DAILY PRACTICE PROBLEM

Concept of Capacity, Capacitors and Capacitance DPP-01

1. A capacitor of capacitance C is charged to a potential V. The flux of the electric field through a closed surface enclosing the capacitor will be

(1) zero
(2) infinite
(3) positive
(4) Negative

2. A capacitor of capacitance C has a charge Q. The net charge on the capacitor is always

(1) zero
(2) infinite
(3) positive
(4) Negative

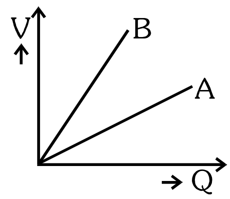
3. A capacitor gets a charge of 50 μC when it is connected to a battery of emf 5 V. Calculate the capacity of the capacitor.

(1) 5 μF
(2) 10 μF
(3) 50 μF
(4) 100 μF

4. When 2×10^{16} electrons are transferred from one conductor to another, a potential difference of 10 V appears between the conductors. Calculate the capacitance of the two conductors system.

(1) 2.3×10^{-3} F
(2) 2.3×10^{-4} F
(3) 3.2×10^{-3} F
(4) 3.2×10^{-4} F

5. The graph shows the variation of voltage V across the plates of two capacitors A & B with charge Q. Which of the two capacitors has larger capacitance ?



(1) $C_A = C_B$
(2) $C_A < C_B$
(3) $C_A > C_B$
(4) None of these

6. **For flash pictures, a photographer uses a 30 μF capacitor and a charger that supplies 3×10^3 volt. Calculate the charge spent for each flash.**

(1) 0.07 C

(2) 0.09 C

(3) 0.08 C

(4) 0.06 C

7. **Two capacitors C_1 and C_2 have equal amount of energy stored in them. What is the ratio of potential differences across their plates?**

(1) $\frac{V_1}{V_2} = \frac{C_1}{C_2}$

(2) $\frac{V_1}{V_2} = \frac{C_2}{C_1}$

(3) $\frac{V_1}{V_2} = \sqrt{\frac{C_2}{C_1}}$

(4) $\frac{V_1}{V_2} = \sqrt{\frac{C_1}{C_2}}$

Answer Key

Question	1	2	3	4	5	6	7
Answer	**1**	**1**	**2**	**4**	**3**	**2**	**3**

SOLUTIONS - 01

1. **(1)**

Zero

2. **(1)**

Zero

3. **(2)**

Capacity of the capacitor $C = \frac{Q}{V} = \frac{50 \times 10^{-6}}{5} = 10\mu F$

4. **(4)**

$C = \frac{Q}{V} = \frac{2 \times 10^{16} \times 1.6 \times 10^{-19}}{10}$

$= 3.2 \times 10^{-4}$ F

5. **(3)**

A Because $C = \frac{Q}{V} \propto \frac{1}{\text{slope}}$

$\Rightarrow C_A > C_B$

6. **(2)**

Q = CV = 0.09 C

7. **(3)**

According to question

$\frac{1}{2}C_1V_1^2 = \frac{1}{2}C_2V_2^2$

$\frac{V_1}{V_2} = \sqrt{\frac{C_2}{C_1}}$

Capacity of an Isolated Conductor and Spherical Capacitor DPP-02

1. The capacitance C of a capacitor is :-

(1) independent of the charge and potential of the capacitor.

(2) dependent on the charge and independent of potential.

(3) independent of the geometrical configuration of the capacitor.

(4) independent of the dielectric medium between the two conducting surfaces of the capacitor.

2. To increase the charge on the plate of a capacitor implies to :-

(1) decrease the potential difference between the plates.

(2) decrease the capacitance of the capacitor.

(3) increase the capacitance of the capacitor.

(4) increase the potential difference between the plates.

3. The earth has Volume 'V' and Surface area 'A' ; then its capacitance would be :

(1) $4\pi\epsilon_0\frac{A}{V}$

(2) $4\pi\epsilon_0\frac{V}{A}$

(3) $12\pi\epsilon_0\frac{V}{A}$

(4) $12\pi\epsilon_0\frac{A}{V}$

4. Capacitors are used in electrical circuits where appliances need rapid :

(1) Current

(2) Voltage

(3) Watt

(4) Resistance

5. Which of the following is called electrical energy tank?

(1) Resistor

(2) Inductance

(3) Capacitor

(4) Motor

6. **The stratosphere acts as a conducting layer for the earth. If the stratosphere extends beyond 50 km from the surface of earth, then calculate the capacitance of the spherical capacitor formed between the stratosphere and earth's surface. Take radius of earth as 6400 km.**

(1) 0.092 F

(2) 1.092 F

(3) 10.092 F

(4) 100.092 F

7. **Two uniformly charged spherical drops each at a potential V coalesce to form a larger drop. If the capacity of each smaller drop is C then find the capacity and potential of larger drop.**

