

Homework No. 01 (Spring 2022)

PHYS 203B-001: COLLEGE PHYSICS

Department of Physics, Southern Illinois University–Carbondale

Due date: Friday, 2022 Jan 21, 10:00am, on D2L

Instructions

- To the extent to which you depend on resources to complete this homework is a measure of how much extra work you need to put in to master the related concepts.
- Describe your thought process in detail and organize it clearly. Make sure your answer has the correct units and the right number of significant digits.
- After completion, scan the pages as a single PDF file, and submit the file on D2L (Assessments → Assignments).

Problems

1. (10 points.)

- (a) Determine the number of electrons in one nano-gram of electrons.
- (b) Calculate the total electric charge on one nano-gram of electrons.

Solution

2. (10 points.) Two identical conducting spheres A and B carry equal charge. They are separated by a distance much larger than their diameters. A third identical conducting sphere C is uncharged. Sphere C is first touched to A , then to B , and finally removed.

- (a) As a result, what is the charge on A , if it was originally Q .
- (b) As a result, what is the charge on B , if it was originally Q .
- (c) As a result, what is the electrostatic force between A and B , if it was originally F .

Solution

3. (10 points.) A pair of electric charges of equal magnitude q and opposite sign separated by distance a has an electric dipole moment

$$p = qa. \tag{1}$$

It has a direction going from the negative charge to the positive charge. Determine the magnitude of the electric dipole moment constituting of an electron and a proton separated by a distance of 0.30 \AA .

Solution

4. (10 points.) Four negative charges of equal magnitude $q = -3.00 \mu\text{C}$ are placed at the corners of a square of length $L = 10 \text{ cm}$. Determine the magnitude of the force on one of the negative charge.

Solution

5. (10 points.) Fig. 1 shows three point charges that lie in the x - y plane. Given $q_1 = -4.0 \mu\text{C}$, $q_2 = +6.0 \mu\text{C}$, $q_3 = +5.0 \mu\text{C}$, charges q_1 and q_2 are separated by a distance of 4.0 cm , and charges q_1 and q_3 are separated by a distance of 6.0 cm . Find the magnitude and direction of the net electrostatic force on charge q_3 .

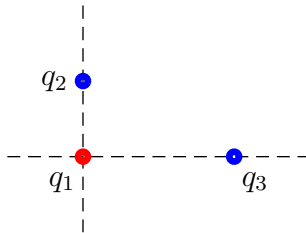


Figure 1: Problem 5

Solution

6. (10 points.) What is the magnitude and direction of the instantaneous acceleration of an electron that has a total force of $\hat{\mathbf{i}} 2.0 \times 10^{-19} \text{ N}$ acting on it. Here $\hat{\mathbf{i}}$ denotes the direction of the force along the positive x axis.

Solution