22. Electromagnetic Induction – Multiple Choice Questions

1. Faraday's and Lenz's Law

1. If a coil of metal wire is kept stationary in a non-uniform magnetic field, then

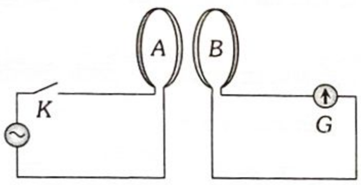
(a) An e.m.f. is induced in the coil

(b) A current is induced in the coil

(c) Neither e.m.f. nor current is induced

(d) Both e.m.f. and current is induced

2. The diagram below shows two coils A and B placed parallel to each other at a very small distance. Coil A is connected to an ac supply. G is a very sensitive galvanometer. When the key is closed



(a) Constant deflection will be observed in the galvanometer for 50 Hz supply

(b) Visible small variations will be observed in the galvanometer for 50 Hz input

(c) Oscillations in the galvanometer may be observed when the input ac voltage has a frequency of 1 to 2 Hz

(d) No variation will be observed in the galvanometer even when the input ac voltage is 1 or 2 Hz

3. The north pole of a long bar magnet was pushed slowly into a short solenoid connected to a galvanometer. The magnet was held stationary for a few seconds with the north pole in the middle of the solenoid and then withdrawn rapidly. The maximum deflection of the galvanometer was observed when the magnet was

(a) Moving towards the solenoid

(b) Moving into the solenoid

(c) At rest inside the solenoid

(d) Moving out of the solenoid

4. A coil of area $100 cm^2$ has 500 turns. Magnetic field of 0.1 *weber/metre*^{2} is perpendicular to the coil. The field is reduced to zero in 0.1 *second*. The induced e.m.f. in the coil is

(a) 1 V (b) 5 V

(c) 50 V (d) Zero

5. A coil has an area of 0.05 m^2 and it has 800 turns. It is placed perpendicularly in a magnetic field of strength $4 \times 10^{-5}\, Wb/m^2$, it is rotated through 90^o in 0.1 *sec*. The average e.m.f. induced in the coil is

(a) 0.056 V (b) 0.046 V

(c) 0.026 V (d) 0.016 V

6. A square loop of wire, side length $10 cm$ is placed at angle of $45°$ with a magnetic field that changes uniformly from $0.1 T$ to zero in 0.7 seconds. The induced current in the loop (its resistance is 1Ω) is

(a) 1.0 mA (b) 2.5 mA

(c) 3.5 mA (d) 4.0 mA

7. A circular coil of radius $R = 10 cm$ having 500 turns and total resistance 2Ω is placed initially perpendicular to the earth's magnetic field of $3 \times 10^{-5} T$. The coil is rotated about its vertical diameter by an angle 2π in 0.5 seconds. The induced current in the coil is

(a) 0.5 mA (b) 1.0 mA

(c) 1.5 mA (d) 3.0 mA

8. A cylindrical bar magnet is rotated about its axis. A wire is connected from the axis and is made to touch the cylindrical surface through a contact. Then,

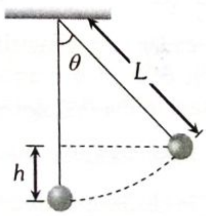
(a) A direct current flow in the ammeter A

(b) No current flows through the ammeter A

(c) An alternating sinusoidal current flow through the ammeter A with a time period $T = \frac{2\pi}{\omega}$

(d) A time varying non-sinusoidal current flows through the ammeter A

9. A simple pendulum with bob of mass m and conducting wire of length L swings under gravity through an angle 2θ. The earth's magnetic field component in the direction perpendicular to swing is B. Maximum potential difference induced across the pendulum is



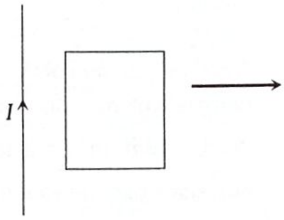
(a) $2BL\sin\left(\frac{\theta}{2}\right)(gL)^{1/2}$

(b) $BL\sin\left(\frac{\theta}{2}\right)(gL)$

(c) $BL\sin\left(\frac{\theta}{2}\right)(gL)^{3/2}$

(d) $BL\sin\left(\frac{\theta}{2}\right)(gL)^2$

10. A rectangular loop of wire shown below is coplanar with a long wire carrying current I. The loop is pulled to the right as indicated. What are the directions of the induced current in the loop and the magnetic forces on the left and the right sides of the loop



Induced current Forces on left side Force on right side

(a) Counterclockwise	To the left	To the right
(b) Clockwise	To the left	To the right
(c) Counterclockwise	To the right	To the left
(d) Clockwise	To the right	To the left

11. A square of side L metres lies in the xy-plane in a region, where the magnetic field is given by $B = B_0\ (2\hat{i} + 3\hat{j} + 4\hat{k})T$, where B_0 is constant. The magnitude of flux passing through the square is

(a) $2B_0L^2Wb$ (b) $3B_0L^2Wb$

(c) $4B_0L^2Wb$ (d) $\sqrt{29}B_0L^2Wb$

12. A loop, made of straight edges has six corners at $A(0,0,0)$, $B(L,0,0)$, $C(L,L,0)$, $D(0,L,0)$, $E(0,L,L)$ and $F(0,0,L)$. A magnetic field $B = B_0(\hat{i} + \hat{k})T$ is present in the region. The flux passing through the loop $ABCDEFA$ (in that order) is

(a) B_0L^2Wb (b) $2B_0L^2\,Wb$

(c) $\sqrt{2}B_0L^2Wb$ (d) $4B_0L^2Wb$

13. In a circuit with a coil of resistance 2 *ohms*, the magnetic flux changes from 2.0 *Wb* to 10.0 *Wb* in 0.2 second. The charge that flows in the coil during this time is