(1) $C' = 2^{2/3}$ C , $V' = 2^{2/3}$ C

(2) $C' = 2^{1/3}$ C , $V' = 2^{1/3}$ C

(3) $C' = 2^{1/3}$ C , $V' = 2^{2/3}$ C

(4) $C' = 2^{2/3}$ C , $V' = 2^{1/3}$ C

Answer Key

Question	1	2	3	4	5	6	7
Answer	**1**	**4**	**3**	**1**	**3**	**1**	**3**

SOLUTIONS - 02

1. **(1)**

C $\rightarrow$ Depends on material & dimensions only

2. **(4)**

Q = CV

C $\rightarrow$ does not depend on Q and V

Q $\uparrow$ V $\uparrow$

3. **(3)**

C = $4\pi\varepsilon_0 R$ and $V = \frac{4}{3}\pi R^3$

$A = 4\pi R^2$

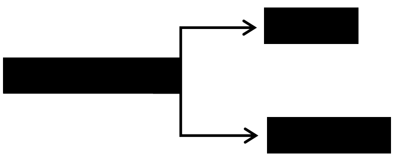
R = $\left(\frac{3V}{A}\right)$

$\therefore C = 12\pi\varepsilon_0\left(\frac{V}{A}\right)$

4. **(1)**

Current

5. **(3)**



6. **(1)**

The capacitance of a spherical capacitor is $C = 4\pi\varepsilon_0\left(\frac{ab}{b-a}\right)$

b = radius of the stratosphere layer = 6400 km + 50 km = 6450 km = 6.45 × 106 m

a = radius of earth = 6400 km = 6.4 × 10^6 m

$$\therefore \quad C = \frac{1}{9\times10^9} \times \frac{6.45\times10^6 \times 6.4\times10^6}{6.45\times10^6 - 6.4\times10^6} = 0.092\ \text{F}$$

7. **(3)**

When drops coalesce to form a larger drop then total charge and volume remains conserved. If r is the radius and q is the charge on smaller drop then $C = 4\pi\varepsilon_0 r$ and q = CV

Equating volume, we get $\frac{4}{3}\pi R^3 = 2 \times \frac{4}{3}\pi r^3 \Rightarrow R = 2^{1/3} r$

Capacitance of larger drop $C' = 4\pi\varepsilon_0 R = 2^{1/3} C$

Charge on larger drop Q = 2q = 2CV

Potential of larger drop $V' = \frac{Q}{C'} = \frac{2CV}{2^{1/3}C} = 2^{2/3}$ V.

Energy Stored in a Capacitor DPP-03

1. A capacitor of capacity C has charge Q and stored energy is W. If the charge is increased to 2Q then what will be the stored energy?

(1) 3 W
(2) 4 W
(3) 5 W
(4) 6 W

2. If the distance between the plates of a capacitor is d and potential difference is V then what is the energy density between the plates?

(1) $\epsilon_0 \frac{d^2}{V^2}$
(2) $\frac{1}{2}\epsilon_0 \frac{d^2}{V^2}$
(3) $\epsilon_0 \frac{V^2}{d^2}$
(4) $\frac{1}{2}\epsilon_0 \frac{V^2}{d^2}$

3. The two plates of a condenser have been connected to a battery of 300 V and the charge collected at each plate is 1 μC. The energy supplied by the battery is :

(1) 6×10^{-4}J
(2) 3×10^{-4}J
(3) 1.5×10^{-4}J
(4) 4.5×10^{-4}J

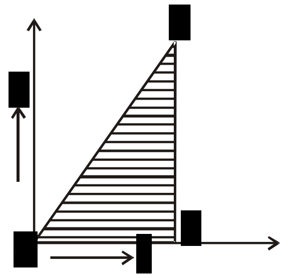
4. When a capacitor of value 200 μF charged to 200V is discharged separately through resistance of 2 ohms and 8 ohms, then heat produced in joule will respectively be:

(1) 4 and 16
(2) 16 and 4
(3) 4 and 8
(4) 4 and 4

5. The potential to which a conductor is raised, depends on :-

(1) the amount of charge
(2) the geometry and size of the conductor
(3) both (1) and (2)
(4) None of these

6. **The charge q on a capacitor varies with voltage as shown in figure. The area of the triangle AOB represents :**



(1) electric field between the plates

(2) electric flux between the plates

(3) energy density

(4) energy stored in the capacitor.

7. **An uncharged capacitor is connected to a battery. On charging the capacitor :-**

(1) all the energy supplied is stored in the capacitor.

(2) half the energy supplied is stored in the capacitor.

(3) the energy stored depends upon the capacity of the capacitor only.

(4) the energy stored depends upon the time for which the capacitor is charged.

