I. Suppose $F: \mathbb{R}^2 \to \mathbb{R}$ with rule $F(x, y) = xy$ and that $G: \mathbb{R} \to \mathbb{R}^2$ with rule $G(t) = (t, t^2)$. Use the chain rule to:

A. calculate the Jacobian matrix of the function $G \circ F$ at the point $(2, 1)$.

B. calculate the derivative of the function $G \circ F$ at the point $(2, 1)$.

C. calculate the Jacobian matrix of the function $F \circ G$ at 1.

D. calculate the derivative of the function $F \circ G$ at 1.
II. Find the equation of the tangent plane at the point \((0, -1, 2)\) to the surface whose equation is \(x^2 + 12y + 8z^2 = 0\).

III. Suppose that \(F : \mathbb{R}^6 \to \mathbb{R}^5\) with rule \(F(x, y, z) = (x^2, x^5y^5, xz^2)\).

A. Calculate \(\text{div} F\)

B. Calculate \(\text{curl} F\)
(10) IV. Consider the path \( f: \mathbb{R} \to \mathbb{R}^2 \) with \( f(t) = (e^{-t \cos t}, e^{-t \sin t}) \) for \( 0 \leq t \leq 1 \).

A. Give an integral that computes the total length of this path.

B. Calculate the value of this integral.
(10) V. Let $f(x, y) = x^2 + y^2$.

A. Calculate the First Taylor polynomial for $f$ at $a = (1, 2)$.

B. Calculate the Second Taylor polynomial for $f$ at $a = (1, 2)$. 
VI. Evaluate: \[ \iiint_E dx dy dz \]

VII. Suppose \[ f(x, y, z) = x^2 y^8 + xy - z - 3y \] and \( a = (1, 1, 1) \).

Calculate the directional derivative of \( f \) at \( a \) in the direction parallel to \( x = (1, 2, 2) \).
(10) VIII. Set up but do not evaluate an iterated integral that gives the volume of the solid below the surface \( x^2 + y^2 + z = 9 \) and above the right triangle with vertices \((0, 0), (1, 0), \) and \((1, 2)\).

(10) IX. The point \((0, 2)\) is a critical point of \( f(x, y) = 2x^2 + xy + y^2 - 4y \). Use the Second Derivative Test to determine whether \((0, 2)\) is a local minimum, a local maximum, a saddle point, or none of these.
(10) X. Evaluate the line integral \( \int_C \mathbf{F}(x,y,z) \cdot d\mathbf{r} \) where \( \mathbf{F}(x,y,z) = (y, z, x) \) if

A) \( C \) is the straight line segment from \((0,0,0)\) to \((1,1,1)\).

B) \( C \) is the straight line segment from \((1,1,1)\) to \((0,0,0)\).