(a) 5.0 *coulomb* (b) 4.0 *coulomb*

(c) 1.0 *coulomb* (d) 0.8 *coulomb*

14. If a coil of 40 turns and area 4.0 cm^2 is suddenly removed from a magnetic field, it is observed that a charge of 2.0×10^{-4} C flows into the coil. If the resistance of the coil is 80Ω, the magnetic flux density in Wb/m^2 is

(a) 0.5 (b) 1.0

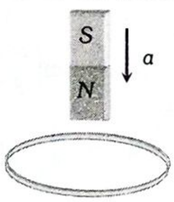
(c) 1.5 (d) 2.0

15. Lenz's law is consequence of the law of conservation of

(a) Charge (b) Momentum

(c) Mass (d) Energy

16. A metallic ring is attached with the wall of a room. When the north pole of a magnet is brought near to it, the induced current in the ring will be



(a) First clockwise then anticlockwise

(b) In clockwise direction

(c) In anticlockwise direction

(d) First anticlockwise then clockwise

17. The north pole of a long horizontal bar magnet is being brought closer to a vertical conducting plane along the perpendicular direction. The direction of the induced current in the conducting plane will be

(a) Horizontal (b) Vertical

(c) Clockwise (d) Anticlockwise

18. There is a uniform magnetic field directed perpendicular and into the plane of the paper. An irregular shaped conducting loop is slowly changing into a circular loop in the plane of the paper. Then

(a) Current is induced in the loop in the anticlockwise direction

(b) Current is induced in the loop in the clockwise direction

(c) AC is induced in the loop

(d) No current is induced in the loop

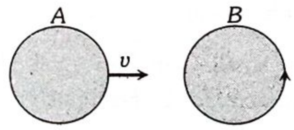
19. There are two coils A and B as shown in figure. A current starts flowing in B as shown when A is moved towards B and stops. when A stops moving, The current in A is counter clockwise. B is kept stationary when A moves. We can infer that

(a) There is a constant current in the clockwise direction in A

(b) There is a varying current in A

(c) There is no current in A

(d) There is a constant current in the counter clockwise direction in A



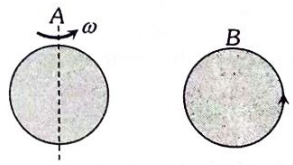
20. Same as problem 4 except the coil A is made to rotate about a vertical axis (figure). No current flows in B if A is at rest. The current in coil A, when the current in B (at $t=0$) is counter –clockwise and the coil A is as shown at this instant, $t = 0$, is

(a) Constant current clockwise

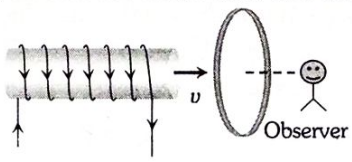
(b) Varying current clockwise

(c) Varying current counter clockwise

(d) Constant current counter clockwise



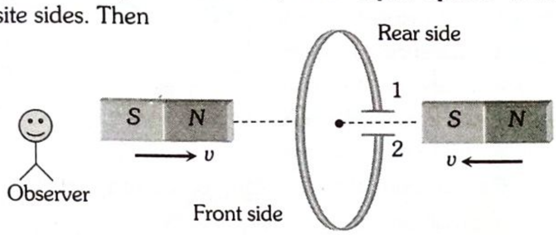
21. A current carrying solenoid is approaching a conducting loop as shown in the figure. The direction of induced current as observed by an observer on the other side of the loop will be



(a) Anticlockwise (b) Clockwise

(c) East (d) West

22. The north and south poles of two identical magnets approach a coil, containing a condenser, with equal speeds from opposite sides. Then



(a) Plate 1 will be negative and plate 2 positive

(b) Plate 1 will be positive and plate 2 negative

(c) Both the plates will be positive

(d) Both the plates will be negative

23. When a bar magnet falls through a long hollow metal cylinder fixed with its axis vertical, the final acceleration of the magnet is

(a) Equal to zero

(b) Less than g

(c) Equal to g

(d) Equal to g in the beginning and then more than g

24. When a metallic plate swings between the poles of a magnet

(a) No effect on the plate

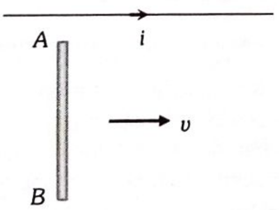
(b) Eddy currents are set up inside the plate and the direction of the current is along the motion of the plate

(c) Eddy currents are set up inside the plate and the direction of the current oppose the motion of the plate

(d) Eddy currents are set up inside the plate

2. Motional EMI

1. The current carrying wire and the rod AB are in the same plane. The rod moves parallel to the wire with a velocity v. Which one of the following statements is true about induced emf in the rod



(a) End A will be at lower potential with respect to B

(b) A and B will be at the same potential

(c) There will be no induced e.m.f. in the rod

(d) Potential at A will be higher than that at B

2. A straight conductor of length 4m moves at a speed of 10m/s. When the conductor makes an angle of 30° with the direction of magnetic field of induction of $0.1\, wb.m^2$ then induced emf is

(a) 8 V (b) 4 V

(c) 1 V (d) 2 V

3. At a place the value of horizontal component of the earth's magnetic field H is 3×10^{-5} $weber/m^2$. A metallic rod AB of length 2 m placed in east-west direction, having the end A towards east, falls vertically downward with a constant velocity of 50 m/s. Which end of the rod becomes positively charged and what is the value of induced potential difference between the two ends

(a) End A, 3×10^{-3} mV (b) End A, 3 mV

(c) End B, 3×10^{-3} mV (d) End B, 3 mV

4. A wire of length 1 m is moving at a speed of $2ms^{-1}$ perpendicular to its length and in a homogeneous magnetic field of 0.5 T. The ends of the wire are joined to a circuit of resistance 6 Ω. The rate at which work is being done to keep the wire moving at constant speed is

(a) $\frac{1}{12}W$ (b) $\frac{1}{6}W$

(c) $\frac{1}{3}W$ (d) $1W$

5. A wire of length 50 cm moves with a velocity of 300 m/min, perpendicular to a magnetic field. If the emf induced in the wire is 2 V, the magnitude of the field in tesla is

