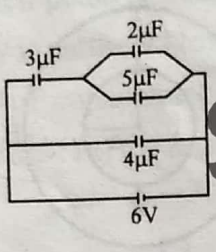
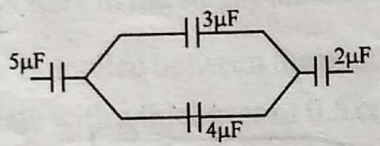
Capacitor circuits

1. In the circuit shown in figure, the ratio of charges on 5μF and 4μF capacitor is :-



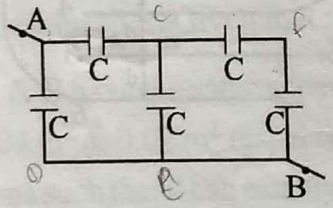
(A) 4/5 (B) 3/5 (C) 3/8 (D) 1/2

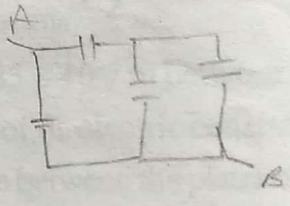
2. If charge on left plate of the 5μF capacitor in the circuit segment shown in the figure is –20μC, the charge on the right plate of 3μF capacitor is :-



(A) +8.57 μC (B) –8.57 μC (C) +11.42 μC (D) –11.42 μC

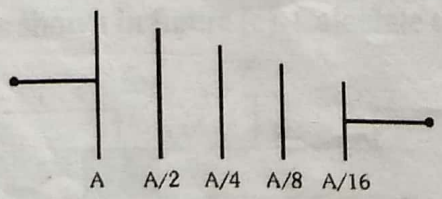
3. What is the equivalent capacitance of the system of capacitors between A & B as shown in the figure.





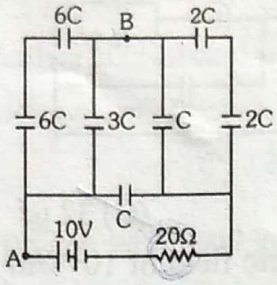
(A) $\frac{7}{6}$C (B) 1.6 C (C) C (D) None

4. 5 Conducting plates each are placed face to face & equi-spaced at distance d. Area of each plate is half the previous plate. If area of first plate is A. Then the equivalent capacitance of the system shown is :-



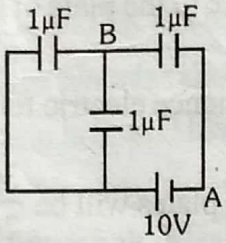
(A) $\frac{\varepsilon_0 A}{d}$ (B) $\frac{\varepsilon_0 A}{10d}$ (C) $\frac{\varepsilon_0 A}{20d}$ (D) $\frac{\varepsilon_0 A}{30d}$

5. For the circuit shown here, the potential difference between points A and B is :-



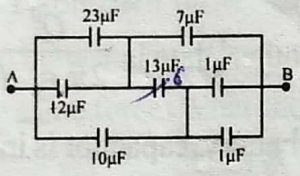
(A) 2.5 V (B) 7.5 V (C) 10 V (D) Zero

6. If potential of A is 10V, then potential of B is -



(A) 25/3 V (B) 50/3 V (C) 100/3 V (D) 50 V

7. Find the equivalent capacitance across A & B :-



(A) $\frac{28}{3}$ μf (B) $\frac{15}{2}$ μF (C) 15 μF (D) none

8. A capacitor of capacitance C is charged to a potential difference V from a cell and then disconnected from it. A charge +Q is now given to its positive plate. The potential difference across the capacitor is now :-

(A) V (B) $V + \frac{Q}{C}$ (C) $V + \frac{Q}{2C}$ (D) $V - \frac{Q}{C}$, if $V < CV$

9. A parallel plate capacitor is made by stacking n equally spaced plates connected alternatively. If the capacitance between any two adjacent plates is C, then the resultant capacitance is **[AIEEE-2005]**

(A) (n–1)C (B) (n+1)C (C) C (D) nC

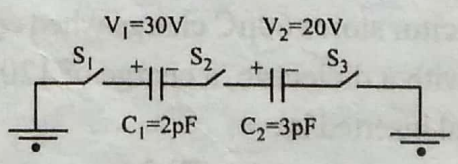
10. For the circuit shown, which of the following statements is true ? **[IIT-JEE 1999]**