Answer Key

Question	1	2	3	4	5	6	7
Answer	**2**	**4**	**2**	**4**	**3**	**4**	**2**

SOLUTIONS - 03

1. **(2)**

$U \propto Q^2$

$$\frac{U_1}{U_2} = \left(\frac{Q_1}{Q_2}\right)^2 \Rightarrow \frac{U_1}{U_2} = \left(\frac{1}{2}\right)^2$$

$\Rightarrow U_2 = 4W$

2. **(4)**

Energy density $= \frac{1}{2} \in_0 E^2$

$\because$ $\frac{V}{d}$

So energy density $= \frac{1}{2} \in_0 \frac{V^2}{d^2}$

3. **(2)**

Energy supplied by the battery is

$U = CV^2 = Q^2/C = QV$

$= (10^{-6})(300)$

$= 3 \times 10^{-4} J$

4. **(4)**

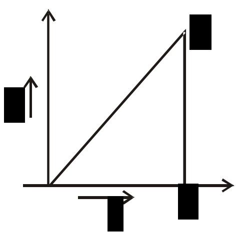
It does not depend on the resistance

$$\frac{1}{2}CV^2 = \frac{1}{2} \times 2 \times 10^{-4} \times (200)^2 = 4J$$

5. **(3)**

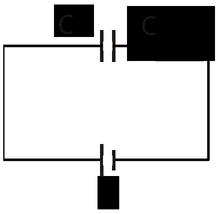
$V = \frac{Q}{C}$

6. **(4)**



Area = $\frac{1}{2}$ qV = Energy stored in capacitor.

7. **(2)**



Energy supplied = $W_B = CV^2$

Stored energy = $U = \frac{1}{2}CV^2$

Parallel Plate Capacitor DPP-04

1. **The plate separation in a parallel plate capacitor is d and plate area is A. If it is charged to V volts then calculate the work done in increasing the plate separation to 2d.**

(1) $\frac{2\varepsilon_0 AV^2}{d}$

(2) $\frac{\varepsilon_0 AV^2}{d}$

(3) $\frac{\varepsilon_0 AV^2}{4d}$

(4) $\frac{\varepsilon_0 AV^2}{2d}$

2. **The capacity of parallel plate condenser depends on :**

(1) the type of metal used

(2) the thickness of plates

(3) the potential difference applied across the plates

(4) the separation between the plates.

3. **A parallel plate capacitor has rectangular plates of 400 cm^2 area and are separated by a distance of 2 mm. What charge will appear on the plates if a 200 volt potential difference is applied across the capacitor ?**

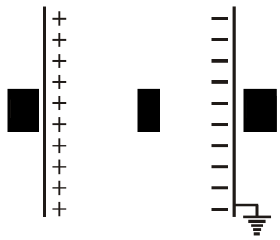
(1) 3.54×10^{-6} C

(2) 3.54×10^{-8} C

(3) 3.54×10^{-10} C

(4) 1770.8×10^{-13} C

4. **There are two metallic plates of a parallel plate capacitor. One plate is given a charge +q while the other is earthed as shown. Points P, P_1 and P_2 are taken as shown in adjoining figure. Then the electric intensity is not zero at :**



(1) P only

(2) P_1 only

(3) P_2 only

(4) P, P_1 and P_2

5. The distance between the plates of a circular parallel plate capacitor of diameter 40 mm, whose capacity is equal to that of a metallic sphere of radius 1m will be :

(1) 0.01 mm

(2) 0.1 mm

(3) 1.0 mm

(4) 10 mm

6. The energy density in a parallel plate capacitor is given as 2.1×10^{-9} J/m^3. The value of the electric field in the region between the plates is :

(1) 2.1 NC^{-1}

(2) 21.6 NC^{-1}

(3) 72 NC^{-1}

(4) 8.4 NC^{-1}

Answer Key

Question	1	2	3	4	5	6
Answer	**4**	**4**	**2**	**1**	**2**	**2**

SOLUTIONS - 04

1. **(4)**

$\because$ $\qquad\qquad C' = \frac{\varepsilon_0 A}{2d}$

V = V $\qquad\qquad$ V' = 2V

$$\therefore U_i = \frac{1}{2}\frac{A\in_0}{d}V^2$$

$$U_f = \frac{1}{2}\frac{A\in_0}{2d}(2V)^2$$

Work = $U_f - U_i = \frac{1}{2}\frac{A\in_0}{d}\times V^2$

2. **(4)**

C = $\frac{\in_0 A}{d}$

3. **(2)**

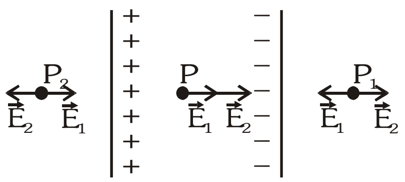
C = $\frac{\in_0 A}{d}$

$$\Rightarrow Q = CV = \frac{\in_0 AV}{d}$$

$$\frac{8.85\times10^{-12}\times400\times10^{-4}\times200}{2\times10^{-3}}$$

= 3.54×10^{-8} C

4. **(1)**



5. **(2)**

For parallel plate capacitor

r = 20 mm

$A = \pi r^2$

$C = \frac{\in_0 A}{d}$ .....(i)

for sphere

R = 1m

$C' = 4\pi \in_0 R$ .....(ii)

From equation (i) and (ii)