(a) 2 (b) 5

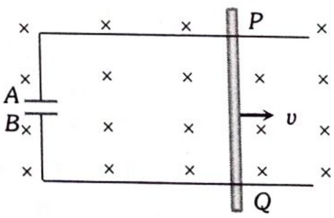
(c) 0.8 (d) 2.5

6. A straight conductor 0.1 m long moves in a uniform magnetic field 0.1 T. The velocity of the conductor is 15m/s and is directed perpendicular to the field. The $m.f.$ induced between the two ends of the conductor is

(a) 0.10 V (b) 0.15 V

(c) 1.50 V (d) 15.00 V

7. A conducting rod PQ of length L = 1.0 m is moving with a uniform speed v = 2 m/s in a uniform magnetic field $B = 4.0T$ directed into the paper. A capacitor of capacity C = 10 μF is connected as shown in figure. Then



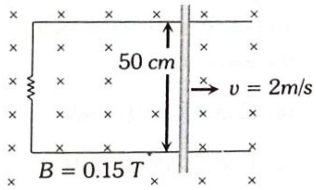
(a) q_A = + 80 μC and q_B = – 80 μC

(b) q_A = – 80 μC and q_B = + 80 μC

(c) $q_A = 0 = q_B$

(d) Charge stored in the capacitor increases exponentially with time

8. As shown in the figure a metal rod makes contact and completes the circuit. The circuit is perpendicular to the magnetic field with $B=0.15$ *tesla*. If the resistance is 3Ω, force needed to move the rod as indicated with a constant speed of $2 m/sec$ is



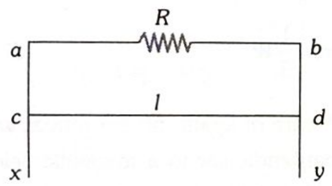
(a) $3.75\times10^{-3} N$

(b) $3.75\times10^{-2} N$

(c) $3.75\times10^{2} N$

(d) $3.75\times10^{-4} N$

9. A wire *cd* of length *l* and mass *m* is sliding without friction on conducting rails *ax* and *by* as shown. The vertical rails are connected to each other with a resistance *R* between *a* and *b*. A uniform magnetic field *B* is applied perpendicular to the plane *abcd* such that *cd* moves with a constant velocity of



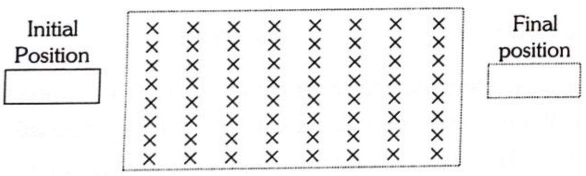
(a) $\frac{mgR}{Bl}$

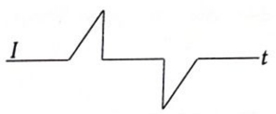
(b) $\frac{mgR}{B^2l^2}$

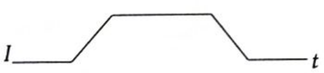
(c) $\frac{mgR}{B^3l^3}$

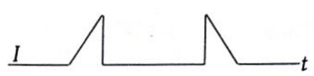
(d) $\frac{mgR}{B^2l}$

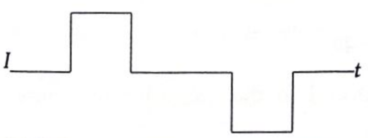
10. A small rectangular loop of wire in the plane of the paper is moved with uniform speed across a limited region of uniform magnetic field perpendicular to the plane of the paper, as shown. Which graph would best represent the variation of the electric current I, in the wire with time t



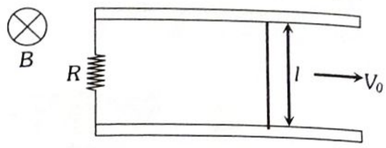
(a) 

(b) 

(c) 

(d) 

11. A conducting rod of rod of mass m and length ℓ is free to move without friction on two parallel long conducting rails, as shown below. There is a resistance R across the rails. In the entire space around, there is a uniform magnetic filed B normal to the plane of the rod and rails. The rod is given an impulsive velocity V_0



Finally, the initial energy $\frac{1}{2}mv_0^2$

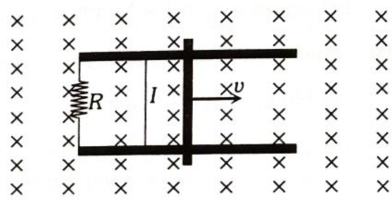
(a) Will be converted fully into heat energy in the resistor

(b) Will enable rod to continue to move with velocity V_0 since the rails are frictionless

(c) Will be converted fully into magnetic energy due to induced current

(d) Will be converted into the work done against the magnetic field

12. A conducting bar of mass m and length I moves on two frictionless parallel rails in the presence of a constant



uniform magnetic field of magnitude B directed into the page as shown in the figure. The bar is given an initial velocity V_0 towards the right at $t=0$. Then the

(a) Induced current in the circuit is in the clockwise direction

(b) Velocity of the bar decreases linearly with time

(c) Distance the bar travels before it comes to a complete stop is proportional to R

(d) Power generated across the resistance is proportional to I

13. A wheel with ten metallic spokes each $0.50\ m$ long is rotated with a speed of 120 *rev/min* in a plane normal to the earth's magnetic field at the place. If the magnitude of the field is 0.4 gauss, the induced e.m.f. between the axle and the rim of the wheel is equal to

(a) $1.256\times10^{-3} V$ (b) $6.28\times10^{-4} V$

(c) $1.256\times10^{-4} V$ (d) $6.28\times10^{-5} V$

14. A rectangular coil of 300 turns has an average area of average area of $25\ cm\times10\ cm$. The coil rotates with a speed of 50 *cps* in a uniform magnetic field of strength $4\times10^{-2}T$ about an axis perpendicular of the field. The peak value of the induced e.m.f. is (in volt)

