5.1 An electron with a speed of 8×10^6 m/s is projected along the positive x direction into a medium containing a uniform magnetic flux density $\mathbf{B} = (\hat{\mathbf{x}}4 - \hat{\mathbf{z}}3)$ T. Given that $e = 1.6 \times 10^{-19}$ C and the mass of an electron is $m_e = 9.1 \times 10^{-31}$ kg, determine the initial acceleration vector of the electron (at the moment it is projected into the medium).

Solution: The acceleration vector of a free particle is the net force vector divided by the particle mass. Neglecting gravity, and using Eq. (5.3), we have

$$\vec{a} = \frac{\vec{F}_m}{m_e} = \frac{-e}{m_e}\vec{u} \times \vec{B} = \frac{-1.6 \times 10^{-19}}{9.1 \times 10^{-31}} \left(\hat{\mathbf{x}}8 \times 10^6\right) \times (\hat{\mathbf{x}}4 - \hat{\mathbf{z}}3)$$

$$= -\hat{\mathbf{y}}4.22 \times 10^{18} \qquad (\text{m/s}^2).$$