CLASS TEST

PHYSICS CLASS TEST # 40

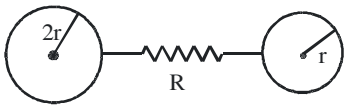
SECTION-I

Single Correct Answer Type **4 Q. [3 M (–1)]**

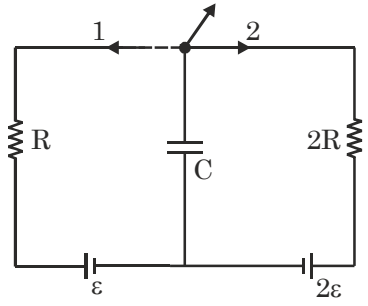
1. Two conducting spheres of radius r and 2r at very large separation. Each sphere is having charge Q. These sphere are connected with a conducting wire of resistance R. Then, the current flowing in the wire at t = 2 ms. (where r = 30 cm, R = 90 MΩ and Q =10 mC)

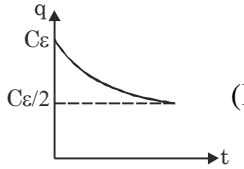
(A) $\frac{100}{3e} amp$ (B) $\frac{5}{3e} amp$

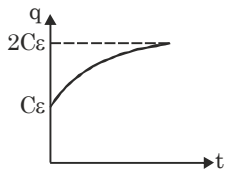
(C) $\frac{50}{3e} amp$ (D) $\frac{25}{3e} amp$

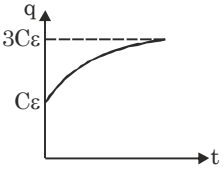


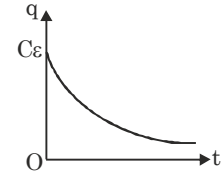
2. In the circuit shown, the switch is shifted from position $1 \to 2$ at t = 0. The switch was initially in position 1 since a long time. The graph between charge on capacitor C and time 't' is :



(A) 

(B) 

(C) 

(D) 

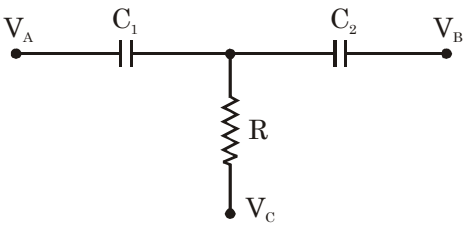
3. For given circuit charge on capacitor C_1 and C_2 in steady state will be equal to :-

(A) $C_1(V_A - V_C)$, $C_2(V_C - V_B)$ respectively

(B) $C_1(V_A - V_B)$, $C_2(V_A - V_B)$ respectively

(C) $(C_1 + C_2)(V_A - V_B)$ on each capacitor

(D) $\left(\frac{C_1C_2}{C_1 + C_2}\right)(V_A - V_B)$ on each capacitor



4. In the following RC circuit, the capacitor was charged in two different ways.

(i) The capacitor was first charged to 5V by moving the toggle switch to position P and then it was charged to 10V by moving the toggle switch to position Q.

(ii) The capacitor was directly charged to 10V, by keeping the toggle switch at position Q.

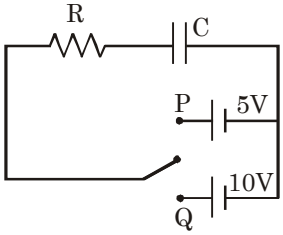
Assuming the capacitor to be ideal, which one of the following statement is correct?

(A) The energy dissipation in cases (i) and (ii) will be equal and non-zero.

(B) The energy dissipation for case (i) will be more than that for case (ii).

(C) The energy dissipation for case (i) will be less than that for case (ii).

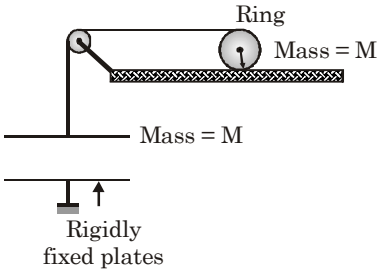
(D) The energy will not be dissipated in either case.



Multiple Correct Answer Type

6 Q. [4 M (–1)]

5. If ring of radius 'R' is placed on smooth floor connected by a string at the top. Other end of string is connected to upper plate of capacitor of same mass "M" and charge density σ and area A. Lower plate of capacitor is rigidly fixed. Then which of the following statements are correct if upper plate of capacitor is falling freely with acceleration 'g'.



