1. (8 points) Find the vector projection, \( \text{proj}_a \mathbf{b} \), of \( \mathbf{b} \) onto \( \mathbf{a} \) when \( \mathbf{a} = 2i - 3j + k \) and \( \mathbf{b} = i + 6j - 2k \).

2. (8 points) Find an equation of the plane through the point \((1, 6, -5)\) and parallel to the plane \(x + 2y + 3z + 7 = 0\).
3. (8 points) Find the time $t$ and the point $(x(t), y(t), z(t))$ on the curve $x = t^2 - 1, y = t^2 + 1, z = t + 1$ at which the tangent line to this curve is parallel to the vector $i + j + k$.

4. (8 points) A moving particle has initial velocity $\mathbf{v}(0) = (1, 1, -1)$. Its acceleration is $\mathbf{a}(t) = (2t, 3t^2, \sin t)$. Find its velocity at time $t$. 
5. (16 points) Find all the critical points of the function $f(x, y) = x^4 - 4xy + y^4 + 4$. For each critical point, use the second derivative test to decide whether it is a local maximum, local minimum or a saddle.
6. (10 points) Carefully change the order of integration and compute
\[ \int_0^{\pi/3} \int_{-\pi/3}^{\pi/3} \frac{\sin y}{y} \, dy \, dx \]

7. (10 points) Find the surface area of that portion of the surface of the paraboloid
\[ z = x^2 + y^2 \]
that lies above the xy-plane and below the plane \( z = 4 \).
8. (12 points) Let $E$ be the solid that lies below the sphere $x^2 + y^2 + z^2 = 9$ and above the cone $z = \sqrt{x^2 + y^2}$, and suppose that the mass density function of the solid is given by $\delta(x, y, z) = \sqrt{x^2 + y^2 + z^2}$. Use spherical coordinates to find the mass of the solid $E$. 
9. (10 points) Evaluate the line integral \( \int_C (x - 4y) \, dy \) where \( C \) is the arc of the parabola \( y = x^2 \) from \((-2, 4)\) to \((1, 1)\).

10. (10 points) Use Green's Theorem to evaluate the line integral \( \int_C \mathbf{F} \cdot d\mathbf{r} \) along the positively oriented curve \( C : x^2 + y^2 = 1 \) where \( \mathbf{F}(x, y) = x^3 \mathbf{i} + x^4 \mathbf{j} \).