(A) with S_1 closed, $V_1 = 15$ V, $V_2 = 20$ V

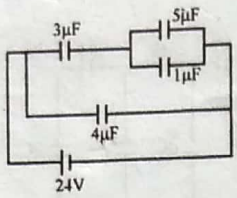
(B) with S_3 closed, $V_1 = V_2 = 25$ V

(C) with S_1 & S_2 closed, $V_1 = V_2 = 0$

(D) with S_1 & S_2 closed, $V_1 = 30$ V, $V_2 = 20$ V



11. In the circuit shown, the energy stored in 1μF capacitor is :-



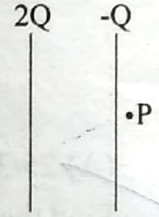
(A) 40 μJ (B) 64 μJ (C) 32 μJ (D) none

12. A parallel plate capacitor has an electric field of 10^5V/m between the plates. If the charge on the capacitor plate is 1μC, then the force on each capacitor plate is :-

(A) 0.1N (B) 0.05N (C) 0.02N (D) 0.01N

13. In the figure shown the plates of a parallel plate capacitor have unequal charges. Its capacitance is 'C'. P is a point outside the capacitor and close to the plate of charge–Q. The distance between the plates is 'd' then which statement is wrong

(A) A point charge at point 'P' will experience electric force due to capacitor



(B) The potential difference between the plates will be $\frac{3Q}{2C}$

(C) The energy stored in the electric field in the region between the plates is $\frac{9Q^2}{8C}$

(D) The force on one plate due to the other plate is $\frac{Q^2}{2\pi \epsilon_0 d^2}$

14. Consider a capacitor connected with a battery, capacitor is in steady state. Now plates of capacitor are drawn apart so as to double the separation in two cases.

Case :

(i) Battery remains connected

(ii) Battery is disconnected

Mark the **CORRECT** statement.

(A) In case (i) energy of capacitor increases

(B) In case (i) work done by battery is positive

(C) In case (ii) energy of capacitor increases

(D) In case (ii) potential difference across capacitor decreases

15. Two identical capacitors, have the same capacitance C. One of them is charged to potential V_1 and the other to V_2. The negative ends of the capacitors are connected together. When the positive ends are also connected, the decrease in energy of the combined system is :- **[IIT-JEE 2002 (Scr)]**

(A) $\frac{1}{4}C\left(V_1^2 - V_2^2\right)$ (B) $\frac{1}{4}C\left(V_1^2 + V_2^2\right)$ (C) $\frac{1}{4}C\left(V_1 - V_2\right)^2$ (D) $\frac{1}{4}C\left(V_1 + V_2\right)^2$

Dielectrics

16. A capacitor stores 60μC charge when connected across a battery. When the gap between the plates is filled with a dielectric, a charge of 120μC flows through the battery. The dielectric constant of the material inserted is :

(A) 1 (B) 2 (C) 3 (D) none

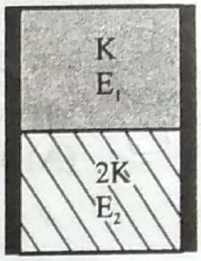
17. Condenser A has a capacity of 15 μF when it is filled with a medium of dielectric constant 15. Another condenser B has a capacity 1 μF with air between the plates. Both are charged separately by a battery of 100V . After charging, both are connected in parallel without the battery and the dielectric material being removed. The common potential now is :-

(A) 400V (B) 800V (C) 1200V (D) 1600V

18. Three capacitors 2 μF, 3 μF and 5 μF can withstand voltages to 3V, 2V and 1V respectively. Their series combination can withstand a maximum voltage equal to :-

(A) 5 Volts (B) (31/6) Volts (C) (26/5) Volts (D) None

19. A parallel plate capacitor is connected from a cell and then isolated from it. Two dielectric slabs of dielectric constant K and 2K are now introduce in the region between upper half and lower half of the plate (as shown in figure). The electric field intensity in upper half of dielectric is E_1 and lower half is E_2 then



(A) $E_1 = 2E_2$

(B) Electrostatic potential energy of upper half is less than that of lower half

(C) Induced charges on both slabs are same

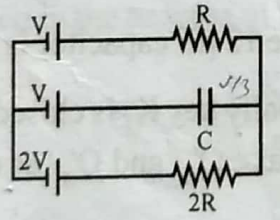
(D) Charge distribution on the plates remains same after insertion of dielectric

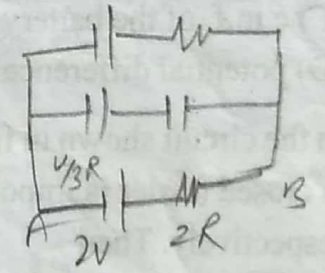
20. Two point charges exert a force F_0 on each other when placed in vacuum. Now the charges are increased to four times, separation between them is doubled and the system is placed is an insulating medium. Now they experience the same force. What should be the dielectric constant of the medium?

