Solution

CET25P2 ELECTROSTATIC POTENTIAL AND CAPACITANCE

Class 12 - Physics

1.
   (b) decreasing the distance between the plates.
   Explanation: C = $\frac{\varepsilon_0 A}{d}$
   So, by decreasing the distance between the plates, capacitance increases.

2.
   (b) capacitance
   Explanation: Q = CV
   When V = 1
   Thus, Q = C

3.
   (c) 1000 V
   Explanation: Electrostatic potential remains constant at all the points inside the conductor and equals to the potential at the surface.

4.
   (b) increases
   Explanation: The work done against the force of repulsion in moving the two charges closer increases the potential energy of the system.

5. **(a)** 12 × 10^{-4} J
   Explanation: $\Delta U = U_2 - U_1 = \frac{1}{2} C \left(V_2^2 - V_1^2\right)$
   $= \frac{1}{2} \times 8 \times 10^{-6} \left(20^2 - 10^2\right)$
   = 4 × 10^{-6} × 300 J = 12 × 10^{-4} J

6. **(a)** 6m
   Explanation: $E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{r^2}$ and $V = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{r}$
   $\therefore r = \frac{V}{E} = \frac{3000 \text{ V}}{500 \text{ V/m}}$ = 6 m

7.
   (b) 0.17×10^{-2}J
   Explanation: Initial energy ,is given by :-
   $U_1 = \frac{1}{2} C_1 V_1^2 + \frac{1}{2} C_2 V_2^2$
   $= \frac{1}{2}\left(2 \times 10^{-6}\right)(100)^2 + \frac{1}{2}\left(4 \times 10^{-6}\right)(50)^2$
   $= 1.5 \times 10^{-2} J$
   The common potential after they are connected in parallel. Thus ,Potential is:-
   $V = \frac{C_1 V_1 + C_2 V_2}{C_1 + C_2}$
   $= \frac{\left(2 \times 10^{-6}\right)(100) + \left(4 \times 10^{-6}\right)(50)}{\left(2 \times 10^{-6}\right) + \left(4 \times 10^{-6}\right)}$
   $= \frac{2}{3} \times 10^2 V$
   Hence the final energy is ,
   $U_2 = \frac{1}{2}\left(C_1 + C_2\right) V^2$
   $= \frac{1}{2}\left[\left(2 \times 10^{-6}\right) + \left(4 \times 10^{-6}\right)\right]\left(\frac{2}{3} \times 10^2\right)^2$
   $= 1.33 \times 10^{-2} J$
   So, change in energy is ΔU = U_1 - U_2 = 0.17 × 10^{-2} J

8. **(a)** $ML^{-1}T^{-2}$
   Explanation: $\left[\frac{1}{2}\varepsilon_0 E^2\right]$ = energy density
   $= \frac{\mathrm{ML^2\,T^{-2}}}{\mathrm{L^3}} = \left[\mathrm{ML^{-1}}\mathbf{T}^{-2}\right]$

9. **(a)** -36

Explanation: $Electric\ field\ =\ -\frac{dv}{dr}=-\frac{d(6Z^2)}{dz}=-12Z$

$for\ (x,y,z)\ =(2,-1,3)$

$we\ get$

$E=-12\times 3\ =-36\ N/C$

10.

(c) $\frac{t}{d+t}$

Explanation: Without dielectric,$C_0=\frac{\varepsilon_0 A}{d}$

With dielectric, $C=\frac{\varepsilon_0 A}{d-t+\frac{t}{k}}=\frac{C_0}{2}=\frac{1}{2}\frac{\varepsilon_0 A}{d}$

$\therefore 2d=d-t+\frac{t}{\mathbf{x}}$

or $d+t=\frac{t}{\kappa}$ or $\kappa=\frac{t}{d+t}$

11.

