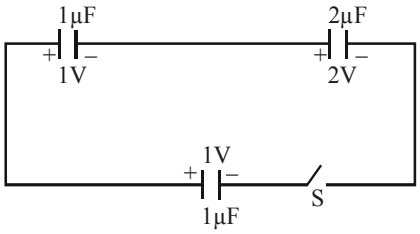
CLASS TEST

CLASS TEST # 42

SECTION-I

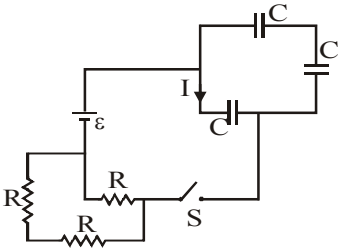
Single Correct Answer Type **5 Q. [3 M (–1)]**

1. Figure shows 3 different capacitors, separately charged by batteries, and then connected as shown, with initially, switch open. When switch is closed, the charge :-



(A) On all capacitors get equalized (B) becomes zero on all capacitors
(C) On 2μF capacitor increases by 20% (D) On 2μF capacitor decreases by 20%

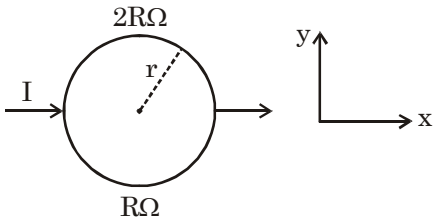
2. In the given circuit switch S is closed at t = 0. The current *I* in the figure at time *t* is



(A) $i = \frac{\varepsilon e^{-t/RC}}{2R}$ (B) $i = \frac{2\varepsilon e^{-t/RC}}{3R}$

(C) $i = \frac{\varepsilon e^{-\frac{2t}{3RC}}}{2R}$ (D) $i = \frac{\varepsilon e^{-t/RC}}{R}$

3. Two wires are bent (shown as joint-circle) with radius r (in xy plane). The upper half has resistance of 2R Ω and the lower half of R Ω. A current I is passed into circle as shown. The magnetic field at centre is :



(A) $\frac{\mu_0 I}{r}$ (B) $\frac{\mu_0 I}{2r}(\hat{z})$ (C) zero (D) $\frac{\mu_0 I}{12r}\hat{z}$

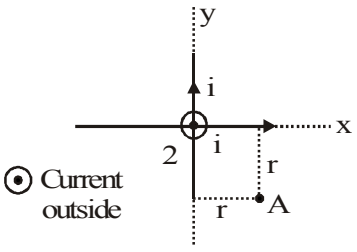
4. Three infinite wires are arranged in space in three dimensions (along x, y and z axis) as shown. Each wire carries current i. Find magnetic field at A.

(A) $-\frac{\mu_0 i}{2\pi r}\hat{i} - \frac{\mu_0 i}{2\pi r}\hat{j} - \frac{\mu_0 i}{\pi r}\hat{k}$

(B) $-\frac{\mu_0 i}{4\pi r}\hat{i} + \frac{\mu_0 i}{4\pi r}\hat{j} - \frac{\mu_0 i}{\pi r}\hat{k}$

(C) $\frac{\mu_0 i}{4\pi r}\hat{i} + \frac{\mu_0 i}{4\pi r}\hat{j} - \frac{\mu_0 i}{\pi r}\hat{k}$

(D) $\frac{\mu_0 i}{2\pi r}\hat{i} + \frac{\mu_0 i}{2\pi r}\hat{j} - \frac{\mu_0 i}{\pi r}\hat{k}$

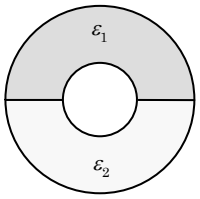


5. A charged particle enters into a uniform magnetic field with velocity v_0 perpendicular to it, the length of magnetic field is $x = \frac{\sqrt{3}}{2}R$, where R is the radius of the circular path of the particle in the field. The magnitude of change in velocity of the particle when it comes out of the field is :-

(A) $2v_0$ (B) $\frac{v_0}{2}$ (C) $\frac{\sqrt{3}v_0}{2}$ (D) v_0

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

6. Radii of the inner and outer concentric conducting spheres of a spherical capacitor are *a* and *b*. One half of the space between the spheres is filled with a linear isotropic dielectric of permittivity ε_1 and the other half with another linear isotropic dielectric of permittivity ε_2 as shown in the figure.
The outer sphere is given a total charge $+Q$ and the inner sphere a total charge $-Q$. Which of the following statements are correct?



