DPP - Daily Practice Problems

Chapter-wise Sheets

Date : ____ **Start Time :** ____ **End Time :** ____

PHYSICS

CP16

SYLLABUS : Electrostatic Potential & Capacitance

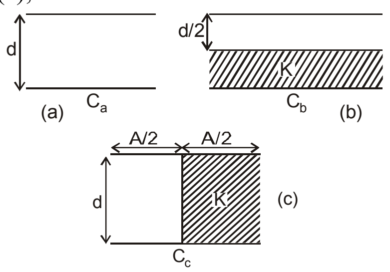
Max. Marks : 180 **Marking Scheme :** (+4) for correct & (–1) for incorrect answer **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQs. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. If n drops, each charged to a potential V, coalesce to form a single drop. The potential of the big drop will be

(a) $\frac{V}{n^{2/3}}$ (b) $\frac{V}{n^{1/3}}$ (c) $Vn^{1/3}$ (d) $Vn^{2/3}$

2. The capacitance of a parallel plate capacitor is C_a (Fig. a). A dielectric of dielectric constant K is inserted as shown in fig. (b) and (c). If C_b and C_c denote the capacitances in fig. (b) and (c), then



(a) both $C_b, C_c > C_a$ (b) $C_c > C_a$ while $C_b > C_a$

(c) both $C_b, C_c < C_a$ (d) $C_a = C_b = C_c$

3. The electric potential $V(x)$ in a region around the origin is given by $V(x) = 4x^2$ volts. The electric charge enclosed in a cube of 1 m side with its centre at the origin is (in coulomb)

(a) $8\varepsilon_0$ (b) $-4\varepsilon_0$ (c) 0 (d) $-8\varepsilon_0$

4. A parallel plate condenser is immersed in an oil of dielectric constant 2. The field between the plates is

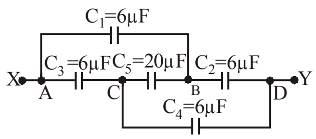
(a) increased, proportional to 2

(b) decreased, proportional to $\frac{1}{2}$

(c) increased, proportional to – 2

(d) decreased, proportional to $-\frac{1}{2}$

5. What is the effective capacitance between points X and Y?



(a) $24\,\mu F$ (b) $18\,\mu F$ (c) $12\,\mu F$ (d) $6\,\mu F$

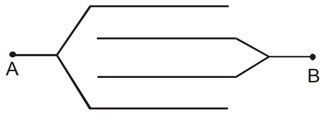
6. Two identical particles each of mass m and having charges –q and +q are revolving in a circle of radius r under the influence of electric attraction. Kinetic energy of each particle is $\left(k = \frac{1}{4\pi\varepsilon_0}\right)$

(a) $kq^2/4r$ (b) $kq^2/2r$ (c) $kq^2/8r$ (d) kq^2/r

RESPONSE GRID					
	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ
	6. ⓐⓑⓒⓓ				

Space for Rough Work

7. Four metallic plates each with a surface area of one side A, are placed at a distance d from each other. The two outer plates are connected to one point A and the two other inner plates to another point B as shown in the figure. Then the capacitance of the system is



(a) $\frac{\varepsilon_0 A}{d}$ (b) $\frac{2\varepsilon_0 A}{d}$ (c) $\frac{3\varepsilon_0 A}{d}$ (d) $\frac{4\varepsilon_0 A}{d}$

8. A parallel plate condenser with a dielectric of dielectric constant K between the plates has a capacity C and is charged to a potential V volt. The dielectric slab is slowly removed from between the plates and then reinserted. The net work done by the system in this process is

(a) zero (b) $\frac{1}{2}(K-1)\,CV^2$

(c) $\frac{CV^2(K-1)}{K}$ (d) $(K-1)\,CV^2$

9. If a slab of insulating material 4×10^{-5} m thick is introduced between the plates of a parallel plate capacitor, the distance between the plates has to be increased by 3.5×10^{-5} m to restore the capacity to original value. Then the dielectric constant of the material of slab is

(a) 8 (b) 6 (c) 12 (d) 10

10. A unit charge moves on an equipotential surface from a point A to point B, then

(a) $V_A - V_B = +\text{ve}$ (b) $V_A - V_B = 0$

(c) $V_A - V_B = -\text{ve}$ (d) it is stationary

11. Identify the false statement.

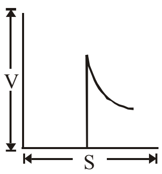
(a) Inside a charged or neutral conductor, electrostatic field is zero

