1. Find the equation of the plane that passes through the points (1, 0, 1), (2, 3, 0) and (−1, 1, 4).

2. Find the length of the curve $y = \frac{4}{3}x^3$ between $x = 0$ and $x = 2$. 
3. Consider the curve in $\mathbb{R}^3$: $\gamma(t) = (3t, t^2 + 2, e^{4t})$. Find the parametric equations of the line tangent to the curve at the point $(0, 2, 1)$.

4. Find an equation of the tangent plane to the surface with equation $z = xe^{xy}$ at the point $(2, 0, 2)$. 
5. Find the directional derivative of the function \( f(x, y, z) = \sin(2x + 3y + 4z) \) at the point \((\pi, \pi, \pi)\) in the direction of \(v = (1, 2, 2)\).

6. Find the value of the iterated integral

\[
\int_0^1 \int_x^1 e^{xy} \, dy \, dx
\]
7. Find the local maximum and minimum points and saddle points of the function:
\[ f(x, y) = y^3 + 3x^2y - 6x^2 - 6y^2 + 2. \]
8. Find the global max and min points and the max and min values of 
$f(x, y, z) = 2xy + 2xz$ subject to the constraint $x^2 + y^2 + z^2 = 4$. 

9. Find the global max and min points and the max and min values of 
\( f(x, y) = x^3 + x^2 + 2y^2 \) defined on the disc \( D = \{ (x, y) \mid x^2 + y^2 \leq 1 \} \).
10. Evaluate the double integral

$$\iint_{D} 2y \, dA$$

where $D$ is the region bounded by the parabolas $y = 2x^2$ and $y = 1 + x^2$. 
11. Use cylindrical coordinates to find the volume of the solid that lies within both the cylinder $x^2 + y^2 = 1$ and the sphere $x^2 + y^2 + z^2 = 4$ and above the plane $z = 0$. 
12. Find the volume of the solid $S$ bounded above by the sphere $x^2 + y^2 + z^2 = 8$ and below by the cone $z = \sqrt{x^2 + y^2}$. 
13. Use an appropriate change of variables to evaluate
\[ \int \int_{R} \frac{x - y}{x + y} \, dA \]
where \( R \) is the square with vertices \((0, 2), (1, 1), (2, 2), \) and \((1, 3)\).
14. Let \( S \) be the surface defined by the equation \( z = xy \). Find the area of the part of \( S \) lying over the disc in the \( xy \)-plane with center \((0,0)\) and radius 2.
Let the force at the point \((x, y)\) be \(F(x, y) = (2xy, x^2 + 4y)\). Find the work done by the force on a particle moving along the curve \(\gamma(t) = (t^4 + \frac{2t^2}{1 + t^2}, t^2 + 3t)\) for \(0 \leq t \leq 1\). Force magnitude is in pounds and distance is in feet.
16. Use Green’s Theorem to evaluate the line integral $\int_C \mathbf{F} \cdot d\mathbf{r}$ for
$\mathbf{F}(x, y) = (y + \cos y, -x \sin y)$, where $C$ is the circle $(x - 4)^2 + (y + 5)^2 = 9$ oriented clockwise.
17. Use Stokes’ Theorem to evaluate the line integral $\int_C \mathbf{F} \cdot d\mathbf{r}$ for 
$\mathbf{F}(x, y, z) = (yz, 2xz, e^{xy})$, and $C$ is the circle $x^2 + y^2 = 4, z = 10$ oriented
counterclockwise as viewed from above.
18. Let the oriented surface \( S \) be the sphere with center \((0, 0, 0)\) and radius 3 with outward normals. Consider the vectorfield \( F = (y^2 z + 6x, xz^3 + 4y, x^2 + y^2 + 2z)\). Find the value of the surface integral of \( F \) on \( S \):

\[
\iint_{S} F = \iint_{S} F \cdot dS
\]