Problem 1. Find parametric equations of the line parallel to the planes 
\( x + y + z = 1 \) and \( x - y + 2z = 5 \), and passing through the point \((1, 2, 3)\).

Problem 2. The curve is given parametrically as 
\[ r(t) = < t + 1, t^2 + 1, t^3 + t^2 >. \]
Find its curvature at the point \((0, 2, 0)\).

Problem 3. Given \( f(x, y) = x^2y + xy^2 + 1 \).

a) Find the directional derivative of \( f(x, y) \) at the point \((1, 2)\) in the direction \(< 3, 4 >\).

b) Find the maximal directional derivative of \( f \) at \((1, 2)\).

c) Find the equation of the tangent plane to the graph of \( z = f(x, y) \) at the point \((1, 2, 7)\).

Problem 4. Find and classify all critical points of 
\( f(x, y) = x^2y - 4y + x^3 + 1 \).

Problem 5. Evaluate \( \oint_C \mathbf{F} \cdot d\mathbf{r} \),
if \( \mathbf{F}(x, y) = xy\mathbf{i} + y\mathbf{j} \), and \( C \) is the path consisting of three line segments from \((0, 0)\) to \((1, 1)\), from \((1, 1)\) to \((1, 2)\), and from \((1, 2)\) to \((0, 0)\).

Problem 6. The density of a circular lamina \( x^2 + y^2 \leq 4 \) is given by the formula \( \rho(x, y) = 10 + xy^2 \). Find the mass of the lamina.

Problem 7. Field \( \mathbf{F} \) is given by the formula 
\[ \mathbf{F}(x, y, z) = \left< \frac{yz}{x}, z \ln x, y \ln x \right> \]
a) Determine whether \( \mathbf{F} \) is conservative.

b) Evaluate 
\[ \int_C \mathbf{F} \cdot d\mathbf{r} \]
where \( C \) is the line segment from the point \((1, 1, 2)\) to the point \((2, -1, 1)\).

Problem 8. Find the maximum value of \( f(x, y) = x \) on the curve 
\( x^2 + xy + y^2 = 3 \).
**Problem 9.** Evaluate the line integral

$$\int_C y \, dx$$

where $C$ is the upper half of the circle $x^2 + y^2 = 1$ from $(1, 0)$ to $(-1, 0)$.

**Problem 10.** Evaluate

$$\iint_S \mathbf{F} \cdot d\mathbf{S},$$

if $\mathbf{F}(x, y) = (x - e^z)i + (y^2 - x^3)j + (\sin(xy) + z)k$ and $S$ is the unit sphere with the normal pointing outward.