(d) CV^2

Explanation: When two charged conductors are connected by a conducting wire, flow of charge will continue until they acquire same potential. Here the two spheres are oppositely charged. So after connecting common potential will be

$V_c=\frac{V+(-V)}{2}$ = 0

Initial energy of system is

$U_i=\frac{CV^2}{2}+\frac{C(-V)^2}{2}$

$U_i = CV^2$

Final potential is zero, so $U_f = 0$

$\Delta U=U_i-U_f=CV^2$

12. **(a)** 200 V

Explanation: The break down potential of the capacitor is 220 V. In order to prevent damage to a capacitor, it should be always used in a circuit where the p.d is less than its break down potential. The p.d difference can be 200 V.

13.

(d) zero

Explanation: The potential at every point of the circle will be same.

$\therefore W=q\Delta V=q\times 0=0$

14.

(c) $\frac{\mathrm{C}_1}{\mathrm{C}_2}$

Explanation: As C_1 and C_2 are connected in parallel, so the potential V=$\frac{Q}{C_1+C_2}$ will be same for both capacitors. thus, Q_1 = $\frac{QC_1}{C_1+C_2}$and Q_2 = $\frac{QC_2}{C_1+C_2}$

$\therefore \frac{\mathrm{Q}_1}{\mathrm{Q}_2}=\frac{\mathrm{C}_1}{\mathrm{C}_2}$

15.

(b) 4 V

Explanation: Charges on the two capacitors are 36 μC and 72 μC. When they are connected in opposition, the total charge on the system = (72 - 36) μC = 36 μC. This is shared between the capacitors so that they acquire the same potential difference. Let this be V. (3 μF)V + (6 μF)V = 36 μC or V = 4 V

16.

(d) No

Explanation: Intersection of two equipotential surfaces at a point will give two directions of electric field intensity at that point, which is not possible.

17.

(b) 32

Explanation: Each capacitor of capacitance $8\mu F$ can withstand a maximum potential of 250 V.

When equal capacitors are connected in series, the potential difference across them is equal.

If there are 'm' capacitors in series such that the potential across each is 250 V, then,

$\frac{1000}{m} = 250; m = 4$

The equivalent capacitance of 4 capacitors connected in series is $C_S = \frac{C}{m} = \frac{8}{4} = 2\mu F$

To achieve a capacitance of 16, 'n' such rows of capacitors need to be connected in parallel.

$C_{eq} = nC_S = 16\mu F$

$n = \frac{16}{C_S} = \frac{16}{2} = 8$

To make a condenser of 16 μF, 8 rows of capacitors with each row containing 4 capacitors are to be connected.

The total number of capacitors = n $\times$ m = 4 $\times$ 8 = 32

18.

(d) is zero.

Explanation: For an equipotential surface, $V_A = V_B$

So, work done = 0

19. **(a)** spheres

Explanation: For equipotential surface, these surfaces are perpendicular to the field lines. So, there must be electric field, which cannot be without charge.

So, the algebraic sum of all charges must not be zero. Equipotential surface at a great distance means that space of charge is negligible as compared to distance. So, the collection of charges is considered as a point charge.

Electric potential due to point charge is,

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

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

20. **(a)** capacitance

Explanation: By definition of capacitance, $C = \frac{Q}{V}$

21.

(d) Potential difference

Explanation: As the battery remains connected with the capacitor, the potential difference remains constant.

22.

(c) $\frac{k_1 k_2 (d_1+d_2)}{(k_1 d_1 + k_2 d_2)}$

Explanation: Capacitance of a parallel plate capacitor filled with dielectric of constant k_1 and thickness d_1 is $C_1 = \frac{k_1 \varepsilon_0 A}{d_1}$

Similarly for other, $C_2 = \frac{k_2 \varepsilon_0 A}{d_2}$,having dielectric of constant k_2 and thickness d_2

Both capacitors are in series so equivalent capacitance C is related as:

