1. Two parallel-plate capacitors with different plate separation but the same capacitance are connected in series to a battery. Both capacitors are filled with air. The quantity that is NOT the same for both capacitors when they are fully charged is:

   A. potential difference

   B. stored energy

   C. electric field between the plates

   D. charge on the positive plate

   E. dielectric constant

2. The table below gives the electric flux in $N \cdot m^2/C$ through the ends and round surfaces of four gaussian surfaces in the form of cylinders. Rank the cylinders according to the charge inside, from the most negative to the most positive.

 | | left end | right end | rounded surface |
   |---|---|---|---|
   | cylinder 1: | $+2 \times 10^{-9}$ | $+4 \times 10^{-9}$ | -6×10^{-9} |
   | cylinder 2: | $+3 \times 10^{-9}$ | -2×10^{-9} | $+6 \times 10^{-9}$ |
   | cylinder 3: | -2×10^{-9} | -5×10^{-9} | $+3 \times 10^{-9}$ |
   | cylinder 4: | $+2 \times 10^{-9}$ | -5×10^{-9} | -3×10^{-9} |

   A. 1, 2, 3, 4

   B. 4, 3, 2, 1

   C. 3, 4, 2, 1

   D. 3, 1, 4, 2

   E. 4, 3, 1, 2

3. Two identical capacitors are connected in series and two, each identical to the first, are connected in parallel. The equivalent capacitance of the series connection is _____ the equivalent capacitance of parallel connection.

   A. twice

   B. four times

   C. half

   D. one fourth

   E. the same as

4. In a certain region of space the electric potential increases uniformly from east and west and does not vary in any other direction. The electric field:

   A. points east and varies with position

   B. points east and does not vary with position

   C. points west and varies with position

D. points west and does not vary with position

E. points north and does not vary with position

5. The diagram shows four pairs of large parallel conducting plates. The value of the electric potential is given for each plate. Rank the pairs according to the magnitude of the electric field between the plates, least to greatest.
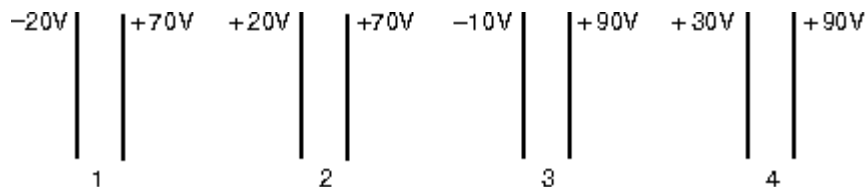

A. 1, 2, 3, 4

B. 4, 3, 2, 1

C. 2, 3, 1, 4

D. 2, 4, 1, 3

E. 3, 2, 4, 1

6. Two particles, each with charge Q, and a third particle, with a charge q, are placed at the vertices of an equilateral triangle as shown. The total force on the particle with charge q is:
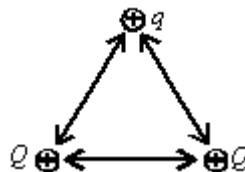
A. Parrallel to the left side of the triangle

B. Parrallel to the right side of the triangle

C. Parrallel to the bottom side of the triangle

D. perpendicular to the bottom side of the triangle

E. perpendicular to the left side of the triangle

7. A 2-μF and a 1-μF capacitor are connected in series and a potential difference is applied across the combination. The 2-μF capacitor has:

A. twice the charge of the 1-μF capacitor

B. half the charge of the 1-μF capacitor

C. twice the potential difference of the 1-μF capacitor

D. half the potential difference of the 1-μF capacitor

E. none of the above

8. An electron moves from point i to point f, in the direction of a uniform electric field. During this placement:
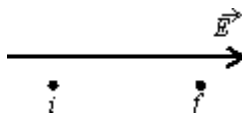
A. the work done by the field is positive and the potential energy of the electron-field system increases

B. the work done by the field is negative and the potential energy of the electron-field system increases

C. the work done by the field is positive and the potential energy of the electron-field system decreases

D. the work done by the field is negative and the potential energy of the electron-field system decreases

E. the work done by the field is positive and the potential energy of the electron-field system does not change

9. A long line of charge with λ_E charge per unit length runs along the cylindrical axis of a cylindrical shell which carries a charge per unit length of λ_c. The charge per unit length on the inner and outer surfaces of the shell, respectively are:

A. λ_E and λ_c

B. $-\lambda_E$ and $\lambda_c + \lambda_E$

C. $-\lambda_E$ and $\lambda_c - \lambda_c$

D. $\lambda_E + \lambda_c$ and $\lambda_c - \lambda_E$

E. $\lambda_E - \lambda_c$ and $\lambda_c + \lambda_E$

10. Pulling the plates of an isolated charged capacitor apart:

A. increases the capacitance

B. increases the potential difference

C. does not affect the potential difference

D. decreases the potential difference

E. does not affect the capacitance

11. Experimenter A uses a test charge q_0 and experimenter B uses a test charge $2q_0$ to measure an electric field produced by stationary charges. A finds a field that is:

