# JEE-ADVANCED-2013-P1-Model

Time:09:00 A.M to 12:00 Noon **IMPORTANT INSTRUCTIONS** Max Marks: 180

## PHYSICS:

| Section | Question Type | +Ve Marks | - Ve Marks | No.of Qs | Total marks |
|---|---|---|---|---|---|
| Sec – I(Q.N : 1 – 10) | Questions with Single Correct Choice | 2 | 0 | 10 | 20 |
| Sec – II(Q.N : 11 – 15) | Questions with Multiple Correct Choice | 4 | -1 | 5 | 20 |
| Sec – III(Q.N : 16 – 20) | Questions with Integer Answer Type | 4 | -1 | 5 | 20 |
| **Total** | | | | **20** | **60** |

## CHEMISTRY:

| Section | Question Type | +Ve Marks | - Ve Marks | No.of Qs | Total marks |
|---|---|---|---|---|---|
| Sec – I(Q.N : 21 – 30) | Questions with Single Correct Choice | 2 | 0 | 10 | 20 |
| Sec – II(Q.N : 31 – 35) | Questions with Multiple Correct Choice | 4 | -1 | 5 | 20 |
| Sec – III(Q.N : 36 – 40) | Questions with Integer Answer Type | 4 | -1 | 5 | 20 |
| **Total** | | | | **20** | **60** |

## MATHEMATICS:

| Section | Question Type | +Ve Marks | - Ve Marks | No.of Qs | Total marks |
|---|---|---|---|---|---|
| Sec – I(Q.N : 41 – 50) | Questions with Single Correct Choice | 2 | 0 | 10 | 20 |
| Sec – II(Q.N : 51 – 55) | Questions with Multiple Correct Choice | 4 | -1 | 5 | 20 |
| Sec – III(Q.N : 56 – 60) | Questions with Integer Answer Type | 4 | -1 | 5 | 20 |
| **Total** | | | | **20** | **60** |

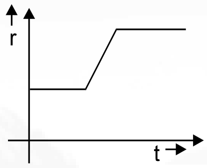
## PHYSICS: Max.Marks : 60

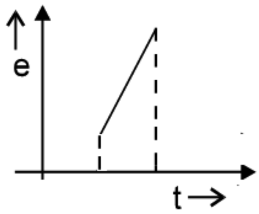
### SECTION I

**Single Correct Answer Type**

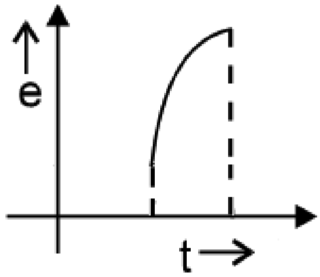
This section contains **10 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. Radius of a circular ring is changing with time and the coil is placed in uniform constant magnetic field perpendicular to its plane. The variation of ' r ' with time ' t ' is shown in the figure. Then induced e.m.f. $\varepsilon$ with time will be best represented by :

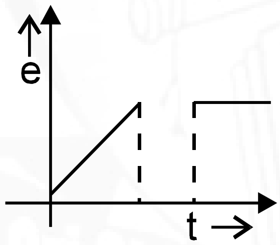


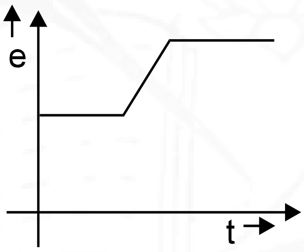

A)




B)

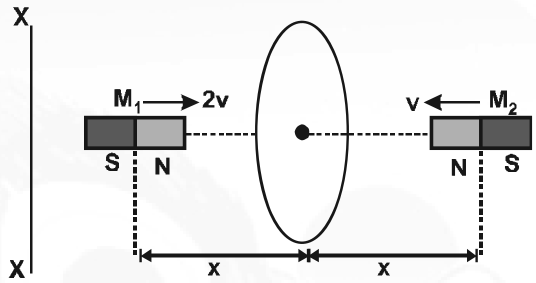



C)




D)

2. A closed conducting ring is placed in between two small bar magnets as shown in the figure. The pole strength of $M_1$ is double that of $M_2$. When the two bar magnets are at same distance from the centre of the ring, the bar magnet $M_1$ has given a velocity 2v while $M_2$ is given velocity v in the direction as shown in the figure.