$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{d_1}{k_1 \varepsilon_0 A} + \frac{d_2}{K_2 \varepsilon_0 A} = \frac{1}{\varepsilon_0 A}\left[\frac{k_2 d_1 + k_1 d_2}{k_1 k_2}\right]$

So $C = \frac{k_1 k_2 \varepsilon_0 A}{(k_1 d_2 + k_2 d_1)}$ ...(i)

$C' = \frac{k \varepsilon_0 A}{d}$ ...(ii)

Where d = (d_1+d_2)

So, Multiply the numerator and denominator of Eqn. i with (d_1+d_2),

$C = \frac{k_1 k_2 \varepsilon_0 A}{(k_1 d_2 + k_2 d_1)} \cdot \frac{(d_1+d_2)}{(d_1+d_2)} = \frac{k_1 k_2 (d_1+d_2)}{(k_1 d_2 + k_2 d_1)} \cdot \frac{\varepsilon_0 A}{(d_1+d_2)}$ ...(iii)

Comparing Eq. II and III, the dielectric constant of the new capacitor is:

$k = \frac{k_1 k_2 (d_1+d_2)}{(k_1 d_2 + k_2 d_1)}$

23. **(a)** 9090

Explanation: $Q = Q_1 + Q_2 + Q_3 + ... Q_n = nC \times V$

$n = \frac{Q}{CV} = \frac{1C}{1\mu F \times 110V}$

$= \frac{10^6}{110}$ = 9090

24.

(d) depend on the radii of the sphere

Explanation: As potential on the surface of conducting sphere is given by

$V = \frac{q}{4\pi\epsilon_0 R}$ thus if q is same for both the sphere

$V \alpha \frac{1}{R}$.

25.

(b) electric polarization

Explanation: When a dielectric is placed between the plates of a capacitor, electric polarization results in a reverse electric field inside the dielectric. The net electric field reduces and therefore the potential reduces.

Since, $C = \frac{Q}{V}$

Thus, the capacitance increases.

26.

(c) $\frac{C_1 V}{C_1 + C_2}$

Explanation: The common potential difference across the parallel combination of two capacitors,

$V' = \frac{C_1 V_1 + C_2 V_2}{C_1 + C_2}$

But $V_1 = V$, $V_2 = 0$

$\therefore V' = \frac{C_1 V}{C_1 + C_2}$

27. **(a)** $4\sqrt{35}$ N

Explanation: V = 6x - 8xy - 8y + 6yz

At the point (1, 1, 1), we have

$E_x = -\frac{\partial V}{\partial x}$ = -(6 - 8y) = 2

$E_y = -\frac{\partial V}{\partial y}$ = -(-8x - 8 + 6z) = 10

$E_2 = -\frac{\partial V}{\partial z}$ = -6y = -6

$E = \sqrt{E_x^2 + E_y^2 + E_z^2} = \sqrt{4 + 100 + 36} = \sqrt{140}$

$= 2\sqrt{35} \mathrm{NC}^{-1}$

$F = qE = 2 \times 2\sqrt{35} = 4\sqrt{35}$ N

28. **(a)** decreases

Explanation: Due to the polarization of the dielectric, an electric field is induced in the opposite direction of the applied field. The net field between the capacitor plates decreases.

29.

(d) -10^{-9}

Explanation: Surface charge density of the earth = -10^{-9} Cm^{-2}

30.

(d) $\frac{3}{2}$

Explanation: Given $\frac{C_p}{C_s} = \frac{25}{6}$

Let $C_p = 25k$; $C_s = 6k$ where k is a constant.

$C_p = C_1 + C_2 = 25k$

$C_s = \frac{C_1 C_2}{C_1 + C_2} = 6k$

$\frac{C_1 C_2}{25k} = 6k$

$C_1 C_2 = 150k^2$

On Solving, We get $C_2 = 15k$; $C_1 = 10k$ and their ratio is $\frac{C_2}{C_1} = \frac{3}{2}$

31. **(a)** $d = 10^{-5}$ m, $A = 10^{-2}$ m^2

Explanation: The capacitance of a parallel plate capacitor of area A, and separation between the plates is d with a dielectric of dielectric constant K is given by $C = \frac{\varepsilon_0 KA}{d}$.

