1. Find the limit
\[ \lim_{(x,y) \to (0,0)} \frac{xy \cos y}{3x^2 + y^2} \]
if it exists, or show that the limit does not exist.

2. Find the limit
\[ \lim_{(x,y) \to (0,0)} \left( x^2 + y^2 \right) \ln \left( x^2 + y^2 \right) \]

3. Find an equation of the tangent plane to the given parametric surface
\[ \mathbf{r}(u,v) = uv\mathbf{i} + u\mathbf{j} + v\mathbf{k} \]
to the point \((u,v) = (1,1)\).

4. Find \( \frac{du}{dx} \) where
\[ \sin x + \cos y = \sin x \cos y \]

5. Find \( \frac{dF}{dr} \) and \( \frac{dF}{dy} \) where
\[ F(x,y) = x^2 + 2x + y^2 \text{ where } x = r \cos \theta \text{ and } y = r \sin \theta \]

6. Find the directional derivative of the function
\[ f(x,y) = e^{2y} \ln x \]

at the point \((1,0,0)\) in the direction of the vector \( \mathbf{v} = \langle 5, -12 \rangle \).

7. Find the critical points of the function
\[ f(x,y) = (x^2 - 4x) (2y - y^2) \]

8. Find the local maximum and minimum values and saddle point(s) of the function
\[ f(x,y) = (x^2 - 4x) (2y - y^2) \]

9. Find the critical points of the function
\[ f(x,y) = 2x^2 + 3y^2 - 4x - 5 \]
10. Find the extreme values of
\[ f(x, y) = 2x^2 + 3y^2 - 4x - 5 \]
subject to the constraint
\[ x^2 + y^2 = 16. \]

11. Find the extreme values of
\[ f(x, y) = 2x^2 + 3y^2 - 4x - 5 \]
on the region described by
\[ x^2 + y^2 \leq 16. \]

12. Evaluate the double integral
\[ \iint_D (x + y) \, dA, \]
where \( D \) is bounded by \( y = \sqrt{x} \) and \( y = x^2 \).

13. Evaluate the integral:
\[ \int_0^2 \int_{\frac{y}{2}}^1 e^{x^2} \, dx \, dy. \]

14. Evaluate
\[ \iint_D (x^2 + y^2)^{\frac{7}{2}} \, dA \]
where \( D \) is the half disk \( x^2 + y^2 \leq 4 \) with \( x \geq 0 \).

15. Find the volume of the solid that lies under the plane \( x - 2y + z = 4 \) and above the square \( R = [-1, 1] \times [0, 2] \).