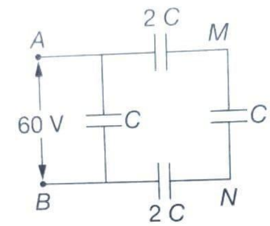
CLASS 12^{TH}

Subject: Physics **Topic: electric charges and fields, electrostatic potential capacitance**

1. In the circuit shown, a potential difference of 60 V is applied across AB. The potential difference between the points M and N is



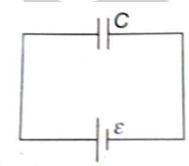
(A) 10 V

(B) 15 V

(C) 20 V

(D) 30 V

2. A capacitor of capacitance C is connected with a battery of emf ε as shown. After full charging, a dielectric of same size of capacitor and dielectric constant k is inserted. Choose correct statements. (Capacitor is always connected to battery.)



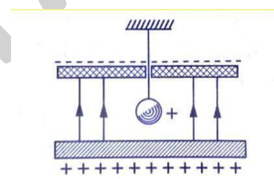
(A) Electric field between plates of capacitor remains same

(B) Charge on capacitor is C ε

(C) Energy on capacitor decreased

(D) Electric field between plates of capacitor increased

3. If a positively charged pendulum is oscillating in a uniform field as shown, then its time period as compared to that when it was uncharged will



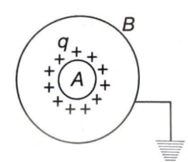
(A) Increase

(B) Decrease

(C) Not change

(D) None of these

4. A and B are two concentric metallic hollow spheres. If A is given a charge q while B is earthed as shown in the figure, then



(A) Charge density of A and B are same.

(B) Field inside and outside A is zero.

(C) Field between A and B is not zero.

(D) Field inside and outside B is zero.

5. In electrolysis, the amount of mass deposited or liberated at an electrode is directly proportional to

(A) Amount of charge. (B) Square of current (C) concentration of electrolyte. (D) Square of electric charge.

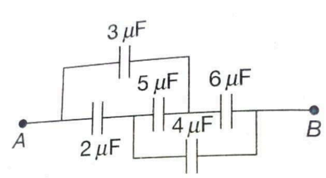
6. A capacitor is connected to a battery. The force of attraction between the plates when the separation between the plates when the separation them is halved

(A) Remains the same (B) Becomes eight times. (C) becomes four times. (D) becomes double.

7. The electric $\vec{E}$ is given by vec $\vec{E}$ =a $\hat{i}$ +b$\hat{j}$ (where a and b is constant and $\hat{i}$, $\hat{j}$ are unit vector along x and y axis, respectively), the flux passing through a square area of side / and parallel to y-z plane is

(A) bl^2 (B) al^2 (C) $\sqrt{\left(a^2+b^2\right)l^2}$ (D) $\sqrt{\left(a^2-b^2\right)l^2}$

8. In the circuit shown, the equivalent capacitance between the points A and B is



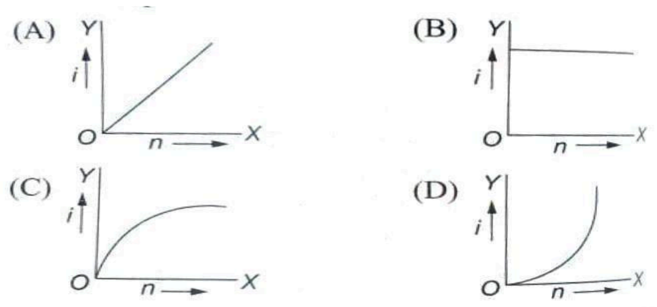
(A) $\frac{10}{3}$μF (B) $\frac{15}{4}$μF

(C) $\frac{12}{5}$μF (D) $\frac{25}{6}$μF

9. A non-conducting ring of radius R has charge Q distributed uniformly over it. If it rotates with an angular velocity ω , the equivalent current will be

(A) Zero (B) Qω (C) $Q\frac{\omega}{2\pi}$ (D) $Q\frac{\omega}{2\pi R}$

10. A battery consists of a variable number n of identical cells having internal resistance r each. They are connected in series. The terminals of the battery are joined by a conducting wire and the current i is measured. Which of the graphs as shown below gives correct relationship between i and n?