The direction of induced current in the ring as seen from XX from this moment to the moment till bar magnets collide is

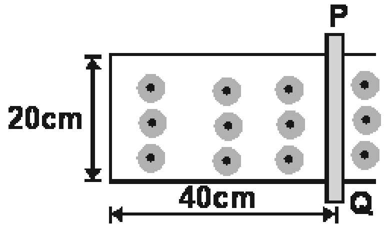
A) always clockwise

B) always anticlockwise

C) first clockwise and then anticlockwise

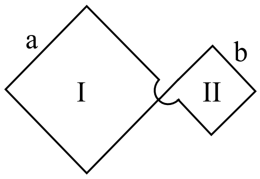
D) first anticlockwise and then clockwise

3. A conducting rod PQ of negligible resistance is sliding on a smooth U shaped tube of resistance 1Ω/m. The position of the rod at t = 0 is shown in figure. A time varying magnetic field B = 2t tesla is switched on at t = 0. By some external means the rod moves to the left at constant speed of 5cm/s. The induced emf at t = 2s has magnitude of




A) 0.12 V B) 0.08V C) 0.04V D) 0.02V

4. A plane loop shown in fig. is shaped as two squares with sides a = 0.20 m and b = 0.10 m and is introduced into a uniform magnetic field at right angles to the loops plane. The magnetic induction varies with time as $B = B_0 \sin \omega t$ where $B_0 = 10^3$ T and $\omega = 100\,\text{rad/s}$. The amplitude of current induced in the loop if the resistance per unit length is equal to (50 milli $\Omega$/metere) (The inductance of the loop is negligible).




A) Zero B) 1.0 C) 1.5 D) 0.5

**5.** Two identical coils (having same self inductances) are placed close to each other, in such a manner that 40% of the magnetic flux generated by one is linked with the other. If a current of 1 A in one coil generates a flux of $10^{-6}$Wb in it, then

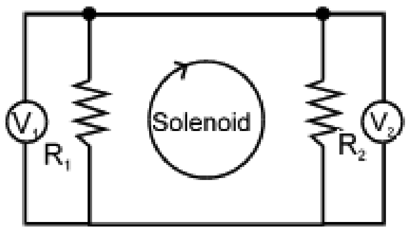
A) Self inductance of the coil is $1\mu$H.

B) Mutual inductance between the cols is $0.4\mu$H.

C) If the current mentioned in question is reversed in 0.3s, then emf induced in other coil would be 8/3 $\mu$V.

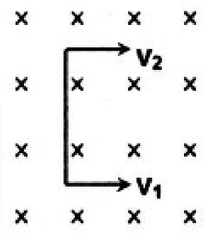
D) All of the above are correct.

**6.** The current through the solenoid is changing in such way that flux through it is given by $\phi = \varepsilon\tau$. Then the reading of the two ac voltmeters $V_1$ and $V_2$ differ by:



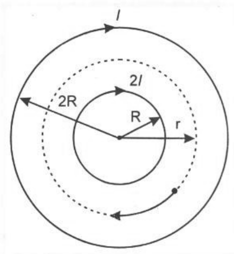

A) zero B) $\varepsilon$ C) $\left|\frac{\varepsilon(R_1 - R_2)}{R_1 + R_2}\right|$ D) $\frac{\varepsilon R_1 R_2}{R_1 + R_2}$

**7.** In the figure magnetic field points into the plane of paper and the rod of length $\ell$ is moving in this field such that the bottom most point has a velocity $v_1$ and the topmost point has the velocity $v_2$ ($v_2 > v_1$). The emf induced is given by




A) $BV_1\ell$ B) $BV_2\ell$ C) $\frac{1}{2}B(V_2+V_1)\ell$ D) $\frac{1}{2}B(V_2-V_1)\ell$

8. A long solenoid of radius 2Rcontains another coaxial solenoid of radius R. Their coils have the same number of turns per unit length and initially both carry no current. At the same instant currents start increasing linearly with time in both solenoids. At any moment the current flowing in the inner coil is twice as large as that in the outer one and their directions are the same. As a result of the increasing currents a charged particle, initially at rest between the solenoids, starts from rest moving along a circular trajectory with constant rate of change of speed. What is the radius r of the circle traced by that charged particle)

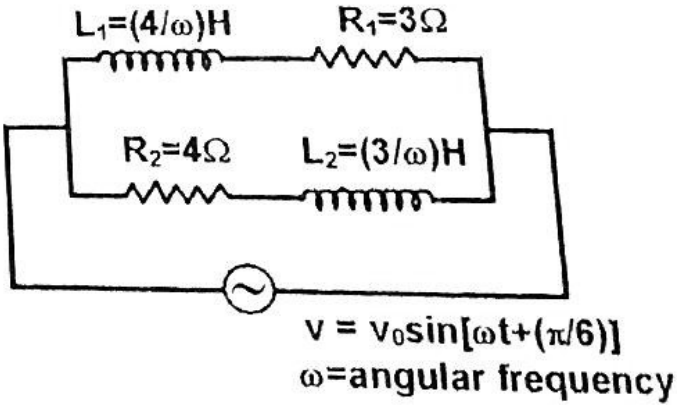



A) $\frac{3R}{2}$ B) $\sqrt{2}R$ C) $\sqrt{3}R$ D) $\frac{4R}{3}$

9. A series L-C-R circuit is connected to an AC supply of 200V and 300 rad/s. The value of resistance is 100Ω. When the capacitor is shorted, the current lags the voltage by 60° and when inductor is shorted, the current leads the voltage by 60°. The current and the power dissipated in the L-C-R circuit are respectively.

