Math Connections

Name: _____ Date: _____

Part I: Defining Electromagnetic Forces

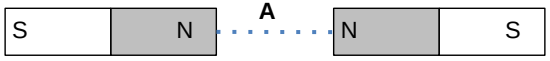
Electric and magnetic forces are attractive or repulsive. Charged particles with the same sign (both positive or both negative) feel a repulsive force, while particles with different signed charges (one is positive and one is negative) feel an attractive force. Protons and electrons have the same charge magnitude; protons have a positive charge while electrons have a negative charge. **Fill in the particles' signs (+ or -) and the electric force felt by the two particles (attractive or repulsive) for questions 1–4 in the following table.**

	Particle 1 (Type)	**Particle 2** (Type)	**Particle 1** (Charge Sign)	**Particle 2** (Charge Sign)	**Electric Force**
1.	proton	proton			
2.	proton	electron			
3.	electron	proton			
4.	electron	electron			

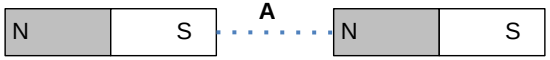
5. Below is a diagram of two charged particles. Is the electric force between them attractive or repulsive? Using what you know of attractive and repulsive forces, draw the direction of the force on each particle.

6. Below is a diagram of two charged particles. Is the electric force between them attractive or repulsive? Using what you know of attractive and repulsive forces, draw the direction of the force on each particle.

7. Forces between magnets are also attractive or repulsive. Below is a diagram of two bar magnets showing their magnetic poles. Is the force between the magnets (along line A) attractive or repulsive?



8. Below is a diagram of the same two bar magnets, with one of the magnets flipped. Is the force between the magnets (along line A) attractive or repulsive?



8.11 Electromagnetic Forces

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Part II: Effect of Increased Charge on Electromagnetic Force

The electric force (in Newtons) between two charged particles (or objects) is directly proportional to the product of the particles' charge magnitudes (Q_1 and Q_2) and a proportionality constant (k), and inversely proportional to **the square of** the distance (r) between them. This is known as **Coulomb's law**, named after the scientist who discovered it. The unit for a charge (Q) is the Coulomb (C).

The table below shows the results of an experiment where the electric force between two charged particles (Q_1 and Q_2) was measured each time the charge of Q_1 was increased. The charge of the Q_2 particle and the distance between the two particles did not change. Plot the results from this experiment on the graph below (force versus charge). Make sure to create a title, properly label your axes, and provide units. **Use your graph and the information provided by Coulomb's law to answer questions 9–12.**

Electric Force Between Two Charged Particles

Trial	**Charge Q_1 (μC)**	**Electric Force (N)**
1	0	0
2	100	9
3	200	18
4	300	27
5	400	36
6	500	45

Title: _____

9. As charge Q_1 increases, what happens to the electric force?

10. What happens to the electric force if charge Q_1 is doubled?

11. What happens to the electric force if charge Q_1 is halved?

12. Does the data in your graph show a directly proportional or inversely proportional relationship?

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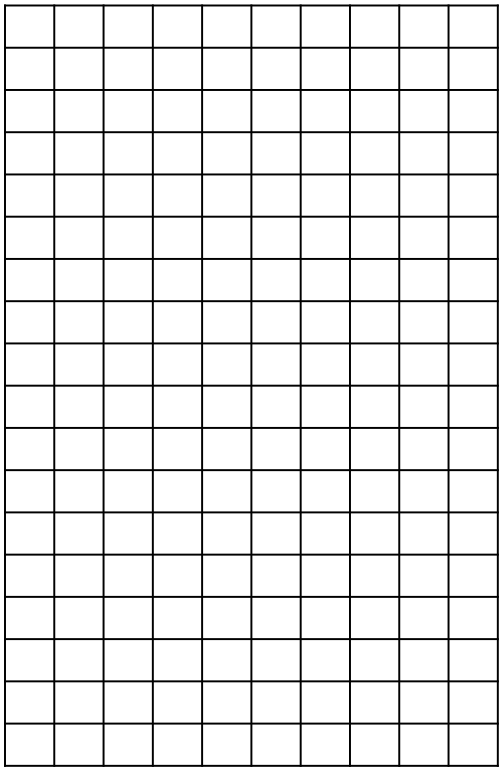
Part III: Effect of Distance on Electromagnetic Force

The table below shows the results of an experiment where the electric force between two charged particles (Q_1 and Q_2) was measured each time the distance between the particles was increased. The charges of the Q_1 and Q_2 particles did not change. Plot the results from this experiment on the graph below (force versus distance). Make sure to create a title, properly label your axes, and provide units. **Use your graph and the information provided by Coulomb's law to answer questions 13–15.**

Electric Force between Two Charged Particles

Trial	Distance (m)	Electric Force (N)
1	0.5	36
2	1.0	9
3	1.5	4
4	2.0	2
5	2.5	1.4
6	3.0	1.0
7	5.0	0.4

Title: _____



13. As distance increases, what happens to the electric force?

14. The distance was doubled from trial 1 to trial 2, how did the electric force change?

15. Does the data in your graph show a linear or nonlinear relationship?