(A) 3 (B) 4 (C) 2 (D) 5

R-C Circuits

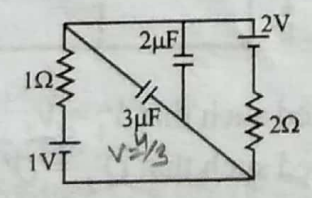
21. In the given circuit, with steady current the potential drop across the capacitor must be :-





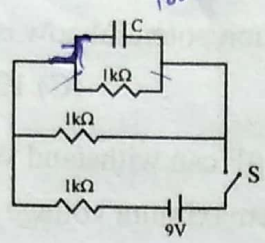
(A) V (B) $\frac{V}{2}$ (C) $\frac{V}{3}$ (D) $\frac{2V}{3}$

22. In the circuit shown, the charge on the 3μF capacitor at steady state will be :-



(A) 6 μC (B) 4 μC (C) $\frac{2}{3}$ μC (D) 3 μC

23. A capacitor C = 100 μF is connected to three resistor each of resistance 1 kΩ and a battery of emf 9V. The switch S has been closed for long time so as to charge the capacitor. When switch S is opened, the capacitor discharges with time constant :-



(A) 33 ms (B) 5 ms (C) 3.3 ms (D) 50 ms

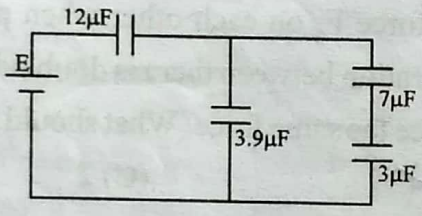
24. An uncharged capacitor of capacitance 4μF, a battery of emf 12 volt and a resistor of 2.5 MΩ are connected in series. The time after which $v_c = 3v_R$ is (take $ln2 = 0.693$) **[IIT-JEE' 2005 (Scr)]**

(A) 6.93 sec. (B) 13.86 sec. (C) 20.52 sec. (D) none of these

MULTIPLE CORRECT TYPE QUESTIONS

Capacitor Circuits

25 Four capacitors and a battery are connected as shown. The potential drop across the 7 μF capacitor is 6 V. Then the :



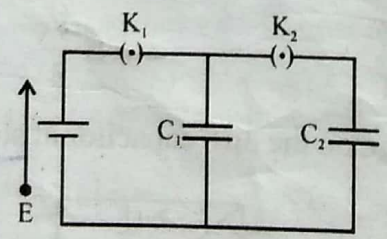
(A) potential difference across the 3 μF capacitor is 10 V

(B) charge on the 3 μF capacitor is 42 μC

(C) e.m.f. of the battery is 30 V

(D) potential difference across the 12 μF capacitor is 10 V.

26. In the circuit shown in figure initially key K_1 is closed and key K_2 is open. Then K_1 is opened and K_2 is closed (order is important). [Take Q'_1 and Q'_2 as charges on C_1 and C_2 and V_1 and V_2 as voltage respectively. Then



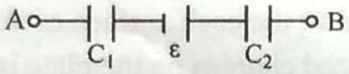
(A) charge on C_1 gets redistributed such that $V_1 = V_2$

(B) charge on C_1 gets redistributed such that $Q'_1 = Q'_2$

(C) charge on C_1 gets redistributed such that $C_1V_1 + C_2V_2 = C_1E$

(D) charge on C_1 gets redistributed such that $Q'_1 + Q'_2 = Q$

27. A circuit shown in the figure consists of a battery of emf 10 V and two capacitance C_1 and C_2 of capacitances 1.0 μF and 2.0 μF respectively. The potential difference $V_A - V_B$ is 5V



(A) charge on capacitor C_1 is equal to charge on capacitor C_2

(B) Voltage across capacitor C_1 is 5V.

(C) Voltage across capacitor C_2 is 10 V

(D) Energy stored in capacitor C_1 is two times the energy stored in capacitor C_2.

Dielectrics

28. A parallel plate capacitor has a parallel slab of copper inserted between and parallel to the two plates, without touching the plates. The capacity of the capacitor after the introduction of the copper sheet is:

(A) minimum when the copper slab touches one of the plates.

(B) maximum when the copper slab touches one of the plates.

(C) invariant for all positions of the slab between the plates.

(D) greater than that before introducing the slab.

29. A parallel plate air-core capacitor is connected across a source of constant potential difference. When a dielectric plate is introduced between the two plates then :

(A) some charge from the capacitor will flow back into the source.

(B) some extra charge from the source will flow back into the capacitor.

(C) the electric field intensity between the two plate does not change.

