

1. An object moving with constant velocity passes through the point  $(1, 1, 1)$ , then through the point  $(2, -1, 3)$  five seconds later. What is its velocity vector? What is its acceleration vector?
2. Suppose  $\vec{r}(t) = 3 \cos(t) \hat{i} + 3 \sin(t) \hat{j} + 4t \hat{k}$  represents the position of a particle on a helix after  $t$  seconds, where  $z$  is the height of the particle above the ground in meters.
  - (a) Is the particle ever moving downwards? If so, when?
  - (b) When does the particle reach a point 12 meters above the ground?
  - (c) What is the velocity of the particle when it is 12 meters above the ground? What is its speed?
  - (d) When it is 12 meters above the ground, the particle leaves the helix and moves along the tangent line to the helix. Find a parametric equation for this tangent line.