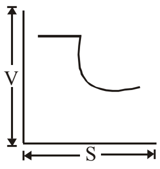
(b) The electrostatic field at the surface of the charged conductor must be tangential to the surface at any point

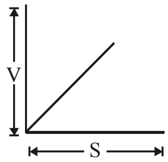
(c) There is no net charge at any point inside the conductor

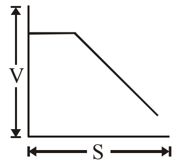
(d) Electrostatic potential is constant throughout the volume of the conductor

12. In a hollow spherical shell, potential (V) changes with respect to distance (s) from centre as

(a) 

(b) 

(c) 

(d) 

13. The 1000 small droplets of water each of radius r and charge Q, make a big drop of spherical shape. The potential of big drop is how many times the potential of one small droplet ?

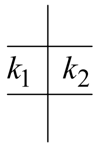
(a) 1 (b) 10 (c) 100 (d) 1000

14. The work done in carrying a charge q once around a circle of radius r with a charge Q placed at the centre will be

(a) $Qq(4\pi\varepsilon_0 r^2)$ (b) $Qq/(4\pi\varepsilon_0 r)$

(c) zero (d) $Qq^2/(4\pi\varepsilon_0 r)$

15. A parallel plate condenser is filled with two dielectrics as shown. Area of each plate is A m^2 and the separation is t m. The dielectric constants are k_1 and k_2 respectively. Its capacitance in farad will be



(a) $\frac{\varepsilon_0 A}{t}(k_1 + k_2)$ (b) $\frac{\varepsilon_0 A}{t}.\frac{k_1 + k_2}{2}$

(c) $\frac{2\varepsilon_0 A}{t}(k_1 + k_2)$ (d) $\frac{\varepsilon_0 A}{t}.\frac{k_1 - k_2}{2}$

16. Two metal pieces having a potential difference of 800 V are 0.02 m apart horizontally. A particle of mass 1.96×10^{-15} kg is suspended in equilibrium between the plates. If e is the elementary charge, then charge on the particle is

(a) 8 (b) 6 (c) 0.1 (d) 3

17. A one microfarad capacitor of a TV is subjected to 4000 V potential difference. The energy stored in capacitor is

(a) 8 J (b) 16 J

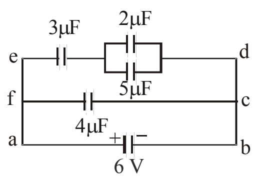
(c) 4×10^{-3} J (d) 2×10^{-3} J

18. An unchanged parallel plate capacitor filled with a dielectric constant K is connected to an air filled identical parallel capacitor charged to potential V_1. If the common potential is V_2, the value of K is

(a) $\frac{V_1 - V_2}{V_1}$ (b) $\frac{V_1}{V_1 - V_2}$

(c) $\frac{V_2}{V_1 - V_2}$ (d) $\frac{V_1 - V_2}{V_2}$

19. In the circuit given below, the charge in μC, on the capacitor having 5 μF is



(a) 4.5
(b) 9
(c) 7
(d) 15

RESPONSE GRID					
	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ
	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ
	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ		

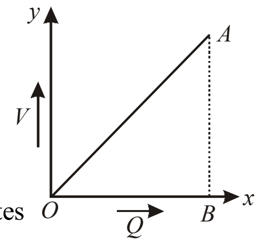
Space for Rough Work

20. Two concentric, thin metallic spheres of radii R_1 and R_2 ($R_1 > R_2$) bear charges Q_1 and Q_2 respectively. Then the potential at distance r between R_1 and R_2 will be

(a) $k\left(\frac{Q_1+Q_2}{r}\right)$ (b) $k\left(\frac{Q_1}{r}+\frac{Q_2}{R_2}\right)$

(c) $k\left(\frac{Q_2}{r}+\frac{Q_1}{R_1}\right)$ (d) $k\left(\frac{Q_1}{R_1}+\frac{Q_2}{R_2}\right)$

