Additional Problems For Self Practice (APSP)

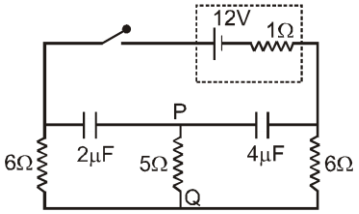
PART-I : PRACTICE TEST PAPER

Max. Marks : 120 **Max. Time : 1 Hr.**

Important Instructions :

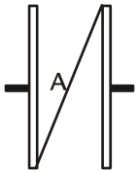
1. The test is of **1 hour** duration and max. marks 120.
2. The test consists **30** questions, **4 marks** each.
3. Only one choice is correct **1 mark** will be deducted for incorrect response. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
4. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instructions 3 above.

1. In the circuit shown in figure the capacitors are initially uncharged. The current through resistor PQ just after closing the switch is :



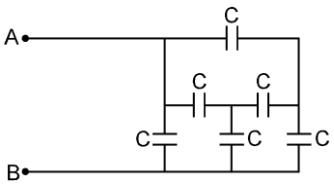
(1) 2A from P to Q
(2) 2A from Q to P
(3) 6A from P to Q
(4) zero

2. A parallel plate capacitor of capacitance C is as shown. A thin metal plate A is placed between the plates of the given capacitor in such a way that its edges touch the two plates as shown. The capacity now be comes.



(1) 0 (2) 3C
(3) 4C (4) ∞

3. The equivalent capacitance between point A and B is



(1) C/4
(2) C/2
(3) C
(4) 2C

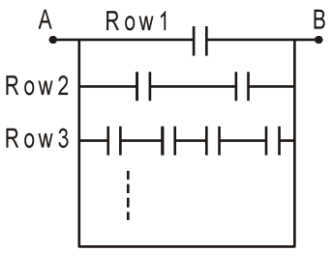
4. A capacitor of capacitance C_0 is charged to a potential V_0 and then isolated. A capacitor C is then charged from C_0, discharged and charged again ; the process is repeated n times. Due to this, potential of the larger capacitor is decreased to V, then value of C is :

(1) $C_0 [V_0/V]^{1/n}$ (2) $C_0[(V_0/V)^{1/n} – 1]$ (3) $C_0 [(V_0/V) – 1]$ (4) $C_0 [(V/V_0)^n + 1]$

5. A parallel plate air capacitor is connected to a battery. The quantities charge, electric field and energy associated with this capacitor are given by Q0, V0, E0 and U0 respectively. A dielectric slab is now introduced to fill the space between the plates with the battery still in connection. The corresponding quantities now given by Q, V, E and U are related to the previous one as ;

(1) $Q < Q_0$ (2) $V > V_0$ (3) $E > E_0$ (4) $U > U_0$

6. Rows of capacitors containing 1,2,4,8,.....∞ capacitors, each of capacitance 2F, are connected in parallel as shown in figure. The potential difference across AB = 10 volt, then :

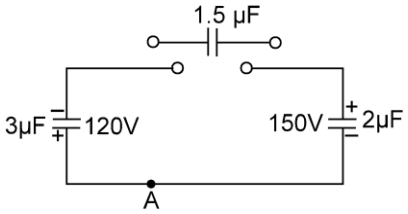


(1) Total capacitance across AB is 2F
(2) Charge of each capacitor will be same
(3)Charge on the capacitor in the first row is more than on any other capacitor
(4) Energy of all the capacitors is 50 J

7. A parallel plate capacitor of plate area A & plate separation d is charged to a potential difference V & then the battery disconnected. A slab of dielectric constant K is then inserted between the plates of the capacitor so as to fill the space between the plates. If Q, E and W denote respectively, the magnitude of the charge on each plate, the magnitude of the electric field between the plates (after the slab is inserted) & the magnitude of the work done on the system, in the process of inserting the slab, then :

(1) $Q = \frac{2\epsilon_0 AV}{d}$ (2) $Q = \frac{\epsilon_0 KAV}{d}$ (3) $E = \frac{V}{Kd}$ (4) $W = \frac{\epsilon_0 AV^2}{d}\left(1-\frac{1}{K}\right)$

8. Two capacitors of 2 μF & 3 μF are charged to 150 volt & 120 volt respectively. The plates of a capacitor are connected as shown in the fig. A discharged capacitor of capacity 1.5 μF falls to the free ends of the wire and connected through the free ends of the wire, Then :



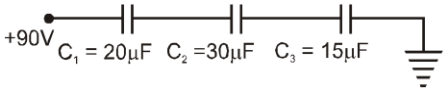
(1)Charge on the 1.5 μF capacitor will become 150 μC at steady state.

