Here is a set of review problems.

1. Find an equation of the tangent plane to the surface \( x^2 + z^2 e^{y-x} = 13 \) at the point \( P = (2, 3, \frac{3}{\sqrt{e}}) \).

2. Calculate the directional derivative in the direction \( \mathbf{v} \) at the given point \( P \) for \( f(x, y, z) = x \ln(y+z) \), \( \mathbf{v} = (2, -1, 1) \), and \( P = (2, e, e) \).

3. Use the chain rule to calculate the partial derivatives: \( \frac{\partial h}{\partial q} \) at \( (q, r) = (3, 2) \), where \( h(u, v) = ue^v \), \( u = q^3 \), \( v = qr^2 \).

4. Use implicit differentiation to calculate the partial derivative: \( \frac{\partial w}{\partial z} \), where \( x^2 w + w^3 + wz^2 + 3yz = 0 \).

5. Find the critical points of the function, then use the Second Derivative Test to determine whether they are local minima, local maxima, or saddle points: \( f(x, y) = x^3 + y^4 - 6x - 2y^2 \); \( g(x, y) = \ln x + 2 \ln y - x - 4y \).

6. Determine the global extreme values of the function on the given domain: \( f(x, y) = (4y^2 - x^2)e^{-x^2-y^2} \), \( x^2 + y^2 \leq 2 \).

7. Calculate the double integral
\[
\int \int_R (xy^2 + \frac{y}{x}) \, dA
\]
where
\[
R = \{(x, y)| 2 \leq x \leq 3, -1 \leq y \leq 0\}.
\]

8. Use the polar coordinate to calculate the double integral
\[
\int_0^1 \int_y^{\sqrt{1-y^2}} \frac{1}{3 + x^2 + y^2} \, dx \, dy.
\]

9. Evaluate the double integral
\[
\int_0^2 \int_{-\sqrt{4-y^2}}^{\sqrt{4-y^2}} x^2 y^2 \, dx \, dy.
\]

10. Calculate the volume of the region above the cone \( z = \sqrt{x^2 + y^2} \) and below the sphere \( x^2 + y^2 + z^2 = 1 \).

11. Find the mass of the region \( D \) that is enclosed by the cardioid \( r = 1 + \cos \theta \) with density \( \rho(x, y) = \sqrt{x^2 + y^2} \).
12. Use the Fubini’s theorem (or equivalently, the iterated integration) to evaluate the triple integral

\[ \int \int \int_E yz \cos(x^5) \, dV, \]

where

\[ E = \{(x, y, z) \mid 0 \leq 1 \leq 1, \ 0 \leq y \leq x, \ 0 \leq z \leq 2x\}. \]

13. Use the spherical coordinates to calculate

\[ \int_{-2}^{2} \int_{0}^{\sqrt{4-y^2}} \int_{-\sqrt{4-x^2-y^2}}^{\sqrt{4-x^2-y^2}} y^2 \sqrt{x^2 + y^2 + z^2} \, dz \, dx \, dy. \]

14. Find the center of mass for the lamina that occupies the region \( D \) and has the given density function \( \rho \): \( D \) is the triangular region with vertices \((0,0), (2,1), (0,3)\); \( \rho(x,y) = x + y \).

15. Evaluate the double integral by making an appropriate change of variables

\[ \int \int_{R} \frac{x + 2y}{\cos(x - y)} \, dx \, dy, \]

where \( R \) is the parallelogram bounded by the lines \( y = x, \ y = x-14, \ x+2y = 0, \ x+2y = 2 \).

16. Use the map

\[ G(u,v) = \left( \frac{u + v}{2}, \frac{u - v}{2} \right) \]

to compute

\[ \int \int_{\mathcal{R}} \left( (x - y) \sin(x + y) \right)^2 \, dx \, dy, \]

where \( \mathcal{R} \) is the square with vertices \((\pi, 0), (2\pi, \pi), (\pi, 2\pi), \mbox{ and } (0, \pi)\).