Concept Check.

1. Let $r(t) = (\cos(t), e^t, t^2 + 1)$, find $r'(t)$.
2. Given two vectors, find their cross product.
3. Given $r(t) = (t, t^2, t^3)$, $1 \leq t \leq 2$, write down an integral for its arc length.
4. Let $r = \sin(4\theta)$, find the area enclosed by the curve.
5. Find the plane through $P = (3, 2, 1)$ with normal vector $\vec{v} = \langle 1, 4, -3 \rangle$.
6. Does $f(x, y) = x^2 y - xy^2$ increase or decrease along $u = \langle 3, 2 \rangle$ at $(1, 2, -2)$?
7. Which direction does $T(x, y, z) = xy^2 + 3z + e^{4-2y}$ decrease the fastest at $(1, 2, 1)$?
8. Find the plane tangent to $xy^2 + z + e^{4-y^2} = 4$ at $(0, 2, 3)$.
9. Find the plane tangent to $f(x, y) = x^2 + xy^2 - 3xy$ at $(-1, 1, 3)$.
10. Find all of the critical points of $f(x, y) = -(x^2 - 1)^2 - (x^2 y - x - 1)^2$.
11. Find $\frac{\partial w}{\partial t}$ for $w(t) = \phi(r(t))$, $\varphi(x, y, z) = \cos x + yz^2$, $r(t) = t\mathbf{i} + \ln(t^2)\mathbf{j} + e^t\mathbf{k}$.

Review.

- List all the ways to represent a line.
- List all the ways to represent a plane.
- Given $r = f(\theta)$, find the shortest interval that it takes to repeat.