11. A half ring of radius R has a charge of λ per unit length. The potential at the centre of the half ring is

(A) $k\frac{}{R}$ (B) $k\frac{}{R}$ (C) $k\frac{}{R}$ (D) kπλ

12. If electric field is given by $\vec{E} = (\frac{1}{x^2})\hat{i}$ V/m, the magnitude of potential difference between points x =10 cm and x = 20 cm is

(A) 1V (B) 2 V (C) 5 V (D) 10 V

13. A cube of side b has a charge q at each of its vertices. The electric potential at the centre of the cube is

(A) $\frac{4q}{\sqrt{3}\pi\varepsilon_0 b}$ (B) $\frac{\sqrt{3}q}{\pi\varepsilon_0 b}$ (C) $\frac{2q}{\pi\varepsilon_0 b}$ (D) Zero

14. Four equal charges Q are placed at the four corners of a square of side a. The work done in removing a charge -Q from the centre of the square to infinity is

(A)Zero (B) $\frac{\sqrt{2}Q^2}{4\pi\varepsilon_0 a}$ (C) $\frac{\sqrt{2}Q^2}{\pi\varepsilon_0 a}$ (D) $\frac{Q^2}{2\pi\varepsilon_{0a}}$

15. A conductor of resistance 3 Ω is stretched uniformly till its length is doubled. The wire is now bent in the form of an equilateral triangle. The effective resistance between the ends of any side of the triangle in ohms is

(A) $\frac{9}{2}$ (B) $\frac{8}{3}$ (C) 2 (D) 1

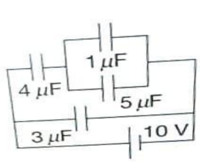
16. If there are n capacitors in parallel connected to V volt source, then total energy stored is equal to

(A) CV (B) $\frac{1}{2}nCV^2$ (C) CV^2 (D) $\frac{1}{2n}CV^2$

17. There is an air-filled 1 pF parallel plate capacitor. When the plate separation is doubled and the space is filled with wax, the capacitance increases to 2 pF. The dielectric constant of wax is

(A) 2 (B) 4 (C) 6 (D) 8

18. For the circuit shown in the figure below, the charge on 4 μF capacitor is

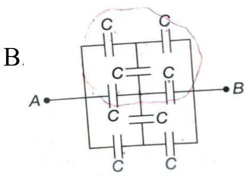


(A) 30 μC (B) 40μC (C) 24 μC (D) 54 μC

19. Two conducting spheres of radii r_1 and r_2 are at the same potential. The ratio of their charges is

(A) $\left(\frac{r_1^2}{r_2^2}\right)$ (B) $\left(\frac{r_2^2}{r_1^2}\right)$ (C) $\frac{r_1}{r_2}$ (D) $\frac{r_2}{r_1}$

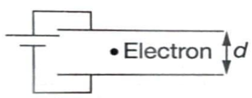
20. In the given figure, find the equivalent capacitance between A and B.



(A) $\frac{2C}{3}$ (B) $\frac{5C}{4}$

(C) $\frac{3C}{2}$ (D) $\frac{4C}{5}$

21. Two large plates separated by a distance d in vertical plane and connected to battery as shown. An electron of charge e and mass m is at rest between the plates. Find the value of potential difference of battery.



(A) $\frac{mge}{d}$ (B) $\frac{2mge}{d}$ (C) $\frac{mgd}{e}$ (D) $\frac{2mgd}{e}$

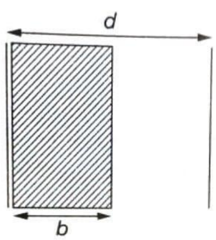
22. Two plates are 2 cm apart. A potential difference of 10 V is applied between them, the electric field between the plates is

(A) 20 N/C (B) 500 N/C (C) 5 N/C (D) 250 N/C

23. Suppose the electrostatic potential at some points in space are given by $V=(x^2-2x)$. The electrostatic field strength at x = 1 is

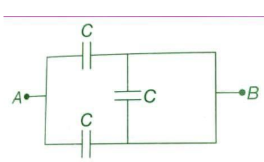
(A) Zero (B)-2 (C) 2 (D) 4

24. A slab of copper of thickness b is inserted in between the plates of parallel plate capacitor as shown in the figure. The separation between the plates is d if $b=\frac{d}{2}$ then the ratio of capacities of capacitors after and before inserting the slab will be