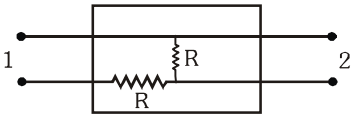
(A) Charge density of plates of capacitor must be $\sigma = \sqrt{2Mg\,\epsilon_0}$

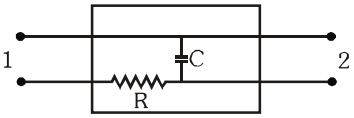
(B) The gain in kinetic energy of the ring and the plate of capacitor is equal to the loss in gravitational potential energy

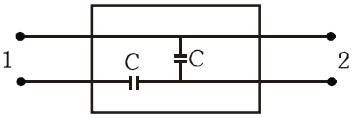
(C) Charge of plates of capacitor must be $q = \sqrt{Mg\,\epsilon_0\,A}$

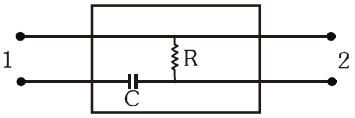
(D) The gain in kinetic energy of the ring and the plate of capacitor is 1.5 times the loss in gravitational potential energy

6. If the battery of voltage V is connected across terminals 1, the voltmeter across terminal 2 reads V/2. If same battery is connected across terminal 2, the voltmeter connected across terminal 1 gives reading V. Which of the following black box is correct

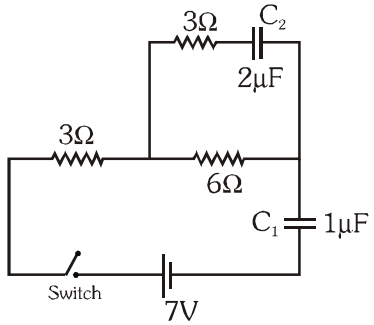
(A) 

(B) 

(C) 

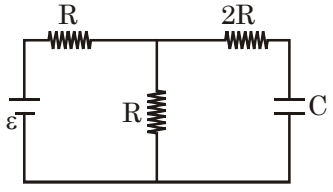
(D) 

7. For the arrangement shown in figure, the switch is closed at t = 0. C_2 is initially uncharged while C_1 has charge of 2μC. Then the current coming out of the battery just after switch is closed, will be



(A) 1 (B) 0 (C) 1.8 (D) 1.4

8. Circuit shown in the figure is in steady state. Now the capacitor is suddenly filled with medium of dielectric constant K = 2.



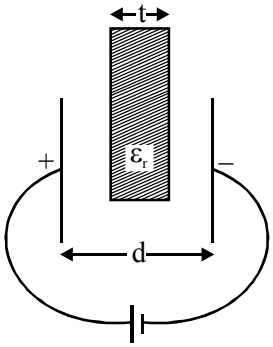
(A) Current through battery just after this moment is $\frac{11\varepsilon}{20R}$.

(B) Current through '2R' just after this moment is $\frac{\varepsilon}{10R}$

(C) Current through '2R' just after this moment is $\frac{\varepsilon}{15R}$

(D) Potential difference across capacitor just after this moment is $\frac{\varepsilon}{4}$

9. A dielectric slab of relative permittivity ε_r and thickness t is inserted into the capacitor. Then



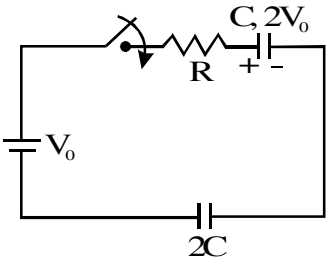
(A) the capacitance of the system increases by $\dfrac{\varepsilon_0 A}{t\left(1-\dfrac{1}{\varepsilon_r}\right)}$

(B) $\dfrac{q_{free}}{q_{bound}} = \dfrac{\varepsilon_r}{\varepsilon_r - 1}$

(C) the fraction change in the energy stored is $\varepsilon_r - 1$

(D) the plates are moved apart by a relative distance $t\left(1-\dfrac{1}{\varepsilon_r}\right)$ to recover the original energy stored (or original capacitance)

