, \quad w = 2 \cdot xy \]
   
   (b) Calculate 
   \[ \frac{\partial M}{\partial u}, \frac{\partial M}{\partial v} \] when \( u = 3, \quad v = -1 \)
   for 
   \[ M = x \cdot e^{y-z^2} \]
   where 
   \[ x = 2 \cdot uv, \quad y = u - v, \quad z = u + v \]

3. The directional derivative is defined as 
   \[ \frac{\partial f}{\partial u} = \nabla f \cdot u \]
   where \( u = (u_1, u_2) \) is a unit vector, i.e., \( u \cdot u = 1 \). Calculate the directional derivative for 
   \[ f(x, y) = 5 \cdot x \cdot y^2 - 4 \cdot x^3 \cdot y \]
   in the direction 
   \[ u = \left( \frac{5}{13}, \frac{12}{13} \right) \]
   at the point 
   \[ (x, y) = (1, 2) \]

4. Find all critical points for the given function and classify them as local maxima, minima, saddle, parabolic points or neither.
   
   (a) 
   \[ z = x^2 \cdot y^3 \cdot (6 - x - y) \]
5. Find all critical points for the function subject to the given constraint(s) and classify them as local maxima, minima, saddle, parabolic points or neither.

(a) 
\[ x - 2 \cdot y + 2 \cdot z \to extr \]
and the constraint is 
\[ x^2 + y^2 + z^2 = 1. \]

(b) 
\[ x \cdot y^2 \cdot z^3 \to extr \]
and the constraint is 
\[ x + 2 \cdot y + 3 \cdot z = 1 \quad (x > 0, \ y > 0, \ z > 0). \]

6. Find the volume of the solid under the plane 
\[ x + 2 \cdot y - z = 0 \]
and above the region bounded by \( y = x \) and \( y = x^4 \).

7. Use polar coordinates to calculate the volume of the solid bounded by 
\[ z^2 = x \cdot y \quad \text{and} \quad x^2 + y^2 = 1 \]

8. Evaluate the integral by reversing the order of integration 
\[ \int_0^1 \int_0^3 e^{x^2} \, dy \, dx \]

9. Evaluate the triple integral 
\[ \int \int \int_E (x + 2 \cdot y) \, dV \]
where \( E \) is bounded by parabolic cylinder \( y = x^2 \) and the planes \( x = z, \ x = y, \) and \( z = 0. \)