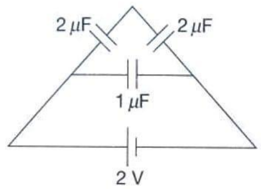
(A) √2:1 (B) 2:1 (C)1:1 (D) 1: √2

25. The equivalent capacity of the combination shown the figure is



(A) C (B) 2C (C) 3/2C (D) C/2

26. The charge on any one of the 2 μF capacitors and 1 μF capacitor will be given, respectively, (in μC) as



(A) 1,2 (B) 2, 1 (C) 1, 1 (D) 2,2

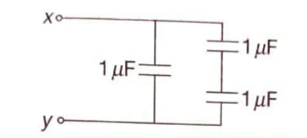
27. The electric potential V (in volt) varies with x (in metre) according to the relation $V = 5+4x^2$. The force experienced by a negative charge of 2 x 10° C located at x=0.5 m is

(A) 2×10^{-6} N (B) 4×10^{-6} N (C) 6×10^{-6} N (D) 8×10^{-6} N

28. The electric potential at a point situated at a distance r on the axis of a short electric dipole of moment p will be $1/4\,(\pi\varepsilon_0)$ times

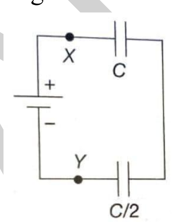
(A) p/r^3 (B) p/r^2 (C) p/r (D) None of the above

29. The effective capacitance between the points x and y in the figure will be



(A) 1 μF (B) 1.5 μF (C) 2 μF (D) 4 μF

30. The equivalent capacitance between the points X and Y in the figure will be



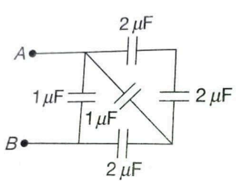
(A) 2C/3

(B) C/3

(C) 3C/2

(D) 3C

31. In the figure shown (circuit), the capacitance between the points A and B will be



(A) 1 μF (B) 2 μF (C) 3 μF (D) 4 μF

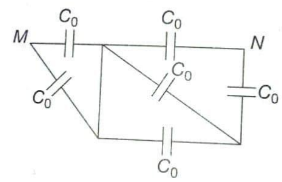
32. The effective capacitance of two capacitors of capacitances C_1 and C_2 (with $C_2 > C_1$) connected in parallel 25/6 is times the effective capacitance when they are connected in series. The ratio C_2/C_1 is

(A) 3/2 (B)4/3 (C) 5/3 (D) 25/6

33. A capacitor of capacitance 4 μF is charged to 80 V and another capacitor of capacitance 6 μF is charged to 30 V. When they are connected together, the energy lost by the 4 μF capacitor is

(A) 7.8 mJ (B) 4.6 mJ (C) 3.2 mJ (D) 2.5 mJ

34. The equivalent capacitance between points M and N is



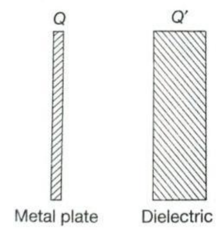
(A) $\frac{10}{11}C_0$

(B) $2C_0$

(C) C_0

(D) None of these

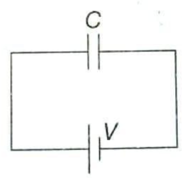
35. As shown in the figure. If value of Q' is $\frac{Q}{2}$ then what is the value of dielectric constant k



(A) 3 (B) 1/2

(C) 2 (D) ∞

36.In the given circuit diagram, initially battery was connected. Find the work done by battery if capacitor is completely filled with a dielectric constant k = 3.



(A)$\frac{1}{2}CV^2$

(B)CV^2

(C) $2CV^2$

(D) $\frac{3}{2}CV^2$

37. A parallel plate capacitor of capacitance C is connected to a battery of emf V. If a dielectric slab is completely inserted between the plates of the capacitor and battery remains connected, then electric field between plates

(A) Decreases. (B) Increases. (C) remains constant. (D) may be increase or may be decrease.

