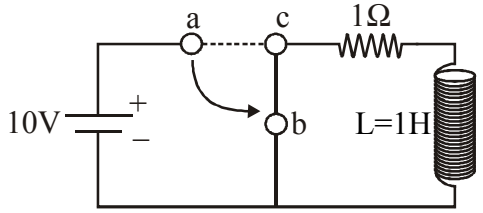
CLASS TEST

PHYSICS CLASS TEST # 59

SECTION-I

Single Correct Answer Type **6 Q. [3 M (–1)]**

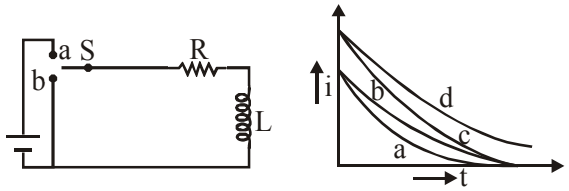
1. In the given circuit, the switch is closed to the position bc from the earlier position of ac at t = 0. The current in the inductor after 2s of closing the switch between b and c is :



(A) $\frac{1}{10e^2}$ A (B) $10e^{-2}$ A (C) 10e A (D) $10e^2$ A

2. In the figure shown below, the switch S has been closed on 'a' for a long time. It is then thrown to 'b'. The resulting current through the inductor is sketched in figure on right for four sets of values of R and L, Which curve goes with which set of values?

(1) R_0, L_0 (2) $2R_0$, L_0 (3) R_0, $2L_0$ (4) $2R_0$, $2L_0$

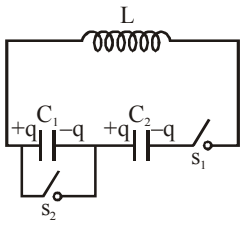


(A) a, 2; b, 4; c, 1; d,3 (B) a, 2; b, 1; c, 4; d,3 (C) a, 4; b, 2; c, 1; d,3 (D) a, 4; b, 2; c, 3; d,4

3. A long solenoid is made of a superconducting wire carrying a current I_0. The solenoid is slowly stretched so that its cross section does not change but its length changes from L_0 to L_1. What is the new current in the solenoid assuming the solenoid is still tightly wound ?

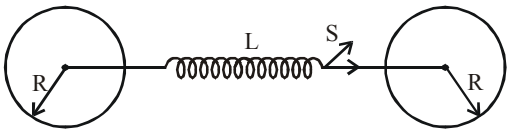
(A) $\frac{L_0 i_0}{L_1}$ (B) $\frac{L_1 i_0}{L_0}$ (C) $\frac{L_0^2 i_0}{L_1^2}$ (D) $\frac{L_1^2 i_0}{L_0^2}$

4. Two capacitors C_1 & C_2 of capacitance $\frac{1}{\pi^2}\times 10^{-2}$ F each and an inductor L of inductance 2×10^{-2} H are connected in series as shown in the figure. Initially charge on each capacitors are $4\sqrt{3}$ μC. At t = 0 switch S_1 is closed and at t = $\frac{1}{400}$ sec , switch S_2 is also closed. The maximum charge on capacitor C_2 during LC oscillation is :-



(A) 3 μC (B) $6\sqrt{2}\mu$C (C) $3\sqrt{3}$ μC (D) $6\sqrt{3}$ μC

5. Two conducting spheres of equal radii R are placed far apart and are connected by an ideal inductor as shown. Initially one of the spheres has a charge Q while other is uncharged. Switch is closed at time, t = 0. Then :-



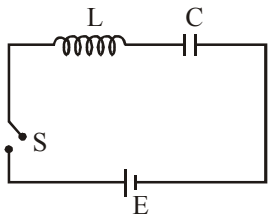
(A) Minimum time after which all charge can be transferred to other sphere is $\sqrt{2\pi^3 \in_0 LR}$

(B) Minimum time after which all charge can be transferred to other sphere is $\sqrt{8\pi^3 \in_0 LR}$

(C) First sphere will acquire a negative charge at some instant of time

(D) At some instant of time both spheres will have zero charge

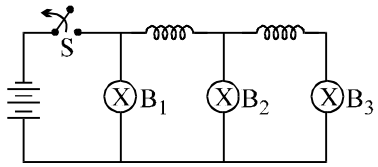
6. An ideal DC source of emf E is connected with an uncharged capacitor and inductor. If switch is closed at t = 0, what is the maximum charge on the capacitor in subsequent flow of charge ?