(a) 3000π (b) 300π

(c) 30π (d) 3π

15. Two identical metallic square loops L_1 and L_2 are placed next to each other with their sides parallel on a smooth horizontal table. Loop L_1 is fixed and a current which increases as a function of time is passed through it. Then loop L_2

(a) Rotates about its centre of mass

(b) Moves towards L_1

(c) Remains stationary

(d) Moves away from L_1

16. A metallic ring of radius a and resistance R is held fixed with its axis along a spatially uniform magnetic field whose magnitude is $B_0 \sin(\omega t)$. Neglect gravity. then

(a) The current in the ring oscillates with a frequency of 2ω

(b) The joule heating loss in the ring is proportional to a^2

(c) The force per unit length on the ring will be proportional to B_0^2

(d) The net force on the ring is non – zero

17. An aircraft with a wingspan of 40 *m* flies with a speed of 1080 *km/hr* in the eastward direction at a constant altitude in the northern hemisphere, where the vertical component of the earth's magnetic field $1.75 \times 10^{-5} T$. Then the emf developed between the tips of the wings is

(a) 0.34 *V* (b) 2.1*V*

(c) 0.5 *V* (d) 0.21*V*

3. Static EMI

1. The inductance of a solenoid 0.5 *m* long of cross-sectional area 20 cm^2 and with 500 turns is

(a) 12.5 *mH* (b) 1.25 *mH*

(c) 15.0 *mH* (d) 0.12 *mH*

2. The equivalent inductance of two inductances is 2.4 *henry* when connected in parallel and 10 *henry* when connected in series. The difference between the two inductances is

(a) 2 *henry* (b) 3 *henry*

(c) 4 *henry* (d) 5 *henry*

3. Three solenoid coils of same dimension, same number of turns and same number of layers of windings are taken. Coil 1 with inductance L_1 was wound using a *Mn* wire of resistance 11 Ω/m, coil 2 with inductance L_2 was wound using the similar wire but the direction of winding was reversed in each layer; coil 3 with inductance L_3 was wound using a superconducting wire. The self inductance of the coils L_1, L_2, L_3 are

(a) $L_1 = L_2 = L_3$ (b) $L_1 = L_2; L_3 = 0$

(c) $L_1 = L_3; L_2 = 0$ (d) $L_1 > L_2 > L_3$

4. The inductance of a closed-packed coil of 400 turns is 8 *mH*. A current of 5 *mA* is passed through it. The magnetic flux through each turn of the coil is

(a) $\frac{1}{4\pi}\mu_0 Wb$ (b) $\frac{1}{2\pi}\mu_0 Wb$

(c) $\frac{1}{3\pi}\mu_0 Wb$ (d) $0.4\,\mu_0 Wb$

5. A circular coil of radius 5 *cm* has 500 turns of a wire. The approximate value of the coefficient of self induction of the coil will be

(a) 25 *millihenry* (b) 25×10^{-3} *millihenry*

(c) 50×10^{-3} *millihenry* (d) 50×10^{-3} *henry*

6. Two identical induction coils each of inductance *L* joined in series are placed very close to each other such that the winding direction of one is exactly opposite to that of the other. What is the net inductance

(a) L^2 (b) 2*L*

(c) *L*/2 (d) Zero

7. When the current through a solenoid increases at a constant rate, the induced current

(a) Is constant and is in the direction of the inducing current

(b) Is constant and is opposite to the direction of the inducing current

(c) Increases with time and is in the direction of the inducing current

(d) Increases with time and opposite to the direction of the inducing current

8. A short solenoid of radius *a*, number of turns per unit length n_1, and length *L* is kept coaxially inside a very long solenoid of radius *b*, number of turns per unit length n_2. What is the mutual inductance of the system

(a) $\mu_0 \pi b^2 n_1 n_2 L$ (b) $\mu_0 \pi a^2 n_1 n_2 L^2$

(c) $\mu_0 \pi a^2 n_1 n_2 L$ (d) $\mu_0 \pi b^2 n_1 n_2 L^2$

9. According to phenomenon of mutual inductance

(a) The mutual inductance does not depend on geometry of two coils involved

(b) The mutual inductance depends on the intrinsic magnetic property, like relative permeability of material

(c) The mutual inductance is independent of the magnetic property of the material

(d) Ratio of magnetic flux produced by the coil 1 at the place of the coil 2 and the current in the coil 2 will be different from that of the ratio defined by interchanging the coils.

10. Two conducting circular loops of radii R_1 and R_2 are placed in the same plane with their centres coinciding. If $R_1 >> R_2$, the mutual inductance M between them will be directly proportional to

(a) R_1 / R_2 (b) R_2 / R_1

(c) R_1^2 / R_2 (d) R_2^2 / R_1

11. The mutual inductance between two coils is 1.25 *henry*. If the current in the primary changes at the rate of 80 *ampere/second*, then the induced e.m.f. in the secondary is

(a) 12.5 *V* (b) 64.0 *V*

(c) 0.016 *V* (d) 100.0 *V*

12. If a current of 3.0 *amperes* flowing in the primary coil is reduced to zero in 0.001 *second*, then the induced e.m.f. in the secondary coil is 15000 *volts*. The mutual inductance between the two coils is

(a) 0.5 *henry* (b) 5 *henry*

(c) 1.5 *henry* (d) 10 *henry*

13. Two circuits have coefficient of mutual induction of 0.09 *henry*. Average e.m.f. induced in the secondary by a change of current from 0 to 20 *ampere* in 0.006 *second* in the primary will be

(a) 120 V (b) 80 V

(c) 200 V (d) 300 V

14. A current $I = 10 \sin (100\,\pi t)$ A is passed in first coil, which induces a maximum emf of $5\,\pi V$ in second coil. The mutual inductance between the coils is

