Name: ____________

Coulomb’s Law Computer Simulation

Background
Coulomb’s law describes the interaction of two charged objects. In this activity, you will interact with a proton and electron to qualitatively develop Coulomb’s law and learn about the variables that affect forces of attraction.

Problem
What is Coulomb’s law?

Materials
- Computer or device with internet access
- Coulomb’s Law computer simulation
  - http://employees.oneonta.edu/viningwj/sims/coulombs_law_s.html

Procedure
1. Access an internet browser (ie. Chrome, Safari) through a computer or other device. Go to the Coulomb’s Law Simulation at: http://employees.oneonta.edu/viningwj/sims/coulombs_law_s.html
2. Take some time to explore with the controls of the simulation. We will use this simulation to model Coulomb’s law in an atom with the red particle representing the proton and the blue particle representing the electron.
3. Vary the distance between the proton and electron. Notice the change in force of attraction. Click on the electron at varying distances from the nucleus (proton). Click on the electron at least 5 very different distances from the proton. On each click, the simulation will plot the data on the Force vs Distance graph. Do not clear the graph. This will make it easier to compare different variables.
4. Increase the proton charge. This is analogous to adding more protons in the nucleus (changing the identity of the element). Notice the change in force of attraction. Click on the electron at varying distances from the nucleus (proton). Click on the electron at least 5 very different distances from the proton. On each click, the simulation will plot the data on the Force vs Distance graph.
5. Answer the analysis questions and revisit the simulation as necessary.
Analysis Questions

1. Why does the red object in the simulation represent the proton in the atom? Why does the blue object represent the electron? What is one limitation of this computer simulation (Why does this simulation not model the real atom well?)?

2. Analyze the arrows in the simulation. What do they communicate? What does a large arrow mean? What would be different about the arrows if the two particles in the simulation had the same charge instead of opposite charges?

3. As the distance between two charged particles increases, the force of attraction _________(increases/decreases). This is a(n) _________ (direct/indirect) relationship. Explain your evidence and reasoning with observations from the simulation.

4. As the magnitude of a charged particle increases, the force of attraction _________ (increases/decreases). This is a(n) _________ (direct/indirect) relationship. Explain your evidence and reasoning with observations from the simulation.
5. Which independent variable (distance or magnitude of charge) has the largest impact on force of attraction? Explain your evidence and reasoning with observations from the simulation.

6. Coulomb’s law describes the variables that affect the forces of attraction and repulsion between charged objects. Based on the answers above and your observations from the simulation, circle the equation that you feel best represents Coulomb’s law. Explain your evidence and reasoning for your selection.

\[ F = k \frac{q_1 q_2}{r} \]
\[ F = k \frac{q_1 q_2}{r^2} \]
\[ F = k \frac{r}{q_1 q_2} \]
\[ F = k \frac{r^2}{q_1 q_2} \]

7. Besides the protons and electrons in the atom, where else in chemistry are there attractions between opposite charges that could be governed by Coulomb’s Law?

**Conclusion**
In your own words, summarize Coulomb’s Law.