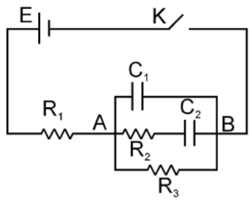
Exercise-2

✍ **Marked Questions can be used as Revision Questions.**

PART - I : OBJECTIVE QUESTIONS

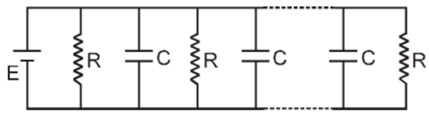
1.✍ A network of uncharged capacitors and resistances is shown
Current through the battery immediately after key K is closed and after a long time interval is :



(1) $\frac{E}{R_1}, \frac{E}{R_1+R_3}$ (2) $\frac{E}{R_1+R_3}, \frac{E}{R_1+\frac{R_2R_3}{R_2+R_3}}$

(3) Zero, $\frac{E}{R_1}$ (4) $\frac{E}{R_1+\frac{R_2R_3}{R_2+R_3}}, \frac{E}{R_1}$

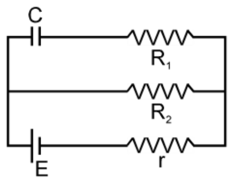
2. n resistances each of resistance R are joined with capacitors of capacity C (each) and a battery of emf E as shown in the figure. In steady state condition ratio of charge stored in the first and last capacitor is



(1) n : 1 (2) (n – 1) : (n + 1)
(3) $(n^2 + 1) : (n^2 – 1)$ (4) 1 : 1

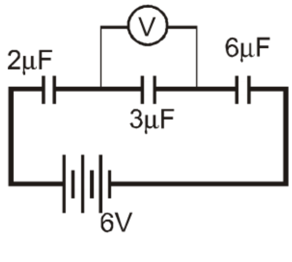
3. Eight drops of mercury of same radius and having same charge coalesce to form a big drop. Capacitance of big drop relative to that of small drop will be
(1) 16 times (2) 8 times (3) 4 times (4) 2 times

4.✍ The magnitude of charge in steady state on either of the plates of condenser C in the adjoining circuit is-



(1) CE (2) $\frac{CER_2}{(R_1+r)}$
(3) $\frac{CER_2}{(R_2+r)}$ (4) $\frac{CER_1}{(R_2+r)}$

5.✍ In the combination shown in the figure, the ideal voltmeter reading will be



(1) 4.5 V
(2) $\left(\frac{18}{11}\right)$V
(3) 3 V
(4) 2 V

6.✍ Three capacitors of same capacitance are connected in parallel. When they are connected to a cell of 2 volt, total charge of 1.8μC is accumulated on them. Now after discharging they are connected in series and then charged by the same cell. The total charge stored in them will be
(1) 1.8μC (2) 0.9μC (3) 0.6μC (4) 0.2μC

7. An uncharged capacitor of capacitance 8.0 μF is connected to a battery of emf 6.0 V through a resistance of 24 Ω, then

(i) the current in the circuit just after the connections are made is :

(1) 0.25 A (2) 0.5 A (3) 0.4 A (4) 0 A

(ii) the current in the circuit at one time constant after the connections are made is :

(1) 0.25 A (2) 0.09 A (3) 0.4 A (4) 0 A

8. A capacitor of capacitance 500μF is charged at the rate of 100μC/s. The time in which the potential difference will become 20 V, is

(1) 100 s (2) 50 s (3) 20 s (4) 10 s

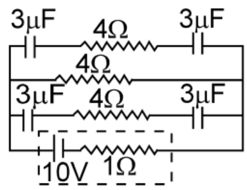
9. The radius of the circular plates of a parallel plate capacitor is R. Air is dielectric medium between the plates. If the capacitance of the capacitor is equal to the capacitance of a sphere of radius R, then the distance between the plates is

(1) R/4 (2) R/2 (3) R (4) 2R

10. A parallel plate condenser of capacity C is connected to a battery and is charged to potential V. Another condenser of capacity 2C is connected to another battery and is charged to potential 2V. The charging batteries are removed and now the condensers are connected in such a way that the positive plate of one is connected to negative plate of another. The final energy of this system is–

(1) zero (2) $\frac{25CV^2}{6}$ (3) $\frac{3CV^2}{2}$ (4) $\frac{9CV^2}{2}$

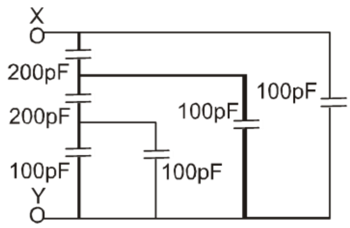
11. In the following figure, the charge on each condenser in the steady state will be–