$C' = C$

$\frac{\in_0 A}{d} = 4\pi \in_0 R$

$d = \frac{r^2}{4R} = \frac{400 \times 10^{-6}}{4 \times 1} = 10^{-4} m$

= 0.1 mm

6. **(2)**

Use U = $\frac{1}{2} \in_0 E^2$

$2.1 \times 10^{-9} J/m^3 = \frac{1}{2} \times 8.85 \times 10^{-12} \times E^2$

Combination of Capacitors - Series and Parallel DPP-05

1. The equivalent capacitance between the points A and B in the given diagram is :

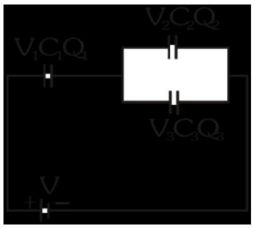
(5) 8 mF

(6) 6 mF

(7) $\frac{8}{3}\mu F$

(8) $\frac{3}{8}\mu F$

2. In an adjoining figure three capacitors C_1, C_2 and C_3 are joined to a battery. The correct condition will be : (Symbols have their usual meanings)



(1) $Q_1 = Q_2 = Q_3$ and $V_1 = V_2 = V_3 = V$

(2) $Q_1 = Q_2 + Q_3$ and $V = V_1 + V_2 + V_3$

(3) $Q_1 = Q_2 + Q_3$ and $V = V_1 + V_2$

(4) $Q_2 = Q_3$ and $V_2 = V_3$

3. A number of capacitors, each of capacitance $1\mu F$ and each one of which gets punctured if a potential difference just exceeding 500 volt is applied, are provided. Then an arrangement suitable for giving a capacitor of capacitance $3\mu F$ across which 2000 volt may be applied requires at least :

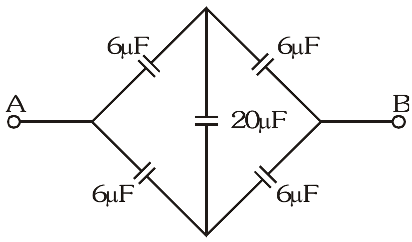
(1) 4 component capacitors

(2) 12 component capacitors

(3) 48 component capacitors

(4) 16 component capacitors

4. The effective capacity of the network between terminals A and B is :



(1) 6 μF

(2) 20 μF

(3) 3 μF

(4) 10 μF

5. A series combination of two capacitances of value $0.1\mu F$ and $1\mu F$ is connected with a source of voltage 500 volts. The potential difference in volts across the capacitor of value $0.1\mu F$ will be :

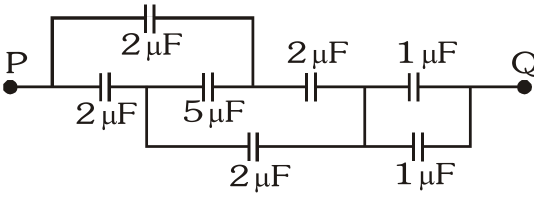
(1) 50

(2) 500

(3) 45.5

(4) 454.5

6. The effective capacitance between the points P and Q of the arrangement shown in the figure is :



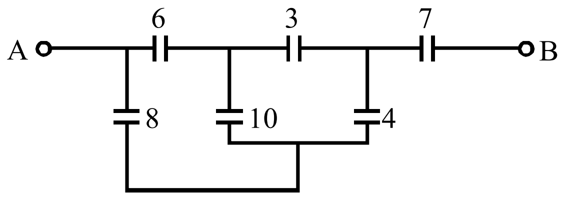
(1) (1 / 2)μF

(2) 1μF

(3) 2 μF

(4) 1.33 μF

7. In the circuit diagram shown all the capacitors are in μ F. The equivalent capacitance between points A & B is (in μ F) :



(1) 14/5

(2) 7.5

(3) 3/7

(4) None of these

8. Two capacitances C_1 and C_2 are connected in series; assume that $C_1 < C_2$. The equivalent capacitance of this arrangement is C, where :

(1) $C < C_1/2$

(2) $C_1/2 < C < C_1$

(3) $C_1 < C < C_2$

(4) $C_2 < C < 2C_2$

Answer Key

Question	1	2	3	4	5	6	7	8
Answer	**3**	**3**	**3**	**1**	**4**	**2**	**1**	**2**

SOLUTIONS - 05

1. **(3)**

$C_{AB} = \dfrac{2}{3}+2=\dfrac{8}{3}\mu F$

2. **(3)**

$V_2 = V_3$ {Because C_2 and C_3 in parallel}

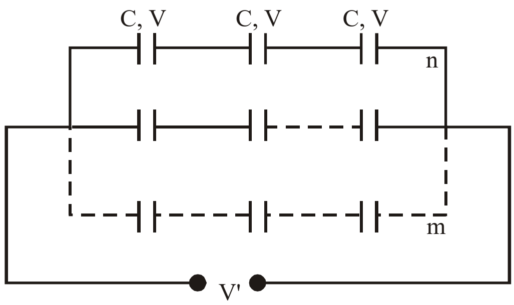
$Q_1 = Q_2 + Q_3$

$V = V_1 + V_2$

3. **(3)**

C = 1 μF, C¢ = 3 μF

V = 500 V, V¢ = 2000 V



Suppose m rows of given capacitors are connected in parallel and each row now contains n capacitors then potential difference across each capacitor $V=\dfrac{V'}{n}$ and equivalent capacitance of network $C'=\dfrac{mC}{n}$ on putting values,

$\Rightarrow \quad V=\dfrac{V'}{n}\Rightarrow 500=\dfrac{2000}{n}$

n = 4 {Minimum Number of capacitors in each row}

$\Rightarrow \quad C'=\dfrac{mC}{n}$

$3=\dfrac{m\times 1}{4}\Rightarrow m=12$

$\therefore$ total capacitors = m × n = 48

4. **(1)**

Given circuit is balanced wheat stone bridge.