(D) the electric field intensity between the two plates will decrease.

30. A parallel plate capacitor of plate area A and plate seperation d is charged to potential difference V and then the battery is 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, the magnitude of charge on each plate, the electric field between the plates (after the slab is inserted) and the work done on the system respectively in question, then in the process of inserting the slab

(A) $Q = \dfrac{\varepsilon_0 AV}{d}$

(B) $Q = \dfrac{\varepsilon_0 KAV}{d}$

(C) $E = \dfrac{V}{Kd}$

(D) $W = -\dfrac{\varepsilon_0 AV^2}{2d}\left(1 - \dfrac{1}{K}\right)$

31. The capacitance of a parallel plate capacitor is C when the region between the plate has air. This region is now filled with a dielectric slab of dielectric constant k. The capacitor is connected to a cell of emf E, and the slab is taken out

(A) charge $CE(k-1)$ flows through the cell

(B) energy $E^2C(k-1)$ is absorbed by the cell.

(C) the energy stored in the capacitor is reduced by $E^2C(k-1)$

(D) the external agent has to do $\dfrac{1}{2}E^2C(k-1)$ amount of work to take the slab out.

32. A capacitor of capacity C_0 is connected to a battery of emf V_0. When steady state is attained a dielectric slab of dielectric constant K is slowly introduced in the capacitor. Mark the Correct statement(s), in final steady state :-

(A) Magnitude of induced charge on the each surface of slab is $C_0V_0(K-1)$

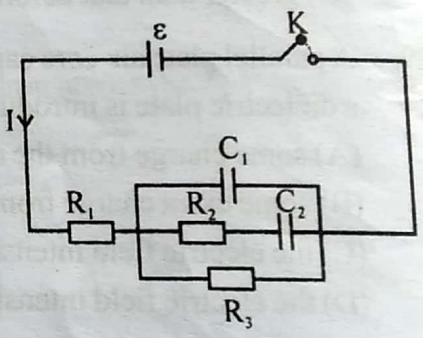
(B) Net electric force due to induced charges on the plate is zero.

(C) Force of attraction between plates of capacitor is $\frac{K(C_0V_0)^2}{2\epsilon_0 A}$

(D) Net field due to induced charges in dielectric slab is $\frac{8V_0(k-1)^2}{K\epsilon_0 A}$

R-C Circuits

33. Mark the **CORRECT** statement(s) regarding the current I through the battery in the circuit shown in figure.



(A) Immediately after the key K is closed, $I = \frac{\varepsilon}{R_1}$

(B) Immediately after the key K is closed, $I = \frac{\varepsilon}{R_1+R_3}$

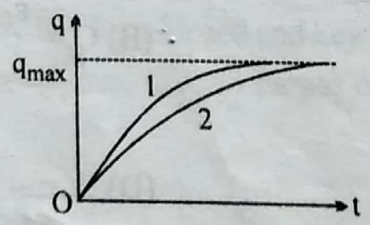
(C) Long time after key K is closed, $I = \frac{\varepsilon}{R_1+R_3}$

(D) Long time after key K is closed, $I = \frac{\varepsilon}{R_1+R_2}$

COMPREHENSION TYPE QUESTIONS

Paragraph for Question No. 34 & 35

The charge across the capacitor in two different RC circuits 1 and 2 are plotted as shown in figure.



34. Choose the correct statement(s) related to the two circuits.

(A) Both the capacitors are charged to the same charge.

(B) The emf's of cells in both the circuit are equal.

(C) The emf's of the cells may be different.

(D) The emf E_1 is more than E_2

35. Identify the correct statement(s) related to the R_1, R_2, C_1 and C_2 of the two RC circuits.

(A) $R_1 > R_2$ if $E_1 = E_2$

(B) $C_1 < C_2$ if $E_1 = E_2$

(C) $R_1C_1 > R_2C_2$

(D) $\frac{R_1}{R_2} < \frac{C_2}{C_1}$

36.

Column-I	Column-II
(A) Plates of an isolated, charged, parallel plate, air core capacitor are slowly pulled apart.	(P) Electric energy stored inside capacitor increases in the process.
(B) A dielectric is slowly inserted inside an isolated and charged parallel plate air cored capacitor to completely fill the space between plates.	(Q) Force between the two plates of the capacitor remain unchanged.
(C) Plates of a parallel plate capacitor connected across a battery are slowly pulled apart.	(R) Electric field in the region between plates remain unchanged.
(D) A dielectric slab is slowly inserted inside a parallel plate capacitor connected across a battery to completely fill the space between plates.	(S) Total electric energy stored inside capacitor decreases in the process.
	(T) Electric field in the region decreases.