Instructions. Show all work, with clear logical steps. No work or hard-to-follow work will lose points.

1.) (5 points) If $z = f(x, y)$ and $x = g(u, v)$ and $y = h(u, v)$, how do you find $\partial z/\partial u$?

Solution. Using the chain rule, we do

$$\frac{\partial z}{\partial u} = \frac{\partial z}{\partial x}\frac{\partial x}{\partial u} + \frac{\partial z}{\partial y}\frac{\partial y}{\partial u}. \qquad \square$$

2.) (5 points) Compute the derivative of $f(x, y) = x^2 - y^2$ in the direction of $\langle 3/5, 4/5\rangle$ at the point (-1,-3).

Solution. Note that $\mathbf{u} = \langle 3/5, 4/5\rangle$ is a unit vector. So

$$\begin{aligned} D_{\mathbf{u}} f(-1,-3) &= \nabla f(-1,-3) \cdot \mathbf{u} \\ &= \langle 2x, -2y\rangle \cdot \langle 3/5, 4/5\rangle \Big|_{(x,y)=(-1,-3)} \\ &= \langle -2, 6\rangle \cdot \langle 3/5, 4/5\rangle \\ &= -\frac{6}{5} + \frac{24}{5} \\ &= \frac{18}{5}. \end{aligned} \qquad \square$$

3.) (5 points) Find an equation of the tangent plane to the following surface at the given point.

$$xy + 7yz + 2xy = 40; \quad (2, 2, 2)$$

Remark. This question was meant to say $2xz$ since there was already a term with xy. But we'll do the problem as written.

Solution. Write $F(x, y, z) = 3xy + 7yz$. Then a normal vector to the tangent plane at the point $(2, 2, 2)$ is given by $\nabla F(2, 2, 2)$. Now

$$\nabla F(x, y, z) = \langle 3y, 3x + 7z, 7y\rangle,$$

which gives $\nabla F(2, 2, 2) = \langle 6, 20, 14\rangle$. So an equation of the tangent plane at $(2, 2, 2)$ is given by

$$6(x - 2) + 20(y - 2) + 14(z - 2) = 0. \qquad \square$$

4.) (5 points) For 5 points write "My section number is ___, and I will remember this for the exam on Monday." In the blank write your section number (8:30 = 616, 9:30 = 608, 10:30 = 624).