Hence effective capacity is 6μF.

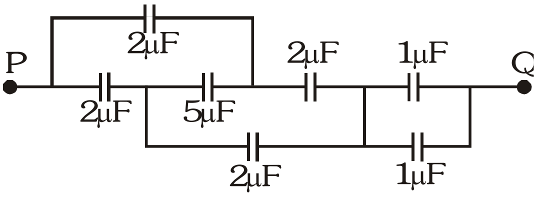
5. **(4)**

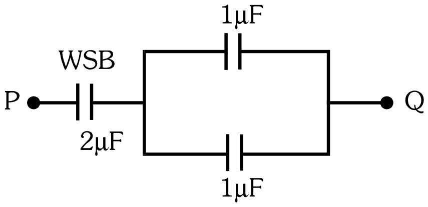
$\dfrac{V_1}{V_2}=\dfrac{C_2}{C_1}=\dfrac{10}{1}$

$V_1 = \dfrac{500}{11}\times 10=\dfrac{5000}{11}$ volt

6. **(2)**

Identify Wheatstone bridge

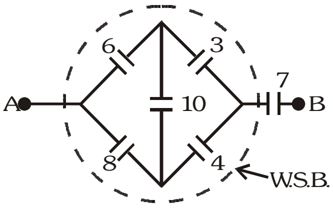




$C_{PQ} = 1\ \mu F$

7. **(1)**

Redraw circuit



C_{net} of W.S.B.

$= \frac{6\times3}{6+3}+\frac{8\times4}{8+4}$

$=2+\frac{32}{12}=\frac{14}{3}$

This is in series with 7

So, $C_{eq.}=\frac{\frac{14}{3}\times7}{\frac{14}{3}+7}=\frac{14}{5}$

8. **(2)**

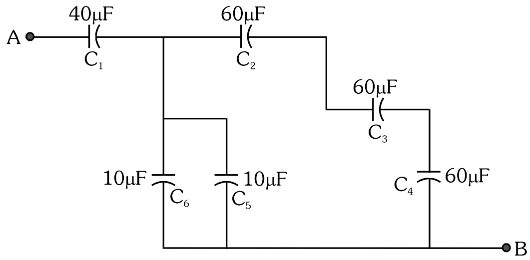
C_{net} of C_1 and C_2, $C_{net}=\frac{C_1C_2}{C_1+C_2}$ $\{C_1<C_2\}$

So, C_{net} will be smaller than C_1

$C_{net} < C_1 < C_2$ so $\frac{C_1}{2}<C<C_1$

Problems based on Combination of Capacitors DPP-06

1. **Find the equivalent capacitance of the combination of capacitors between the points A and B as shown in figure. Also calculate the total charge that flows in the circuit when a 100 V battery is connected between the points A and B**



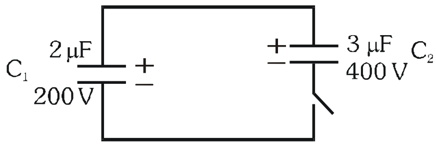
(9) $C_{eq} = 20\mu F$, $Q_{flow} = 2\times10^{-3}$ C

(10) $C_{eq} = 20\mu F$, $Q_{flow} = 2\times10^{-4}$ C

(11) $C_{eq} = 30\mu F$, $Q_{flow} = 2\times10^{-3}$ C

(12) $C_{eq} = 30\mu F$, $Q_{flow} = 2\times10^{-4}$ C

2. **Two capacitors of capacity C_1 and C_2 are connected as shown in figure.**



Now the switch is closed. Calculate the charge on each capacitor.

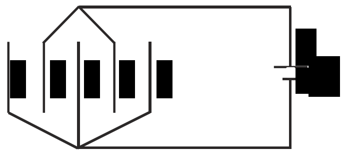
(1) 620μC, 950μC

(2) 660μC, 910μC

(3) 640μC, 960μC

(4) 630μC, 980μC

3. **Five identical plates each of area A are joined as shown in the figure. The distance between successive plates is d. The plates are connected to potential difference of V volt. Find the charges of plates 1 and 4**



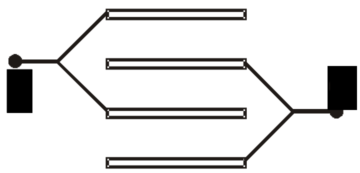
(1) $-\frac{\epsilon_0 A}{d}V, 2\frac{\epsilon_0 A}{d}V$

(2) $\frac{\epsilon_0 A}{d}V, -2\frac{\epsilon_0 A}{d}V$

(3) $-2\frac{\epsilon_0 A}{d}V, 2\frac{\epsilon_0 A}{d}V$

(4) $2\frac{\epsilon_0 A}{d}V, -\frac{\epsilon_0 A}{d}V$

4. **Four plates of the same area A are joined as shown in the figure. The distance between successive plates is d. Find the equivalent capacity across PQ will be**



