

Please show all work and justify all answers on the blank pages provided.

1. Find a parameterization for the line passing through the points $(2, 3, -1)$ and $(5, -1, 1)$.
2. Find the dot product of the vectors $\mathbf{u} = 3\mathbf{i} + 8\mathbf{j} - 2\mathbf{k}$ and $\mathbf{v} = 5\mathbf{i} + \mathbf{j} + 2\mathbf{k}$.
3. Find the angle between the vectors $\mathbf{u} = 2\mathbf{i}$ and $\mathbf{v} = 3\mathbf{i} + 4\mathbf{j}$.
4. Find the projection of $\mathbf{u} = 2\mathbf{i} + \mathbf{j} + \mathbf{k}$ onto $\mathbf{v} = \mathbf{i} + \mathbf{j} + \mathbf{k}$.
5. Find a vector that is perpendicular to the vectors $\mathbf{u} = (3, -1, 2)$ and $\mathbf{v} = (1, 1, -4)$.
6. Convert the point $P = (2, \pi/6, 2)$ from cylindrical coordinates to spherical coordinates.
7. Consider the function $f(x, y) = y^2 - x^2$.
 - a. Sketch at least two distinct level curves of f .
 - b. Compute $\nabla f(x, y)$.
 - c. Find the equation of the plane tangent to the surface $z = f(x, y)$ at the point $(2, 3, 5)$.
8. Suppose that a particle follows the path $c(t) = (t, \sin t, e^t \cos t)$. At time $t = 1$, the particle flies off on the line tangent to the path. What will be the particle position when $t = 4$?
9. Compute the directional derivative of $f(x, y) = \ln(xy) + x^2$ at the point $(1, 1)$ in the direction of $\mathbf{v} = (-2, 1)$.