38. Two capacitors of capacitance 3 μF and 6 μF are charged to a potential of 12 V each. They are now connected to each other, with the positive plate of one to the negative plate of the other. Then

(A) the potential difference across 3 μF is zero.

(B) the potential difference across 3 μF is 4 V.

(C) the charge on 3 μF is zero.

(D) the charge on 3 μF is 10 μC.

39. If three moles of monatomic gas is mixed with 1 moles diatomic gas, the resultant value of γ for the mixture is

(A) 1.66 (B) 1.50 (C) 1.40 (D) 1.57

40. Capacitance of a capacitor becomes 4/3 times its original value if a dielectric slab of thickness t = d / 2 is inserted between the plates (d = separation between the plates). The dielectric constant of the slab is

(A) 2 (B) 4 (C) 6 (D) 8

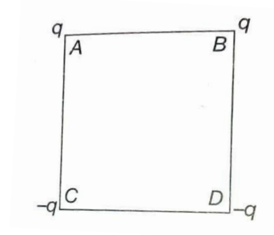
41. If the electric flux entering and leaving an enclosed surface, respectively, is φ_1 and φ_2 the electric charge inside the surface will be

(A)$(\varphi_2-\varphi_1)/\varepsilon_0$ (B) $(\varphi_1+\varphi_2)/\varepsilon_0$ (C) $(\varphi_2-\varphi_1)/\varepsilon_0$ (D) $(\varphi_1+\varphi_2)\varepsilon_0$

42. A thin spherical conducting shell of radius R has a charge q. Another charge Q is placed at the centre of the shell. The electrostatic potential at a point P at a distance R/2 from the centre of the shell is

(A) $\frac{2Q}{4\pi\varepsilon_0 R}$ (B) $\frac{2Q}{4\pi\varepsilon_0 R} - \frac{2q}{4\pi\varepsilon_0 R}$ (C) $\frac{2Q}{4\pi\varepsilon_0 R} + \frac{q}{4\pi\varepsilon_0 R}$ (D) $\frac{(q+Q)}{4\pi\varepsilon_0}\,\frac{2}{R}$

43. Charges are placed on the vertices of a square as shown. Let $\vec{E}$ be the electric field and V the potential at the centre. If the charges on A and B are inter- changed with those on D and C, respectively, then



(A) $\vec{E}$ remains unchanged, V changes.

(B) Both $\vec{E}$ and V change.

(C) $\vec{E}$ and V remain unchanged.

(D) $\vec{E}$ changes, V remains unchanged.

45. Two capacitors C_1 and C_2 are charged to 120 V and 200 V, respectively. It is found that by connecting them together, the potential on each one can be made zero. Then

(A) $3C_1=5C_2$ (B) $3C_1+5C_2=0$ (C) $9C_1=4C_2$ (D) $5C_1=3C_2$

46. A uniformly charged solid sphere of radius R has potential V_0 (measured with respect to ∞) on its surface. For this sphere, the equipotential surfaces with potential $\frac{3V_0}{2}$, $\frac{5V_0}{4}$, $\frac{3V_0}{4}$ and $\frac{V_0}{4}$ have radius R_1, R_2, R_3 and R_4 respectively. Then

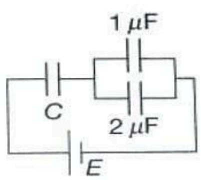
(A) $R_1 \neq 0$ and $(R_2 - R_1) > (R_4 - R_3)$

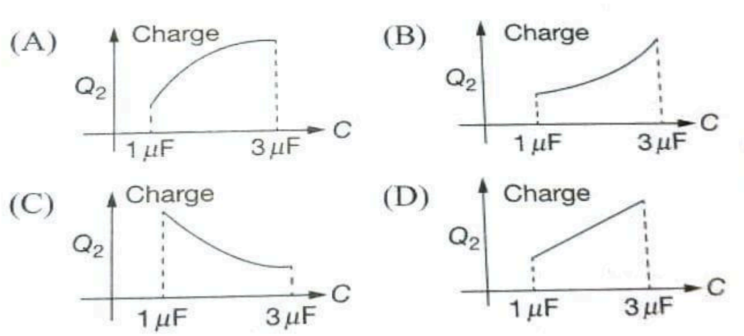
(B) $R_1 = 0$ and $R_2 < (R_4 - R_3)$

(C) $2R < R_4$

(D) $R_1 = 0$ and $R_2 > (R_4 - R_3)$

47. In the given circuit, charge Q_2 on the 2μF capacitor changes as C is varied from 1 μF to 3 μF. Q_2 as a function of C is given properly by (The figures are drawn schematically and are not to scale)

