1. The first few terms of the Taylor series of a function $f$ centered at $x = 0$ are given by

$$f(x) = 11 - 2x + 16x^2 + 23x^4 - 9x^5 + \cdots$$

Find $f'''(0)$.

2. Show that the distance from a point $P$ to a line $\ell$ which passes through $Q$ and $Q + v$ is equal to the norm of $\overrightarrow{QP} \times v$ divided by the norm of $v$.

3. Show that $\lim_{(x,y) \to (1,0)} \frac{(x - 1)y}{x^2 - 2x + 1 + y^2}$ does not exist.

4. Find the point $(x_0, y_0)$ at which the graph of $f(x, y) = x^2 + y^2 - 4x + 2y$ has a tangent plane which is parallel to the $xy$ plane.

5. Suppose that $z = f(x(t), y(t))$, where $x(3) = 4$, $y(3) = 2$, $x'(3) = 5$, $y'(3) = 7$, $f_x(4, 2) = -3$, and $f_y(4, 2) = -5$. Use the chain rule to find $dz/dt$ at time $t = 3$.

6. Apply the second derivative test to classify the critical points of $f(x, y) = xy(x + y)(y + 1)$.

7. Consider the function $f(x, y) = e^{-x^2 - y^2}$. Find a unit vector $u$ so that the directional derivative of $f$ at the point $(3, 4)$ is as large as possible.

8. Maximize $e^{xy}$ subject to the constraint $x^3 + y^3 = 16$.

9. Integrate $\int_0^1 \int_x^1 \sin(y^2) \, dy \, dx$

10. Find the surface area of the part of the sphere $x^2 + y^2 + z^2 = 4$ that lies below the plane $z = 1$.

11. Integrate $(x^2 + y^2 + z^2)^{1/2}$ over the set of points $(x, y, z)$ in $\mathbb{R}^3$ for which $\sqrt{x^2 + y^2} < z < 1$.

12. Use the change of variables $x = (u + v)/4$, $y = (v - 3u)/4$ to find $\iint_R (x + 2y) \, dA$, where $R$ is the parallelogram with vertices $(-1, 3), (1, -3), (3, -1),$ and $(1, 5)$.