1. Let \( \mathbf{r}(t) = (t^2, t, t^4) \). Find normal plane at point \( t = 1 \).
2. Find the equation of the plane containing the points $(1, 2, 3), (1, 1, -1)$ and $(-1, 2, 1)$.

3. Find the area of the parallelogram generated by the vectors $(2, 2, -1)$ and $(-1, 1, 3)$. 
4. Let $f(x, y) = xe^y - x^2y^2$. Find all second partial derivatives: $f''_{xx}$, $f''_{xy}$, $f''_{yy}$.

5. Find local maximum, minimum and saddle points (if any) of the function

$$f(x, y) = x^2 + 4xy + 6y^2 - 2y + 1.$$
6. Let \( z = x^2y^2 + \frac{1}{y} \). Find equation of the tangent plane at point \((1,1)\).

7. Find the maximum rate of change of \( f(x, y) = y^2 - \frac{x}{y} \) at the point \((1, -1)\). In which direction does it occur?
8. Find the area of the region $D$ bounded by $y = x^2$ and $y = 3x$.

9. Sketch the region of integration and change the order of integration:

$$\int_0^1 \int_{x^4}^x f(x, y) dy dx.$$
10. Find the volume under the surface $z = x^2 + y^2$ and above the ring $1 \leq x^2 + y^2 \leq 4$ in the $xy$ plane.

11. Acceleration of the particle is given by $\mathbf{a} = (0, 1, 1)$. Find velocity and position of the particle as functions of time if at time $t = 0$ we have $\mathbf{v}(0) = (1, 1, -1)$ and $\mathbf{r}(0) = (0, -1, 1)$. 
12. Find the absolute maximum and absolute minimum of the function \( f(x, y) = x^2 + 2y^2 - 4x + 1 \) on the region \( 0 \leq x \leq 3, \ -1 \leq y \leq 1 \). Be sure to provide coordinates of the points and the values of absolute maximum and minimum.
13. Using spherical coordinates, calculate the integral \[ \iiint_V z \, dx \, dy \, dz \], where the region \( V \) is the spherical layer in the first octant: \( \{ 1 \leq x^2 + y^2 + z^2 \leq 4, \ x \geq 0, \ y \geq 0, \ z \geq 0 \} \).
14. Find the volume of the solid above the region $D = \{(x, y) : y^2 \leq x \leq 1\}$ in $xy$ plane and below the surface $z = xy^2$. 