1 (8 points) Calculate all the second order partial derivatives of $g(x, y, z) = \dfrac{x}{y + 3z}$.

2 (8 points) Find the linear approximation of the function $f(x, y) = y \sin(2x - y)$ at $(1, 2)$ and use it to approximate $f(1.02, 1.9)$.

3 (9 points) Find three positive numbers whose sum is 12 and the sum of whose squares is as small as possible. Use the Second Derivative Test to verify that your answer is a minimum.

4 (16 points) Evaluate the following double integrals.

(a) (8 points) $\iint_R \frac{x}{1+xy}\,dA, \quad R = [0,1] \times [0,2]$

(b) (8 points) $\iint_D xy^2\,dA, \quad D$ is the triangle with vertices $(0,0)$, $(0,2)$ and $(1,2)$.

5 (9 points) Let $\mathbf{r}(t) = e^t\,\mathbf{i} + 2e^t \sin t\,\mathbf{j} + 2e^t \cos t\,\mathbf{k}$. Reparameterize the curve with respect to arclength measured from the point $(1, 0, 2)$.