(a) 5 *mH* (b) 10 *mH*

(c) 15 *mH* (d) 20 *mH*

15. A solenoid has 2000 turns wound over a length of 0.30 *metre*. The area of its cross-section is $1.2\times10^{-3} m^2$. Around its central section, a coil of 300 turns is wound. If an initial current of 2 A in the solenoid is reversed in 0.25 *sec*, then the e.m.f. induced in the coil is

(a) $6\times10^{-4}V$ (b) $4.8\times10^{-3}V$

(c) $6\times10^{-2}V$ (d) 48 *mV*

16. A coil of resistance 10 Ω and an inductance 5*H* is connected to a 100 *volt* battery. Then energy stored in the coil is

(a) 125 *erg* (b) 125 *J*

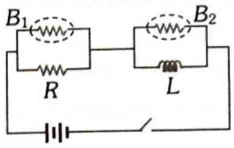
(c) 250 *erg* (d) 250 *J*

17. A uniformly wound solenoid coil of self-inductance $1.8\times10^{-4}H$ and resistance 6Ω is broken up into two identical coils. These identical coils are then connected in parallel across a 12 V battery of negligible resistance.The time constant for the current in the circuit is

(a) 0.1×10^{-4} s (b) 0.2×10^{-1} s

(c) 0.3×10^{-4} s (d) 0.4×10^{-4} s

18. If the switch in the following circuit is turned off, then



(a) The bulb B_1 will go out immediately whereas B_2 after sometimes

(b) The bulb B_2 will go out immediately whereas B_1 after sometime

(c) Both B_1 and B_2 will go out immediately

(d) Both B_1 and B_2 will go out after sometime

19. In an *LR*-circuit, time constant is that time in which current grows from zero to the value (where I_0 is the steady state current)

(a) $0.63\,I_0$ (b) $0.50\,I_0$

(c) $0.37\,I_0$ (d) I_0

20. The current in a *LR* circuit builds up to 3/4th of its steady state value in 4s. The time constant of this circuit is

(a) $\frac{1}{\ln 2}s$ (b) $\frac{2}{\ln 2}s$

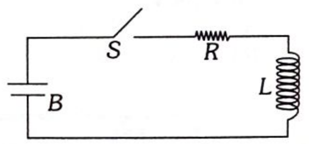
(c) $\frac{3}{\ln 2}s$ (d) $\frac{4}{\ln 2}s$

21. An inductor of 2 *henry* and a resistance of 10 *ohms* are connected in series with a battery of 5 *volts*. The initial rate of change of current is

(a) 0.5 *amp/sec* (b) 2.0 *amp/sec*

(c) 2.5 *amp/sec* (d) 0.25 *amp/sec*

22. The circuit shown consider of a switch (S), a battery (B) of *emf* E, a resistance R, and an inductor L.

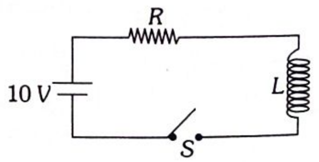


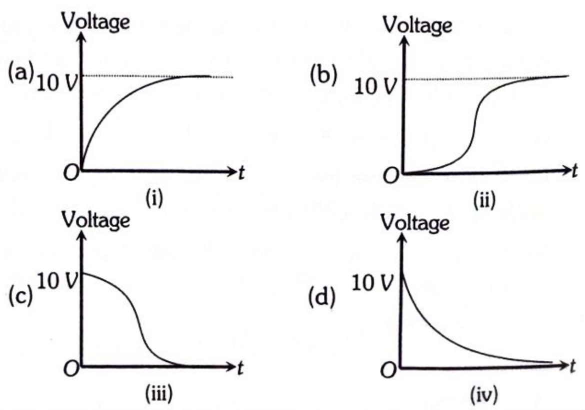
The current in the circuit at the instance the switch is closed is

(a) E/R (b) $E/R(1-e)$

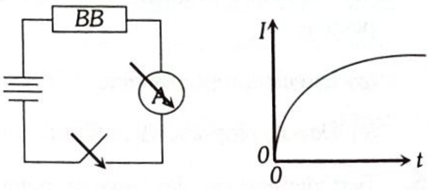
(c) ∞ (d) 0

23. In the circuit shown, the switch is closed at time $t=0$ which of the graphs shown below best represents the voltage across the inductor, as seen on an oscilloscope





24. A black box (BB) which may contain a combination of electrical circuit elements (resistor, capacitor or inductor) is connected with other external circuit elements as shown below in the figure (a). After the switch (S) is closed at time $t=0$, the current (I) as a function of time (t) is shown in the figure (b).



(a) (b)

From this we can infer that the black box contains

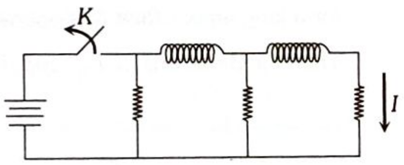
(a) A resistor and a capacitor in series

(b) A resistor and a capacitor in parallel

(c) A resistor and an inductor in series

(d) A resistor and an inductor in parallel

25. In the circuit shown below, all the inductor (assumed ideal) and resistors are identical. The current through the resistance on the right is I after the key K has been switched on for a long time. The currents through the three resistors (in order, from left to right) immediately after the key is switched off are



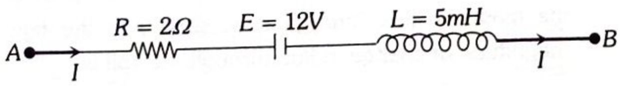
(a) $2I$ upwards, I downwards and I downwards

(b) $2I$ downwards, I downwards and I downwards

(c) I downwards, I downwards and I downwards

(d) $0.I$ downwards and I downwards

26. The Network shown in Figure is a part of the circuit. (The battery has negligible resistance)



At a certain instant the current $I=2A$ and it is decreasing at the rate of $10^2 As^{-1}$. What is the potential difference between the point B and A