A) 1A, 200W B) 1A, 400W C) 2A, 200W D) 2A, 400W

10. A combination of inductors and resistances are conducted across an ac source as shown in the figure. The phase difference between the current flowing through $R_1$ and $R_2$ (in radians) is




A) $\frac{37\pi}{180}$ B) $\frac{\pi}{2}$ C) $\frac{16}{180}\pi$ D) can not be decided

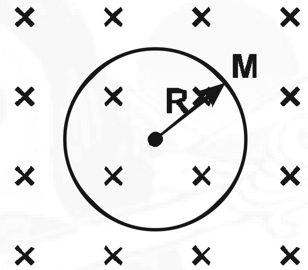
## SECTION II

### Multiple Correct Answer(s) Type

This section contains **5 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE are correct.**

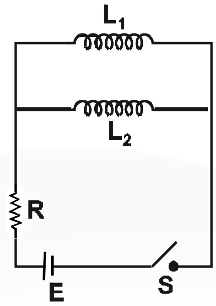
11. Which of the following statement(s) is/are correct regarding induced electric field?
A) Induced electric field is non–conservative in nature.
B) Potential difference due to induced electric field is not defined.
C) Induced electric lines of force form closed loops.
D) Induced emf in the loop is $\varepsilon = \oint \vec{E}.d\vec{\ell} = -\frac{d\phi}{dt}$, $\vec{E}$ is induced electric field.

12. A uniformly charged non-conducting disc. having charge density $\sigma$ is placed in an uniform time varying magnetic field B = $2\beta t$, as shown in the figure. The magnetic field is switched on at t = $t_0$, the disc is free to rotate in the region.




For this situation mark the correct statement(s).
A) Angular velocity of the disc at all instant is zero.
B) Angular velocity of the disc for t > $t_0$ is zero.
C) Angular velocity of the disc for t > $t_0$ is given by $\frac{\pi \sigma \beta R^2 t}{M}$ in anti clockwise direction.
D) Angular velocity of the disc for t > $t_0$ is given by $\frac{\pi \sigma \beta R^2 t}{M}$ in clockwise direction.

13. For the circuit shown in the figure. $L_1$ and $L_2$ are ideal inductors and circuit is closed at t = 0. Then,




A) Current in $L_1$ at steady state is $\frac{E}{R}\times\frac{L_2}{L_1+L_2}$

B) Current in $L_2$ at steady state is $\frac{E}{L}\times\frac{L_2}{L_1+L_2}$

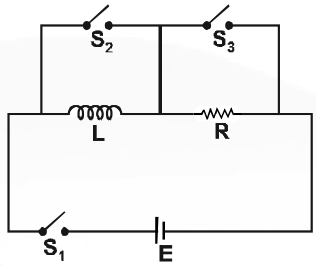
C) If a resistor $R_1$ is connected in series with $L_1$, then the current through $L_1$ at steady state is zero.

D) If a resistor $R_2$ is connected in series with $L_2$, then the current through $L_1$ at steady state is E/R.

14. Two different coils have self inductances $L_1 = 8mH \text{ and } L_2 = 2mH$. The current in both the coils is increased at the same constant rate. At a certain instant of time, the power given to the two coils is the same. At that time the current, the induced voltage and the energy stored in the first coil are $i_1$, $v_1$ and $w_1$ respectively. Corresponding values for the second coil at the same instant are $i_2$, $v_2$, and $w_2$ respectively. Then,

A) $\frac{i_1}{i_2}=\frac{1}{4}$ B) $\frac{i_1}{i_2}=4$ C) $\frac{W_2}{W_1}=4$ D) $\frac{V_2}{V_1}=\frac{1}{4}$

15. An ideal inductor of inductance L and a resistor of resistance R are connected in series to an ideal battery of emf E, as shown in figure. Three switches are also shown in the figure. For this arrangement, mark out the correct option(s). [Consider all wires of zero resistance]




A) If $S_1$ is closed at t = 0, keeping $S_2$ and $S_3$ open, then the magnetic energy stored in the inductor at $t = \infty$ is $\frac{LE^2}{2R^2}$

B) After $S_1$ has been closed for a long time, $S_1$ is opened and $S_2$ is closed (keeping $S_3$ opened) at t = 0, then the current through inductor as a function of time is $\frac{E}{R}\left[e^{-\frac{RT}{L}}\right]$.

