# 05-12-15_Sr.IPLCO_Jee-Main_RPTM-13_ Syllabus

## MATHS:

Trigonometry Upto Transformations, General Solutions, Heights And Distances

## PHYSICS

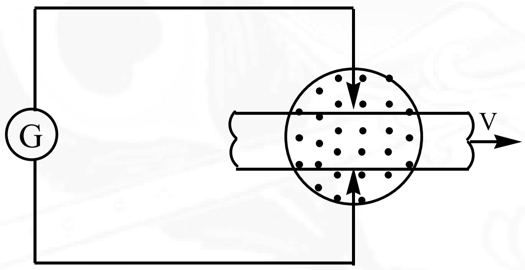
**E M I & AC :** Magnetic flux calculation, Faraday's laws Lenz's law, Motional EMF, Induced electric filed ,Self and mutual induction, L-R,C-R,L-C-R circuits, L-C Oscillations with D-C source, LCR series circuit with AC , resonance: Quality factor, Power in AC circuits,Wattless current.AC generator and transformer

## CHEMISTRY

Atomic Structure, Stoichiometry, Surface Chemistry

## PHYSICS

1. A conducting strip, as shown in given figure is displaced at a velocity V in the plane of paper towards right through a region in which a magnetic field $\vec{B}$ is applied. Magnetic field is directed out of paper towards the observer. A galvanometer G is connected to fixed contacts (arrows) touching the moving strip. From the given situation we may conclude




1) Electric current may not flow through galvanometer

2) Current may flow through galvanometer circuit directed clockwise

3) There may not be any displacement of free electrons in the moving strip

4) Free electrons in the moving strip will be displaced downwards.

2. Two horizontal metal rails, separated by a distance L, run parallel to the x – axis. At x = 0, a resistor R is connected between the rails. A closed circuit is formed by a metal rod which slides along the rails with constant velocity $v$ such that its position at time t is given by $x = vt$ . There is a constant magnetic field B perpendicular to the plane of the rails. Neglecting the resistance of the rails and the rod and the self inductance of the circuit, calculate the power supplied to maintain the steady motion of the rod.

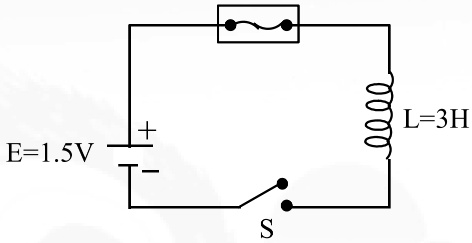
1) $\frac{BLv}{R}$ 2) $\frac{B^2L^2v}{R}$

3) $\frac{B^2L^2v^2}{R}$ 4) $\frac{BLv^2}{R}$

3. A very long hollow metallic pipe is held vertical. A small bar magnet with its N – pole pointing downwards is allowed to fall through it. After a lapse of some time, the magnet will be observed to be falling with an acceleration a, where

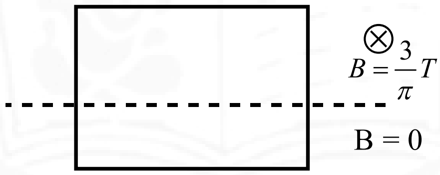
1) a > g 2) a < g 3) a = g 4) a = 0

4. In the given circuit, the cell is ideal. The coil has an inductance of 3 H and zero resistance. F is a fuse of zero resistance and will blow when the current through it reaches 3A. The switch is closed at t = 0. The fuse will blow



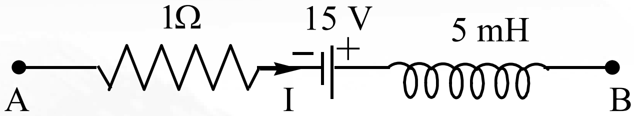

1) after 2 sec 2) after 4 sec 3) after 6 sec 4) almost at once

5. A vertical square loop of copper wire with sides of length 10 cm is falling with velocity 17 mm/sec as shown in given figure, from a region where the magnetic field is horizontal and of magnitude $\frac{3}{\pi}T$ into a region where the field is zero. If the diameter of the wire is 2 mm, the induced current in the loop will be, (the resistivity of copper = $1.7\times10^{-8}\Omega m$)



