

Physics 117 HW # 8 Problems

Ch 10 Q 23, 33, 34; Ex 7, 13, 17
Ch 11 Q 5, 9; Ex 3, 8

23. In an experiment to measure the lifetime of muons moving through the laboratory, scientists obtained an average value of 8 microseconds before a muon decayed into an electron and two neutrinos. If the muons were at rest in the laboratory, would they have a longer, a shorter, or the same average life? Why?

33. Muons are created in the upper atmosphere, thousands of meters above sea level. A muon at rest has an average lifetime of only 2.2 microseconds, which would allow it to travel a maximum distance of 660 meters before disintegrating. However, most muons created in the upper atmosphere survive to strike Earth. This effect is often explained in terms of time dilation. In this explanation, is the observer in the reference system of Earth or the reference system of the muon? Explain.

34. An alternative explanation for the survival of muons as described in Question 33 invokes length contraction. In this explanation is the observer in the reference system of Earth or the reference system of the muon? Explain.

7. The average lifetime of a pion moving at 99% the speed of light is measured to be 2.69 nanoseconds ($1 \text{ ns} = 10^{-9} \text{ s}$). What would be the average lifetime of a pion at rest in the laboratory?

13. The conductor of a high-speed train uses a meter stick to measure the length of her train at 200 m while the train is stopped at the station. The train then travels at 80% of the speed of light (this is the supersupersonic train!). If she repeats the measurement on the moving train, what answer will she get?

17. According to the classical form of Newton's second law, $F\Delta t = \Delta p$, it would require a force of 9.5 N acting for a year to accelerate a 1-kg mass to a speed of $0.9999c$. Using the relativistic form of Newton's second law, what force is required?

5. Your friend notices that a brown can of diet cola floats whereas a green can of lemon-lime soda and a can of orange soda both sink. He postulates a model in which only nonbrown cans of soda sink. To prove his model, he tries a brown can of diet root beer and finds that it floats as expected. Has he proven that his model is correct? In general, can a model ever be proven true?

9. Which of the following are not elements: hydrogen, salt, nitrogen, granite, sodium, chlorine, water?

3. Given that 1 g of hydrogen combines completely with 8 g of oxygen to form water, how many grams of water can you make with 8 g of hydrogen and 32 g of oxygen?

8. Given that the sulfur molecule has a mass of 32 amu, how many sulfur molecules are in 1 g of sulfur?



Fig 33 Ch 10