21. Charge Q on a capacitor varies with voltage V as shown in the figure, where Q is taken along the X-axis and V along the Y-axis. The area of triangle OAB represents



(a) capacitance
(b) capacitive reactance
(c) magnetic field between the plates
(d) energy stored in the capacitor

22. An alpha particle is accelerated through a potential difference of 10^6 volt. Its kinetic energy will be

(a) 1 MeV (b) 2 MeV (c) 4 MeV (d) 8 MeV

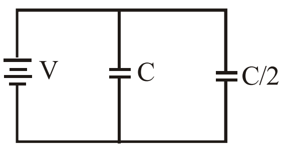
23. Four point charges $-Q$, $-q$, $2q$ and $2Q$ are placed, one at each corner of the square. The relation between Q and q for which the potential at the centre of the square is zero is :

(a) $Q=-q$ (b) $Q=-\frac{1}{q}$ (c) $Q=q$ (d) $Q=\frac{1}{q}$

24. A parallel plate capacitor having a separation between the plates d, plate area A and material with dielectric constant K has capacitance C_0. Now one-third of the material is replaced by another material with dielectric constant 2K, so that effectively there are two capacitors one with area 1/3A, dielectric constant 2K and another with area 2/3A and dielectric constant K. If the capacitance of this new capacitor is C then $\frac{C}{C_0}$ is

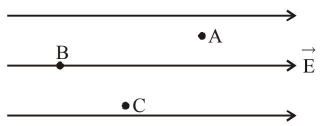
(a) 1 (b) 4/3 (c) 2/3 (d) 1/3

25. Two condensers, one of capacity C and other of capacity C/2 are connected to a V-volt battery, as shown. The work done in charging fully both the condensers is



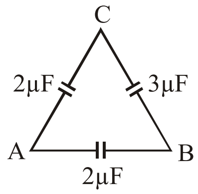
(a) $\frac{1}{4}CV^2$ (b) $\frac{3}{4}CV^2$ (c) $\frac{1}{2}CV^2$ (d) $2CV^2$.

26. A, B and C are three points in a uniform electric field. The electric potential is



(a) maximum at B
(b) maximum at C
(c) same at all the three points A, B and C
(d) maximum at A

27. Three capacitors are connected in the arms of a triangle ABC as shown in figure 5 V is applied between A and B. The voltage between B and C is



(a) 2V (b) 1V
(c) 3V (d) 1.5V

28. Two parallel metal plates having charges + Q and –Q face each other at a certain distance between them. If the plaves are now dipped in kerosene oil tank, the electric field between the plates will

(a) remain same (b) become zero
(c) increases (d) decrease

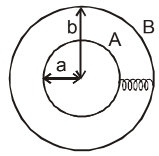
29. An air capacitor C connected to a battery of e.m.f. V acquires a charge q and energy E. The capacitor is disconnected from the battery and a dielectric slab is placed between the plates. Which of the following statements is correct ?

(a) V and q decrease but C and E increase
(b) V remains unchange, but q, E and C increase
(c) q remains unchanged, C increases, V and E decrease
(d) q and C increase but V and E decrease.

30. Choose the wrong statement about equipotential surfaces.

(a) It is a surface over which the potential is constant
(b) The electric field is parallel to the equipotential surface
(c) The electric field is perpendicular to the equipotential surface
(d) The electric field is in the direction of steepest decrease of potential

31. Two spherical conductors A and B of radii a and b (b>a) are placed concentrically in air. The two are connected by a copper wire as shown in figure. Then the equivalent capacitance of the system is



(a) $4\pi\varepsilon_0\frac{ab}{b-a}$ (b) $4\pi\varepsilon_0(a+b)$

(c) $4\pi\varepsilon_0 b$ (d) $4\pi\varepsilon_0 a$

32. A capacitor is charged to store an energy U. The charging battery is disconnected. An identical capacitor is now connected to the first capacitor in parallel. The energy in each of the capacitors is

(a) U/2 (b) 3U/2 (c) U (d) U/4

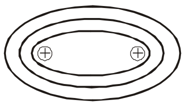
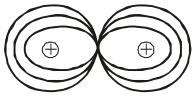
33. Equipotentials at a great distance from a collection of charges whose total sum is not zero are approximately