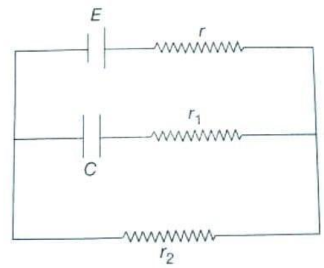




48. A capacitance of 2 μF is required in an electrical circuit across a potential difference of 1.0 kV. A large number of 1 μF capacitors are available which can withstand a potential difference of not more than 300 V. The minimum number of capacitors required to achieve this, is

(A) 16 (B) 24 (C) 32 (D) 2

49. In the given circuit diagram, when the current reaches steady state in the circuit, the charge on the capacitor of capacitance C will be



(A) CE$\frac{r_1}{r_2+r}$

(B) CE$\frac{r_2}{r+r_2}$

(C) CE$\frac{r_1}{r_1+r}$

(D) CE

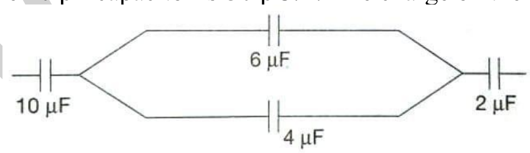
50. An electric dipole has a fixed dipole moment $\vec{p}$, which makes an angle θ with respect to X-axis. When subjected to an electric field, $\vec{E}_1$=E $\hat{i}$, it experiences a torque, $\vec{T}_1=\tau\hat{k}$ When subjected to another electric field, $\vec{E}_2 = \sqrt{3}E_1\hat{j}$ it experiences a torque, $\vec{T}_2 =-\vec{T}_1$ Then, the angle θ is

(A) 45° (B) 60° (C) 90° (D) 30°

51. A parallel plate capacitor of capacitance 90 pF is connected to a battery of emf 20 V. If a dielectric material of dielectric constant K = $\frac{5}{3}$ is inserted between the plates, the magnitude of the induced charge will be

(A) 1.2 nC (B) 0.3 nC (C) 2.4 nC (D) 0.9 nC

52. In the figure shown below, the charge on the left plate of the 10 μF capacitor is-30 μC. ? The charge on the right plate of the 6 μF capacitor is:



(A) +12 μC (C) +18 μC
(B) -18 μC (D) -12 μC

53. A parallel plate capacitor having capacitance 12 pF is charged by a battery to a potential difference of 10 V between its plates. The charging battery is now disconnected and a porcelain slab of dielectric constant 6.5 is slipped between the plates the work done by the capacitor on the slab is:

(A) 692 pJ (B) 600 pJ (C) 560 pJ (D) 508 pJ

54. A 10 m long horizontal wire extends from North E ay to South West. It is falling with a speed of 5ms^{-1} .a right angles to the horizontal component of the earth's magnetic field, of 0.3 * 10^{-4} Wb/m^2. The value of the induced emf in wire is:

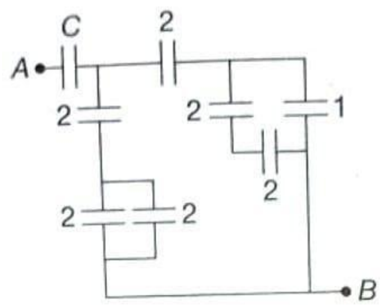
(A) 2.5 * 10^{-3} V (B) 1.5 * 10 $^{-3}$ V (C) 1.1 * 10^{-3}V (D) 0.3 * 10^{-3}V

55. A parallel plate capacitor with plates of area 1 m² each, area t a separation of 0.1 m. If the electric field between the plates is 100 N/C, the magnitude of charge each plate is:

(Take ϵ_0 = 8.85 * 10$^{-12}\frac{C^2}{N-m^2}$)

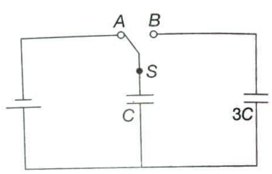
(A) 6.85 * 10^{-10} C (B) 9.85 *10^{-10} C (C) 8.85 * 10^{-10} C (D) 7.85 * 10^{-10} C

56. In the circuit shown, find C if the effective capacitance of the whole circuit is to be 0.5 µF. All values in the circuit are in µF.