(1) $\frac{\epsilon_0 A}{d}$

(2) $\frac{2\epsilon_0 A}{d}$

(3) $\frac{3\epsilon_0 A}{d}$

(4) $\frac{4\epsilon_0 A}{d}$

5. **Two spheres of radii R_1 and R_2 having equal charges are joined together with a copper wire. If V is the potential of each sphere after they are separated from each other, then the initial charge on both spheres was :**

(1) $\frac{V}{k}(R_1 + R_2)$

(2) $\frac{V}{2k}(R_1 + R_2)$

(3) $\frac{V}{3k}(R_1 + R_2)$

(4) $\frac{V}{k}\frac{(R_1R_2)}{(R_1 + R_2)}$

6. **Two spheres of radii 1 cm and 2 cm have been charged with 1.5×10^{-8} and 0.3×10^{-7} coulombs of positive charge. When they are connected with a wire, charge:**

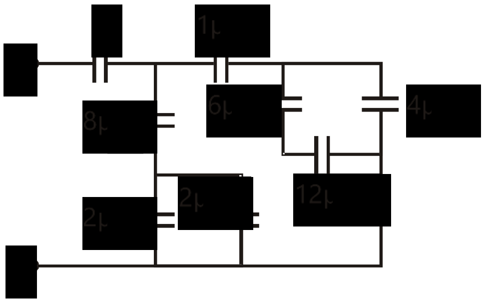
(1) will flow from the first to the second

(2) will flow from the second to the first

(3) will not flow at all

(4) may flow either from first to second, or from the second to first, depending upon the length of the connecting wire

7. **In the following circuit the resultant capacitance between A & B is 1μF. Find the value of C:**



(1) $\frac{23}{32}\mu F$

(2) $\frac{32}{23}\mu F$

(3) $\frac{13}{23}\mu F$

(4) $\frac{23}{13}\mu F$

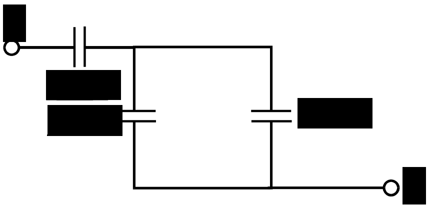
Answer Key

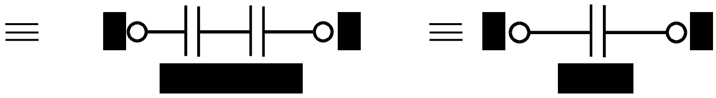
Question	1	2	3	4	5	6	7
Answer	**1**	**3**	**1**	**3**	**2**	**3**	**2**

SOLUTIONS - 06

1. **(1)**

Given circuit can be reduced to





Therefore C_{AB} = 20 μF

If V_{AB} = 100 V then charge flow through circuit

= $C_{AB}V_{AB}$=(100) (20)= 2 × 10^{-3} C

2. **(3)**

Common potential $V_{cm} = \dfrac{C_1V_1 + C_2V_2}{C_1 + C_2}$

$= \dfrac{2\times 200 + 3\times 400}{2+3} = 320$ V

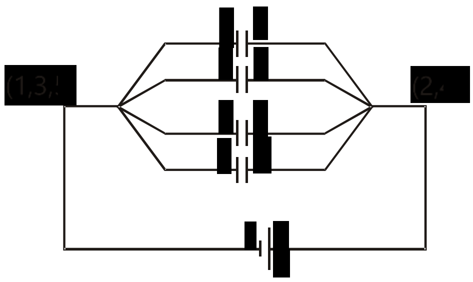
Charge on $C_1 \Rightarrow Q_1 = C_1 V_{cm}$ = 2 × 320 μC

= 640 μC

Charge on $C_2 \Rightarrow Q_2 = C_2 V_{cm}$ = 3 × 320 μC

= 960 μC

3. **(1)**

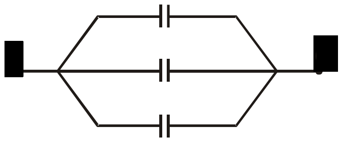


Q = CV = $\dfrac{\epsilon_0 A}{d}V$

Charge on plate 1 = $-\dfrac{\epsilon_0 A}{d}V$

Charge on plate 4 = $\dfrac{\epsilon_0 AV}{d} + \dfrac{\epsilon_0 A}{d}V = 2\dfrac{\epsilon_0 A}{d}V$

