

1. Consider a particle moving along the path  $\vec{P}(t) = \langle 3 \sin(2t), 3 \cos(2t), -6t \rangle$ .
  - (a) Identify the graph of the path of the particle and its direction of travel.
  - (b) Find the velocity and acceleration of the particle.
  - (c) Is  $t$  the arc length parameter? Why/why not?
  - (d) Find the unit tangent, the curvature, and the unit normal vectors.
  - (e) Find the length of the path from  $T$  to  $T + 4\pi$ .

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2. Find a unit vector that is perpendicular to the plane determined by the three points  $A(2, 1, -3)$ ,  $B(0, 2, 4)$  and  $C(1, 5, -1)$ .

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3.
  - (a) Sketch the surface  $f(x, y) = -x^2 - y^2 + 2$  and label at least one point on the surface.
  - (b) Draw at least three level sets for the surface.
  - (c) What is the domain of  $f$ ?

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4. Is the curve  $x = \cos t$ ,  $y = 2 \sin t$ ,  $z = -1 - 3 \sin^2 t$  on the surface  $z = -x^2 - y^2$ ? Write the tangent line to the curve at  $t = 0$ .

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5. Let  $z = \ln(x - y^2) + y \cos(xy)$ . Compute  $\partial z / \partial x$ ,  $\partial z / \partial y$ .

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6. Find a parametrization of the tangent line to the curve of intersection of the plane  $x = 1$  and the surface  $z = \sqrt{4 - x^2} + e^y$  at the point  $(1, 0, 2)$ .