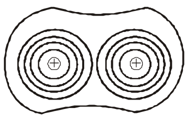
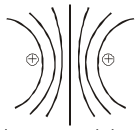
(a) spheres (b) planes
(c) paraboloids (d) ellipsoids

RESPONSE GRID					
	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ
	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ
	30. ⓐⓑⓒⓓ	31. ⓐⓑⓒⓓ	32. ⓐⓑⓒⓓ	33. ⓐⓑⓒⓓ	

Space for Rough Work

34. Which of the following figure shows the correct equipotential surfaces of a system of two positive charges?

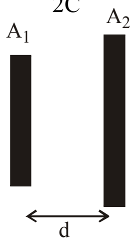
(a)  (b) 

(c)  (d) 

35. Two identical metal plates are given positive charges Q_1 and Q_2 ($< Q_1$) respectively. If they are now brought close together to form a parallel plate capacitor with capacitance C, the potential difference between them is

(a) $\frac{Q_1+Q_2}{2C}$ (b) $\frac{Q_1+Q_2}{C}$ (c) $\frac{Q_1-Q_2}{C}$ (d) $\frac{Q_1-Q_2}{2C}$

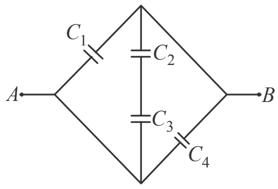
36. The capacitance of the capacitor of plate areas A_1 and A_2 ($A_1 < A_2$) at a distance d, as shown in figure is



(a) $\frac{\epsilon_0 (A_1+A_2)}{2d}$ (b) $\frac{\epsilon_0 A_2}{d}$

(c) $\frac{\epsilon_0 \sqrt{A_1A_2}}{d}$ (d) $\frac{\epsilon_0 A_1}{d}$

37. In a given network the equivalent capacitance between A and B is [$C_1 = C_4 = 1\ \mu F$, $C_2 = C_3 = 2\mu F$]



(a) $3\ \mu F$ (b) $6\ \mu F$

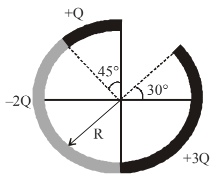
(c) $4.5\ \mu F$ (d) $2.5\ \mu F$

38. A parallel plate air capacitor is charged to a potential difference of V volts. After disconnecting the charging battery the distance between the plates of the capacitor is increased using an insulating handle. As a result the potential difference between the plates

(a) does not change (b) becomes zero

(c) increases (d) decreases

39. Figure shows three circular arcs, each of radius R and total charge as indicated. The net electric potential at the centre of curvature is



(a) $\frac{Q}{2\pi\varepsilon_0 R}$ (b) $\frac{Q}{4\pi\varepsilon_0 R}$

(c) $\frac{2Q}{\pi\varepsilon_0 R}$ (d) $\frac{Q}{\pi\varepsilon_0 R}$

40. An electric field $\vec{E} = (25\hat{i} + 30\hat{j})NC^{-1}$ exists in a region of space. If the potential at the origin is taken to be zero then the potential at $x = 2\ m$, $y = 2\ m$ is :

(a) –110 V (b) –140 V (c) –120 V (d) –130 V

41. If a unit positive charge is taken from one point to another over an equipotential surface, then

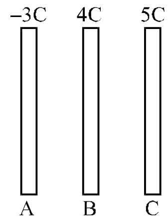
(a) work is done on the charge

(b) work is done by the charge

(c) work done is constant

(d) no work is done

42. Three large plates A, B and C are placed parallel to each other and charges are given as shown. The charge that appears on the left surface of plate B is



(a) 5C (b) 6C (c) 3C (d) –3C

43. Three charges 2 q, – q and – q are located at the vertices of an equilateral triangle. At the centre of the triangle

(a) the field is zero but potential is non-zero

(b) the field is non-zero, but potential is zero

(c) both field and potential are zero

(d) both field and potential are non-zero

44. If a charge – 150 nC is given to a concentric spherical shell and a charge +50 nC is placed at its centre then the charge on inner and outer surface of the shell is

(a) –50 nC, –100 nC (b) +50 nC, –200 nC

(c) –50 nC, –200 nC (d) 50 nC, 100 nC

45. Two capacitors of capacitances C_1 and C_2 are connected in parallel across a battery. If Q_1 and Q_2 respectively be the charges on the capacitors, then $\frac{Q_1}{Q_2}$ will be equal to

