1. Find an equation for the line of intersection of the planes \( x + 2y - 5z = -1 \) and \( 2x + 2y - z = 3 \).

2. Find an equation for the plane which contains the point \((0, -1, 2)\) and the line 
   \[ r(t) = (-1, 1, 2) + t(1, 4, 5) \]
3. At $t = 7$, we are given a velocity $\mathbf{r}'(7) = \langle -2, 2, 1 \rangle$ and acceleration $\mathbf{r}''(t) = \langle 1, 0, 0 \rangle$. Find $a_T(7)$ and $a_N(7)$.

4. Determine if $\lim_{(x,y)\to(0,0)} \frac{xy}{\sqrt{x^4 + y^4}}$ exists. If so, find the value.

5. Use the Chain Rule to compute $g_u(0,0)$, where $g(u,v) = f(x,y)$, $x = e^u + \sin v$, $y = e^u + \cos v$, $f_x(0,0) = 4$, $f_y(0,0) = 8$, $f_x(1,2) = 2$ and $f_y(1,2) = 5$. 

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6. Find the directional derivative of \( f(x, y, z) = x \ln(y + z^2) \) at the point \((1, 1, 1)\) towards the point \((3, 2, -1)\).

7. Use Lagrange Multipliers to find any extreme values of \( f(x, y, z) = 2x + 3y + z \) on the paraboloid \( z = 5 - x^2 - y^2 \).
8. Sketch the region of integration, and obtain a single integral by reversing the order for
\[ \int_0^1 \int_0^{\sqrt{y}} f(x, y) \, dx \, dy + \int_1^2 \int_0^{\sqrt{2-y}} f(x, y) \, dx \, dy. \]

9. SET UP, BUT DO NOT EVALUATE, the integral for the moment about the \(xy\)-plane of
the region between the cone \(z = \sqrt{x^2 + y^2}\) and \(z = 4\), using \textit{cylindrical polar coordinates}
and constant density \(\sigma = K\).

10. SET UP, BUT DO NOT EVALUATE, a simplified integral using \textit{spherical polar coordinates}
for the mass of the region above \(z = 0\), between the spheres \(x^2 + y^2 + z^2 = 5\) and \(x^2 + y^2 + z^2 = 7\),
satisfying \(y \geq 0\), with density \(\sigma = 1 + z^2\).
11. Show that \( \vec{F} = (y \cos(xy) + \frac{1}{y} e^{x/y} - 2x) \hat{i} + (x \cos(xy) - \frac{x}{y^2} e^{x/y} + 3y^2) \hat{j} \) is a conservative vector field, by finding a potential \( f \) such that \( \vec{F} = \nabla f \)

12. Evaluate \( \oint_C (x^2y^3 - 2xy) \, dx + (x^3y^2 - x^2 + 2xy) \, dy \), where \( C \) is the closed, positively-oriented curve which consists of the upper half of the circle \( x^2 + y^2 = 9 \), plus the line segment from \((-3,0)\) to \((3,0)\).

You may use Green’s Theorem: \( \oint_C P \, dx + Q \, dy = \iint_D (Q_x - P_y) \, dA \)
13. Given the vector field \( \mathbf{F} = xy \mathbf{i} + yz^2 \mathbf{j} - xyz \mathbf{k} \), find and simplify:

(a) curl \( \mathbf{F} \)

(b) div \( \mathbf{F} \)

14. Evaluate the line integral \( \int_C \mathbf{F} \cdot d\mathbf{r} \), where \( \mathbf{F} = y \mathbf{i} - x \mathbf{j} + z^2 \mathbf{k} \) and \( \mathbf{r}(t) = \cos(t) \mathbf{i} + \sin(t) \mathbf{j} + t \mathbf{k} \), \( 0 \leq t \leq 2 \).

15. Show that \( \int_C \nabla f \cdot d\mathbf{r} = 0 \), where \( f(x, y, z) = (x+y-1)e^{x-2y+3z} \) and \( \mathbf{r}(t) = \cos(t) \mathbf{i} + \sin(t) \mathbf{j} - t \mathbf{k} \), \( 0 \leq t \leq \frac{\pi}{2} \).

Does this mean that \( \mathcal{C} \) is a closed curve?