(A) 2CE (B) CE (C) 1.5 CE (D) 4CE

Multiple Correct Answer Type 5 Q. [4 M (–1)]

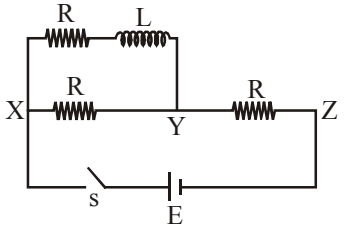
7. The circuit shown in figure consisting of three identical lamps and two coils is connected to a direct current source. The ohmic resistance of the coils is negligible. After some time switch S is opened. Which of the following statement(s) is/are **correct** for the instant immediately after opening the switch?



(A) All the lamps are turned off (B) Brightness of B_2 & B_3 remains unchanged

(C) Brightness of B_1 suddenly increases (D) Insufficient data to draw any conclusion.

8. The switch is closed at t = 0 in the adjoining circuit. Which of the following is/are **CORRECT** ?



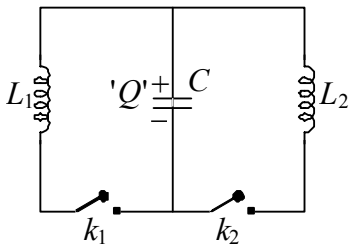
(A) The potential difference across YZ at t = 0 is 2E/3

(B) The potential difference across XY at t = ∞ is E/2

(C) The potential difference across YZ at t = 0 is E/2

(D) The potential difference across XY at t = ∞ is 2E/3

9. The given arrangement carries a capacitor with capacitance 40mF and two inductors L_1 = 25 H and L_2 = 100 H. If the capacitor initially carries a charge of 10 mC, then :-



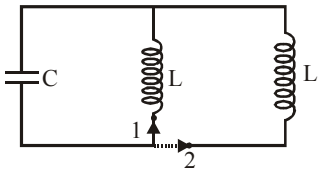
(A) the maximum current through the inductor L_1 when key k_1 is closed is 20 mA

(B) the maximum current through the inductor L_2 when key k_2 is closed is 5mA

(C) the maximum current through inductor L_2 when both the keys are closed is $\sqrt{5}$ mA

(D) time period of oscillation of charge is minimum when both the keys are closed

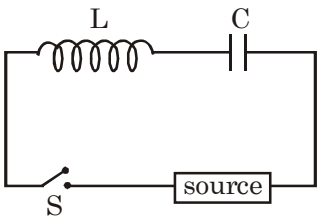
10. A capacitor with charge Q on it is connected to an inductor L as shown in diagram at t = 0. When the switch is flipped from position 1 to 2, the current in the circuit is observed to be at half of its maximum value. Then :-



(A) Charge on capacitor at the time was $\frac{Q}{2}$ (B) Charge on capacitor at that time was $\frac{Q\sqrt{3}}{2}$

(C) Total energy lost is $\frac{Q^2}{4C}$ (D) Total energy lost is $\frac{Q^2}{8C}$

11. In the circuit shown source may be AC or DC. At t = 0 switch S is closed. Choose the correct statement(s) :-



(A) After a long time charge on the capacitor will be zero if source is DC

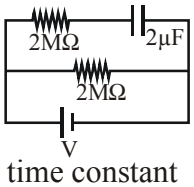
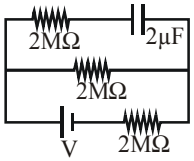
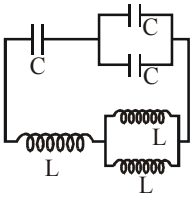
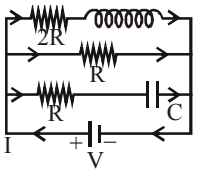
(B) After a long time charge on the capacitor will be zero if source is AC

