

General Physics - E&M (PHY 1308) Lecture

Notes

Homework005

SteveSekula, 20 September 2010 (created 19 September 2010)

no tags

Homework 5

Expectations for the quality of your handed-in homework are available at <http://www.physics.smu.edu/sekula/phy1308/HomeworkPolicy.pdf>. Failure to meet these guidelines will result in loss of points as detailed in that document. This assignment covers material from Wolfson Chapter 23. Each problem is worth 20 points, and the total assignment is worth 80 points.

This homework is due by 5pm on Monday, September 27 (place in my mailbox in Fondren Science 102

Reading Assignment:

Chapter 23

Optional *Warm-Up* Problems

These problems are not required. They are odd-numbered problems from Wolfson, similar to those below, to help you warm up. You can compare your answers to those in the student solution manual. If you do not have this manual, ask another student in the class for a photocopy of the solutions.

- CH23-15
- CH23-31

Problems from Wolfson

- CH23-18
- CH23-30
- CH23-32

Problems from Prof. Sekula

SS-13: The Capacitive Properties of the Neuron's Axon

In problem SS-12 we treated the axon (the long cellular structure of the neuron that connects the central cell body of the neuron - the soma - to the axon terminals) as a thin wire (the axon filaments) enclosed in a conductive sheath (the myelin sheath). This basically modeled the axon as a coaxial cable.

Calculate the capacitance of the axon in a spinal neuron (the axon length is about 1.0m), using the same "coaxial cable" model you used to solve SS-12. The thickness (diameter) of the axon filaments (central wire of the coaxial system) is $1.0 \times 10^{-2} \mu\text{m}$, the diameter of the myelin sheath is $1.0 \mu\text{m}$, and the linear charge density is $\lambda = 1.0 \times 10^{-11} \text{C/m}$.