4. **(3)**



$C_{PQ} = \dfrac{3\in_0 A}{d}$

5. **(2)**

Let Initial charge = q

then from charge conservation

$Q_1 + Q_2 = Q'_1 + Q'_2$

$q + q = C_1V + C_2V = V[C_1+C_2]$

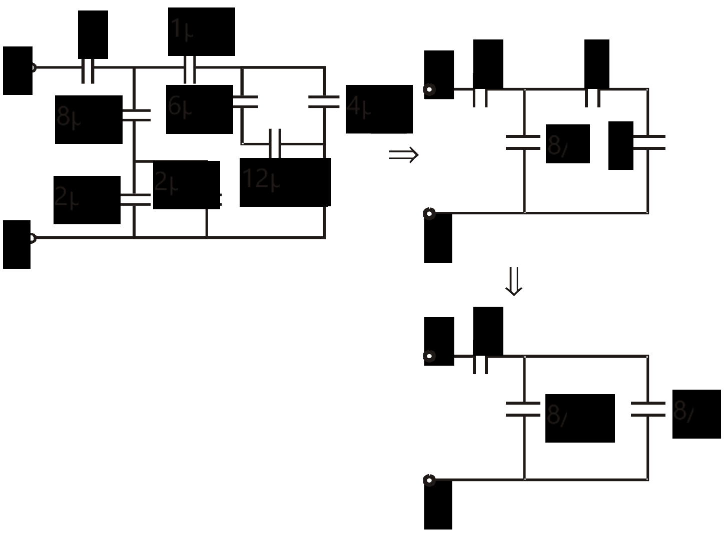
$V = \dfrac{2q}{C_1+C_2} = \dfrac{2q}{4\pi\in_0(R_1+R_2)} = \dfrac{2kq}{(R_1+R_2)}$

$\Rightarrow q = \dfrac{V(R_1+R_2)}{2k}$

6. **(3)**

As the potential of two spheres is same hence there will be no flow of charge.

7. **(2)**



$C_{AB} = \dfrac{C\times\frac{32}{9}}{C+\frac{32}{9}} = 1 \Rightarrow C = \dfrac{32}{23}\mu F$

Effects of Dielectrics in Capacitor DPP-07

1. **A capacitor has a capacitance of 50 pF, which increases to 175 pF with a dielectric material between its plates. What is the dielectric constant of the material?**
(13) 2.5
(14) 3.5
(15) 4.5
(16) 5.5

2. **The capacity and the energy stored in a parallel plate condenser with air between its plates are respectively C_0 and W_0. If the air between the plates is replaced by glass (dielectric constant = 5) find the capacitance of the condenser and the energy stored in it.**
(1) $5C_0, 5W_0$
(2) $\frac{C_0}{5}, 5W_0$
(3) $5C_0, \frac{W_0}{5}$
(4) $\frac{C_0}{5}, \frac{W_0}{5}$

3. **A parallel plate capacitor is to be designed with a voltage rating 1 kV using a material of dielectric constant 10 and dielectric strength 10^6 Vm^{-1}. What minimum area of the plates is required to have a capacitance of 88.5 pF ?**
(1) 10^{-3} m²
(2) 10^{-4} m²
(3) 10^{-5} m²
(4) 10^{-6} m²

4. **An air capacitor of capacity $C = 10\,\mu F$ is connected to a constant voltage battery of 10 V. Now the space between the plates is filled with a liquid of dielectric constant 5. Calculate additional charge which flows from the battery to the capacitor.**
(1) $100\mu C$
(2) $200\mu C$
(3) $300\mu C$
(4) $400\mu C$

5. **64 droplets of mercury each of radius r and carrying charge q, coalesce to form a big drop. Compare the surface density of charge of each drop with that of the big drop.**

(1) $\sigma_{big} = 2 \times \sigma_{small}$

(2) $\sigma_{big} = 4 \times \sigma_{small}$

(3) $\sigma_{big} = 8 \times \sigma_{small}$

(4) $\sigma_{big} = 16 \times \sigma_{small}$

6. **The energy and capacity of a charged parallel plate capacitor are U and C respectively. Now a dielectric slab of $\in_r = 6$ is inserted in it then energy and capacity becomes: (Assuming charge on plates remains constant)**

(1) 6U, 6C

(2) U, C

(3) $\frac{U}{6}$, 6C

(4) U, 6C

7. **When a slab of dielectric medium is placed between the plates of a parallel plate capacitor which is connected with a battery, then the charge on plates in comparison with earlier charge :**

(1) is less

(2) is same

(3) is more

(4) depends on the nature of the material inserted

8. **A glass slab is put within the plates of a charged parallel plate condenser. Which of the following quantities does not change ?**

(1) energy of the condenser

(2) capacity

(3) intensity of electric field

(4) charge

9. **A parallel plate capacitor is connected to a battery and a dielectric slab is inserted between the plates, then which quantity increase :**

(1) potential difference

(2) electric field

(3) stored energy

(4) E.M.F. of battery

10. **Can a metal be used as a medium for dielectric?**

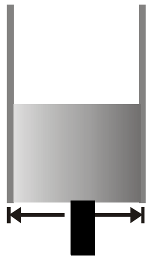
(1) Yes

(2) No

(3) Depends on its shape

(4) Depends on dielectric

11. **A parallel plate air capacitor has a capacitance C. When it is half filled with a dielectric of dielectric constant 5, the percentage increase in the capacitance will be :-**



(1) 400%

(2) 66.6%

(3) 33.3%

(4) 200%

12. **If the maximum circumference of a sphere is 2 m, then its capacitance in water would be :-**
(Dielectric constant of water = 81)

