Student Name:

- The quiz is closed book, closed notes, and calculator free. No form of collaboration or help is allowed.
- The quiz is **45 minutes** long. This time includes downloading, working on, and submitting a quiz **in a PDF format via Gradescope**.
- The quiz have **20 points** in total.
- There is **no extension or quiz retake**.
- Show your full work to receive a full credit on each problem.

1. **[5 points]** Find and sketch the domain of the following function

$$f(x, y, z) = \ln(16 - 4x^2 - 4y^2 - z^2)$$

2. **[5 points]** Consider the limit

$$\lim_{(x,y)\to(0,0)} \frac{x^2 + 3y^2}{3x^2 + y^2}.$$

Either show it does not exist, or give strong evidence for suspecting it does.

3. **[5 points]** Give an equation for the **linear (tangent plane) approximation** to $f(x, y) = e^{x-y}$ at the point $(2, 2)$, and use it to estimate $f(2.1, 2.2)$.

4. **[5 points]** Use the **Chain Rule** to compute $\dfrac{dh}{dt}(0)$, where

$$h(t) = f(t^2 + t - 3, -2e^{5t} + 1) \quad \text{and} \quad f(x, y) = x^2y + 3xy^4.$$