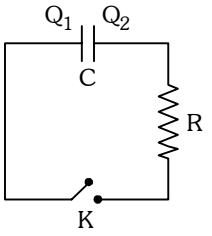
(A) Electric fields in both the dielectrics at the same radial distance are not equal.

(B) Electric field intensities in both the dielectrics at radial distance r from center are given by $E_1 = E_1 = \frac{Q}{2\pi(\varepsilon_1 + \varepsilon_2)r^2}$.

(C) Potential difference between the spheres is given by $V = \frac{Q(b-a)}{2\pi(\varepsilon_1 + \varepsilon_2)ab}$.

(D) Charge densities on both the halves of a sphere are equal.

7. The two plates of a capacitor of capacitance C are given charges Q_1 and Q_2. This capacitor is connected across a resistance R as shown key is closed at t = 0. Find the charges on the plates after time t.



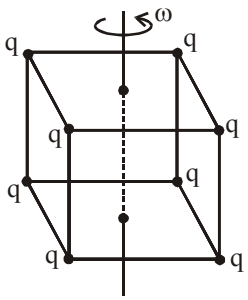
(A) Total charge of the right plate $q_2 = \frac{Q_1 + Q_2}{2} - \left(\frac{Q_1 - Q_2}{2}\right)e^{-\frac{t}{RC}}$

(B) Total charge on the left plate $q = \frac{Q_1 + Q_2}{2} + \left(\frac{Q_1 - Q_2}{2}\right)e^{-\frac{t}{RC}}$

(C) Initial potential difference across the plates is given by $\frac{Q_1 - Q_2}{2C}$

(D) Initial potential difference across the plates is given by $\frac{Q_1 + Q_2}{2C}$

8. Consider a cube of side 'a' as shown. Eight point charges are placed at the corners. The cube is rotated about the axis with constant angular velocity 'ω':



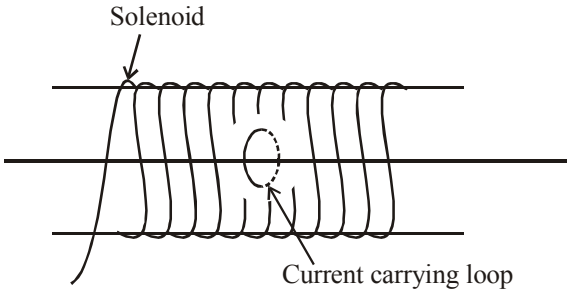
(A) Net magnetic field at the centre of cube is zero

(B) Net magnetic field at the centre of cube is $\frac{\sqrt{2}\mu_0 q\omega}{\pi a}$

(C) Net magnetic field at the centre of cube is $\frac{8}{3\sqrt{3}}\frac{\mu_0 q\omega}{\pi a}$

(D) If polarity of any four charges are reversed, then magnetic field at the centre of cube will be zero.

9. A single circular loop of wire with radius 0.02 m carries a current of 8.0 A. It is placed at the centre of a long solenoid that has length 0.65m, radius 0.080 m and 1300 turns. (Axis of circular loop coincide with axis of solenoid). Let 'i' be the current in solenoid.

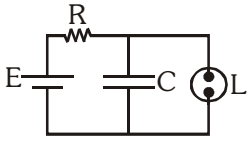


(A) If i = 100 mA, the magnetic field at the center of coil can be zero.
(B) If i = 44 mA, the magnetic field at the center of coil can be zero.
(C) If i = 100 mA, the magnetic field at the center of coil can be $8\pi \times 10^{-5}$ T.
(D) If i = 100 mA, the magnetic field at the center of coil can be $16\pi \times 10^{-5}$ T.

