

$$\begin{aligned}
 6. \quad L &= L_0 \sqrt{1 - \frac{v^2}{c^2}} \\
 &= (1.00 \text{ m}) \sqrt{1 - (0.600)^2} \\
 &= 0.800 \text{ m}
 \end{aligned}$$

Lesson 3—Mass

$$\begin{aligned}
 1. \quad m &= \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} \\
 &= \frac{1.67 \times 10^{-27} \text{ kg}}{\sqrt{1 - (0.95)^2}} \\
 &= 5.3 \times 10^{-27} \text{ kg}
 \end{aligned}$$

$$\begin{aligned}
 2. \quad m &= \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} \\
 m_0 &= m \left(\sqrt{1 - \frac{v^2}{c^2}} \right) \\
 &= (7.20 \times 10^{-20} \text{ kg}) \left(\sqrt{1 - \left(\frac{2.50 \times 10^8 \text{ m/s}}{3.00 \times 10^8 \text{ m/s}} \right)^2} \right) \\
 &= 3.98 \times 10^{-20} \text{ kg}
 \end{aligned}$$

$$\begin{aligned}
 3. \quad m &= \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} \\
 m_0 &= m \sqrt{1 - \frac{v^2}{c^2}} \\
 &= (5.50 \times 10^{-10} \text{ kg}) \left(\sqrt{1 - (0.800)^2} \right) \\
 &= 3.30 \times 10^{-10} \text{ kg}
 \end{aligned}$$

$$4. \quad \text{Let } x = \frac{v}{c}$$

$$\begin{aligned}
 m &= \frac{m_0}{\sqrt{1 - x^2}} \\
 x &= \sqrt{1 - \left(\frac{m_0}{m} \right)^2} \\
 &= \sqrt{1 - \left(\frac{6.05 \times 10^{-27} \text{ kg}}{8.00 \times 10^{-27} \text{ kg}} \right)^2} \\
 &= 0.654
 \end{aligned}$$

$$v = xc$$

$$\begin{aligned}
 &= (0.556)(3.00 \times 10^8 \text{ m/s}) \\
 &= 1.96 \times 10^8 \text{ m/s}
 \end{aligned}$$

$$5. \quad \text{Let } x = \frac{v}{c}$$

$$\begin{aligned}
 m &= \frac{m_0}{\sqrt{1 - x^2}} \\
 x &= \sqrt{1 - \left(\frac{m_0}{m} \right)^2} \\
 &= \sqrt{1 - \left(\frac{1}{3} \right)^2} \\
 &= 0.943
 \end{aligned}$$

$$\begin{aligned}
 v &= xc \\
 &= (0.943)(3.00 \times 10^8 \text{ m/s}) \\
 &= 2.83 \times 10^8 \text{ m/s}
 \end{aligned}$$

$$6. \quad \text{Let } x = \frac{v}{c}$$

$$\begin{aligned}
 m &= \frac{m_0}{\sqrt{1 - x^2}} \\
 x &= \sqrt{1 - \left(\frac{m_0}{m} \right)^2} \\
 &= \sqrt{1 - \left(\frac{1}{4} \right)^2} \\
 &= 0.968
 \end{aligned}$$

$$\begin{aligned}
 v &= xc \\
 &= (0.968)(3.00 \times 10^8 \text{ m/s}) \\
 &= 2.90 \times 10^8 \text{ m/s}
 \end{aligned}$$

$$\begin{aligned}
 7. \quad E &= mc^2 \\
 &= (10.0 \text{ kg})(3.00 \times 10^8 \text{ m/s})^2 \\
 &= 9.00 \times 10^{17} \text{ J}
 \end{aligned}$$

$$\begin{aligned}
 8. \quad E &= mc^2 \\
 m &= \frac{E}{c^2} \\
 &= \frac{7.25 \times 10^{16} \text{ J}}{(3.00 \times 10^8 \text{ m/s})^2} \\
 &= 0.833 \text{ kg}
 \end{aligned}$$

$$9. \quad E = mc^2$$