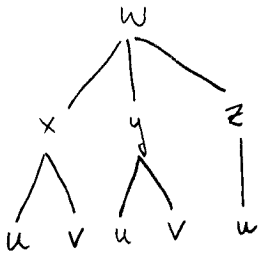
Name: Key *Student ID:*_____

Show all work and justifications to receive full credit.
No Calculators.

1. (*5 pts*)
Let

$$w = \sin(xy) + ln(z), \quad x = vu^2, \quad y = uv, \quad z = cos(u).$$

Find $\frac{\partial w}{\partial u}$ using Chain Rule.



$$\frac{\partial w}{\partial u} = \frac{\partial w}{\partial x}\frac{\partial x}{\partial u} + \frac{\partial w}{\partial y}\frac{\partial y}{\partial u} + \frac{\partial w}{\partial z}\frac{\partial z}{\partial u}$$

$$= y\cos(xy) \cdot 2uv + x\cos(xy) \cdot v + \frac{1}{z} \cdot -\sin u$$

$$= \cos(xy)(2uvy + xv) - \frac{\sin u}{z}$$

$$= \cos(u^3v^2)(2u^2v^2 + u^2v^2) - \frac{\sin u}{\cos u}$$

$$= 3\cos(u^3v^2)u^2v^2 - \tan u \quad //$$

2. (*5 pts*)
Find the derivative of the function $f(x, y) = 2x^3 + y^2$ at the point $(-1, 1)$ in the direction $\mathbf{A} = 3i - 4j$.

$D_u f(-1,1)$ where $u = \frac{A}{|A|} = \frac{\langle 3, -4\rangle}{\sqrt{3^2 + (-4)^2}} = \frac{\langle 3, -4\rangle}{5}$

$$\nabla f|_{(-1,1)} \cdot u = \langle 6x^2, 2y\rangle|_{(-1,1)} \cdot u = \frac{\langle 6, 2\rangle \cdot \langle 3, -4\rangle}{5}$$

$$= \frac{10}{5} = 2 \quad //$$