10. Two capacitors are connected to a resistance and battery as given. Capacitor with capacitance C is charge upto $2V_0$, where V_0 is potential of battery and capacitor of 2C capacitance is initially uncharged. If switch is closed at t = 0 then choose ***CORRECT*** statement(s)



(A) Ratio of final charge on C to 2C is 2

(B) total work done by battery after switch is closed is $\dfrac{-2CV_0^2}{3}$

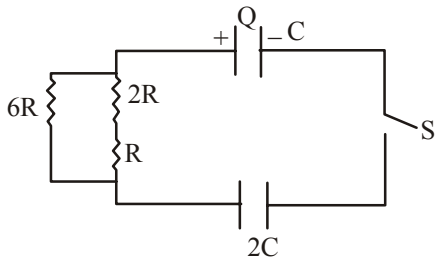
(C) total work done by battery after switch is closed is $\dfrac{+2CV_0^2}{3}$

(D) total heat loss across resistance after closing switch is $\dfrac{1}{3}CV_0^2$

Linked Comprehension Type (1 Para × 2 Q.) [4 M (–1)]
(Multiple Correct Answer Type)

Paragraph for Questions 11 and 12

In the given figure switch 'S' is closed at t = 0



11. Mark the **CORRECT** option(s) :

(A) Charge on capacitor 2C as function of time is $\dfrac{2Q}{3}\left(1-e^{-\frac{3t}{4RC}}\right)$.

(B) Charge on capacitor C as function of time is $\dfrac{Q}{3}\left(1-e^{-\frac{3t}{4RC}}\right)$.

(C) Current through the resistance 6R as a function of time is $\dfrac{Q}{2RC}e^{-\frac{3t}{4RC}}$

(D) Current through the resistance 6R as a function of time is $\dfrac{Q}{6RC}e^{-\frac{3t}{4RC}}$

12. Mark the **CORRECT** option(s) :

(A) Amount of heat produced in resistance 'R' in long time is $\frac{2Q^2}{27C}$.

(B) Amount of heat produced in resistance '2R' in long time is $\frac{4Q^2}{27C}$.

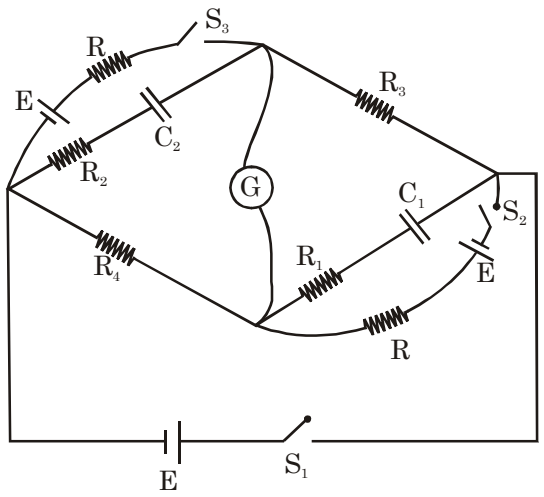
(C) Amount of heat produced in resistance '6R' in long time is $\frac{Q^2}{9C}$.

(D) Amount of heat produced in resistance '6R' in long time is $\frac{Q^2}{18C}$.

Matching list based comprehension Type (4 × 4 × 4) 1 Table × 3 Q.[3M(–1)]
Single option correct (Three Columns and Four Rows)

Answer Q.13, Q.14 and Q.15 by appropriately matching the information given in the three columns of the following table.

In the shown DC–RC circuit galvanometer of resistance 'R' is connected as shown. (Initially at t = 0 all switchs are open & capacitors are uncharged)



Condition of switch, resistance & capacitance is given in column (I), (II), (III) respectively.

	Column–I		Column-II		Column-III
(I)	S_1 closed, S_2 & S_3 open	(i)	$R_1 = 2R$, $R_2 = 2R$ $R_3 = R$, $R_4 = R$	(P)	$C_1 = C_2 = C$
(II)	S_1 open, S_2 & S_3 closed	(ii)	$R_2 = R$, $R_4 = 3R$ $R_3 = 2R$, $R_1 = 6R$	(Q)	$C_1 = C_2 = 2C$
(III)	S_1, S_2 closed S_3 open	(iii)	$R_1 = R_2 = R_3 = R_4 = R$	(R)	$C_1 = C$, $C_2 = 2C$
(IV)	S_1, S_3 open, S_2 closed	(iv)	$R_1 = R_2 = 2R$, $R_4 = R_3 = R$	(S)	$C_1 = 2C$, $C_2 = C$

13. Initially both capacitors are uncharged. In which of the following case galvanometer shown no deflection at t = 0 (just after switches is closed) ?

