1. Work the following problems from the text:
   (a) Section 10.6: 29, 31, 32, 34
   (b) Section 10.7: 28, 30, 73, 79
   (c) Section 10.8: 44, 45, 52

2. Can anything be said about the acceleration vector of a particle that is moving at a constant speed? Give specific reasons to support your answer.

3. Can anything be said about the speed of a particle whose acceleration vector is always orthogonal to its velocity vector? Give specific reasons to support your answer.

4. Consider the ellipsoid described by \( \frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1 \) with \( 0 < b < a \).
   (a) Use a geometrical argument to determine the shortest path on the surface of the ellipsoid from \((-a, 0, 0)\) to \((a, 0, 0)\) that passes through the point \((0, b, 0)\). (Drawing or plotting would probably be of great help.) Write down the parameterization of this path.
   (b) Calculate the length of this path. (HINT 1: Try Mathematica to evaluate the integral.)
   (c) Now consider the two surfaces given by
      \[
      \begin{align*}
      \frac{x^2}{4^2} + \frac{y^2}{(\sqrt{3})^2} + \frac{z^2}{(\sqrt{3})^2} &= 1 \quad (1) \\
      \frac{x^2}{4^2} + \frac{y^2}{(\sqrt{3})^2} &= \frac{-(z - 9/4)}{(\sqrt{3})^2} \quad (2)
      \end{align*}
      \]
      Equation (1) is just another ellipsoid. What shape is given by equation (2)? If we must remain on these two surfaces (i.e. we cannot pass through them), then using a geometric argument, what is the shortest path from \((-4, 0, 0)\) to \((4, 0, 0)\) that passes through the point \((0, 0, 9/4)\)?
   (d) Calculate the length of this path. (HINT 2: If you already know how, you may have to look up how to parameterize a parabola. HINT 3: You will have to find the intersections of curves. Make sure the points of intersection you find are the correct ones.)

5. Calvin the ant has recently found some spilled beer on a college campus. The location of the spill is \((1, 2, 0)\). He wishes to return to his anthill to report on the find, however, for some reason, he finds that instead of walking in a straight path, he returns home along a path that has velocity
   \[ \mathbf{v}(t) = (\cos(t) + 1)\mathbf{i} + 5\mathbf{j} + 0\mathbf{k} \]
   starting at time \( t = 0 \).
   (a) What is Calvin’s actual path \( \mathbf{r}(t) \)?
   (b) If the entrance to the anthill is at \( \left(\frac{3}{2}, \frac{15\pi + 4}{2}, 0\right) \), will Calvin make it to the entrance? If so, when?
   (c) How far would Calvin walk from \( t = 0 \) to \( t = \frac{3\pi}{2} \)?
   (d) How far would Calvin walk if he went directly from the spill location to the anthill entrance?