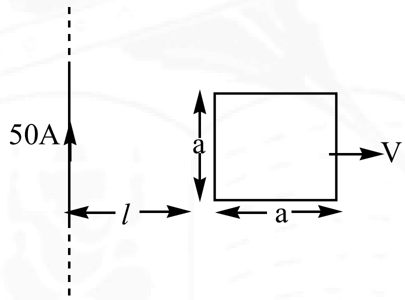

1) 0.75 A 2) 0.50 A 3) 0.25 A 4) 3.0 A

6. The network shown in figure is a part of a complete circuit. If at a certain instant the current I is 5A and is decreasing at a rate of $10^3$ A/sec. Then potential difference between B and A i.e., $V_B - V_A$ is



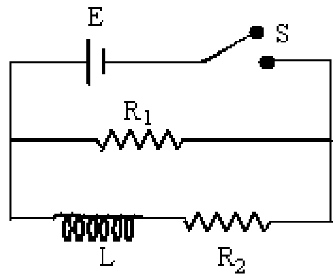

1) 20V 2) 15 V 3) 10 V 4) 5 V

7. A long straight wire carries a current of 50 A. A square loop of side a = 0.1 m has an instantaneous velocity, V = 10 m/s at the location $l$ = 0.2 m as shown in given figure. The induced emf in the loop is




1) $\frac{25}{3}\mu v$ 2) $\frac{50}{3}\mu v$ 3) $25\mu v$ 4) $12.5\mu v$

8. For the circuit shown in given figure, inductor has inductance, L =200 mH and resistors have resistances $R_1 = 1\Omega$ and $R_2 = 1\Omega$. Battery has emf 6 V and its internal resistance is negligible. The switch s is closed at t = 0. The potential drop across inductor as a function of time is



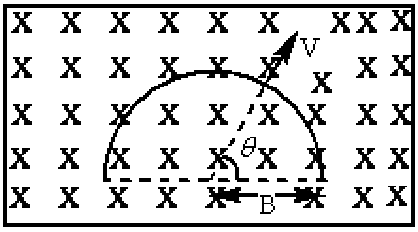

1) $6\left(1-e^{-t/0.2}\right)V$   2) $12e^{-5t}V$

3) $6e^{-5t}V$   4) $\frac{6}{t}e^{-3t}V$

9. A conducting rod of length $l$ is oscillating as a physical pendulum about one of its end with small angular amplitude $\alpha$ in a crossed magnetic field B. The maximum emf induced in the rod will be

1) $B\alpha\sqrt{\frac{1}{2}g\ell^3}$   2) $B\alpha\sqrt{\frac{3g\ell^3}{8}}$   3) $B\alpha\sqrt{\frac{1}{3}g\ell^3}$   4) $B\alpha\sqrt{g\ell^3}$

10. A semicircular conducting loop of radius R is placed in a uniform magnetic field, B. Which acts at right angle to its plane as shown in given figure. Loop is pulled with a constant velocity v. The induced emf in the loop is




1) $BV(\pi R)\cos\theta$ 2) $BV(\pi R)\sin\theta$

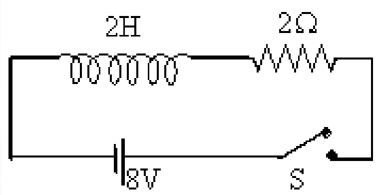
3) $BV(2R)\cos\theta$ 4) $BV(2R)\sin\theta$

11. The magnetic flux $\phi$ linked with a coil depends on time t as $\phi = at^n$ where a and n are constants. Related to emf, $\varepsilon$ induced in the coil, wrong statement is

1) $\varepsilon = 0$ if 0 <n < 1 2) $\varepsilon \neq 0$ if 0 < n < 1

3) $\varepsilon$ is constant if n = 1 4) $|\varepsilon|$ increases with time if n > 1