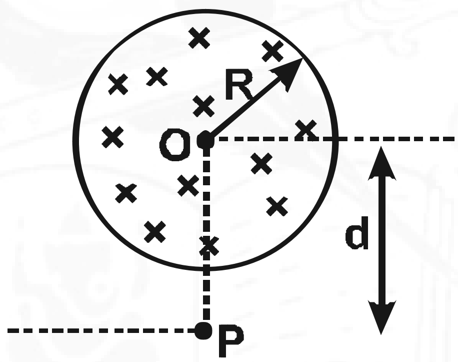
C) After $S_1$ has been closed for a long time, $S_1$ is opened and $S_2$ is closed (keeping $S_3$ opened) at t = 0, then the current through inductor for any time t > 0 is zero.

D) After $S_1$ has been closed for a long time, $S_1$ is opened and $S_2$, $S_3$ are closed at t = 0, then the current through battery as a function of time is zero.

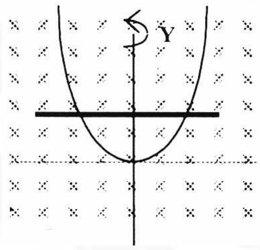
## SECTION III
### Integer Answer Type

This section contains **5 questions.** The answer to each question is single digit integer, ranging from 0 to 9 (*both inclusive*).

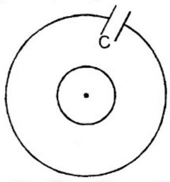
16. In a cylindrical region of radius R, these exists a time varying magnetic field B = Kt [K>0]. A charged particle having charge q is placed at the point P at a distance d from the centre of cylinder, as shown in figure. Now the particle is moved slowly in the direction perpendicular to OP by an external agent up to infinity. Work done by the external agent in doing this was $\alpha \times \frac{qK \times \pi R^2}{12}$. Determine the value of α.



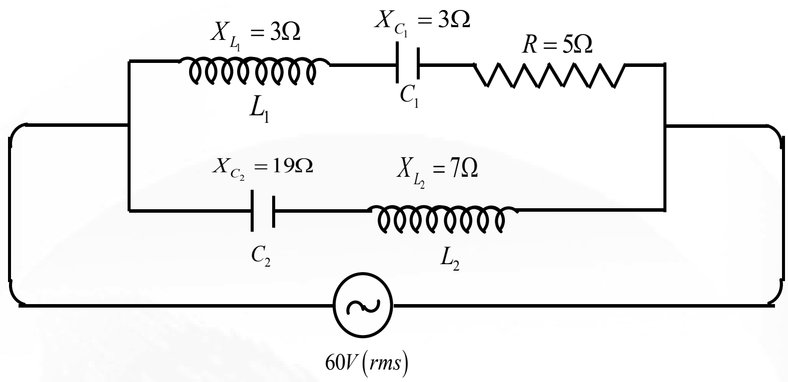
17. A conducting resistance less rod is bent as a parabola $y = Kx^2$, where K is a constant and it is placed in a uniform magnetic field of induction B. At t = 0 a conductor of resistance per unit length λ starts sliding up on the parabola with a constant acceleration a and the parabolic frame starts rotating with constant angular frequency ω about the axis of symmetry, as shown in the figure. The current induced in the rod when frame turns through an angle $\frac{\pi}{4}$ is $\frac{Ba\pi\left(\pi-12\right)}{n\times12\sqrt{2}\,\omega\lambda}$. The value of 'n' is




18. Figure shows two concentric coplanar coils with radii a and b (a<<b).
If the current in the inner loop changes according to $i=2t^2$, then the current in the capacitor after a long time is $\frac{p\mu_0\pi a^2C}{b}$ where p is an integer, then p = ______.
(Neglect the self inductance of larger loop and take the resistance of the larger loop as R)



19. In the given A.C circuit the r.m.s voltage of the source is 60V then the r.m.s current passing through the source is $(10+x)A$ then the value of $x$ is




20. In the figure, a conducting rod of length $\ell$= 1 meter and mass m = 1 kg moves with initial velocity u = 5 m/s. on a fixed horizontal frame containing inductor L = 2 H and resistance R = 1 Ω. PQ and MN are smooth, conducting wires. There is a uniform magnetic field of strength B = 1T. Initially there is no current in the inductor. Find the total charge in coulomb, flown through the inductor by the time velocity of rod becomes $v_f$ = 1 m/s and the rod has travelled a distance x= 3 meter.