(1) 27.65 pF

(2) 2385 pF

(3) 236.5 pF

(4) 2865 pF

13. **The distance between the plates of a parallel plate capacitor is 'd'. Another thick metal plate of thickness d/2 and area same as that of plates is so placed between the plates, that it does not touch them. The capacity of the resulting capacitor :–**

(5) remains the same

(6) becomes double

(7) becomes half

(8) becomes one fourth

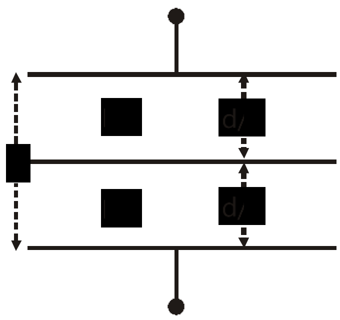
14. **Two dielectric slabs of dielectric constants K_1 and K_2 have been inserted in between the plates of a capacitor as shown below. What will be the capacitance of the capacitor inserted?**
(Plate area = A)

(1) $\frac{K_1K_2}{(K_1+K_2)}\frac{\in_0 A}{d}$

(2) $\frac{K_1K_2}{2(K_1+K_2)}\frac{\in_0 A}{d}$

(3) $\frac{K_1K_2}{4(K_1+K_2)}\frac{\in_0 A}{d}$

(4) $\frac{2K_1K_2}{(K_1+K_2)}\frac{\in_0 A}{d}$



Answer Key

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Answer	2	3	1	4	2	3	3	4	3	2	4	4	2	4

SOLUTIONS - 07

1. **(2)**

$C_{medium} = KC$

$\Rightarrow K = \frac{175\text{pF}}{50\text{pF}} = 3.5$

2. **(3)**

$C' = KC_0 = 5C_0$

$U' = \frac{Q^2}{2C'} = \frac{W_0}{5}$

3. **(1)**

$\therefore$ Electric field $E = \frac{V}{d}$

$\therefore\ d = \frac{V}{E} = \frac{10^3}{10^6} = 10^{-3}\text{m}$

Capacitance $C = \frac{\epsilon_0 \epsilon_r A}{d}$

$\Rightarrow A = \frac{Cd}{\epsilon_0 \epsilon_r} = \frac{88.5 \times 10^{-12} \times 10^{-3}}{8.85 \times 10^{-12} \times 10} = 10^{-3}\text{m}^2$

4. **(4)**

Since battery is connected so voltage across capacitor remains constant

Initial charge on capacitor

$$Q = CV = 10 \times 10^{-6} \times 10 = 100\,\mu C$$

When liquid of dielectric constant 5 is filled between plates then capacity becomes $C' = 5C = 50\,\mu F$

So final charge after placing liquid

$$Q' = C'V = 50 \times 10^{-6} \times 10 = 500\,\mu C$$

So additional charge flowing from battery to capacitor $\Delta Q = Q' - Q = 500 - 100 = 400\,\mu C$

5. **(2)**

$\sigma_{big} = (n)^{\frac{1}{3}} \times \sigma_{small} = (64)^{\frac{1}{3}} \times \sigma_{small}$

$\sigma_{big} = 4 \times \sigma_{small}$

6. **(3)**

Q remains same.

$U = \frac{Q^2}{2C}$

$\therefore C' = KC = 6C$

& $U' = \frac{U}{K} = \frac{U}{6}$

7. **(3)**

$Q = CV$;

when a slab of dielectric medium is placed capacitance is increased

$Q \propto C$ so charge is also increased

8. **(4)**

Charge does not change. It remains constant.

9. **(3)**

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

$\because$ when a dielectric is inserted then $C \uparrow$ so $U \uparrow$

10. **(2)**

No

11. **(4)**

$C = \frac{\epsilon_0 A}{d}$; $C_1 = \frac{\epsilon_0 A}{2d} = \frac{C}{2}$

$C_2 = \frac{5\epsilon_0 A}{2d} = \frac{5C}{2}$

$C_{eq} = C_1 + C_2 = 3C$

$\frac{\Delta C}{C}\% = \frac{2C}{C} \times 100 = 200\%$

12. **(4)**

$C = 4\pi\varepsilon_0\varepsilon_r R$ $\quad\quad$ $\left[\because 2\ \ R\ \ \ 2 \Rightarrow R = \frac{1}{\pi}\right]$

$C = \frac{4\pi\varepsilon_0\varepsilon_r}{\pi}$

$C \approx 2800\text{pF}$

13. **(2)**

$$C = \frac{\in_0 A}{d - t + \frac{t}{K}} \qquad \left(t = \frac{d}{2}, K = \infty\right)$$

$$\frac{\in_0 A}{\left(d - \frac{d}{2}\right) + \frac{d}{2K}} = \frac{2 \in_0 A}{d} = 2C_0$$

14. **(4)**

$$Ceff = \frac{C_1 C_2}{C_1 + C_2}$$

$$C_1 = \frac{K_1 \in_0 A}{d/2} = \frac{2K_1 \in_0 A}{d}$$

$$C_2 = 2K_2 \frac{\in_0 A}{d}$$

$$C_{eff} = \frac{2K_1 K_2}{(K_1 + K_2)} \frac{\in_0 A}{d}$$