(1) 3μC (2) 6μC

(3) 9μC (4) 12μC

12. The equivalent capacitance between the terminals X and Y in the figure shown will be–



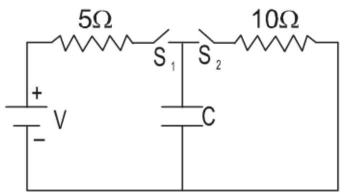
(1) 100 pF

(2) 200 pF

(3) 300 pF

(4) 400 pF

13. In the adjoining diagram, (assuming the battery to be ideal) the condenser C will be fully charged to potential V if



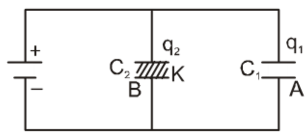
(1) S_1 and S_2 both are open

(2) S_1 and S_2 both are closed

(3) S_1 is closed and S_2 is open

(4) S_1 is open and S_2 is closed.

14. In the adjoining diagram two geometrically identical capacitors A and B are connected to a battery. Air is filled between the plates of C_1 and a dielectric is filled between the plates of C_2, then -



(1) $q^1 < q^2$ (2) $q^1 > q^2$

(3) $q^1 = q^2$ (4) None of these

15. An uncharged capacitor of capacitance C is connected to a battery of emf ε at t = 0 through a resistance R, then

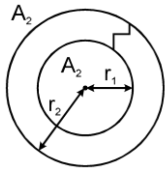
(i) the maximum rate at which energy is stored in the capacitor is :

(1) $\frac{\varepsilon^2}{4R}$ (2) $\frac{\varepsilon^2}{2R}$ (3) $\frac{\varepsilon^2}{R}$ (4) $\frac{2\varepsilon^2}{R}$

(ii) time at which the rate has this maximum value is

(1) 2CR ln2 (2) $\frac{1}{2}$ CR ln2 (3) CR ln2 (4) 3CR ln2

16. Two spherical conductors A_1 and A_2 of radii r_1 and r_2 are placed concentrically in air. The two are connected by a copper wire as shown in figure. Then the equivalent capacitance of the system is



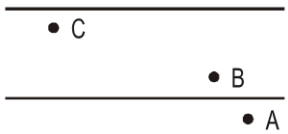
(1) $\frac{4\pi\varepsilon_0 k r_1 . r_2}{r_2 - r_1}$ (2) $4\pi\epsilon_0 (r_1 + r_2)$

(3) $4\pi\epsilon_0 r_2$ (4) $4\pi\epsilon_0 r_1$

17. The plates of a parallel plate condenser are being moved away with a constant speed v. If the plate separation at any instant of time is d then the rate of change of capacitance with time is proportional to–

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

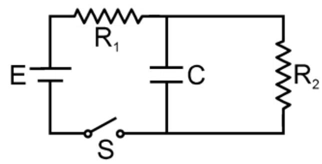
18. For a charged parallel plate capacitor shown in the figure, the force experienced by an alpha particle will be :



(1) maximum at C (2) zero at A

(3) same at A and C (4) zero at C

19. In the circuit shown in figure the switch is closed at t = 0.



A long time after closing the switch

(1) voltage drop across the capacitor is E

(2) current through the battery is $\frac{E}{R_1 + R_2}$

(3) energy stored in the capacitor is $C\left(\frac{R_2 E}{R_1 + R_2}\right)^2$

(4) current through the capacitor becomes none zero

PART - II : MISCELLANEOUS QUESTIONS

Section (A) : Assertion/Reasoning

A-1. **STATEMENT-1 :** If the potential difference across a plane parallel plate capacitor is doubled then the potential energy of the capacitor becomes four times under all conditions.

STATEMENT-2 : The potential energy U stored in the capacitor is U = $\frac{1}{2}$ CV^2, where C and V have usual meaning.

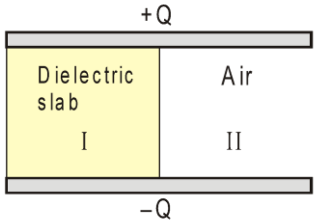
(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

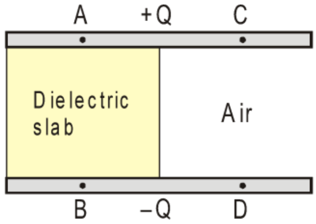
(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

A-2. **STATEMENT-1 :** A charged plane parallel plate capacitor has half interplanar region (I) filled with dielectric slab. The other half region II has air. Then the magnitude of net electric field in region I is less than that in region II.