(C) After a long time charge on the capacitor will not be constant if source is DC

(D) After a long time charge on the capacitor will not be constant if source is AC

Matching List Type (4 × 4) 1Q.[3 M (–1)]

12. Match the physical quantity of List-I with value given in List-II.

List-I	List-II
(P)  time constant τ = ... sec	(1) 100
(Q)  time constant, τ = ... sec	(2) 1.33
(R)  C = 100 μF, L = 1H angular frequency ω = ... rad/sec	(3) 4
(S)  $\frac{I(0)}{I(\infty)}$ = ... I(0) and I(∞) are current drawn from the battery at t = 0 and t → ∞	(4) 6

Codes :

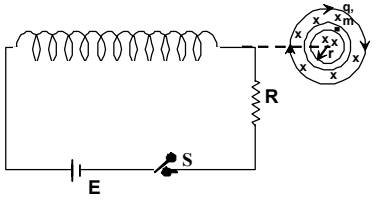
	P	Q	R	S		P	Q	R	S
(A)	2	1	4	3	(B)	3	1	4	2
(C)	3	4	1	2	(D)	4	2	3	1

SECTION-III

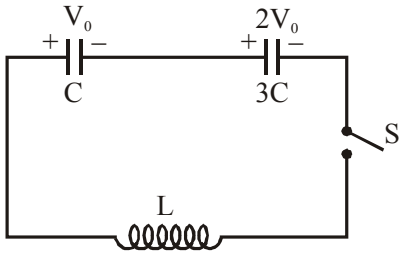
Numerical Grid Type (Ranging from 0 to 9) 5 Q. [4 M (0)]

1. There are two concentric coplanar rings where outer ring has radius 4m. The inner ring has radius 1mm, resistance 1 Ω & self inductance 2 μH. Initially the outer and inner rings have current of 5×10^6 A & 2A respectively in clockwise sense. Later on current in inner ring is found to be 3A clockwise whereas for outer ring it is 5×10^6 A anticlockwise. If total charge flown through the inner ring till this moment is Q_0 μC then find value of Q_0. (Take $\pi^2 = 10$)

2. A small charged particle (charge q and mass m) is released at t = 0 inside a smooth hollow circular tube (it's like tube of wheel) placed inside a long solenoid (n turns per unit length). Cross sectional view of the arrangement is given. Axis of tube is coinciding with axis of solenoid. Radius of tube is very small i.e. r such that we can take magnetic field which is passing through the tube is same as at axis of solenoid. Cross-sectional area of tube is also very small such that charged particle can just move inside it. [Neglect the resistance of solenoid.] If the switch S is closed at t = 0. The speed of the particle after a long time is $\frac{\mu_0 nEqr}{kmR}$. Find the value of k.

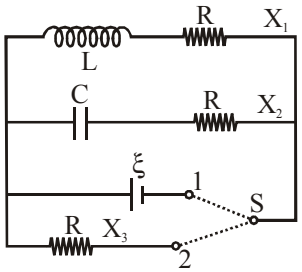


3. Two capacitors of capacitance C and 3C are charged to potential difference V_0 and $2V_0$ respectively and connected to an inductor of inductance L as shown in the figure. Initially the current in the inductor is zero. Now the switch S is closed. Find the maximum current (in mA) in the inductor. (Take C = 12 μF, L = 1H & V_0 = 1V)

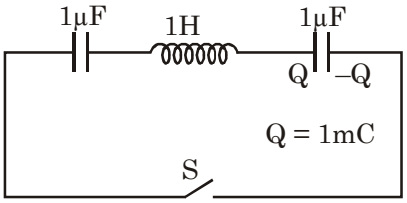


4. Figure shows a circuit containing three resistor X_1, X_2 & X_3 having resistance R each, an inductor, capacitor and an emf source having inductance 'L', capacitance C & emf ε respectively (Given $R = \sqrt{\frac{L}{C}}$).