(a) $\frac{C_2}{C_1}$ (b) $\frac{C_1}{C_2}$ (c) $\frac{C_1^2}{C_2^2}$ (d) $\frac{C_2^2}{C_1^2}$

RESPONSE GRID					
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	39. ⓐⓑⓒⓓ	40. ⓐⓑⓒⓓ	41. ⓐⓑⓒⓓ	42. ⓐⓑⓒⓓ	43. ⓐⓑⓒⓓ
	44. ⓐⓑⓒⓓ	45. ⓐⓑⓒⓓ			

DAILY PRACTICE PROBLEM DPP CHAPTERWISE CP16 - PHYSICS			
Total Questions	45	Total Marks	180
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	50	Qualifying Score	70
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

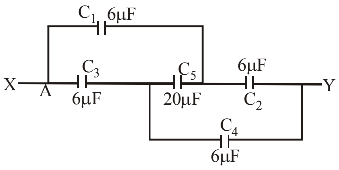
Space for Rough Work

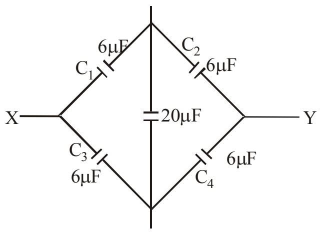
1. **(d)** As volume remains constant, therefore,
$\frac{4}{3}\pi R^3 = n \times \frac{4}{3}\pi r^3 \quad \therefore \quad R = n^{1/3} r.$
New potential $= V' = \frac{nq}{4\pi\varepsilon_0 R} = \frac{nq}{4\pi\varepsilon_0 (n^{1/3} r)}$
$= n^{2/3} \frac{q}{4\pi\varepsilon_0 r} = n^{2/3} V.$

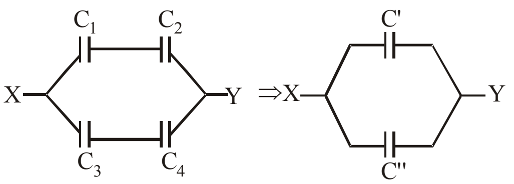
2. **(a)** $C_a = \frac{\epsilon_0 A}{d}$ and $C_b = \frac{\epsilon_0 A}{\frac{d}{2} + \frac{d}{2K}} = \frac{2\epsilon_0 A(1+K)}{d}$
and $C_c = \frac{\epsilon_0 \frac{A}{2}}{d} + \frac{\epsilon_0 \frac{A}{2}K}{d} = \frac{\epsilon_0 A}{2d}(1+K)$
or $C_b = \frac{\epsilon_0 A}{d} 2(1+K) > C_a$
or $C_c = \frac{\epsilon_0 A}{d} \frac{1+K}{2} > C_a \quad \therefore C_b$ and $C_c > C_a$

3. **(c)** Charges reside only on the outer surface of a conductor with cavity.

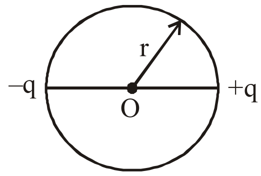
4. **(b)** In oil, C becomes twice, V becomes half. Therefore, E = V/d becomes half.

5. **(d)**


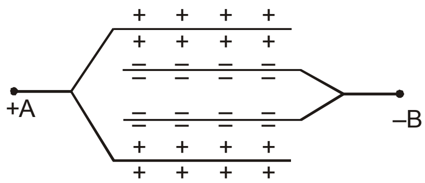
Equivalent circuit


Here, $\frac{C_1}{C_3} = \frac{C_2}{C_4}$
Hence, no charge will flow through 20μF


C_1 and C_2 are in series, also C_3 and C_4 are in series.
Hence, $C' = 3\ \mu F$, $C'' = 3\ \mu F$
C' and C'' are in parallel.
Hence net capacitance $= C' + C'' = 3 + 3 = 6\ \mu F$

6. **(c)**


$\frac{mv^2}{r} = \frac{kq^2}{(2r)^2}$; $mv^2 = \frac{kq^2}{4r}$
Kinetic energy of each particle
$= \frac{1}{2}mv^2 = \frac{kq^2}{8r}$

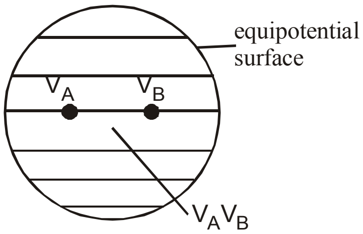
7. **(b)** It consists of two capacitors in parallel, therefore, the total capacitance is $= \frac{2\epsilon_0 A}{d}$


(The plates of B, having negative charge do not constitute a capacitor).

