Solve the following exercises. **Show your work.**

**Ex. 1.** Show that the following limit does not exist
\[
\lim_{(x,y)\to(0,0)} \frac{2xy}{3x^2 + 4y^2} =
\]

**Ex. 2.** Compute the first order partial derivatives of 
\[ h(x,y,z) = e^{2x+3y} \sin x \tan y. \]

**Ex. 3.** Compute the second order partial derivatives of 
\[ g(u,v) = \ln(u + 2v) - \sin u \cos v. \]

**Ex. 4.** Find an equation of the plane tangent to the surface 
\[ z = \ln x - \sin y \] at the point 
\[ P(1, \pi/2, -1). \]

**Ex. 5.** Find the absolute maximum and the absolute minimum of the function 
\[ f(x,y) = 4x^2 + 2xy + y^2 \] on the region bounded below by the parabola 
\[ y = x^2 \] and above by the line 
\[ y = 9. \]

**Ex. 6.** Find the gradient of 
\[ g(x,y,z) = x^2 + e^{yz} + \cos(x + 2y). \]

**Ex. 7.** Find the first octant point on the surface 
\[ xyz = 8 \] which is the closest to the point 
\[ P(0, 0, 0). \] (The first octant is the set of points \((x, y, z)\) with \(x \geq 0, y \geq 0,\) and \(z \geq 0.\))

**Ex. 8.** Find the directional derivative of 
\[ f(x,y) = \sin x \cos y \] at the point 
\[ P(\pi/3, -2\pi/3) \] in the direction of the vector \( v = (4, -3). \)

**Ex. 9.** Find the volume of the solid bounded by the surfaces: 
\[ z = x^2 + 3y^2, \ x = 0, \ y = 1, \ y = x, \] and \( z = 0. \)

**Ex. 10.** Evaluate the integrals:
\[
(a) \int_{-1}^{2} \int_{-y}^{0} (x + 2y^2) \, dx \, dy =
\]
\[
(b) \int_{0}^{1} \int_{y}^{1} e^{-x^2} \, dx \, dy =
\]