Linked Comprehension Type (1 Para × 3Q. & 1 Para × 2Q.) [3 M (-1)] (Single Correct Answer Type)

Paragraph for Questions no. 10 to 12

Figure shows the circuit of a flashing lamp, used at construction sites. The fluorescent lamp L, having negligible capacitance, is connected in parallel across the capacitor C of an RC circuit. There is a current through the lamp only when the potential difference across it reaches the breakdown voltage V_L. In this event, the capacitor discharges completely through the lamp and lamp flashes briefly.



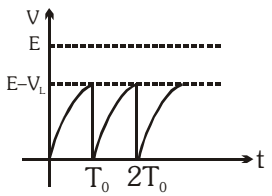
10. Consider an instant, when the capacitor has just discharged through the flash light. Taking this instant as t = 0, the time after which the lamp flashes briefly is given by :-

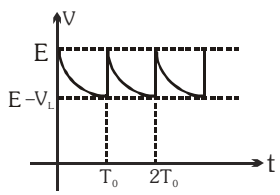
(A) $RC\ell n\left(\frac{E}{E-V_L}\right)$ (B) $RC\left[1-\ell n\left(\frac{E}{V_L}\right)\right]$ (C) $RC\ell n\left(\frac{E}{V_L}\right)$ (D) $RC\ell n\left(\frac{E-V_L}{E}\right)$

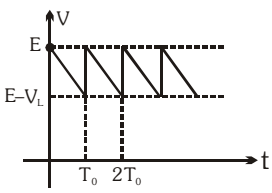
11. The number of flashes per second produced by the arrangement is (neglecting the time of flashing or discharging of capacitor) :-

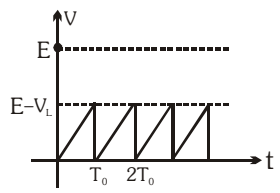
(A) $\frac{1}{RC\ell n\left(\frac{E}{E-V_L}\right)}$ (B) $\frac{1}{RC\ell n\left(\frac{E}{V_L}\right)}$ (C) $\frac{1}{RC\ell n\left(\frac{E-V_L}{E}\right)}$ (D) $\frac{1}{RC\left[1-\ell n\left(\frac{E}{V_L}\right)\right]}$

12. Which of the following graph represents the variation of potential drop across the resistor ?

(A)


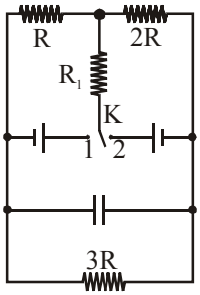
(B)


(C)


(D)


Paragraph for Question no. 13 and 14

When the switch is shifted from position 1 to position 2 (as shown in figure), the steady state current through the resistance R_1 does not change its direction, but decreases to $\frac{2}{3}$ times of its previous value. The batteries are ideal and identical :-



13. Value of R_1 is :-

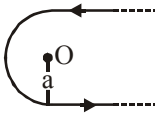
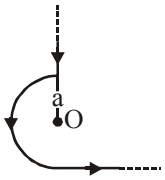
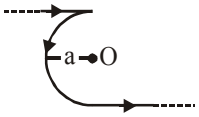
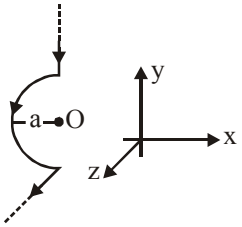
(A) $\frac{R}{2}$ (B) $\frac{R}{6}$ (C) $\frac{R}{3}$ (D) $\frac{R}{4}$

14. What is the ratio of the steady state charge on the capacitor before switching and after switching ?

(A) $\frac{3}{5}$ (B) $\frac{1}{2}$ (C) $\frac{3}{4}$ (D) $\frac{4}{5}$

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

15.

