

Unit 10: Special Relativity

Text:

Chapter 37 Skip Sections 7-9. (We will mention them in class, but not do any of the math.)

Problems (p. 1050-56)

#1: 1, 3, 5, 6, 9, 13, 14 (*time dilation, length contraction*)

#2: 40, 43, 44, 45, 83 (*momentum, energy*)

Vocabulary:

simultaneity, time dilation, length contraction, proper time, proper length, speed parameter, Lorentz factor, spacetime, ether, inertial reference frame, rest energy, twin paradox

Math:

definitions:

$$\beta = \frac{v}{c} \qquad \gamma = \frac{1}{\sqrt{1-\beta^2}} \qquad E_0 = mc^2 \qquad E = \gamma mc^2$$

derived formulas:

$$t = \gamma t_0 \qquad L = \frac{1}{\gamma} L_0 \qquad p = \gamma mv \qquad K = (\gamma - 1)E_0$$

constants:

$$c = 3 \times 10^8 \text{ m/s}$$

$$m_{\text{electron}} = 9.1 \times 10^{-31} \text{ kg}$$

$$1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$$

$$m_{\text{proton}} = 1.67 \times 10^{-27} \text{ kg}$$

$$M = 10^6$$

$$\mu = 10^{-6}$$

$$u = 1.66054 \times 10^{-27} \text{ kg}$$

Key Objectives:

- state and explain the two postulates of special relativity.
- explain and derive the equations for time dilation and length contractions.
- correctly apply the equations listed above to a variety of word problems.
- compare the order of events in different reference frames.
- explain the Michelson-Morley experiment, what they tried to show, and what their results were.
- make qualitative statements about different reference frames observations of events and objects (e.g. lengths, times, frequencies, velocities.)
- explain the significance of special relativity in terms of our understanding of time and space.
- explain the significance of special relativity in terms of our understanding of mass and energy.
- explain the “twin paradox.”
- explain the “barn and pole paradox.”