(2)Charge on the 2 μF capacitor will become 100 μC at steady state.

(3) Positive charge flows through point A from left to right.

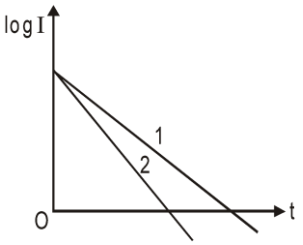
(4) Positive charge flows through point A from right to left.

9. We have a combination as shown in following figure. Choose the wrong options :



(1) Total charge in this series combination is 600 μC
(2) The potential difference between the plates of C_1 is 30 V
(3) The potential difference between the plates of C_2 is 20 V
(4) The potential difference between the plates of C_3 is 10 V

10. A capacitor of capacitance C is charged to a potential difference V_0 and is then discharged through a resistance R. The discharge current gradually decreases, with a straight line 1 corresponding to this process, as shown in figure where time is along x axis and the logarithm of the current on y-axis. Later on, one of the three parameters V_0, R or C, is changed (keeping the other two unchanged) in such a manner than the $\ell n\, I$ v/s t dependence is represented by the straight line 2. Which option correctly represents the change ?

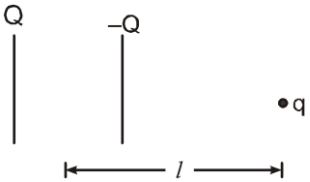


(1) V_0 is decreased (2) R is decreased
(3) R is increased (4) C is decreased.

11. In the capacitor discharge formula $q = q_0 e^{-t/\tau}$ the symbol τ represents :
(1) the time it takes for C to loose q_0/e charge.
(2) the time it takes for C to loose charge $q_0\left(1-\frac{1}{e}\right)$
(3) the time it takes for C to loose essentially all of its initial charge.
(4) none of the above.

12. An air capacitor is completely charged upto the energy U and removed from battery.Now distance between plates is increased slowly by an external agent. If work done by external agent is 3U then ratio of final sepration between the plates to the intial sepration :
(1) 5 (2) 4 (3) 3 (4) 1.5

13. The plates of small size of a parallel plate capacitor are charged as shown. The force on the charged particle of 'q' at a distance 'l' from the capacitor is :(Assume that the distance between the plates is d << *l*



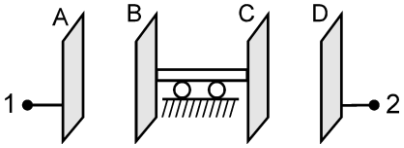
(1) zero (2) $\frac{Qqd}{2\pi\epsilon_0 \ell^3}$

(3) $\frac{Qqd}{\pi \in_0 \ell^3}$ (4) $\frac{Qqd}{4\pi \in_0 \ell^3}$

14. The plates of a parallel plate capacitor have charges Q and -2Q. It's capacitance is C. The potential difference between it's plates will be
(1) 3Q/2C (2) Q/C (3) 2Q/3C (4) none of these

15. The capacitance of a parallel plate capacitor will increase if:
(1) a battery is connected to it
(2) distance between the plates is increased
(3) one plate is displaced parallel to itself by distance less than its length
(4) none of these.

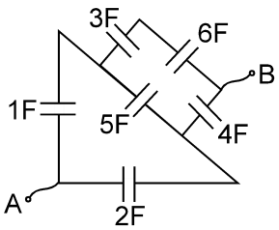
16. A,B,C,D are large conducting plates kept parallel to each other. A and D are fixed. Plates B and C, connected to each other by a rigid conducting rod can slide over frictionless rails as shown. Initially the distance between plates A and B is same as that between plates C and D. If now the rod (along with plates B and C) is slightly moved towards right, the capacitance between the terminals 1 and 2.