List-I **Current Carrying Wires**		**List-II** B_0	
(P)		(1)	$\frac{\mu_0 i}{4a}\left(1+\frac{1}{\pi}\right)$
(Q)		(2)	$\frac{\mu_0 i}{4a}\sqrt{1+\frac{1}{\pi^2}}$
(R)		(3)	$\frac{\mu_0 i}{2a}\left(\frac{1}{2}+\frac{1}{\pi}\right)$
(S)		(4)	$\frac{\mu_0 i}{4a}$

Codes :

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

SECTION-II

Numerical Answer Type Question **1 Q. [3(0)]**

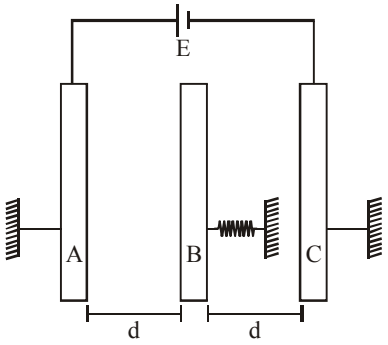
(upto second decimal place)

1. A 20 ohms resistor is connected in series with a capacitor or 0.01 farad and *e.m.f.* E volts given by $40e^{-3t} + 20e^{-6t}$. If q = 0 at t = 0, the maximum charge on the capacitor is (in C).

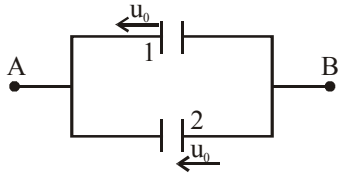
SECTION-III

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

1. A, B, C are three identical neutral conducting plates, A and C are rigidly attached to fixed supports whereas plate B is attached to a spring having constant K. The supports and spring are very small in size and their effect on induced charges on plates A, B, C is negligible. The seperations between plates are d as shown. If plate B is displaced by x (x << d) in the plane and released it is found that plate B under goes SHM. If K = 2 N/m, mass of plate B is 8 kg, emf of battery = 2V and system is in gravity free space, the time period of B is found to be T = $\alpha\pi$. Find value of α.

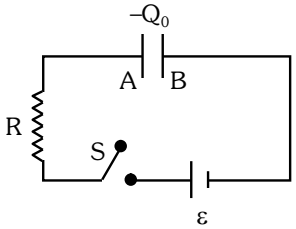


2. Two identical capacitors having plate separation 1mm are connected parallel to each other across points A and B as shown in figure. Total charge of 4 μC is imparted to the system by connecting a battery across A and B and battery is removed. Now first plate of first capacitor and second plate of second capacitor starts moving with constant velocity 3 m/s towards left. Find the magnitude of current (in mA) flowing in the loop initially.

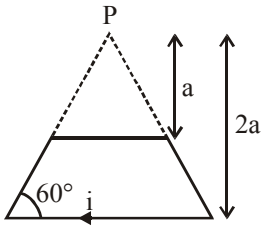


3. The figure shows a RC circuit with a parallel plate capacitor. Before switching on the circuit, plate A of the capacitor has a charge $-Q_0$ while plate B has no net charge. Now, at t = 0, the circuit is switched on. How much time (in second) will elapse before the net charge on plate A becomes zero.

(Given C = 1μF, Q_0 = 1mC, ε = 1000 V and $R = \frac{2\times10^6}{\ln 3}\Omega$)



4. Figure shows a conducting loop in shape of a trapezium carrying a current i = 10A. Find the magnetic field B (in μT) at a point P. It is given that a = 10 cm.



CLASS TEST # 42			ANSWER KEY
SECTION-I			
Single Correct Answer Type			**5 Q. [3 M (–1)]**
1. Ans. (D)	**2. Ans. (B)**	**3. Ans. (D)**	**4. Ans. (C)**
5. Ans. (D)			
Multiple Correct Answer Type			**4 Q. [4 M (–1)]**
6. Ans. (B,C)	**7. Ans. (ABC)**	**8. Ans. (C,D)**	**9. Ans. (A,D)**
Linked Comprehension Type (Single Correct Answer Type)			**(1 Para × 3Q. & 1 Para × 2Q.) [3 M (-1)]**
10. Ans. (A)	**11. Ans. (A)**	**12. Ans. (B)**	**13. Ans. (B)**
14. Ans. (C)			
Matching List Type (4 × 4)			**1 Q. [3 M (–1)]**
15. Ans.(A)			
SECTION-II			
Numerical Answer Type Question (upto second decimal place)			**1 Q. [3(0)]**
1. Ans. 0.25			
SECTION-III			
Numerical Grid Type (Ranging from 0 to 9)			**4 Q. [4 M (0)]**
1. Ans. 4	**2. Ans. 6**	**3. Ans. 2**	**4. Ans. 5**