12. In the circuit shown in given figure switch s is closed at t = 0. At $t = \log_e 2$ sec incorrect statement is




1) potential difference across inductor is 4V

2) rate of heat dissipated across resistance is 8 J/s

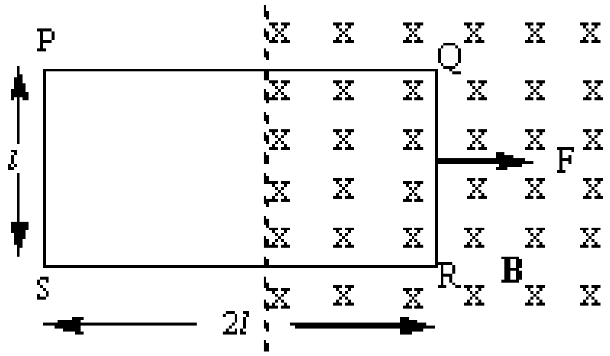
3) rate of energy supplied by the battery is 16 J/s

4) rate of energy supplied by the battery is 32 J/s

13. Two long straight wires of a telephone circuit inside a house are coplanar with and run parallel to a third long straight conductor that carries current, $I = I_0 \sin \omega t$. The wires are at distances $d_1$ and $d_2$ from the conductor respectively. The conductor creates noises in the telephone circuit by inducing emf in it. The rms value of this induced emf per unit length will be, (given $d_2 = 2d_1$, $I_0 = \frac{2\sqrt{2}}{\log_e 2}$ A, $\omega$ = 50 rad/s)

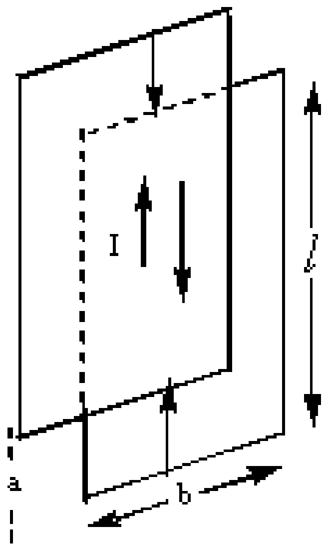
1) $2 \times 10^{-5} V/m$ 2) $4 \times 10^{-5} V/m$ 3) $1 \times 10^{-5} V/m$ 4) $5 \times 10^{-5} V/m$

14. A rectangular conducting loop PQRS, is being pulled with constant speed into a uniform transverse, magnetic field 'B' by a force F (as shown). If resistance of rectangular loop is r, potential, difference between points P and S will be




1) $\frac{Fr}{B\ell}$ 2) zero 3) $\frac{Fr}{6B\ell}$ 4) $\frac{Fr}{2B\ell}$

15. Two parallel rectangular superconducting plates of length $l$, width b and separation a $(\ell >> b >> a)$ are joined at each end to form a one – turn coil of negligible resistance. Energy stored in the magnetic field when a steady current I flows, will be

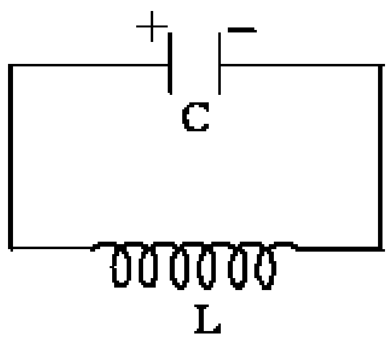



1) $\frac{\mu_0 \ell a I^2}{2b}$ 2) $\frac{\mu_0 \ell b I^2}{2a}$ 3) $\frac{\mu_0 \ell^2 I^2}{2ab}$ 4) $\frac{\mu_0 ab I^2}{2\ell}$

16. In a uniform magnetic field of induction B, a wire in the form of semicircle of radius r rotates about the diameter of the circle with angular frequency $\omega$. If the total resistance of the circuit is R, the mean power generated per period of rotation is