8. **(a)** The potential energy of a charged capacitor is given by $U = \frac{Q^2}{2C}$.
If a dielectric slab is inserted between the plates, the energy is given by $\frac{Q^2}{2KC}$, where K is the dielectric constant.
Again, when the dielectric slab is removed slowly its energy increases to initial potential energy. Thus, work done is zero.

9. **(a)** As $x = t\left(1 - \frac{1}{K}\right)$, where x is the addition distance of plate, to restore the capacity of original value.
$\therefore \quad 3.5 \times 10^{-5} = 4 \times 10^{-5}\left(1 - \frac{1}{K}\right).$
Solving, we get, K = 8.

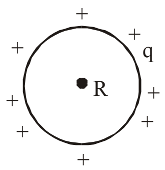
10. **(b)** At. equipotential surface, the potential is same at any point i.e., $V_A = V_B$ as shown in figure. Hence no work is required to move unit change from one point to another i.e.,
$V_A - V_B = \frac{W}{\text{unit charge}} = 0 \Rightarrow W = 0$



11. (b)
(i) Electrostatic field is zero inside a charged conductor or neutral conductor.
(ii) Electrostatic field at the surface of a charged conductor must be normal to the surface at every point.
(iii) There is no net charge at any point inside the conductor and any excess charge must reside at the surface.
(iv) Electrostatic potential is constant throughout the volume of the conductor and has the same value (as insde) on its surface.
(v) Electric field at the surface of a charged conductor is

$$\vec{E} = \frac{\sigma}{\varepsilon_0}\hat{n}$$

12. (b) In shell, q charge is uniformly distributed over its surface, it behaves as a conductor.



V= potential at surface $= \frac{q}{4\pi\varepsilon_0 R}$ and inside

$$V = \frac{q}{4\pi\varepsilon_0 R}$$

Because of this it behaves as an equipotential surface.

13. (c) Volume of big drop = 1000 × volume of each small drop

$$\frac{4}{3}\pi R^3 = 1000 \times \frac{4}{3}\pi r^3 \Rightarrow R = 10r$$

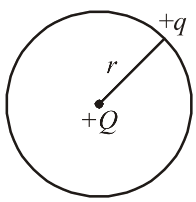
$$\because \quad V = \frac{kq}{r} \text{ and } V' = \frac{kq}{R} \times 1000$$

Total charge on one small droplet is q and on the big drop is 1000q.

$$\Rightarrow \quad \frac{V'}{V} = \frac{1000r}{R} = \frac{1000}{10} = 100$$

$$\therefore \quad V' = 100V$$

14. (c) In a round trip, displacement is zero. Hence, work done is zero.



15. (b) The two capacitors are in parallel so

$$C = \frac{\varepsilon_0 A}{t \times 2}(k_1 + k_2)$$

16. (d) In equilibrium, $F = qE = (ne)\frac{V}{d} = mg$

$$n = \frac{mg\,d}{eV} = \frac{1.96 \times 10^{-15} \times 9.8 \times 0.02}{1.6 \times 10^{-19} \times 800} = 3$$

17. (a) $E = \frac{1}{2}CV^2 = \frac{1}{2} \times 1 \times 10^{-6} \times (4000)^2 = 8\,\text{J}.$

18. (d) As we know,

$$\text{Common potential} = \frac{\text{Total charge}}{\text{Total capacity}}$$

$Q_1 = C_0V_1, Q_2 = 0$, therefore

$$V_2 = \frac{C_0V_1 + 0}{C_0 + kC_0} = \frac{V_1}{1+k}$$

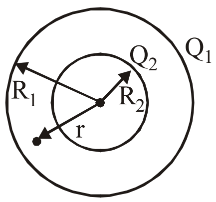
$$1 + k = \frac{V_1}{V_2} \text{ or } k = \frac{V_1}{V_2} - 1 = \frac{V_1 - V_2}{V_2}$$