(a) 8.0 V (b) 8.5 V

(c) 10 V (d) 15 V

4. Application of EMI (Dynamo, Transformer...)

1. Which of the following is constructed on the principle of electromagnetic induction

(a) Galvanometer (b) Electric motor

(c) Generator (d) Voltmeter

2. A transformer is employed to

(a) Obtain a suitable dc voltage

(b) Convert dc into ac

(c) Obtain a suitable ac voltage

(d) Convert ac into dc

3. Voltage in the secondary coil of a transformer does not depend upon

(a) Voltage in the primary coil

(b) Ratio of number of turns in the two coils

(c) Frequency of the source

(d) Both (a) and (b)

4. When power is drawn from the secondary coil of the transformer, the dynamic resistance

(a) Increases (b) Decreases

(c) Remains unchanged (d) Changes erratically

5. Core of transformer is made up of

(a) Soft iron (b) Steel

(c) Iron (d) Alnico

6. The turn ratio of a transformers is given as 2 : 3. If the current through the primary coil is 3 A, thus calculate the current through load resistance

(a) 1 A (b) 4.5 A

(c) 2 A (d) 1. 5 A

7. A step up transformer connected to a 220 V AC line is to supply 22 kV for a neon sign in secondary circuit. In primary circuit a fuse wire is connected which is to blow when the current in the secondary circuit exceeds 10 mA. The turn ratio of the transformer is

(a) 50 (b) 100

(c) 150 (d) 200

8. The ratio of secondary to the primary turns in a transformer is 3 : 2. If the power output be P, then the input power neglecting all losses must be equal to

(a) 5 P (b) 1.5 P

(c) P (d) $\frac{2}{5}P$

9. A power transformer is used to step up an alternating e.m.f. of 220 V to 11 kV to transmit 4.4 kW of power. If the primary coil has 1000 turns, what is the current rating of the secondary ? Assume 100% efficiency for the transformer

(a) 4 A (b) 0.4 A

(c) 0.04 A (d) 0.2 A

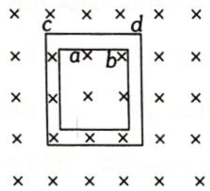
10. The number of turns of the primary and the secondary coils of a transformer are 10 and 100 respectively. The primary voltage and the current are given as 2 V and 1 A. Assuming the efficiency of the transformer as 90%, the secondary voltage and the current respectively are

(a) $20V$ and $0.1A$ (b) $0.2V$ and $1A$

(c) $20V$ and $0.09A$ (d) $0.2V$ and $0.9A$

5. IIT-JEE/AIEEE

1. The figure shows certain wire segments joined together to form a coplanar loop. The loop is placed in a perpendicular magnetic field in the direction going into the plane of the figure. The magnitude of the field increases with time. I_1 and I_2 are the currents in the segments **ab** and **cd.** Then, **[2009]**



(a) $I_1 > I_2$

(b) $I_1 < I_2$

(c) I_1 is in the direction **ba** and I_2 is in the direction **cd**

(d) I_1 is in the direction **ab** and I_2 is in the direction **dc**

2. The magnetic flux linked with a coil, in *webers*, is given by the equations $\phi = 3t^2 + 4t + 9$. Then the magnitude of induced e.m.f. at t = 2 *second* will be **[2006]**

(a) 2 *volt* (b) 4 *volt*

(c) 8 *volt* (d) 16 *volt*

3. A coil having n turns and resistance $R\,\Omega$ is connected with a galvanometer of resistance $4R\Omega$. This combination is moved in time t *seconds* from a magnetic field W_1 *weber* to W_2 *weber*. The induced current in the circuit is **[2004]**

(a) $-\dfrac{W_2 - W_1}{5\,Rnt}$ (b) $-\dfrac{n(W_2 - W_1)}{5\,Rt}$

(c) $-\dfrac{(W_2 - W_1)}{Rnt}$ (d) $-\dfrac{n(W_2 - W_1)}{Rt}$

4. An infinitely long cylinder is kept parallel to a uniform magnetic field B directed along positive z-axis. The direction of induced current as seen from the z axis will be **[2005]**

(a) Clockwise of the $+ve$ z axis

(b) Anticlockwise of the $+ve$ z axis

(c) Zero

(d) Along the magnetic field

5. A circular loop of radius R carrying current I lies in x-y plane with its centre at origin. The total magnetic flux through x-y plane is **[1999]**

(a) Directly proportional to I (b) Directly proportional to R

(c) Directly proportional to R^2 (d) Zero

6. Two identical circular loops of metal wire are lying on a table without touching each other. Loop-A carries a current which increases with time. In response, the loop-B **[1999]**

(a) Remains stationary

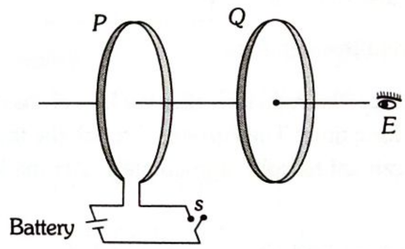
(b) Is attracted by the loop-A

(c) Is repelled by the loop-A

(d) Rotates about its CM, with CM fixed

(CM is the centre of mass)

7. As shown in the figure, P and Q are two coaxial conducting loops separated by some distance. When the switch S is closed, a clockwise current I_P flows in P (as seen by E) and an induced current I_{Q_1} flows in Q. The switch remains closed for a long time. When S is opened, a current I_{Q_2} flows in Q. Then the directions of I_{Q_1} and I_{Q_2} (as seen by E) are **[2002]**



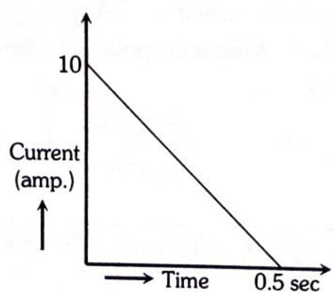
(a) Respectively clockwise and anticlockwise

