This exam contains six problems. Make sure you have them all. You can use a calculator, but only to perform arithmetic calculations. You must SHOW ALL WORK other than arithmetic calculations. Textbooks, class notes, formula sheets, etc. are NOT allowed.

BOX YOUR FINAL ANSWERS. Don’t write anything below this line.

1. (15) ____________  
2. (10) ____________  
3. (15) ____________  
4. (20) ____________  
5. (20) ____________  
6. (20) ____________  
Total (100) ____________
1. (a) Find an equation of the tangent plane to the surface \( z = e^x + \frac{1}{y} \) at the point \((0, 1, 2)\).

(b) Find the differential of the function \( z = e^x + \frac{1}{y} \).
2. Let \( f(x, y, z) = \frac{x}{y+5z} \).
   
   (a) Find the gradient vector \( \nabla f \) at the point \((6, 1, 1)\).

   (b) Find the directional derivative of \( f \) at the point \((6, 1, 1)\) in the direction of the vector \( \langle 1, 2, -2 \rangle \).
3. Find all points on the surface $xy + xz + 3yz = -3$ where the tangent plane is horizontal (i.e. parallel to the $xy$-plane).
4. Find the critical points of the function \( f(x, y) = xy^2 - 6xy + 5x - x^2 \) and determine whether they are local maximum, local minimum or saddle points.
5. Use Lagrange multipliers to find all points \((x, y)\) where the function \(f(x, y) = x + 3y\) has an extreme value (maximum or minimum) subject to the constraint \(x^2 + 2xy + 5y^2 = 32\).
6. Evaluate the double integral 
\[ \iint_D e^x \, dA, \]
where \( D \) is the region bounded by the lines \( y = 0, \ x = 0, \ x = 2, \) and \( y = 3 - x. \)
Scratch paper