The ratio $\frac{A}{d} = \frac{C}{\varepsilon_0 K} = \frac{1.77 \times 10^{-6}}{8.85 \times 10^{-12} \times 200} = 10^3$.

The minimum plate separation d' for which the capacitor will not breakdown is found using $E = \frac{V}{d'}$

where E is the breakdown strength and V is the maximum potential the capacitor can withstand .Thus,

$d' = \frac{V}{E} = \frac{20}{3 \times 10^6} = 6.67 \times 10^{-6} m$.

The plate separation has to be greater than $6.67 \times 10^{-6} m$

Thus, if d = 10^{-5} m, A = 10^{-2} m^2, it will satisfies the condition, $\frac{A}{d} = \frac{10^{-2}}{10^{-5}} = 10^3$

32.

(b) 200μC, 200μC

Explanation: $C_{eq} = \frac{10 \times 20}{10+20} = \frac{20}{3} \mu F$

$q = C_{eq} V = \frac{20}{3} \mu F \times 30 V = 200 \mu C$

33.

(b) 0.32 J

Explanation: Heat produced = Energy stored in capacitor

$= \frac{1}{2} \times 4 \times 10^{-6} \times (400)^2$

$= \frac{1}{2}$ CV^2J = 0.32 J

34.

(c) $\frac{(V_0 - V)}{V}$

Explanation: Common potential

$V = \frac{C_1 V_1 + C_2 V_2}{C_1 + C_2}$

$= \frac{0 + CV_0}{\kappa C + C} = \frac{CV_0}{C(1+\kappa)} = \frac{V_0}{1+\kappa}$

35.

(b) 400 V

Explanation: $V = \frac{C_1 V_1 + C_2 V_2}{C_1 + C_2}$

$= \frac{20 \mu \mathrm{F} \times 500 \mathrm{~V} + 10 \mu \mathrm{F} \times 200 \mathrm{~V}}{20 \mu \mathrm{F} + 10 \mu \mathrm{F}}$

$= \frac{12000}{30} \mathrm{~V} = 400 \mathrm{~V}$

36.

(c) zero

Explanation: The potential at any point on the perpendicular bisector of the dipole is zero.

$\therefore \Delta V = V_O - V_P = 0$

$W = q \Delta V = 5 \mu C \times 0 = 0$

37. **(a)** 90 kW

Explanation: $P = \frac{W}{t} = \frac{\frac{1}{2} CV^2}{t} = \frac{\frac{1}{2} \times (40 \times 10^{-6}) \times (3000)^2}{2 \times 10^{-3}}$ W

= 9 $\times$ 10^4 W = 90 kW

38.

(b) 10μC

Explanation: $\frac{1}{C_{eq}} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{6}{6} = \frac{1}{1}$

$C_{eq} = 1 \mu \mathrm{F}$

Charge on each capacitor is

$\therefore q = CV = 1 \mu \mathrm{F} \times 10 \mathrm{~V} = 10 \mu \mathrm{C}$

39.

(c) E = 0, but V is same as on the surface and non-zero

Explanation: The electric field on the surface of a hollow conductor is maximum and it drops to zero abruptly inside the conductor.

Since $E = -\frac{dV}{dr}$, the potential difference between any two points inside the hollow conductor is zero.

This means that the potential at all points inside the hollow charged conductor is same and it is equal to the value of the potential at its surface.

40.

(b) zero

Explanation: As on an equipotential surface, the potential is constant. Thus the potential difference between two points in zero. So,

W = $\frac{(V_b - V_a)}{q}$ will be equal to zero as V_b - V_a = 0

41.

(c) 100

Explanation: At the top of the stratosphere, E = 100 Vm^{-1}

42.

