Practice Problems Solutions Section 1

1. The electric force between two charged particles becomes weaker with increasing distance. Suppose instead that the electric force was *independent* of distance (but still had the same rules: opposites attract, likes repel).

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1. In this case, would a negatively charged rod still cause a neutral insulator to become polarized? Explain.

Yes, since likes still repel and opposites attract, the electrons would rotate away from the rod and thus the protons and electrons would be, on average, slightly separated, with the electrons further from the rod and the protons closer. When charge separates in a neutral object, it is said to be polarized.

1. In this case, would the insulator still be attracted to the negatively charged rod? Explain.

No. Since the hypothetical electric force does not depend on distance, the rod would exert an equal repulsive force on the electrons in comparison to the attractive force exerted on the protons. Thus, the net force on the insulator would be zero, and there would be no net attraction of the insulator.

1. At the origin, there is an object with charge . You also have an object with charge .

You want the electric force on a charge placed at to be zero. At what location on the x-axis should you place the charge? **Explain your answer and/or show your work! An answer with no work or explanation will receive no credit!**

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0

We want the net force on the charge located at to be zero. The charge at will attract this charge, pulling it to the left. Therefore, we need the charge to pull it to the right. Since it attracts the opposite charge, we will need to put the charge to the right of .

To figure out where to put it, there are two methods; a conceptual method and a mathematical proof method.

Method 1: Conceptual Method

We note that Coulomb’s law is an inverse square law. The charge has four times the amount of charge as the charge. To make up for this, the charge must be twice as close! Therefore, since the charge is two units away from , the charge must be four units away.

**Thus, the charge must be placed at .**

Method 2: Mathematical Proof Method

We set the magnitude of force on the charge due to the charge equal to the magnitude of the force due to the charge, using Coulomb’s law.

where is the unknown distance between the charge and the charge. Solving this equation yields

Thus the charge must be 4 units away from the charge and for that to happen, it must be placed at

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