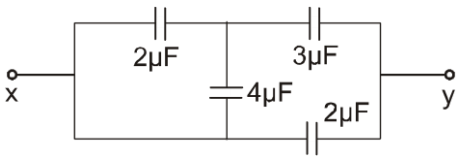
(1) remains unchanged
(2) increases
(3) decreases
(4) nothing can be said

17. The dimensional formula of capacitance is: (where Q is charge)
(1) $M^{-1} L^{-1} T Q$ (2) $M_1 L_1 T^{-2} Q_2$ (3) $M^{-1} L^{-2} T_2 Q_2$ (4) $M^{-1} L^{-3} T_2 Q_2$

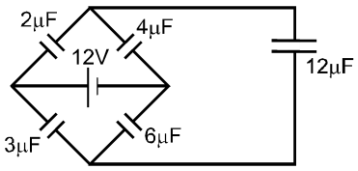
18. In the figure shown the equivalent capacitance between 'A' and 'B' is :
(1) 3.75 F
(2) 2 F
(3) 21 F
(4) 16 F



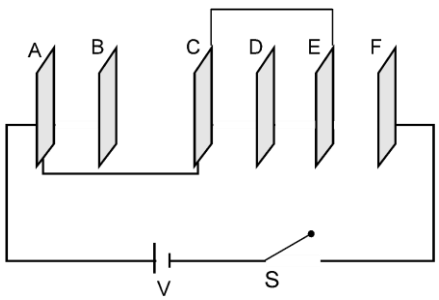
19. The equivalent capacitance between x and y is:
(1) $\frac{5}{6}$ μF (2) $\frac{7}{6}$ μF
(3) $\frac{8}{3}$ μF (4) 4 μF



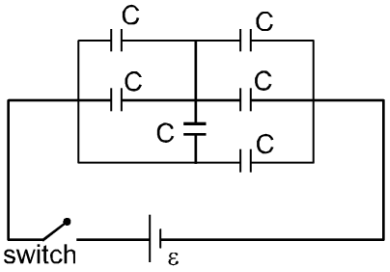
20. In the figure shown the charge on 6μF and 12μF capacitors is :
(1) 0, 24 μC (2) 0, 0
(3) 24 μC, 0 (4) 24 μC, 24 μC



21. A, B, C, D, E, F are square conducting plates each of area A and any two consecutive plates separated by a distance d ($\sqrt{A} >> d$). The net energy stored in the system after the switch S is closed is:
(1) $\frac{3\varepsilon_0 A}{2d} V^2$ (2) $\frac{5\varepsilon_0 A}{12d} V^2$
(3) $\frac{\varepsilon_0 A}{2d} V^2$ (4) $\frac{\varepsilon_0 A}{d} V^2$



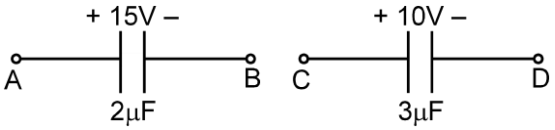
22. Six capacitors each of capacitance 'C' is connected as shown in the figure and initially all the capacitors are uncharged. Now a battery of emf = ε is connected. How much charge will flow through the battery if the switch is on :

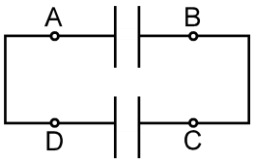


(1) $\frac{9C\varepsilon}{5}$ (2) $\frac{11\,C\varepsilon}{5}$

(3) $\frac{13\,C\varepsilon}{5}$ (4) $\frac{7\,C\varepsilon}{5}$

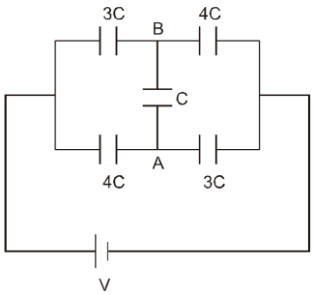
23. In the figure initial status of capacitor and their connection is shown. Which of the following is incorrect about this circuit :



