

Practice Quiz PS303 Modern Physics
February 5, 2015

Show your work

Name _____

5 points

1. A certain particle has a proper lifetime of $1.00 \times 10^{-8} \text{ s}$. It is moving through the laboratory at a speed of $0.85c$. What distance does the particle travel in the laboratory?

- (a) 2.55 m (b) 4.84 m (c) 1.34 m (d) 9.19 m

$$L = v \tau = v \gamma \tau_0 = \frac{0.85c (10^{-8} \text{ s})}{\sqrt{1 - 0.85^2}} = 4.84 \text{ m}$$

5 points

2. A particle of mass M at rest decays into two identical particles each of mass $m = 0.100M$ that travel in opposite directions. What is the speed of these particles?

- (a) 0.98c (b) 0.96c (c) 0.50c (d) 0.32c



$$E_i = E_f \Rightarrow Mc^2 = 2mc^2 + 2K \quad Mc^2 = 0.2Mc^2 + 2K \quad 2K = 0.8Mc^2$$

$$K = 0.4Mc^2$$

$$mc^2(\gamma - 1) = 0.4Mc^2$$

\uparrow
0.1M

$$\gamma = 5 \quad \beta = \sqrt{1 - \frac{1}{\gamma^2}}$$

$$\beta = \sqrt{\frac{24}{25}} = 0.980$$

5 points

3. Tom observes a blinking light bulb that is at rest in his reference frame. Mary is moving relative to Tom at a speed of $0.735c$. According to Mary, the light blinks on for a time interval of 5.25 ms . What is the blinking interval according to Tom?

- (a) 7.74 ms (b) 1.48 ms (c) 3.56 ms (d) 10.76 ms
(e) 5.25 ms

$$\tau = \gamma \tau_0$$

\uparrow Mary \uparrow Tom

$$\tau_0 = \frac{\tau}{\gamma} = \frac{5.25 \text{ ms}}{\gamma} \sqrt{1 - (0.735)^2} = 3.56 \text{ ms}$$

$$\boxed{\tau_0 = 3.56 \text{ ms}}$$