1) $\frac{B\pi r^2\omega}{2R}$ 2) $\frac{(B\pi r^2\omega)^2}{8R}$ 3) $\frac{(B\pi r\omega)^2}{2R}$ 4) $\frac{(B\pi r\omega^2)^2}{8R}$

17. In an ideal LC circuit, the capacitor is charged by connecting it to a dc source which is then disconnected. The current in the circuit




1) becomes zero instantaneously 2) grows monotonically
3) decays monotonically 4) oscillates instantaneously

18. In an AC circuit, an a.c source of voltage $V = V_0 \sin \omega t$ and inductor L are connected across the circuit. Then the instantaneous power will be

1) $\frac{V_0^2}{2\omega L}\sin \omega t$ 2) $\frac{-V_0^2}{2\omega L}\sin \omega t$ 3) $\frac{-V_0^2}{2\omega L}\sin 2\omega t$ 4) $\frac{V_0^2}{\omega L}\sin 2\omega t$

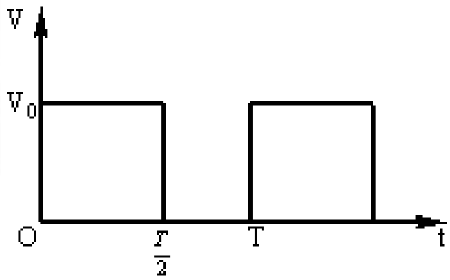
19. In an electrical circuit, R, L, C and an a.c. Voltage source are all connected in series. When L is removed from the circuit, the phase difference between the voltage and the current in the circuit is $\frac{\pi}{3}$. If instead, C is removed from the circuit, the phase difference is again $\frac{\pi}{3}$. The power factor of the circuit is

1) 1 2) $\frac{\sqrt{3}}{2}$ 3) $\frac{1}{2}$ 4) $\frac{1}{\sqrt{2}}$

20. A capacitor of capacitance C is charged to a potential difference of $V_1$, the plates of the capacitor then connected to an ideal inductor of inductance L. The current through the inductor, when the potential difference across the capacitor reduces to $V_2$ is

1) $\frac{C\left(V_1^2 - V_2^2\right)}{L}$ 2) $\frac{C\left(V_1^2 + V_2^2\right)}{L}$ 3) $\left\{\frac{C\left(V_1^2 - V_2^2\right)}{L}\right\}^{1/2}$ 4) $\left\{\frac{C\left(V_1 - V_2\right)}{L}\right\}^{1/2}$

21. In an electrical circuit, potential difference V varies with time as shown in given figure. The r.m.s value of V will be




1) $\frac{V_0}{2}$ 2) $\frac{V_0}{\sqrt{2}}$ 3) $V_0$ 4) $\frac{V_0}{\sqrt{3}}$

22. In an electrical circuit, L, C and R are connected in series with an alternating voltage source of frequency f. The current leads the voltage by $45^0$. The value of C is

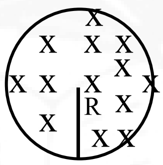
1) $\frac{1}{2\pi f(2\pi f L-R)}$ 2) $\frac{1}{2\pi f(2\pi f L+R)}$

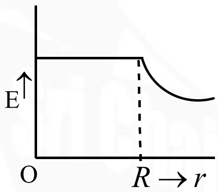
3) $\frac{1}{\pi f(2\pi f L-R)}$ 4) $\frac{1}{\pi f(2\pi f L+R)}$

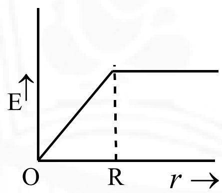
23. A coaxial cable of length 1 Km consists of two thin coaxial cylinders electrically connected at one end, an inner cylindrical conducting tube of radius 5 mm carrying a steady current I which is screened by an outer cylindrical conducting sheath of radius 10 mm which provides a return path. Now if this cable is employed to make a resistance less LC circuit by connecting it to a capacitor of capacitance $1000\mu F$, the time period of oscillations will be (nearly) $(\log_e 2 = 0.693)$