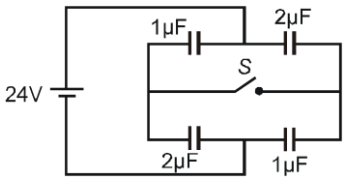


(1) Final charge on each capacitor will be zero
(2) Final total electrical energy of the capacitors will be zero
(3) Total charge flown from A to D is 30μC
(4) Total charge flown from A to D is – 30μC

24. Consider the given circuit.
If $V_A - V_B = 3$ volt, potential different across the terminals of battery is :
(1) 18 volt
(2) 9 volt
(3) 27 volt
(4) 36 volt

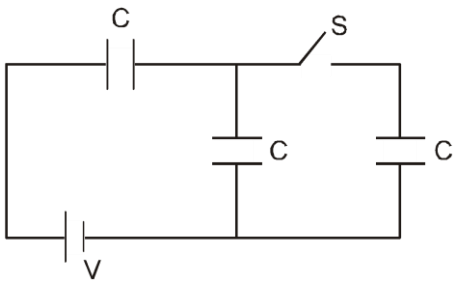


25. The connection shown in figure are established with the switch opened. The amount of charge which will flow through the switch after closing it is :



(1) 12 μC (2) Zero
(3) 8 μC (4) 32 μC

26. Find the heat generated after the switch S is closed.



(1) $\frac{CV^2}{2}$ (2) $\frac{CV^2}{6}$

(3) $\frac{2CV^2}{3}$ (4) $\frac{CV^2}{12}$

27. From a metallic charged body a current is drawn. The rate of increase of current at an instant is equal to the charge on the body at that instant.If the initial charge on the body is Q

(1) the minimum time it will take for the charge to become zero is $\frac{\pi}{2}$ sec.
(2) the minimum time it will take for the charge to become zero is 2 sec.
(3) The value of the current when the charge on the body is Q/2 is $Q\sqrt{\frac{3}{2}}$

(4) The value of the current when the charge on the body is Q/2 is $\frac{Q}{\sqrt{3}}$.

Comprehension # 1

A capacitor of capacitance C, a resistor of resistance R and a battery of emf ε are connected in series at t = 0. What is the maximum value of

28. the potential difference across the resistor,

(1) $\frac{\varepsilon}{2}$ (2) ε (3) $\frac{\varepsilon}{4}$ (4) None of these

29. the current in the circuit,

(1) i = $\frac{\varepsilon}{R}$ (2) i = $\frac{\varepsilon}{2R}$ (3) i = $\frac{2\varepsilon}{R}$ (4) None of these

30. the potential difference across the capacitor,

(1) $\frac{\varepsilon}{2}$ (2) ε (3) $\frac{\varepsilon}{4}$ (4) None of these

Practice Test (JEE-Main Pattern)

OBJECTIVE RESPONSE SHEET (ORS)

Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										
Que.	21	22	23	24	25	26	27	28	29	30
Ans.										

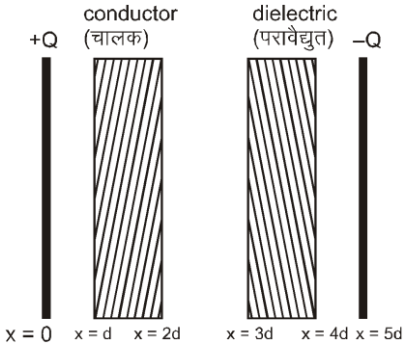
PART - II : PRACTICE QUESTIONS

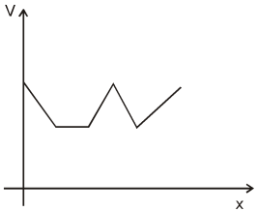
1. A parallel plate capacitor is charged to a potential V, then battery disconnected. Separation between the plates is d and plate dimension is (L × L). A dielectric of dielectric constant K which has thickness slightly less than d and dimension $L \times \frac{L}{2}$ is inserted between the plate. New potential difference between the plates will be :

