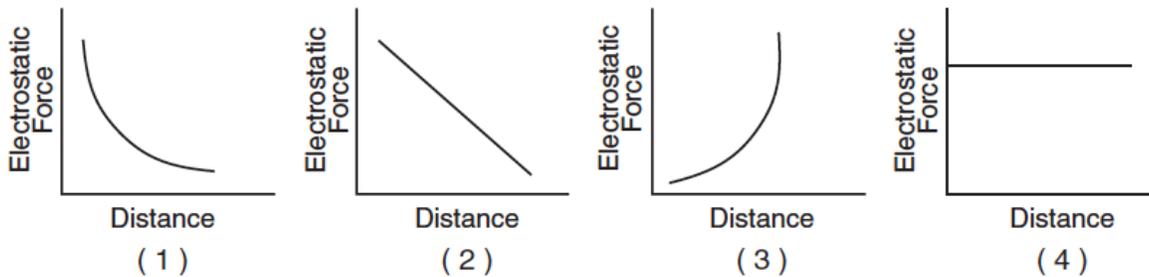
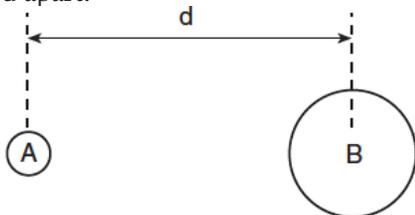


Electrostatics-Coulomb's Law

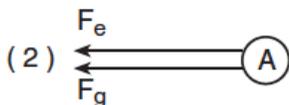
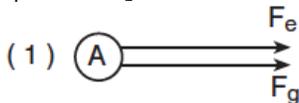
1. Which graph best represents the electrostatic force between an alpha particle with a charge of +2 elementary charges and a positively charged nucleus as a function of their distance of separation?



2. In the diagram below, two positively charged spheres, A and B, of masses m_A and m_B are located a distance d apart.



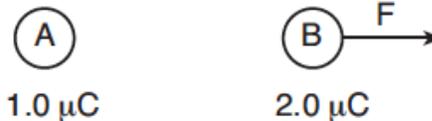
Which diagram best represents the directions of the gravitational force, F_g , and the electrostatic force, F_e , acting on sphere A due to the mass and charge of sphere B? [Vectors are not drawn to scale.]



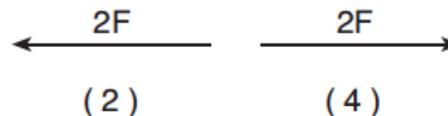
3. What is the magnitude of the electrostatic force between two electrons separated by a distance of 1.00×10^{-8} meter?

1. 2.56×10^{-22} N
2. 2.30×10^{-20} N
3. 2.30×10^{-12} N
4. 1.44×10^{-1} N

4. Two metal spheres, A and B, possess charges of 1.0 microcoulomb and 2.0 microcoulombs, respectively. In the diagram below, arrow F represents the electrostatic force exerted on sphere B by sphere A.



Which arrow represents the magnitude and direction of the electrostatic force exerted on sphere A by sphere B?



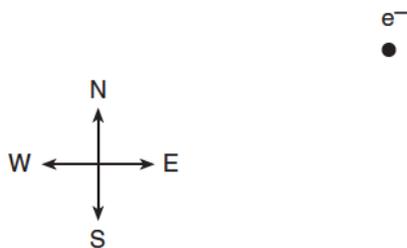
5. Two small identical metal spheres, A and B, on insulated stands, are each given a charge of $+2.0 \times 10^{-6}$ coulomb. The distance between the spheres is 2.0×10^{-1} meter. Calculate the magnitude of the electrostatic force that the charge on sphere A exerts on the charge on the sphere B. [Show all work, including the equation and substitution with units.]

Electrostatics-Coulomb's Law

Base your answers to questions 6 through 9 on the information below.

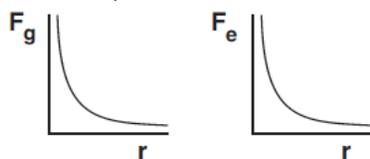
A force of 6.0×10^{-15} newton due south and a force of 8.0×10^{-15} newton due east act concurrently on an electron, e^- .

6. On the diagram, draw a force diagram to represent the two forces acting on the electron. (The electron is represented by a dot.) Use a metric ruler and the scale of 1.0 centimeter = 1.0×10^{-15} newton. Begin each vector at the dot representing the electron and label its magnitude in newtons.

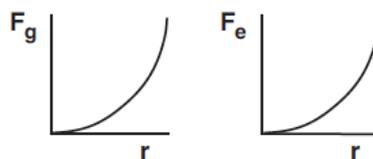


7. Determine the resultant force on the electron graphically. Label the resultant vector R.
8. Determine the magnitude of the resultant vector R.
9. Determine the angle between the resultant and the 6.0×10^{-15} -newton vector.

