Solution to 14.4, number 22: The problem is to show that the velocity and acceleration vectors of a particle moving at constant speed are orthogonal. Suppose that the vector valued function $\mathbf{r(t)}$ gives the position vector of the particle at time t. Then the velocity vector at time t is $\mathbf{v(t)} = \mathbf{r'(t)}$. Also, $\mathbf{a(t)} = \mathbf{v'(t)}$, so

$$\mathbf{v(t)} \cdot \mathbf{a(t)} = \mathbf{v(t)} \cdot \mathbf{v'(t)}.$$

Now using the constant speed assumption, we know that the length of $\mathbf{v(t)}$ is constant. Therefore, by example 5 in section 14.2 which states that the dot product of a vector-valued function of constant length with its derivative is zero, we see that

$$\mathbf{v(t)} \cdot \mathbf{v'(t)} = \mathbf{0},$$

which implies that the velocity and acceleration vectors are orthogonal.