Electric Charges

1. The ***fundamental rule*** of all electrical phenomena is:

Like charges _____, opposite charges _____

2. ***Thomson's cathode ray experiment*** proved that:

_____

3. ***Millikan's oil drop experiment*** proved that:

_____

4. The SI unit of ***charge*** is _____, symbol _____

5. The charge of an ***electron*** is _____

The charge of a ***proton*** is _____

The charge of a ***neutron*** is _____

6. 1 C is the charge of _____electrons

Charging an Object

7. There are three ways to charge an object:
1) Electrons are being transferred when one material rubs against another

_____

2) Electrons can be transferred from one material to another by simply touching

_____

3) A charged object can be used to charge another object without contact is called:

_____

8. Three identical metal balls A, B, and C. Ball A has 4 C, and both ball B and C are neutral. If ball A contacts ball B momentarily, and then ball B contacts ball C momentarily, what will be the charge on all three balls afterward?

_____ _____ _____

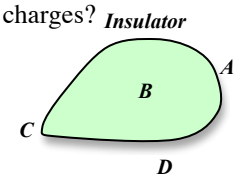
9. Write down the Law of conservation of charge.

_____

_____

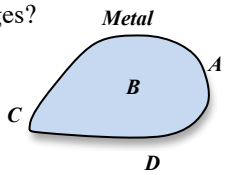
10. When a charged rod touched an insulator at B, where can you find the highest density of charges?

_____



11. When a charged rod touched a metal at B, where can you find the highest density of charges?

_____



12. Approach a negatively charged rod to a neutral metal ball and touch the other side of the ball momentarily with your finger, what will happen to the ball?

_____

13. The reason a charged balloon will stick to a wall is that
   a) electrons transfer back and forth between the wall and the balloon.
   b) induced opposite charges in the wall are closer than other wall charges.
   c) the rubber of the balloon simply sticks to walls.
   d) the charge is slightly sticky and acts like glue.
   e) none of the above

14. When a charged cloud passes overhead, the ground below is charged by

_____

15. Many molecules are electrically polarized in their normal states. The distribution of electric charge is not perfectly even. Such molecules are called

_____

16. An electroscope is charged negatively, as shown by foil leaves that stand apart. As a positively charged rod is brought close to the electroscope, the leaves
   a) spread farther apart.
   b) do not move.
   c) move closer together.
   d) spread farther apart first, and then move closer together.
   e) can not be determined.
   f) none of the above.

Types of Materials

17. Which of the following statement is true?
   a) The semiconductor becomes conductive when doped with impurities.
   b) In a good insulator, electrons are usually free to move around.
   c) A conductor has more electrons than protons.

d) Superconductor becomes a perfect conductor when the temperature is high enough.
e) Water is a good conductor since it's an electric dipole.
f) None of the above.

Electrostatic Force— The Coulomb's Law

18. ***Coulomb's torsion balance experiment*** concluded that:

_____

_____

19. ***Coulomb's Law*** formula:

F_e =

k = _____

20. ***Proportional & Inverse Square*** relations of ***Coulomb's Law***:

Charge 1	*Charge 2*	*Distance*	*Electric Force*
q_1	q_2	d	F_e
$2q_1$	$3q_2$	d	
$2q_1$	$\frac{1}{2}\, q_2$	d	
$2q_1$	q_2	$2d$	
q_1	$3q_2$	$2d$	
$2q_1$	$2q_2$	$2d$	
$2q_1$	q_2	$\frac{1}{2}\, d$	
$\frac{1}{2}\, q_1$	q_2	$\frac{1}{2}\, d$	
$2q_1$	$\frac{1}{2}\, q_2$	$2d$	
$\frac{1}{2}\, q_1$	$\frac{1}{2}\, q_2$	$\frac{1}{2}\, d$	

Application of Coulomb's Law

21. A 3-C charge and a 2-C charge attract each other with 5 N of force. How much will a 4-C charge and a 6-C charge attract each other when placed the same distance apart?

a. 5 N
b. 12 N
c. 10 N
d. 20 N
e. 40 N
f. none of the above.

22. Two charges separated a distance of 1.0 meter exert a 6.0-N force on each other. If the charges are pushed to a separation of 2.0 meter, the force on each charge will be

a. 0.75 N.
b. 1.5 N.
c. 3.0 N.
d. 6.0 N.
e. 12.0 N.
f. 24.0 N.