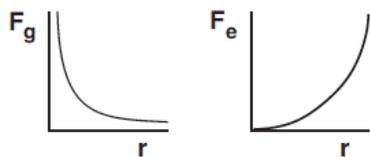
10. The distance between an electron and a proton is varied. Which pair of graphs best represents the relationship between gravitational force, F_g , and distance, r , and the relationship between electrostatic force, F_e , and distance, r , for these particles?



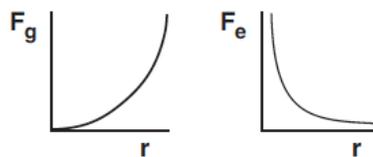
(1)



(3)



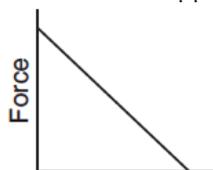
(2)



(4)

Electrostatics-Coulomb's Law

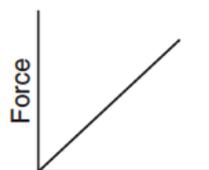
11. Which graph best represents the relationship between the magnitude of the electrostatic force and the distance between two oppositely charged particles?



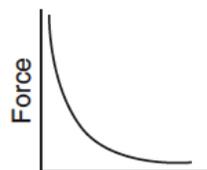
(1)



(2)

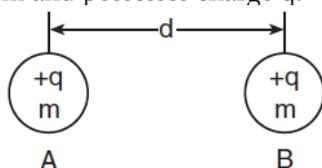


(3)

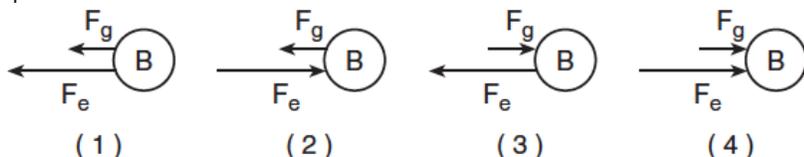


(4)

12. The diagram below shows two identical metal spheres, A and B, separated by a distance d . Each sphere has mass m and possesses charge q .



Which diagram best represents the electrostatic force F_e and the gravitational force F_g acting on sphere B due to sphere A?



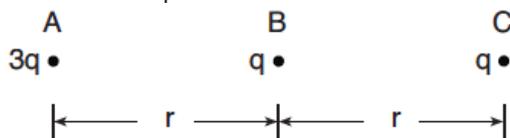
(1)

(2)

(3)

(4)

13. The diagram below shows the arrangement of three small spheres, A, B, and C, having charges of $3q$, q , and q , respectively. Spheres A and C are located distance r from sphere B.



Compared to the magnitude of the electrostatic force exerted by sphere B on sphere C, the magnitude of the electrostatic force exerted by sphere A on sphere C is

1. the same
 2. twice as great
 3. $3/4$ as great
 4. $3/2$ as great
14. If the distance separating an electron and a proton is halved, the magnitude of the electrostatic force between these charges particles will be
1. unchanged
 2. doubled
 3. quartered
 4. quadrupled

15. Two similar metal spheres, A and B, have charged of $+2.0 \times 10^{-6}$ coulomb and $+1.0 \times 10^{-6}$ coulomb, respectively, as shown in the diagram below.

$+2.0 \times 10^{-6} \text{ C}$ $+1.0 \times 10^{-6} \text{ C}$

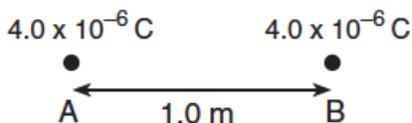


The magnitude of the electrostatic force on A due to B is 2.4 newtons. What is the magnitude of the electrostatic force on B due to A?

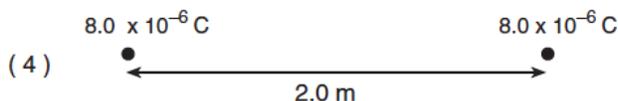
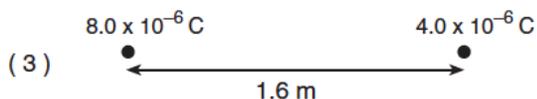
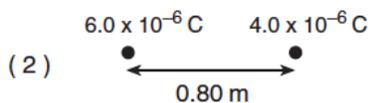
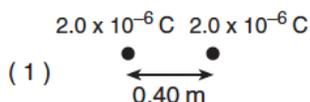
1. 1.2 N
 2. 2.4 N
 3. 4.8 N
 4. 9.6 N
16. Two protons are located one meter apart. Compared to the gravitational force of attraction between the two protons, the electrostatic force between the protons is
1. stronger and repulsive
 2. weaker and repulsive
 3. stronger and attractive
 4. weaker and attractive

Electrostatics-Coulomb's Law

17. The diagram below shows two small metal spheres, A and B. Each sphere possesses a net charge of 4.0×10^{-6} coulomb. The spheres are separated by a distance of 1.0 meter.