(b) Both clockwise

(c) Both anticlockwise

(d) Respectively anticlockwise and clockwise

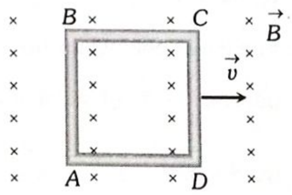
8. In a coil resistance 100Ω, a current is induced by changing the magnetic flux through it as shown in the figure. The magnitude of change in flux through the coil is **[2017]**



(a) 275 Wb (b) 200 Wb

(c) 225 Wb (d) 250 Wb

9. A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnetic induction B constant in time and space, pointing perpendicular and into the plane of the loop exists everywhere. The current induced in the loop is **[1989]**



(a) $\frac{Blv}{R}$ clockwise

(b) $\frac{Blv}{R}$ anticlockwise

(c) $\frac{2Blv}{R}$ anticlockwise

(d) Zero

10. A metal rod moves at a constant velocity in a direction perpendicular to its length. A constant uniform magnetic field exists in space in a direction perpendicular to the rod as well as its velocity. Select the correct statement(s) from the following **[1998]**

(a) The entire rod is at the same electric potential

(b) There is an electric field in the rod

(c) The electric potential is highest at the centre of the rod and decreases towards its ends

(d) The electric potential is lowest at the centre of the rod and increases towards its ends

11. A 10 *metre* wire kept in east-west direction is falling with velocity 5 *m/sec* perpendicular to the field 0.3×10^{-4} Wb/m^2. The induced e.m.f. across the terminal will be **[2011]**

(a) 0.15 V (b) 1.5 mV

(c) 1.5 V (d) 15.0 V

12. Two rails of a railway track insulated from each other and the ground are connected to a milli voltmeter. What is the reading of voltmeter, when a train travels with a speed of 180 *km/hr* along the track. Given that the vertical component of earth's magnetic field is 0.2×10^{-4} $weber/m^2$ and the rails are separated by 1 *metre* **[1981]**

(a) 10^{-2} *volt* (b) 10^{-4} *volt*

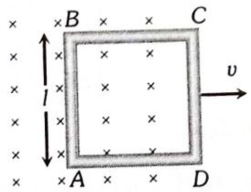
(c) 10^{-3} *volt* (d) 1 *volt*

13. A boat is moving due east in a region where the earth's magnetic field is $5.0\times10^{-5}NA^{-1}m^{-1}$ due north and horizontal. The boat carries a vertical aerial $2m$ long. If the speed of the boat is $1.50ms^{-1}$, the magnitude of the induced emf in the wire of aerial is **[2011]**

(a) 1 mV (b) 0.75 mV

(c) 0.50 mV (d) 0.15 mV

14. A conducting square loop of side l and resistance R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnetic induction B constant in time and space, pointing perpendicular and into the plane at the loop exists everywhere with half the loop outside the field, as shown in figure. The induced e.m.f. is **[2002]**



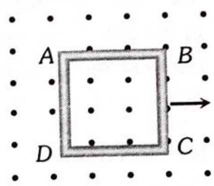
(a) Zero

(b) RvB

(c) vBl/R

(d) vBl

15. A metallic square loop $ABCD$ is moving in its own plane with velocity v in a uniform magnetic field perpendicular to its plane as shown in the figure. An electric field is induced **[2001]**



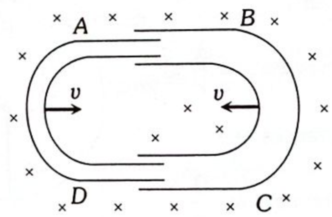
(a) In AD, but not in BC

(b) In BC, but not in AD

(c) Neither in AD nor in BC

(d) In both AD and BC

16. One conducting U tube can slide inside another as shown in figure, maintaining electrical contacts between the tubes. The magnetic field B is perpendicular to the plane of the figure. If each tube moves towards the other at a constant speed v then the emf induced in the circuit in terms of B, l and v where l is the width of each tube, will be **[2005]**



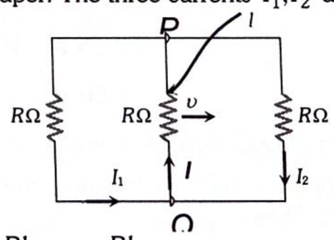
(a) Zero

(b) $2Blv$

(c) Blv

(d) $-Blv$

17. A rectangular loop has a sliding connector PQ of length l and resistance $R\ \Omega$ and it is moving with a speed v as shown. The set-up is placed in a uniform magnetic field going into the plane of the paper. The three currents I_1, I_2 and I are **[2010]**



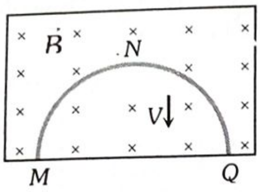
(a) $I_1 = I_2 = \frac{Blv}{6R},\ I = \frac{Blv}{3R}$

(b) $I_1 = -I_2 = \frac{Blv}{R},\ I = \frac{2Blv}{R}$

(c) $I_1 = I_2 = \frac{Blv}{3R},\ I = \frac{2Blv}{3R}$

(d) $I_1 = I_2 = I = \frac{Blv}{R}$

18. A thin semicircular conducting ring of radius R is falling with its plane vertical in a horizontal magnetic induction B. At the position MNQ, the speed of the ring is V and the potential difference developed across the ring is **[1996]**



(a) Zero

(b) $Bv\pi R^2/2$ and M is at higher potential

(c) πRBV and Q is at higher potential

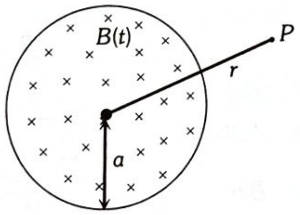
(d) $2RBV$ and Q is at higher potential

19. A short-circuited coil is placed in a time-varying magnetic field. Electrical power is dissipated due to the current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be **[2002]**