23. Two charged particles held close to each other are released. As they move, the force on each particle increases. Therefore, the particles have

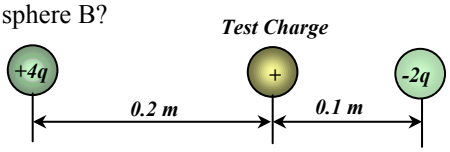
a. opposite signs.
b. the same sign.
c. charges that cannot be determined

24. Determine the electrical force of attraction between two balloons with separate charges of 2.5×10^{-8} C and -3.2×10^{-8}C when separated a distance of 1.2 m.

25. Each of the two identical hot-air balloons acquires a charge of 2.4×10^{-3} C on its surface as it travels through the air. How far apart are the balloons if the electrostatic force between them is 2.3×10^{4} N?

26. The hydrogen atom consists of a single electron (mass 9.1×10^{-31} kg) and a proton (mass 1.7×10^{-27} kg) at an average separation distance of 5.3×10^{-11} m. Compare the electrical and gravitational force between the proton and the electron in a hydrogen atom.

27. If a positive test charge is located between two charged spheres, A and B. Sphere A has a charge of +4q 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?



Electric Fields—

28. Write the definition and formula of the ***electric field***.

_____

E = =

E: _____ *unit:* _____

F_e*:* _____ *unit:* _____

k: _____ *unit:* _____

Q: _____ *unit:* _____

q: _____ *unit:* _____

r: _____ *unit:* _____

29. What is the magnitude of the electric field strength when an electron experiences a 1.5 N force?

30. What are the magnitude and direction of the electric field 0.2 m away from a negative charge of 2.4×10^{-9} C?

31. There is a negative charged particle of 0.25 C in the free space. (a) What are the magnitude and direction of the electric field 1.2 m away from the particle? (b) What are the magnitude and direction of the electric force when an electron is placed 2.0 m away from this particle?

32. Draw the ***vector representation*** for a ***positive source charge***.

33. Sketch the ***line-of-force representation*** for a pair of opposite charges.

34. Sketch the ***line-of-force representation*** for a pair of like charges.

35. What is special about the electric field between the charged parallel plates?

_____

36. The electric field around an isolated electron has a certain strength 1 cm from the electron. The electric field strength 2 cm from the electron is
    a) half as much.
    b) the same.
    c) twice as much.
    d) four times as much.
    e) none of the above

37. Sketch the electric field for oppositely charged parallel plates using line-of-force representation?

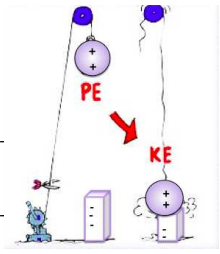
38. A charged droplet of mass 5.87 x 10^{-10} kg is hovering motionless between two parallel plates. The parallel plates have an electric field of 1.2 x 10^{7} N/C and are 2.00 mm apart. (a) What is the charge on the particle? (b) By how many electrons is the particle deficient?

Electric Potential Energy—

39. What is ***Electric Potential Energy***?

_____

_____



Electric Potential

40. Write the definition and formula of ***electric potential***.

_____

Formula:

V: _____ *unit:* _____

W_e: _____ *unit:* _____

q: _____ *unit:* _____

41. Electrical potential energy is the energy a charged object has because of its
    a) momentum.
    b) location.
    c) mass.
    d) motion.
    e) volume.

42. How much work is required to move 0.5 C of positive charge from the negative terminal of a 12-volt battery to the positive terminal?

43. If an electron loses 1.5 x 10^{-15} J of energy in traveling from the cathode to the screen of a computer monitor, across what potential difference must it travel?

Electric Potential: Parallel Plates

44. Electric field lines between two oppositely charged parallel metal plates will be
    a) straight lines, randomly spaced.
    b) straight lines, evenly spaced.
    c) curved lines grouped together in small bunches.
    d) curved lines, evenly spaced.
    e) curved lines, randomly spaced.

45. A 10-C charge is located near a positively charged sphere so that it has 100 J of electric potential energy. Its electric potential is
    a) 2 V.
    b) 5 V.
    c) 10 V.
    d) 20 V.
    e) 250 V.

46. Write the formula describing the relation between ***Electric potential*** (***V***) and ***Electric field*** (***E***).

Formula:

Equipotential: Parallel Plates

47. Definition of Equipotential lines

_____

Equipotential lines are perpendicular to

_____

48. Draw the ***Electric Field Lines*** and ***Equipotential lines*** for charged parallel plates:

49. Draw the ***Electric Field Lines*** and ***Equipotential lines*** for a charged pair:

50. A charged droplet of mass 5.87×10^{-10} kg is hovering motionless between two parallel plates. The parallel plates have a potential difference of 24000 V and are 2.00 mm apart. What is the charge on the particle?