Which combination of charged spheres and separation distance produces an electrostatic force of the same magnitude as the electrostatic force between spheres A and B?



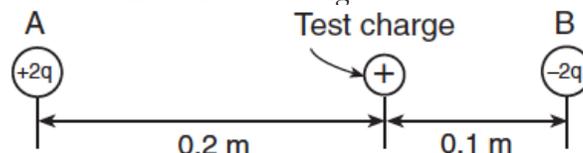
18. A balloon is rubbed against a student's hair and then touched to a wall. The balloon "sticks" to the wall due to
1. electrostatic forces between the particles of the balloon
 2. magnetic forces between the particles of the wall
 3. electrostatic forces between the particles of the balloon and the particles of the wall
 4. magnetic forces between the particles of the balloon and the particles of the wall



19. The magnitude of the electrostatic force between two point charges is F . If the distance between the charges is doubled, the electrostatic force between the charges will become

1. $F/4$
2. $2F$
3. $F/2$
4. $4F$

20. In the diagram below, a positive test charge is located between two charged spheres, A and B. Sphere A has a charge of $+2q$ and is located 0.2 meter from the test charge. Sphere B has a charge of $-2q$ and is located 0.1 meter from the test charge.



If the magnitude of the force on the test charge due to sphere A is F , what is the magnitude of the force on the test charge due to sphere B?

1. $F/4$
2. $2F$
3. $F/2$
4. $4F$

21. Two positively charged masses are separated by a distance, r . Which statement best describes the gravitational and electrostatic forces between the two masses?

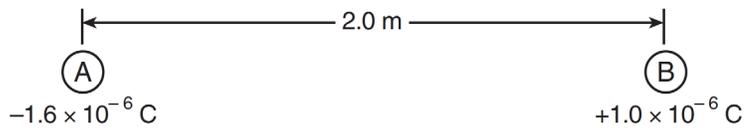
1. Both forces are attractive.
2. Both forces are repulsive.
3. The gravitational force is repulsive and the electrostatic force is attractive.
4. The gravitational force is attractive and the electrostatic force is repulsive.

22. A distance of 1.0 meter separates the centers of two small charged spheres. The spheres exert gravitational force F_g and electrostatic force F_e on each other. If the distance between the spheres' centers is increased to 3.0 meters, the gravitational force and electrostatic force, respectively, may be represented as

1. $F_g/9$ and $F_e/9$
2. $F_g/3$ and $F_e/3$
3. $3F_g$ and $3F_e$
4. $9F_g$ and $9F_e$

Electrostatics-Coulomb's Law

Base your answers to questions 23 and 24 on the diagram below and on your knowledge of physics. The diagram represents two small, charged, identical metal spheres, A and B, that are separated by a distance of 2.0 meters.



23. What is the magnitude of the electrostatic force exerted by sphere A on sphere B?
1. $7.2 \times 10^{-3} \text{ N}$
 2. $3.6 \times 10^{-3} \text{ N}$
 3. $8.0 \times 10^{-13} \text{ N}$
 4. $4.0 \times 10^{-13} \text{ N}$
24. If the two spheres were touched together and then separated, the charge on sphere A would be
1. $-3.0 \times 10^{-7} \text{ C}$
 2. $-6.0 \times 10^{-7} \text{ C}$
 3. $-1.3 \times 10^{-6} \text{ C}$
 4. $-2.6 \times 10^{-6} \text{ C}$
-
25. Two electrons are separated by a distance of 3.00×10^{-6} meter. What are the magnitude and direction of the electrostatic forces each exerts on the other?
1. $2.56 \times 10^{-17} \text{ N}$ away from each other
 2. $2.56 \times 10^{-17} \text{ N}$ toward each other
 3. $7.67 \times 10^{-23} \text{ N}$ away from each other
 4. $7.67 \times 10^{-23} \text{ N}$ toward each other
26. When two point charges of magnitude q_1 and q_2 are separated by a distance r , the magnitude of the electrostatic force between them is F . What would be the magnitude of the electrostatic force between point charges $2q_1$ and $4q_2$ when separated by a distance of $2r$?
1. F
 2. $2F$
 3. $16F$
 4. $4F$
27. When two point charges are a distance d apart, the magnitude of the electrostatic force between them is F . If the distance between the point charges is increased to $3d$, the magnitude of the electrostatic force between the two charges will be
1. $F/9$
 2. $F/3$
 3. $2F$
 4. $4F$