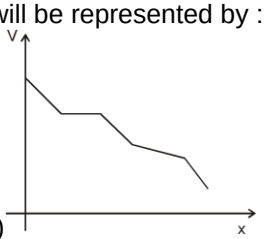
(1) $\left(\frac{K+1}{2}\right)V$ (2) V

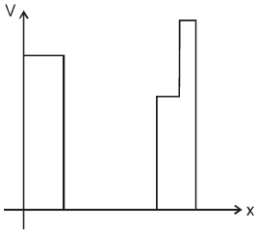
(3) $\frac{2V}{K+1}$ (4) $\frac{V}{K}$

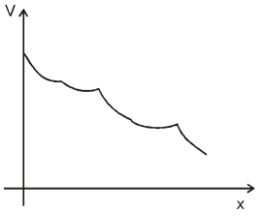
2. The distance between plates of a parallel plate capacitors is 5d. Let the positively charged plate is at x = 0 and negatively charged plate is at x = 5d. Material of the one slab is a conductor and material of other slab is dielectric are inserted between the plates is shown in figure. Potential v/s distance graph will be represented by :



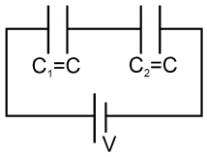
(1) 

(2) 

(3) 

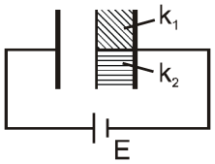
(4) 

3. Two identical capacitor C_1 and C_2 are connected in series with a battery. They are fully charged. Now a dielectric slab is inserted between the plates of C_2. The potential difference across C_1 will :



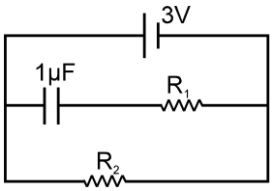
(1) increase
(2) decrease
(3) remain same
(4) depend on internal resistance of the cell

4. A capacitior is filled with dielectrics as shown in the diagram. Which of the options is correct.



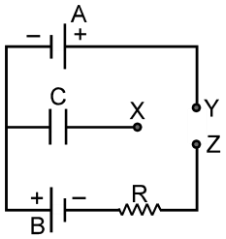
(1) electric field inside dielectric k_1 is equal to that of k_2.
(2) Surface charge density on the plates is uniform.
(3) Potential difference across k_1 is equal to the potential difference across k_2.
(4) electric field inside the free space is nonuniform.

5. A 1 μF capacitor is connected in the circuit shown below. The e.m.f. of the cell is 3 volts and internal resistance is 0.5 ohms. The resistors R_1 and R_2 have values 4 ohms and 1 ohm respectively. The charge on the capacitor in steady state must be :



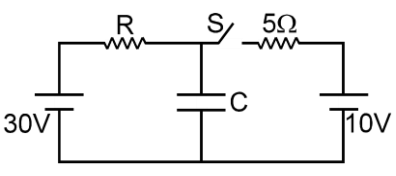
(1) 2 μ C
(2) 1 μ C
(3) 1.33 μ C
(4) zero

6. In the circuit shown the cells are ideal & of equal e.m.f. , the capacitance of the capacitor is C & the resistance of the resistor is R . X is first joined to Y and then to Z . After a long time the total heat produced in the resistor will be



(1) equal to the energy finally stored in the capacitor
(2) half of the energy finally stored in the capacitor
(3) twice the energy finally stored in the capacitor
(4) 4 times the energy finally stored in the capacitor.

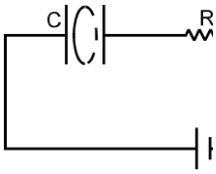
7. In the circuit shown the capacitor is in steady state. The current through the 5 Ω resistance just after the switch S is closed is:



(1) 2 A
(2) 4 A
(3) depends on value of R only
(4) depends on the value of R and C

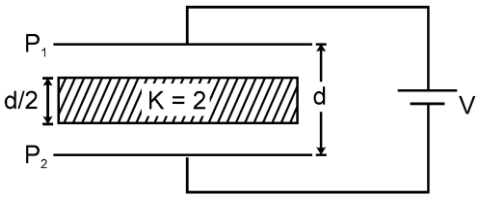
8. A capacitor (without dielectric) is discharging through a resistor. At some instant a dielectric is inserted between the plates, then
(1) Just after the insertion of the dielectric, current will increase.
(2) Just after the insertion of the dielectric, charge on capacitor will increase.
(3) Just after the insertion of the dielectric, energy stored in the capacitor will increase.
(4) after the insertion of the dielectric, time constant will increase