(b) decreases

Explanation: With temperature rise, the dielectric constant of liquid decreases.

43. **(a)** 10^5 V

Explanation: $V=\frac{1}{4\pi\varepsilon_0}\frac{q}{r}=9\times10^9\times\frac{100\times10^{-6}}{9}=10^5$ V

44.

(d) 4 W

Explanation: $W=\frac{1}{2}CV^2\Rightarrow W\propto V^2$

$\therefore\frac{W_2}{W_1}=\left(\frac{\Delta V_2}{\Delta V_1}\right)^2$

$=\left(\frac{60-30}{30-15}\right)^2=\left(\frac{30}{15}\right)^2=4$

or $W_2 = 4W_1 = 4W$

45.

(d) $\vec{E}=\hat{i}\left(2xy+z^3\right)+\hat{j}x^2+\hat{k}3xz^2$

Explanation: $\vec{E}=-\frac{\partial V}{\partial r}=\left[-\frac{\partial V}{\partial x}\hat{i}-\frac{\partial V}{\partial y}\hat{j}-\frac{\partial V}{\partial z}\hat{k}\right]$

$=\left[\left(2xy+z^3\right)\hat{i}+x^2\hat{j}+3xz^2\hat{k}\right]$

46.

(c) 1 keV

Explanation: K.E. gained = qV = e $\times$ 1 kV = 1 keV

47. **(a)** $\frac{1}{4}C(V_1-V_2)^2$

Explanation: The initial energy of the two capacitors $U_i=\frac{1}{2}CV_1^2+\frac{1}{2}CV_2^2$

The charges on the capacitors are $Q_1=CV_1;Q_2=CV_2$

When they are joined, they attain a common potential V.

$V=\frac{\text{total charge}}{\text{total capacitance}}$

$=\frac{Q_1+Q_2}{C+C}=\frac{CV_1+CV_2}{2C}=\frac{V_1+V_2}{2}$

Final energy $U_f=\frac{1}{2}CV^2+\frac{1}{2}CV^2=CV^2$

Loss of energy,

$U_i-U_f=\frac{1}{2}C\left(V_1^2+V_2^2\right)-CV^2$

$=\frac{1}{2}C\left(V_1^2+V_2^2\right)-C\left(\frac{V_1+V_2}{2}\right)^2$

$=\frac{1}{4}C(V_1-V_2)^2$

48.

(c) energy will remain same, potential difference will become nV

Explanation: energy will remain same, potential difference will become nV

49.

(c) R

Explanation: As potential on surface of a conducting sphere will be

$V=\frac{q}{4\pi\in_0R}$

and q = CV

So, putting value of V, we get

$C=4\pi\in_0R$

50.

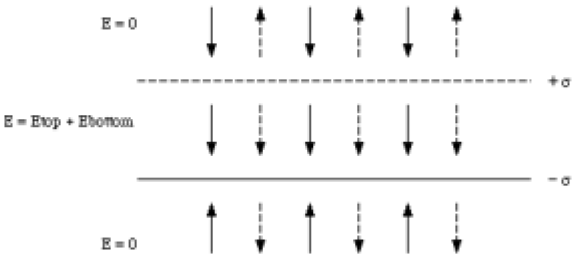
(c) $\frac{q_0Q}{8\pi\epsilon_0a}$

Explanation: Electric potential energy is given as $\frac{q_0Q}{8\pi\epsilon_0a}$

51.

(b) outside the plates will be zero

Explanation: The electric field outside two large plates with opposite charge densities will be zero.



The electric field between the plates , having area=2 m^2 of the capacitor is given by :-

$E=\frac{\sigma}{\varepsilon_0}=\frac{\frac{Q}{A}}{\varepsilon_0}$

$=\frac{Q}{A\varepsilon_0}=\frac{8.85\times10^{-10}}{2\times8.85\times10^{-12}}$

= 50 N/C

and it is a constant electric field.

