Arc Length
1. Find the arc length of \( \mathbf{r}(t) = \left( e^{2t} \cos(3t), -4, e^{2t} \sin(3t) \right) \) on \( 0 \leq t \leq 4 \).

Limits
Find each limit, if it exists, or show that it doesn’t exist.

2. \( \lim_{(x,y) \to (0,0)} \frac{e^{x^2-y^2}}{3x + 7y - 5} \)

3. \( \lim_{(x,y) \to (0,0)} \frac{(y-3x)^3}{2y^3 + 5x^3} \)

4. \( \lim_{(x,y) \to (0,0)} \frac{x^6 y^2}{3y^2 - x^{12}} \)

Partial Derivatives
For problems 5 – 7 find all the first derivatives.

5. \( g(x, y, z) = x^2 y z^3 - \ln(2x - 3z) + \cos^3(4x) \)

6. \( w = \sin(x - z) e^{2x-y^2} \)

7. \( f(u, v, s, t) = s^2 \ln\left( \frac{4u}{v} \right) + \tan(u^2 + 4s) \)

8. Use implicit differentiation to find \( \frac{\partial z}{\partial x} \) and \( \frac{\partial z}{\partial y} \) for the following function.
\[
\frac{z^2}{\sec(3y)} = x^2 e^{3z+4z}
\]

Higher Order Derivatives
For problems 9 and 10 find all four second derivatives.

9. \( z = x + 3y^4 - \ln(xy) \)

10. \( h(u, v) = e^{2uv} - \frac{3v}{u} \)

For problems 11 and 12 find the indicated derivatives.

11. \( f(u, t) = \sin(u + t^2) + t\left(u^2 - u^{10}\right)^9 \) find \( f_{uut} \)

12. \( u = z^4 y^{-2} 4\sqrt{x^2 + \ln\left( \frac{zy}{x} \right)} \) find \( \frac{\partial^5 u}{\partial x \partial y^2 \partial x} \)