(A) 7/11 µF (B)7/10 µF (C)6/5 µF (D) 138.

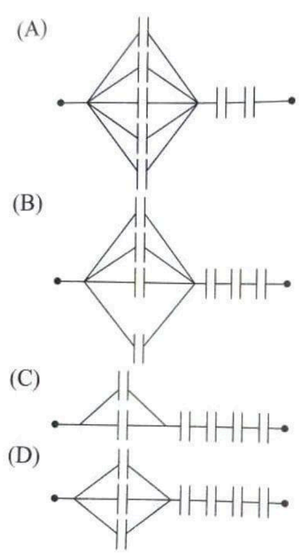
57. In the figure shown, after the switch 'S' is turned from position 'A' to position 'B', the energy dissipated" the circuit in terms of capacitance 'C' and total charge 'Q' is:



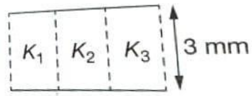
(A) $\frac{1}{8}\frac{Q^2}{C}$ (B) $\frac{3}{8}\frac{Q^2}{C}$ (C) $\frac{5}{8}\frac{Q^2}{C}$ (D) $\frac{3}{4}\frac{Q^2}{C}$

58. Seven capacitors, each of capacitance 2uF, are to be connected in a configuration to obtain in effective capacitance of $\left(\frac{6}{13}\right)$µF

Which of the combinations, shown in figures below, will achieve the desired value?

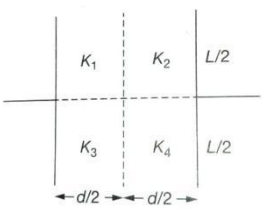


59. A parallel plate capacitor is of area 6cm^2 and a separation 3 mm. The gap is filled with three dielectric materials of equal thickness (see figure) with dielectric constants K_1 =10 , K_2 = 12 and K_3= 14 The dielectric constant of a material which when fully inserted in above capacitor, gives same capacitance would be:



(A) 12 (B) 4 (C) 36 (D) 14

60. A parallel plate capacitor with square plates is filled with four dielectrics of dielectric constants K_1 , K_2 ,K_3 , K_4 arranged as shown in the figure. The effective dielectric constant K will be:



(A) K= $\frac{(K_1+K_2)(K_3+K_4)}{2(K_1+K_2+K_3+K_4)}$ (B) K=$\frac{(K_1+K_4)(K_2+K_3)}{2(K_1+K_2+K_3+K_4)}$

(C) K= $\frac{(K_1+K_3)(K_2+K_3)}{(K_1+K_2+K_3+K_4)}$ (D) K=$\frac{(K_1K_2)}{(K_1+K_2)}+\frac{(K_3K_4)}{(K_3+K_4)}$

61. A parallel plate capacitor is made of two square plates of side 'a', separated by a distance d (d << a). The lower triangle portion is filled with a dielectric of dielectric constant K, as shown in the figure. Capacitance of this capacitor is:

(A)$\frac{1k\epsilon_0 a^2}{2d}$ (B) $\frac{k\epsilon_0 a^2}{d}$ InK (C) $\frac{k\epsilon_0 a^2}{d(K-1)}$InK (D) $\frac{k\epsilon_0 a^2}{2d(K+1)}$

62. Charge is distributed within a sphere of radius R with a volume charge density ρ(r) =$\frac{A}{r^2}$ e^{-2r}|a, where A and a are constants. If Q is the total charge of this charge distribution, the radius R is

(A)$\frac{a}{2}\log log\left(1-\frac{Q}{2\pi aA}\right)$ (B) $a\log log\left(1-\frac{Q}{2\pi aA}\right)$ (C) $a\log log\left(\frac{1}{1-\frac{Q}{2\pi aA}}\right)$ (D) $\frac{a}{2}\log log\left(\frac{1}{1-\frac{Q}{2\pi aA}}\right)$