The switch is first connected to position-1. When charge on capacitor becomes half of it maximum possible value then switch S is connected to position-2. Current in resistance X_3 just after shifting the switch from position-1 to position-2 is (given L = 20mH, C = 2μF, R = 100Ω, ξ = 5V)



5. Two capacitors of equal capacity 1 μF each are joined in series with an inductor of inductance 0.5 H. One of the capacitors has an initial charge 1 mC and other is uncharged. Switch is closed at t = 0. Find maximum current (in A) through the inductor.



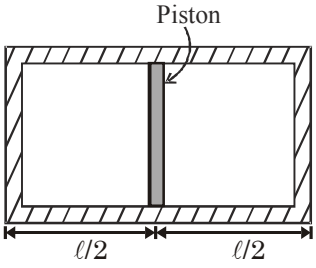
SECTION-IV

Matrix Match Type (4 × 5) **1 Q. [8 M (for each entry +2(0)]**

1. Match the following Questions.

Column-I **Column-II**

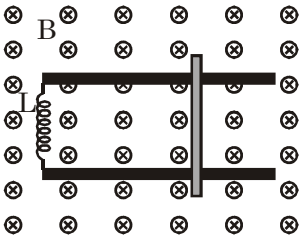
(A)



Thermally insulated container. Friction is absent. Helium gas is present on both sides of the thermally insulated piston. Piston is slightly displaced from equilibrium & released. Piston is A.

(P) Equilibrium of A can be unstable

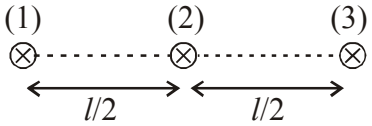
(B)



Rod & parallel rails are conducting. Uniform magnetic field B is pointing into the plane of paper. B is time independent. Friction is absent between rod and parallel rails. Inductor L is ideal. At equilibrium rod is given an impulse perpendicular to its length. Rod is A. (Neglect self inductance of rectangular loop)

(Q) Acceleration of A increases on moving away from equilibrium position

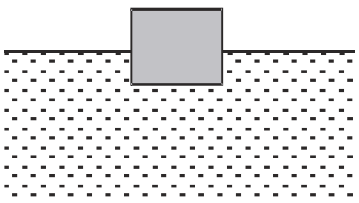
(C)



Infinite long parallel current carrying wires are placed as shown. Wire (1) and (3) are fixed and wire (2) can move freely. Wire is slightly displaced from equilibrium & released. Wire 2 is A.

(R) Graph of kinetic energy of A as a function of position measured from equilibrium can be parabola.

(D)



A cubical block floats in a non-viscous liquid as shown. Block is slightly displaced in vertical direction from equilibrium and released. Block is A.

(S) Motion of A can be oscillatory

(T) Graph of velocity of A as a function of position measured from equilibrium can be ellipse.

CLASS TEST # 59 **ANSWER KEY**

SECTION-I

Single Correct Answer Type **6 Q. [3 M (–1)]**

1. Ans. (B) **2. Ans. (A)** **3. Ans. (B)** **4. Ans. (B)**
5. Ans. (A) **6. Ans. (A)**

Multiple Correct Answer Type **5 Q. [4 M (–1)]**

7. Ans. (B,C) **8. Ans. (C)** **9. Ans. (B,C,D)** **10. Ans. (B, D)**
11. Ans. (C, D)

Matching List Type (4 × 4) **1Q.[3 M (–1)]**

12. Ans. (C)

SECTION-III

Numerical Grid Type (Ranging from 0 to 9) **5 Q. [4 M (0)]**

1. Ans. 3 **2. Ans. 2** **3. Ans. 9** **4. Ans. 0**
5. Ans. 1

SECTION-IV

Matrix Match Type (4 × 5) **1 Q. [8 M (for each entry +2(0)]**

1. Ans. (A) Q,R,S,T; (B) Q,R,S,T; (C) P,Q,R,S,T; (D) Q,R,S,T