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. **[10 points]** Use **cylindrical coordinates** to find the mass of the solid enclosed below by the paraboloid $z = x^2 + y^2 + 1$ and above by the sphere $x^2 + y^2 + z^2 = 4$ if the density function is given by $\rho(x, y, z) = \dfrac{2}{z^2}$.

   Hint: use the following formula

$$m = \iiint_E \rho(x, y, z)\, dV.$$

3. **[5 points]** Find the Jacobian of the transformation:

$$x = ue^v, \quad y = ve^u.$$

4. **[5 points]** Sketch the vector field $\mathbf{F}$ on the xy-plane:

$$F(x, y) = y\,\mathbf{i} + (x + y)\,\mathbf{j}.$$