19. (b) Potential difference across the branch de is 6 V. Net capacitance of de branch is 2.1 μF
So, q = CV
$\Rightarrow$ q = 2.1 × 6 μC
$\Rightarrow$ q = 12.6 μC
Potential across 3 μF capacitance is

$$V = \frac{12.6}{3} = 4.2 \text{ volt}$$

Potential across 2 and 5 combination in parallel is 6 – 4.2 = 1.8 V
So, q' = (1.8) (5) = 9 μC

20. (c)



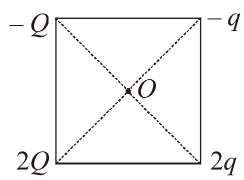
$$V_r = \frac{Q_2}{4\pi\varepsilon_0 r} + \frac{Q_1}{4\pi\varepsilon_0 R_1}$$

$$V_r = \frac{1}{4\pi\varepsilon_0}\left(\frac{Q_2}{r} + \frac{Q_1}{R_1}\right)$$

21. (d) $U = \frac{1}{2}QV$ = Area of triangle OAB

22. (b) Charge on α particle, q = 2 e.
K.E. = work done = q × V = 2e × 10^6 V = 2 MeV.

23. (a) Let the side length of square be '*a*' then potential at centre *O* is



$$V = \frac{k(-Q)}{\left(\frac{a}{\sqrt{2}}\right)} + \frac{k(-q)}{\frac{a}{\sqrt{2}}} + \frac{k(2q)}{\frac{a}{\sqrt{2}}} + \frac{k(2Q)}{\frac{a}{\sqrt{2}}} = 0$$

(Given)

$= -Q - q + 2q + 2Q = 0 = Q + q = 0$

$= Q = -q$

24. **(b)** $C_0 = \frac{k \epsilon_0 A}{d}$

$$C = \frac{k \epsilon_0 2}{3d} + \frac{2k \epsilon_0 A}{3d} = \frac{4}{3}\frac{k \epsilon_0 A}{d}$$

$$\therefore \frac{C}{C_0} = \frac{\frac{4}{3}\frac{k \epsilon_0 A}{d}}{\frac{k \epsilon_0 A}{d}} = \frac{4}{3}$$

25. **(b)** Work done = Change in energy

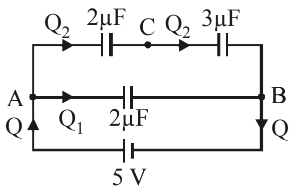
$$= \frac{1}{2}\left(C + \frac{C}{2}\right)V^2 = \frac{1}{2}\left(\frac{3C}{2}\right)V^2 = \frac{3CV^2}{4}$$

26. **(a)** Potential at B, V_B is maximum

$$V_B > V_C > V_A$$

As in the direction of electric field potential decreases.

27. **(a)** The equivalent circuit diagram as shown in the figure.



The equivalent capacitance between A and B is

$$C_{eq} = \frac{2\mu F \times 3\mu F}{2\mu F + 3\mu F} + 2\mu F = \frac{16}{5}\mu F$$

Total charge of the given circuit is

$$Q = \frac{16}{5}\mu F \times 5V = 16\mu C$$

$$Q_1 = (2\mu F) \times 5V = 10\mu C$$

$\therefore$ $Q_2 = Q - Q_1 = 16\ \mu C - 10\ \mu C = 6\ \mu C$

$\therefore$ Voltage between B and C is

$$V_{BC} = \frac{Q_2}{3\mu F} = \frac{6\mu C}{3\mu F} = 2\,V$$

28. **(d)** Electric field

$$E = \frac{\sigma}{\varepsilon} = \frac{Q}{A\varepsilon}$$

ε of kerosine oil is more than that of air.

As ε increases, E decreases.

29. **(c)** When a battery across the plates of capacitor is disconnected and dielectric slab is placed in between the plates, then

(i) capacity C increases

(ii) charge q remains unchanged

(iii) potential V decreases

(iv) energy E decreases

30. **(b)** Electric lines of force are always perpendicular to an equipotential surface.

31. **(c)** All the charge given to inner sphere will pass on to the outer one. So capacitance that of outer one is $4\pi \epsilon_0 b$.

