No books, no notes, no calculators or other devices! Write legibly, and show all relevant work—or risk losing credit. Answer what is asked, and only what is asked.

1. Let \( f(x, y) = \sin(2x^2 - xy^2) \). Determine \( f_x(0, 3) \) and \( f_y(x, y) \).

2. Determine the angle between the vectors \( 3i + 5j + 7k \) and \( 3i + j - 2k \).

3. Express in simplest form:

\[
[(\sin t)(i + t^2k)] \times e^{3t}i
\]
4. Let \( \ell \) be the line with equations
\[
\frac{x}{2} = \frac{y - 1}{3} = \frac{z + 1}{4}.
\]

a) Verify that \( \ell \) does not pass through the origin.

b) Determine the equation of the plane that passes through the origin and contains the line \( \ell \).

5. On the axes below, sketch and label the \( c \)-level curves of the surface \( x^2z^3 - yz^3 = 1 \) for \( c = 0, 1, \frac{1}{2}, 2 \). As customary, the \( z \)-coordinate gives the level.
6. a) *I should have first asked* In this part, $f$ is a function of two variables. Complete the definitions below:

$$f_x(x, y) = \lim$$

$$f_y(x, y) = \lim$$

b) Consider the function of two variables is given by the formula:

$$f(x, y) = \begin{cases} 
    y & \text{if } y > 0 \\
    x^2 & \text{if } y = 0 \\
    0 & \text{if } y < 0 
\end{cases}$$

i) Verify that $f_x(x, y)$ exists for all $(x, y)$.

(6.b) cont’d] ii) Determine the domain of $f_y$. 
7. Let $\ell_1$ be the line with parametric equations
\[ x = t, \quad y = 2t, \quad z = 5 - t. \]
Let $\ell_2$ be the line with parametric equations
\[ x = t + 1, \quad y = t + 2, \quad z = t + 3. \]

a) Verify that $\ell_1$ and $\ell_2$ are not parallel.

b) Verify that $\ell_1$ and $\ell_2$ do not intersect.

c) We project $\ell_1$ and $\ell_2$ onto the $(x,y)$-plane. Determine the point of intersection of their projections.
8. A particle moves in space according to the vector function:

\[ \mathbf{r}(t) = t^3 \mathbf{i} + t^5 \mathbf{j} + t^7 \mathbf{k}. \]

tracing a curve.

a) Determine equations (any kind) for the line tangent to the curve at the point (1, 1, 1).

b) Express the length of the segment of the curve from the origin to (1, 1, 1) as a definite integral with explicit integrand and limits of integration.

9. Let \( g(x, y) = xy(x^2 + y^4)^{-1} \). Compute the limit of \( g(x, y) \) as \( (x, y) \to (0, 0) \) along the line \( x = 2y \).