(A) (IV) (ii) (S) (B) (I) (i) (R) (C) (I) (ii) (S) (D) (IV) (iii) (R)

14. In which of the following case galvanometer shown no deflection at (t = ∞) (steady state)

(A) (II) (iv) (P) (B) (IV) (i) (S) (C) (II) (ii) (S) (D) (IV) (ii) (P)

15. In which of the following case final charge on capacitor C_2 is zero :-

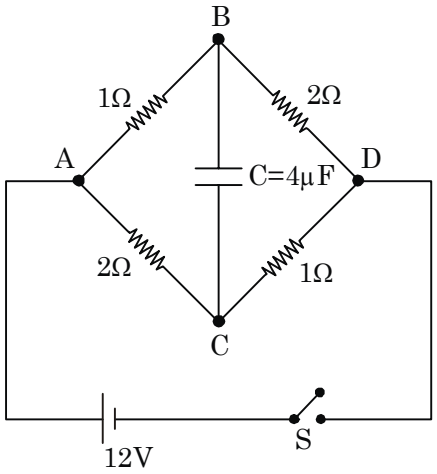
(A) (III) (iv) (R) (B) (III) (iii) (Q) (C) (II) (ii) (Q) (D) (IV) (ii) (R)

SECTION-II

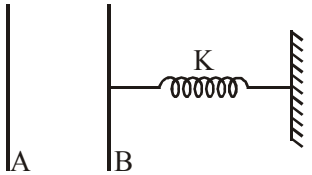
Numerical Answer Type Question **3Q.[3(0)]**

(upto second decimal place)

1. An uncharged capacitor of capacitance C is connected in given circuit diagram, switch S is closed at t = 0. If current in branch BC as function of time is given by $I = I_0(\text{amp})\, e^{-\frac{t}{\tau(\text{in }\mu S)}}$ then find the numerical value of $I_0\tau$.



2. Initially the plates of the parallel plate capacitor shown in the figure are A and B containing charge +2μC and –2μC respectively. Negatively charged plate B is connected to a spring of spring constant 5000N/m at one end and the other end of the spring is connected to a rigid support. Now the plate A is fixed and the system is released from rest. The maximum elongation produced in the spring is $\frac{\alpha \times 10^{-12}}{\in_0}$ m. The area of the plates is 2 cm^2 , the medium between the plates is air and Electric permittivity of air is $\in_0$ (in SI). Then the value of α.



3. Between the plates of a parallel-plate capacitor there is a metallic plate whose thickness takes up η = 0.60 of the capacitor gap. When that plate is absent the capacitor has a capacity C = 20 nF. The capacitor is connected to a dc voltage source V = 100 V. The metallic plate is slowly extracted from the gap. Find the mechanical work performed in the process of plate extraction (in μJ). If your answer is N fill value N/30.

CLASS TEST # 40	ANSWER KEY

SECTION-I

Single Correct Answer Type **4 Q. [3 M (–1)]**

1. Ans. (B) **2. Ans. (B)** **3. Ans. (A)** **4. Ans (C)**

Multiple Correct Answer Type **6 Q. [4 M (–1)]**

5. Ans. (C,D) **6. Ans. (A,C)** **7. Ans. (A,C)** **8. Ans. (A,B,D)** **9. Ans. (B, D)** **10. Ans. (A,B,D)**

Linked Comprehension Type **(1 Para × 2 Q.) [4 M (–1)]**

(Multiple Correct Answer Type)

11. Ans. (A,D) **12. Ans. (A,B,C)**

Matching list based comprehension Type (4 × 4 × 4) **1 Table × 3 Q. [3(–1)]**

Single option correct **(Three Columns and Four Rows)**

13. Ans. (C) **14. Ans. (A)** **15. Ans. (B)**

SECTION-II

Numerical Answer Type Question **3Q.[3M(0)]**

(upto second decimal place)

1. Ans. 16.00 **2. Ans. 4.00** **3. Ans. 5.00**