32. **(a)** In Ist case when capacitor C attached with battery charged with the energy.

U_1 = U (stored energy on capacitor).

In IInd case after disconnect of battery similar capacitor is attached in parallel with Ist capacitor then

$C_{eq.} = C' = 2C.$

$$\text{Now, } \frac{U_1}{U_2} = \frac{\frac{1}{2}\frac{q^2}{C}}{\frac{1}{2}\frac{q^2}{C'}} = \frac{C'}{C} = \frac{2C}{C} \qquad (\because C' = 2C)$$

$$U_2 = \frac{U}{2}$$

33. **(a)** Here we have to findout the shape of equipotential surface, these surface are perpendicular to the field lines, so there must be electric field which can not be without charge.

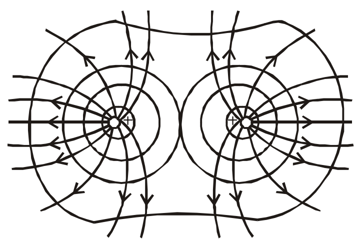
So, the collection of charges, whose total sum is not zero, with regard to great distance can be considered as a point charge. The equipotentials due to point charge are spherical in shape as electric potential due to point charge q is given by

$$V = K_e \frac{q}{r}$$

This suggest that electric potentials due to point charge is same for all equidistant points. The locus of these equidistant points which are at same potential, form spherical surface.

The lines of field from point charge are radial. So the equipotential surface perpendicular to field lines from a sphere.

34. **(c)** Equipotential surfaces are normal to the electric field lines. The following figure shows the equipotential surfaces along with electric field lines for a system of two positive charges.



35. **(c)** Let plate A plate B be carrying charges Q_1 and Q_2 respectively. When they are brought closer, they induce equal and opposite charges on each other i.e. $-Q_2$ on

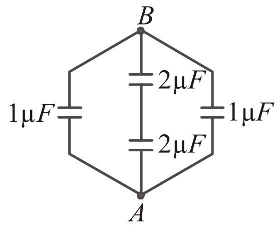
plate A and $-Q_1$ on plate B. Therefore, net charge on plate A = $Q_1 - Q_2$ and net charge on plate B = $-(Q_1 - Q_2)$, so the charge on the capacitor = $Q_1 - Q_2$.
$\therefore$ Potential different between the plates

$$V = \frac{Q_1 - Q_2}{C}$$

36. (d) $C = \frac{\epsilon_0 A}{d}$

$A \to$ common area, Here $A = A_1$

37. (a) The equivalent circuit is shown in figure.
$C_{AB} = 3\mu F$.



38. (c) If we increase the distance between the plates its capacity decreases resulting in higher potential as we know $Q = CV$. Since Q is constant (battery has been disconnected), on decreasing C, V will increase.

39. (a) $V = V_1 + V_2 + V_3 = \frac{1}{4\pi \epsilon_0} \cdot \frac{Q}{R} + \frac{1}{4\pi \epsilon_0}\left(\frac{-2Q}{R}\right)$

$$+ \frac{1}{4\pi \epsilon_0}\left(\frac{3Q}{R}\right) = \frac{1}{4\pi \epsilon_0}\left(\frac{2Q}{R}\right)$$

40. (a) As we know, $E = -\frac{dV}{dx}$

Potential at the point x = 2m, y = 2m is given by :

$$\int_0^V dV = -\int_0^{2,2} (25dx + 30dy)$$

on solving we get,
$V = -110$ volt.

41. (d) On the equipotential surface, electric field is normal to the charged surface (where potential exists) so that no work will be done.

42. (b)

43. (b) Potential at the centre of the triangle,

$$V = \frac{\Sigma q}{4\pi\varepsilon_0 r} = \frac{2q - q - q}{4\pi\varepsilon_0 r} = 0$$

Obviously, $E \neq 0$

44. (a) Whenever a charge (+50 nC) is kept inside a hollow metallic spherical shell, it induces an equal and opposite charge on the inner surface and an equal and same type of charges on the outer surface.
$\therefore$ Inside, induced charge is – 50 nC and outside, +50 nC – 150 nC already present.

45. (b) In parallel, potential is same, say V

$$\frac{Q_1}{Q_2} = \frac{C_1 V}{C_2 V} = \frac{C_1}{C_2}$$