52. **(a)** infinite

Explanation: Capacitor does not allow DC to pass through it. The effective capacitance or the capacitive reactance,

$X_C=\frac{1}{C\omega}$

where ω is the frequency of voltage source.

Since DC current is a constant current, its frequency is zero.

The capacitive reactance is therefore infinity.

53.

(d) $(\frac{6}{5})C$

Explanation: $(\frac{6}{5})C$

54.

(b) 12, 4

Explanation: $C_P = C_1 + C_2 = 16\ \mu F$

$C_s=\frac{C_1C_2}{C_1+C_2}=3\mu F$

or $C_1C_2 = 3(C_1 + C_2) = 3 \times 16 = 48\ \mu F$

$C_1(16 - C_1) = 48$

On solving, $C_1 = 12\ \mu$ F, $C_2 = 4\ \mu F$

55.

(c) 5×10^7

Explanation: $E=\frac{V}{d}=\frac{2}{4\times10^{-8}}$

$= 0.5 \times 10^8 = 5 \times 10^7\ Vm^{-1}$

56.

(b) $\frac{F}{2}$

Explanation: $\frac{F}{2}$

57.

(d) 125×10^{-3}

Explanation: Initial energy of the capacitor $U_i=\frac{1}{2}CV^2=\frac{1}{2}\times100\times10^{-6}\times(50)^2=0.125J$

When the plates are kept at half the original distance, the new capacitance

$C_1 = 2C$

Final energy, $U_f=\frac{1}{2}C_1V^2=\frac{1}{2}(2C)V^2$ = CV^2

Increase in energy = additional energy given by the battery =

$U_f-U_i=CV^2-\frac{1}{2}CV^2$

$= \frac{1}{2}CV^2 = \frac{1}{2} \times 100 \times 10^{-6} \times (50)^2 = 0.125J$
$= 125 \times 10^{-3}J$

58. **(a)** 8μC
Explanation: At steady state, the capacitor is open-circuited so no current flows through the 10-ohm resistor. So current will flow across 2 ohm resistor is
$I = \frac{V}{R+r} = \frac{2.5}{2+0.5} = \frac{2.5}{2.5} = 1A$mp
So P.D. across 2Ω resistance V = RI = 2$\times$1 = 2 Volt.
As a battery, capacitor and 2Ω branches are in parallel. So P.D. will remain the same across all three branches.
As current does not flow through the capacitor branch so no potential drop will be across 10Ω
So P.D. across 4μF capacitor = 2 Volt
charge on the capacitor plate is given by:
$[q = CV] = 4\mu F \times 2 = 8\mu C$

59. **(a)** $\frac{1}{2}\varepsilon_0\frac{V^2}{d^2}$
Explanation: Energy stored per unit volume in a capacitor,
$u = \frac{1}{2}\varepsilon_0 E^2 = \frac{1}{2}\varepsilon_0\left(\frac{V}{d}\right)^2 = \frac{1}{2}\varepsilon_0 \cdot \frac{V^2}{d^2}$

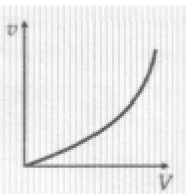
60.
(b) Two of them connected in series and the combination in parallel to the third.
Explanation: Two of them connected in series and the combination in parallel to the third.

61.
(b) remains constant.
Explanation: As the electric field inside a conductor is zero.
So, the potential at any point is constant.

62.
(c) zero
Explanation: For an equipotential surface ΔV = 0
W = qΔV = q $\times$ 0 = 0

63.
(d) $\frac{U}{2}$
Explanation: Initial energy stored in the capacitor, $U = \frac{1}{2}CV^2 = \frac{q^2}{2C}$
When the battery is disconnected, charge q = constant. Another capacitor connected across the first capacitor is in parallel with it. So,
C_{eq} = C + C = 2C
Final energy stored by the system of two capacitors,
$U = \frac{q^2}{2C_{eq}} = \frac{q^2}{2\times 2C} = \frac{1}{2}u$

64. **(a)** no work is done
Explanation: On the equipotential surface, the electric field is normal to the charged surface (where the potential exists) So that no work will be done.