STATEMENT-2 : In a dielectric medium induced (or polarised) charges tend to reduce the electric field inside the dielectric.

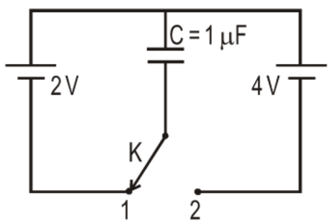


(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1
(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1
(3) Statement-1 is True, Statement-2 is False
(4) Statement-1 is False, Statement-2 is True.

A-3. **Statement-1 :** The circuits containing capacitor be handled cautiously even when there is no current.
Statement-2 : A charged capacitor, can discharge through our body and harm us.
(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(3) Statement-1 is True, Statement-2 is False
(4) Statement-1 is False, Statement-2 is True.

Section (B) : Match the column

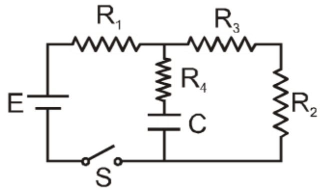
B-1. The circuit involves two ideal cells connected to a 1 μF capacitor via a key K. Initially the key K is in position 1 and the capacitor is charged fully by 2V cell. The key is then pushed to position 2. Column I gives physical quantities involving the circuit after the key is pushed from position 1. Column II gives corresponding results. Match the statements in Column I with the corresponding values in Column II.



Column I	Column II
(1) The net charge crossing the 4 volt cell in μC is	(p) 2
(2) The magnitude of work done by 4 Volt cell in μJ is	(q) 6
(3) The gain in potential energy of capacitor in μJ is	(r) 8
(4) The net heat produced in circuit in μJ is	(s) 16

Section (C) : One or More Than One Options Correct

C-1. In the circuit shown in figure the switch S is closed at t = 0. A long time after closing the switch

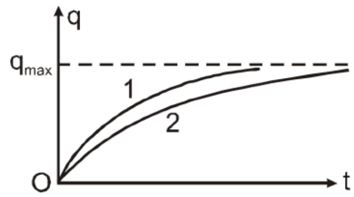


(1) voltage drop across the capacitor is E
(2) current through the battery is $\frac{E}{R_1+R_2+R_3}$
(3) energy stored in the capacitor is $\frac{1}{2}C\left(\frac{(R_2+R_3)E}{R_1+R_2+R_3}\right)^2$
(4) current through the resistance R_4 becomes zero

C-2. When a charged capacitor is connected with an uncharged capacitor, then which of the following is/are correct option/options.
(1) the magnitude of charge on the charged capacitor decreases.

(2) a steady state is obtained after which no further flow of charge occurs.
(3) the total potential energy stored in the capacitors remains conserved.
(4) the charge conservation is always true.

C-3. The charge on capacitor in two different RC circuits 1 and 2 are plotted as shown in figure.



Choose the correct statement(s) related to the two circuits.
(1) Both the capacitors are charged to the same magnitude of charge
(2) The emf's of cells in both the circuits are equal.
(3) The emf's of the cells may be different
(4) The emf E_1 is more than E_2

C-4. Capacitor C_1 of the capacitance 1 microfarad and capacitor C_2 of capacitance 2 microfarad are separately charged fully by a common battery. The two capacitors are then separately allowed to discharge through equal resistors at time t = 0.
(1) the current in each of the two discharging circuits is zero at t = 0.
(2) the current in the two discharging circuits at t = 0 are equal but non zero.
(3) the current in the two discharging circuits at t = 0 are unequal
(4) capacitor C_1 loses 50% of its initial charge sooner than C_2 loses 50% of its initial charge

C-5. The terminals of a battery of emf V are connected to the two plates of a parallel plate capacitor. If the space between the plates of the capacitor is filled with an insulator of dielectric constant K, then :
(1) the electric field in the space between the plates does not change
(2) the capacitance of the capacitor increases
(3) the charge stored in the capacitor increases
(4) the electrostatic energy stored in the capacitor decreases

C-6. The plates of a parallel plate capacitor with no dielectric are connected to a voltage source. Now a dielectric of dielectric constant K is inserted to fill the whole space between the plates with voltage source remaining connected to the capacitor.

(1) the energy stored in the capacitor will become K-times

(2) the electric field inside the capacitor will decrease to K-times
(3) the force of attraction between the plates will increase to K^2 – times
(4) the charge on the capacitor will increase to K-times