A. the same as the field found by B

B. greater than the field found by B

C. less than the field found by B

D. either greater or less than the field found by B, depending on the masses of the test charges

E. either greater or less than the field found by B, depending on the accelerations of the test charges

12. Two point charges are arranged as shown. In which region could a third charge +1 C be placed so that the net electrostatic force on it is zero?
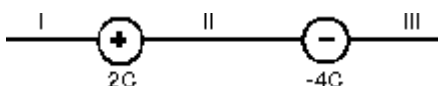
A. I only

B. I and II only

C. III only

D. I and III only

E. II only

13. Positive charge $+Q$ is uniformly distributed on the upper half of a semicircular rod and negative charge $-Q$ is uniformly distributed on the lower half. What is the direction of the electric field at point P, the center of the semicircle?
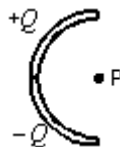
A. ↑

B. ↓

C. ←

D. →

E. «

14. Two large insulating parallel plates carry charge of equal magnitude, one positive and the other negative, that is distributed uniformly over their inner surfaces. Rank the points 1 through 5 according to the magnitude of the electric field at the points, least to greatest.
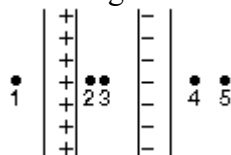
A. 1, 2, 3, 4, 5

B. 5, 4, 3, 2, 1

C. 1, 4, and 5 tie, then 2 and 3 tie

D. 2 and 3 tie, then 1 and 4 tie, then 5

E. 2 and 3 tie, then 1, 4, and 5 tie

15. A point particle with charge q is placed inside the cube but not at ist center, The electric flux thrugh any one side of the cube.

A. is zero

B. is $q/5_0$

C. is $q/45_0$

D. is $q/65_0$

E. cannot be computed using Gauss' law

16. Two identical conducting spheres A and B carry equal charge. They are separated by a distance much larger than their diameters. A third identical conducting sphere C is uncharged. Sphere C is first touched to A, then to B, and finally removed. As a result, the electrostatic force between A and B, which was originally F, becomes:

    A. $F/2$

    B. $F/4$

    C. $3F/8$

    D. $F/16$

    E. 0

17. When a hard rubber rod is given a negative charge by rubbing it with wool:

    A. positive charges are transferred from rod to wool

    B. negative charges are transferred from rod to wool

    C. positive charges are transferred from wool to rod

    D. negative charges are transferred from wool to rod

    E. negative charges are created and stored on the rod

18. A hollow metal sphere is charged to a potential V. The potential at its center is:

    A. V

    B. 0

    C. $-V$

    D. $2V$

    E. πV

19. Two small charged objects repel each other with a force F when separated by a distance d. If the charge on each object is reduced to one-fourth of its original value and the distance between them is reduced to $d/2$ the force becomes:

    A. $F/16$

    B. $F/8$

    C. $F/4$

    D. $F/2$

    E. F

20. Two particles have charges Q and $-Q$ (equal magnitude and opposite sign). For a net force of zero to be exerted on a third charge it must be placed:

    A. midway between Q and $-Q$

    B. on the perpendicular bisector of the line joining Q and $-Q$, but not on that line itself

    C. on the line joining Q and $-Q$, to the side of Q opposite $-Q$

    D. on the line joining Q and $-Q$, to the side of $-Q$ opposite Q

E. at none of these places (there is no place)

21. The plate areas and plate separations of five parallel plate capacitors are
    capacitor 1: area A_0, separation d_0

    capacitor 2: area $2A_0$, separation $2d_0$

    capacitor 3: area $2A_0$, separation $d_0/2$

    capacitor 4: area $A_0/2$, separation $2d_0$

    capacitor 5: area A_0, separation $d_0/2$

    Rank these according to their capacitances, least to greatest.
    A. 1, 2, 3, 4, 5
    B. 5, 4, 3, 2, 1
    C. 5, 3, and 4 tie, then 1, 2
    D. 4, 1, and 2 tie, then 5, 3
    E. 3, 5, 1 and 2 tie, 1, 4

22. An electron is accelerated from rest through a potential difference V. Its final speed is proportional to:
    A. V

    B. V^2

    C. $\sqrt{V}$

    D. 1/V

    E. $1/\sqrt{V}$

23. A 2-μF and a 1-μF capacitor are connected in parallel and a potential difference is applied across the combination. The 2-μF capacitor has:
    A. twice the charge of the 1-μF capacitor
    B. half the charge of the 1-μF capacitor
    C. twice the potential difference of the 1-μF capacitor
    D. half the potential difference of the 1-μF capacitor
    E. none of the above

24. An isolated charged point particle produces an electric field with magnitude E at a point 2 m away. At a point 1 m from the particle the magnitude of the field is:
    A. E

    B. $2E$

    C. $4E$

    D. $E/2$

E. $E/4$

25. A point charge is placed at the center of a spherical Gaussian surface. The electric flux Φ_E is changed if:

A. the sphere is replaced by a cube of the same volume

B. the sphere is replaced by a cube of one-tenth the volume

C. the point charge is moved off center (but still inside the original sphere)

D. the point charge is moved to just outside the sphere

E. a second point charge is placed just outside the sphere