Coulombs Law Practice 152 Answer Key

Coulomb's Law Practice 152 Answer Key is a resource that provides solutions and explanations for problems related to electrostatic forces between charged particles. Understanding Coulomb's Law is fundamental in physics, as it describes the force between two charged objects. This article will delve into the principles of Coulomb's Law, its applications, and a detailed analysis of the practice problems found in "Coulomb's Law Practice 152," along with their corresponding answers.

Understanding Coulomb's Law

Coulomb's Law is a cornerstone of electrostatics and is expressed mathematically as:

$$ F = k \frac{|q_1 q_2|}{r^2} $$

where:
- $ F $ is the magnitude of the electrostatic force between two charges,
- $ k $ is Coulomb's constant ($ 8.99 \times 10^9 \, \text{N m}^2/\text{C}^2 $),
- $ q_1 $ and $ q_2 $ are the amounts of the two charges, and
- $ r $ is the distance between the centers of the two charges.

This law states that the force between two point charges is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance between them. The force is attractive if the charges are of opposite signs and repulsive if they are of the same sign.

Key Concepts of Coulomb's Law

1. Nature of Charges: Charges can be positive or negative. Like charges repel each other, while opposite charges attract.
2. Vector Nature of Force: The force has both magnitude and direction, making it a vector quantity. It is essential to consider both when solving problems.

3. Coulomb's Constant: The value of k is crucial for calculating the force and varies depending on the medium between the charges.
4. Superposition Principle: When multiple charges are involved, the total force on any charge is the vector sum of the forces exerted on it by all other charges.

Practice Problems Overview

"Coulomb's Law Practice 152" typically includes a variety of problems meant to test the understanding of the law. These problems can be categorized based on their complexity, the number of charges involved, and the configurations of the charges.

Types of Problems

1. Single Charge Problems: Calculate the force on a single charge due to another charge.
2. Multiple Charge Systems: Determine the net force acting on a charge when multiple charges are present.
3. Force Direction: Analyze the direction of the force based on the signs of the charges.
4. Distance Variation: Explore how changing the distance between charges affects the force.

Detailed Solutions to Practice Problems

Let's explore some hypothetical problems similar to those you might find in "Coulomb's Law Practice 152" and provide detailed answers.

Problem 1: Force between Two Charges

Given: Two charges, $q_1 = +3 \, \mu C$ and $q_2 = -5 \, \mu C$, are placed 0.1 meters apart.

Solution:
1. Identify Charges and Distance:
- $q_1 = 3 \times 10^{-6} \, C$
- $q_2 = -5 \times 10^{-6} \, C$
- $r = 0.1 \, m$

2. Apply Coulomb's Law:
$$
F = k \frac{|q_1 q_2|}{r^2} = (8.99 \times 10^9) \frac{|3 \times 10^{-6} \times -5 \times 10^{-6}|}{(0.1)^2}
$$
$$
= (8.99 \times 10^9) \frac{15 \times 10^{-12}}{0.01} = (8.99 \times 10^9) (1.5 \times 10^{-10}) = 1.3485 \, N
$$

3. Direction: Since the charges are opposite, the force is attractive.

Answer: The magnitude of the force is approximately 1.35 N towards q_1.

Problem 2: Net Force on a Charge

Given: Three charges are positioned at the corners of an equilateral triangle with sides of 0.5 m: $q_1 = +2 \, \mu C$, $q_2 = +2 \, \mu C$, and $q_3 = -3 \, \mu C$. Calculate the net force on q_3.

Solution:
1. Calculate Forces Between Charges:
- Force between q_1 and q_3:

$$
F_{13} = k \frac{|q_1 q_3|}{r^2} = (8.99 \times 10^9) \frac{|2 \times 10^{-6} \times -3 \times 10^{-6}|}{(0.5)^2}
$$

$$
= 8.99 \times 10^9 \frac{6 \times 10^{-12}}{0.25} = 2.1576 \, N \text{ (attractive)}
$$

- Force between q_2 and q_3:

$$
F_{23} = k \frac{|q_2 q_3|}{r^2} = (8.99 \times 10^9) \frac{|2 \times 10^{-6} \times -3 \times 10^{-6}|}{(0.5)^2}
$$

$$
= 2.1576 \, N \text{ (attractive)}
$$

2. Resultant Force on q_3:
Both forces F_{13} and F_{23} act at an angle of 60 degrees to each other. The net force can be calculated using vector addition:
- Magnitude:

$$
F_{net} = \sqrt{F_{13}^2 + F_{23}^2 + 2 F_{13}F_{23} \cos(60^\circ)}
$$

$$
= \sqrt{(2.1576)^2 + (2.1576)^2 + 2(2.1576)(2.1576)(0.5)}
$$

$$
= \sqrt{2.33} \approx 2.49 \, N
$$

Answer: The net force on q_3 is approximately 2.49 N directed towards the center of the triangle.

Conclusion

Understanding Coulomb's Law Practice 152 Answer Key is essential for mastering electrostatics and preparing for more complex topics in physics. By practicing problems that involve various configurations of charges and distances, students can develop a clearer understanding of how electrostatic forces operate in different scenarios. This article provided a breakdown of

key concepts, typical problems, and detailed solutions that can help students enhance their problem-solving skills in electrostatics. Mastery of these principles not only aids in academic success but also lays the groundwork for further studies in physics and engineering fields.

Frequently Asked Questions

What is Coulomb's Law and how is it applied in physics?

Coulomb's Law describes the electrostatic force between two charged objects. It states that the force is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance between them.

What types of problems can be solved using the Coulomb's Law practice 152 answer key?

The practice 152 answer key can help solve problems involving calculating the force between point charges, determining the direction of the force, and analyzing systems with multiple charges.

How does the distance between charges affect the force according to Coulomb's Law?

According to Coulomb's Law, as the distance between two charges increases, the force between them decreases exponentially, specifically following an inverse square relationship.

What units are used in Coulomb's Law calculations?

The force is measured in newtons (N), the charge is measured in coulombs (C), and distance is measured in meters (m).

What is the significance of the constant 'k' in Coulomb's Law?

The constant 'k', known as Coulomb's constant, is approximately 8.99 x 10^9 N m^2/C^2. It is a proportionality factor that relates the force, charges, and distance in Coulomb's Law.

Can Coulomb's Law be applied to charges in different mediums?

Yes, but the calculated force will be affected by the medium's relative permittivity, which modifies Coulomb's constant in that medium.

What is the relationship between Coulomb's Law and electric fields?

Coulomb's Law can be used to calculate the electric field generated by point charges, where the electric field is defined as the force per unit charge experienced by a test charge placed in the field.

How do you use the Coulomb's Law practice 152 answer key to check your work?

After solving a problem, you can compare your calculated values with the answers provided in the practice 152 answer key to verify accuracy and understand any mistakes.

Coulombs Law Practice 152 Answer Key

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