## \_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

# **Chapter 20 Problems**

### **Multiple Choice**

Identify the choice that best completes the statement or answers the question.

- 1. Which of the following statements is true about electric forces?
  - Electric forces cause objects to only attract each other. a.
  - b. Electric forces cause objects to only repel each other.
  - Electric forces cause objects to repel or attract each other. c.
  - d. Electric forces have no effect on each other.
- 2. Three rods of different materials P, Q, and R, are charged by various methods. When the rods are brought near each other, the rods P and Q repel each other, while the rods P and R attract each other. Which of the following could be the signs of the charges on the rods? Dod D Dod O Dad D

	Nou 1	Kou Q	Kou K						
	a. –	+		_					
	b. –	+		-					
	c. –	-		+					
	d. –	-		-					
3	. Which of the follo	Which of the following materials is the best conductor of electricity?							
	a. Wet skin	с.	Dry air						
	b. Glass	d.	Rubber						
4	. When two bodies	When two bodies are charged, the total charge before and after charging remains the same because of:							
	a. quantization	of charges c.	law of induction						
	b. conservation	of charges d.	Coulomb's law						
5	<ul> <li>When a conducting sphere is charged positively, initially the charge is deposited on the left side. However, due to the sphere's conducting nature, the charge spreads uniformly throughout the surface of the sphere. Charge is uniformly distributed because: <ul> <li>a. charged atoms at the location of charge distribute throughout the surface.</li> <li>b. excess protons move from the location of charge to rest.</li> <li>c. excess electrons within the sphere move toward excess protons.</li> <li>d. excess charge within the sphere moves out into the ground from the surface.</li> </ul> </li> </ul>								
U	h atwaar than if th	The distance between two charges $q_a$ and $q_b$ is r, and the force between them is r. What is the force between them is doubled?							
	$2 \frac{E}{A}$	the distance between them is dot							
	b $AE$	c. d	<i>F</i> /0						
7		u.	abing it with a sharead haden w	uhanaa ahanaina hu					
/. Unarging by charges a neutral body by touching it with a charged body; whereas char									
	a conduction i	nduction	force conduction						
	b induction co	nduction c.	force induction						
Q	Electric forces on	n be either repulsive or attractiv	vo whoreas gravitational forea	ia almana.					
C	b. Electric forces car	i de entiler repuisive of attractiv	both a and b	is always.					
	a. attractive	C.	neither a nor b						
		u.							

#### Name: \_\_\_\_\_

	9.	charges repel, whereas charges	attra	act.	
		a. Like, opposite	c.	Positive, negative	
		b. Opposite, like	d.	Negative, positive	
	10.	A/An is a material in which charges will not move easily, whereas a/an is a material that			
		allows charges to move about easily.			
		a. conductor, insulator	c.	electroscope, conductor	
		b. insulator, conductor	d.	insulator, electroscope	
	11.	Metals contain electrons; rubber has		electrons.	
		a. bound, free	c.	excess, insufficient	
		b. free, bound	d.	insufficient, excess	
12 forces between charges are enormous in comparison to forces.				comparison to forces.	
		a. Electrical, gravitational	c.	Positive, negative	
		b. Gravitational, electrical	d.	Negative, positive	
	13.	An area with excess electrons has a net	ch	arge; an area with a deficit of electrons has a net	
		charge.			
		a. negative, positive	c.	positive, neutral	
		b. positive, negative	d.	negative, neutral	

#### Problem

- 14. Two identical, electrically isolated conducting spheres, A and B, are separated by a distance r. Sphere A has a charge of +Q and sphere B is electrically neutral. The spheres are connected for a short time with a thin conducting wire.
  - a. What is the magnitude of the electrostatic force between the spheres after the wire is removed?
  - b. Is the force attractive or repulsive?
- 15. What is the force between two small charged spheres that have charges of  $2 \times 10^{-7}$  C and  $3 \times 10^$
- 16. What is the value of charge of a body that carries 20 excess electrons?
- 17. Two like charged balloons, placed at a distance of 0.50 m, experience a repulsive force of 0.32 N. What is the force if the distance between the balloons is doubled?
- 18. Three charged objects, X, Y, and Z, are placed on the x-axis. Object X has a charge of +58  $\mu$ C and is located at the origin. Object Y has a negative charge of -44  $\mu$ C and is located at -1.4 m from the origin. Object Z has a charge of +78  $\mu$ C and is located at the +2.4 m position. Determine the magnitude of the net electric force acting on object Y.
- 19. Three charges  $q_1$ ,  $q_2$ , and  $q_3$  are placed on the x-axis at points A, B, and C, respectively. The charge  $q_1$  is equal to 1.5  $\mu$ C,  $q_2$  is equal to 0.20  $\mu$ C, and  $q_3$  is equal to -0.50  $\mu$ C. The distance between A and B is 1.2 m and between B and C is 0.60 m. Determine the resultant force on  $q_2$ .

20. Three equal charges are placed at three corners of a square as shown in the diagram. The force exerted by  $q_1$  on  $q_2$  is represented by  $F_{12}$  and the force exerted by  $q_1$  on  $q_3$  is represented by  $F_{13}$ . Determine the ratio of the magnitude between  $F_{12}$  and  $F_{13}$ .



21. The charges +2.0  $\mu$ C, +3.0  $\mu$ C, and +4.0  $\mu$ C are placed at points A, B, and C of an equilateral triangle with each side of 0.20 m. Determine the force on the charge +4.0  $\mu$ C placed at the point C.



22. Three charges,  $q_1$ ,  $q_2$ , and  $q_3$ , are placed as shown in the diagram. The magnitude of charges  $q_1$  and  $q_2$  is 3.0 C each. The magnitude of the charge  $q_3$  is 1.0 C. The distance between  $q_1$  and  $q_3$  is 2.0 m. The distance between  $q_2$  and  $q_3$  is 3.0 m. The vector from  $q_1$  to  $q_3$  has an angle of 55°. Determine the net force on charge  $q_3$ .



23. Two charges +5.0  $\mu$ C and +2.0  $\mu$ C are placed at a distance of 3.0 m from each other as shown in the diagram. Where would you put a positive charge of +1.0  $\mu$ C in the diagram so that the net electrostatic force on it is zero?



24. There are two balloons of charges +3.37  $\mu$ C and -8.21  $\mu$ C. The distance between the two balloons is 2.00 m. Determine the force between the two balloons.



26. Three charges A, B, and C, are placed on the *x*-axis as shown in the diagram. The charge on C is  $+2 \mu$ C, the charge on B is  $-4 \mu$ C, and the charge on A is  $-8 \mu$ C. The distance between A and B,  $r_1$ , is 15 cm. The distance between A and C,  $r_2$ , is 18 cm. Determine the net force on A.



27. Three charges A, B, and C are placed on the *x*-axis as shown in the diagram. The charge of C is + 3.00  $\mu$ C, the charge on B is -3.00  $\mu$ C, and the charge on A is -5.00  $\mu$ C. The distance between A and B is 12.0 cm and distance between A and C is 20.0 cm. Determine the net force on A.