65. **(a)**


Explanation: K.E. gained by the electron $\frac{1}{2}mv^2 = eV$
$\therefore v^2 \propto V$

66. **(a)** 8
Explanation: When a dielectric of constant K is introduced between the plates of a capacitor, the capacitance becomes KC, where C is initial capacitance with air as the medium between plates.
Now, Q = CV

After filling the medium, charge remains the same, thus potential V changes.
As V $\propto \frac{1}{C}$, thus the potential V reduces to $\frac{V}{K}$. Therefore K = 8

67.

(b) 4

Explanation: Dielectric constant of air is 1. All dielectrics generally have a value of the dielectric constant greater than 1.
$K = \frac{F}{F_m}$
where Fm is the force between two charged particles in a medium of dielectric constant K and F is the force between the two charges when placed in air.The force between two charges is greatest in air or vacuum and it decreases when any medium is placed between the charges. K cannot have negative, fractional or zero values.

68.

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

Explanation: $U = \frac{1}{2}CV^2$

69.

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

Explanation: The charges Q_1 and Q_2 on the two capacitors $Q_1 = CV$; $Q_2 = (2C)(2V) = 4CV$

The capacitors are connected in parallel in such a way that the positive plate of one is connected to the negative plate of the other.

The common potential $V = \frac{Q_2 - Q_1}{C + 2C} = \frac{4CV - CV}{3C} = V$
The final energy $U_f = \frac{1}{2}CV^2 + \frac{1}{2}(2C)V^2 = \frac{3}{2}CV^2$

70.

(c) $8\mu F$

Explanation: Given that,
Capacitor = 2μF
Voltage = 200 volt
Q = CV
put the value into the formula
Q = 2 $\times$ 10^{-6} $\times$ 200
Q = 400 $\times$ 10^{-6} C
Q = 400 μC
Using conservation of charge
$Q_{in} = Q_{final}$
400 $\times$ 10^{-6} = 2 $\times$ 10^{-6} $\times$ 40 + C $\times$ 40
C = $\frac{400 \times 10^{-6} - 2 \times 10^{-6} \times 40}{40}$
C = 0.000008 F
C = 8 $\times$ 10^{-6} F
C = 8 μF

71.

(c) 

Explanation: P.E. of a dipole is maximum when $\vec{p}$ is antiparallel to $\vec{E}$.
U = -pE cos 180° = +pE = maximum +ve value.

72.

(d) 0.02 J

Explanation: $U = \frac{1}{2}CV^2 = \frac{1}{2} \times 4 \times 10^{-6} \times (100)^2$
= 2 $\times$ 10^{-2} J = 0.02 J

73.

(d) $\frac{16C_1}{n_1 n_2}$

Explanation: $\frac{1}{2}C_pV^2 = \frac{1}{2}C_s(4V)^2$

or $\frac{1}{2} n_2 C_2 V^2 = \frac{1}{2} \frac{C_1}{n_1} (4V)^2$

or $C_2 = \frac{16 C_1}{n_1 n_2}$

74. **(a)** $\frac{\mathrm{V}}{2}$

Explanation: $\frac{\mathrm{V}}{2}$

75. **(a)** They are concentric spheres for uniform electric fields.

Explanation: Key Idea: There is no potential gradient along any direction parallel to the surface. Any surface over which the electric potential is the same everywhere is called an equipotential surface. The electric field and hence, lines of force everywhere are at right angles to the equipotential surface. This is so because there is no potential gradient along any direction parallel to the surface and, so no electric field parallel to the surface. This means the electric field and hence, lines of force are always at right angles to the equipotential surface. Hence, they are not concentric spheres for a uniform electric field. They are concentric spheres for an isolated point charge.