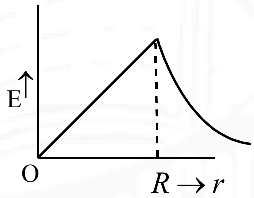
1) 1.43 ms 2) 4.23 ms 3) 6.83 ms 4) 2.33 ms

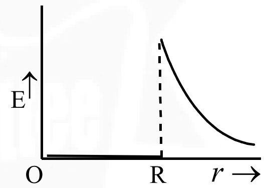
24. A uniform but time varying magnetic field B (t) exists in a circular region of radius r and is directed into the plane of the paper as shown in given figure. The magnitude of induced electric field 'E' varies with distance r from the centre of circular region in accordance to graph,



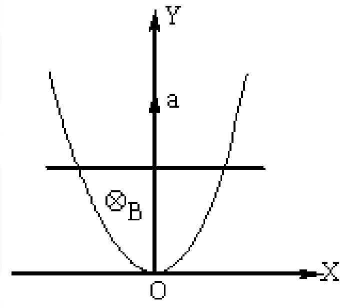

1) 

2) 

3) 

4) 

25. A wire in the shape of a parabola $y = kx^2$ is in a uniform magnetic field B perpendicular to the plane XY. A jumper translates without initial velocity and at a constant acceleration 'a' from the apex of the parabola as shown in given figure the e.m.f induced in the formed contour as a function of the co-ordinate y is




1) $By\sqrt{\frac{4a}{k}}$ 2) $By\sqrt{\frac{2a}{k}}$ 3) $By\sqrt{\frac{8a}{k}}$ 4) $By\sqrt{\frac{a}{k}}$

26. A coil of N turns with the cross sectional area A is placed inside a long solenoid. The coil is rotated at a constant angular velocity w around the axis coinciding with its diameter and perpendicular to the axis of the solenoid. The magnetic field in the solenoid varies according to the law, $B = B_0 \sin wt$. If at the instant t = 0, the axis of the coil coincides with the axis of the solenoid, the emf induced in the O coil is

1) $NB_0A$ w cos 2 wt 2) $NB_0A$ w cos wt

3) $NB_0A$ w sin 2 wt 4) $NB_0A$ w sin wt

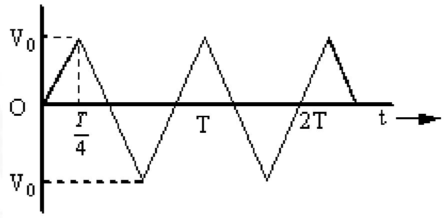
27. A 50 w, 100 V lamp is to be connected to an ac mains of 200 V, 50 Hz. The capacitance of the capacitor essential to be put in series with the lamp is

1) 4.6 $\mu F$ 2) 2.9 $\mu F$ 3) 1.5 $\mu F$ 4) 9.2 $\mu F$

28. A direct current of 5A is superimposed on an alternating current $I = (10\sin\omega t)$A flowing through a wire. The effective value of the resulting current will be

1) $\frac{15}{2}A$ 2) $5\sqrt{3}$ A 3) $5\sqrt{5}$ A 4) 15 A

29. The voltage time (V-t) graph for a triangular wave having peak value $V_0$ is as shown in figure. The r.m.s value of V is




1) $\frac{V_0}{3}$ 2) $\frac{V_0}{2}$ 3) $\frac{V_0}{\sqrt{2}}$ 4) $\frac{V_0}{\sqrt{3}}$

30. When 100 volt DC is applied across a solenoid, a current of 1.0 amp. flows in it. When 100 volt AC is applied across the same coil, the current drops to 0.5 amp. If the frequency of the AC source is 50 Hz, the impedance and inductance of the solenoid are

1) $200\Omega$ and 0.55 H 2) $100\Omega$ and 0.86 H

3) $100\Omega$ and 1.0 H 4) $100\Omega$ and 0.93 H