9. In the circuit shown the capacitor is initially uncharged. The charge passed through an imaginary circular loop parallel to the plates (also circular) and having the area equal to half of the area of the plates, in one time constant is:



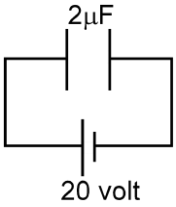
(1) $0.63\ \varepsilon C$ (2) $0.37\ \varepsilon C$
(3) $\frac{\varepsilon C}{2}$ (4) zero

10. In the figure shown a parallel plate capacitor has a dielectric of width d/2 and dielectric constant K = 2. The other dimensions of the dielectric are same as that of the plates. The plates P_1 and P_2 of the capacitor have area 'A' each. The energy of the capacitor is :

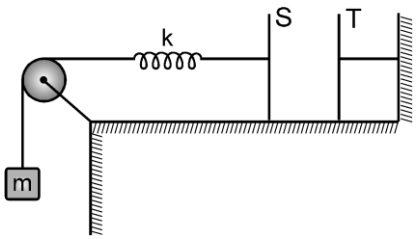


(1) $\frac{\epsilon_0 AV^2}{3d}$ (2) $\frac{2\epsilon_0 AV^2}{d}$
(3) $\frac{3}{2}\frac{\epsilon_0 AV^2}{d}$ (4) $\frac{2\epsilon_0 AV^2}{3d}$

11. In the figure a capacitor of capacitance 2μF is connected to a cell of emf 20 volt. The plates of the capacitor are drawn apart slowly to double the distance between them. The work done by the external agent on the plates is
(1) – 200 μJ (2) 200 μJ
(3) 400 μJ (4) – 400 μJ



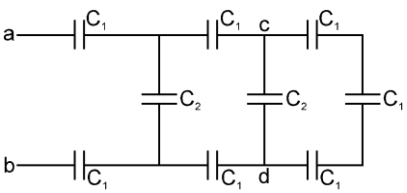
12. The plates S and T of an uncharged parallel plate capacitor are connected across a battery. The battery is then disconnected and the charged plates are now connected in a system as shown in the figure. The system shown is in equilibrium. All the strings and spring are insulating and massless. The magnitude of charge on one of the capacitor plates is: [Area of plates = A]



(1) $\sqrt{2mgA\epsilon_0}$ (2) $\sqrt{\frac{4mgA\epsilon_0}{k}}$
(3) $\sqrt{mgA\epsilon_0}$ (4) $\sqrt{\frac{2mgA\epsilon_0}{k}}$

Comprehension # 1

In the arrangement of the capacitors shown in the figure, each C_1 capacitor has capacitance of 3μF and each C_2 capacitor has capacitance of 2μF then,



13. Equivalent capacitance of the network between the points a and b is :

(1) 1μF (2)2μF (3) 4μC (4) $\frac{3}{2}$ μF

14. If V_{ab} = 900 V, the charge on each capacitor nearest to the points 'a' and 'b' is :

(1) 300 μC (2) 600 μC (3) 450 μC (4) 900 μC

15. If V_{ab} = 900 V, then potential difference across points c and d is :

(1) 60 V (2) 100 V (3) 120 V (4) 200 V

APSP Answers

PART-I

1.	(4)	**2.**	(4)	**3.**	(4)	**4.**	(2)	**5.**	(4)	**6.**	(3)	**7.**	(3)
8.	(3)	**9.**	(4)	**10.**	(4)	**11.**	(2)	**12.**	(2)	**13.**	(2)	**14.**	(1)
15.	(4)	**16.**	(1)	**17.**	(3)	**18.**	(2)	**19.**	(4)	**21.**	(3)	**22.**	(2)
23.	(4)	**24.**	(3)	**25.**	(1)	**26.**	(4)	**27.**	(1)	**28.**	(2)	**29.**	(1)
30.	(2)												

PART - II

1.	(3)	**2.**	(2)	**3.**	(1)	**4.**	(4)	**5.**	(1)	**6.**	(4)	**7.**	(2)
8.	(4)	**9.**	(4)	**10.**	(4)	**11.**	(2)	**12.**	(1)	**13.**	(1)	**14.**	(4)
15.	(2)												