(a) Halved (b) The same

(c) Doublcd (d) Quadrupled

20. A uniform but time-varying magnetic field $B(t)$ exists in a circular region of radius a and is directed into the plane of the paper, as shown. The magnitude of the induced electric field at point P at a distance r from the centre of the circular region **[2000]**



(a) Is zero

(b) Decreases as $\frac{1}{r}$

(c) Increases as r

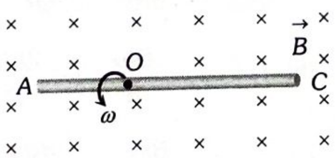
(d) Decreases as $\frac{1}{r^2}$

21. A metal conductor of length $1m$ rotates vertically about one of its ends at angular velocity 5 *radians per second*. If the horizontal component of earth's magnetic field is $0.2\times10^{-4}\ T$, then the e.m.f. developed between the two ends of the conductor is **[2004]**

(a) $5\ mV$ (b) $5\times10^{-4}\ V$

(c) $50\ mV$ (d) $50\ \mu V$

22. A conducting rod AC of length $4l$ is rotated about a point O in a uniform magnetic field $\vec{B}$ directed into the paper. $AO = l$ and $OC = 3l$. Then **[2013]**



(a) $V_A - V_O = \frac{B\omega l^2}{2}$

(b) $V_O - V_C = \frac{7}{2}B\omega l^2$

(c) $V_A - V_C = 4B\omega l^2$

(d) $V_C - V_O = \frac{9}{2}B\omega l^2$

23. In an AC generator, a coil with N turns, all of the same area A and total resistance R, rotates with frequency ω in a magnetic field B. The maximum value of emf generated in the coil is **[2006]**

(a) N.A.B (b) N.A.B.R

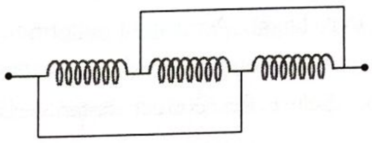
(c) N.A.B. ω (d) N.A.B.R. ω

24. In circular coil, when no. of turns is doubled and resistance becomes $\frac{1}{4}th$ of initial, then inductance becomes **[2002]**

(a) 4 *times* (b) 2 *times*

(c) 8 *times* (d) No change

25. Pure inductance of 3.0 H is connected as shown below. The equivalent inductance of the circuit is **[2002]**



(a) 1 H (b) 2 H

(c) 3 H (d) 9 H

26. When the current changes from + $2A$ to – $2A$ in 0.05 *second*, an e.m.f. of 8 V is induced in a coil. The coefficient of self-induction of the coil is **[2003]**

(a) 0.1 H (b) 0.2 H

(c) 0.4 H (d) 0.8 H

27. Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon **[2003]**

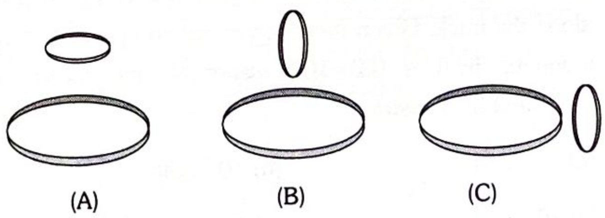
(a) The rates at which currents are changing in the two coils

(b) Relative position and orientation of the two coils

(c) The material of the wires of the coils

(d) The currents in the two coils

28. Two circular coils can be arranged in any of the three situations shown in the figure. Their mutual inductance will be **[2001]**



(a) Maximum in situation (A) (b) Maximum in situation (B)

(c) Maximum in situation (C) (d) The same in all situations

29. A small square loop of wire of side l is placed inside a large square loop of wire of side L ($L > l$). The loops are coplanar and their centres coincide. The mutual inductance of the system is proportional to **[1998]**

(a) l / L (b) l^2 / L

(c) L / l (d) L^2 / l

30. Two coaxial solenoids are made by winding thin insulated wire over a pipe of cross-sectional area A = 10 cm^2 and length = 20 cm. If one of the solenoids has 300 turns and the other 400 turns, their mutual inductance is **[2008]**

$(\mu_0 = 4\pi \times 10^{-7} TmA^{-1})$

(a) $4.8\pi \times 10^{-4} H$ (b) $4.8\pi \times 10^{-5} H$

(c) $2.4\pi \times 10^{-3} H$ (d) $4.8\pi \times 10^{4} H$

31. A circular loop of radius 0.3 *cm* lies parallel to a much bigger circular loop of radius 20 *cm*. The centre of the small loop is on the axis of the bigger loop. The distance between their centres is 15 *cm*. If a current of 2.0 *A* flows through the smaller loop, then the flux linked with bigger loop is **[2013]**

(a) 9.1×10^{-11} *weber* (b) 6×10^{-11} *weber*

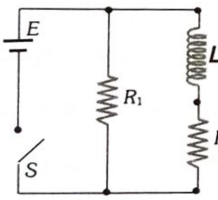
(c) 3.3×10^{-11} *weber* (d) 6.6×10^{-9} *weber*

32. An ideal coil of 10 *henry* is joined in series with a resistance of 5 *ohm* and a battery of 5 *volt*. 2 second after joining, the current flowing in *ampere* in the circuit will be **[2007]**

(a) e^{-1} (b) $(1-e^{-1})$

(c) $(1-e)$ (d) e

33. An inductor of inductance L = 400 *mH* and resistors of resistances $R_1 = 2\Omega$ and $R_2 = 2\Omega$ are connected to a battery of *emf* 12*V* as shown in the figure. The internal resistance of the battery is negligible. The switch *S* is closed at $t = 0$. The potential drop across *L* as a function of time is **[2009]**



(a) $6e^{-5t}V$ (b) $\frac{12}{t}e^{-3t}V$

(c) $6\left(1-e^{\frac{-t}{0.2}}\right)V$ (d) $12e^{-5t}V$

34. A coil of inductance 300 *mH* and resistance 2Ω is connected to a source of voltage 2*V*. The current reaches half of its steady state value in **[2005]**

(a) 0.15 *s* (b) 0.3 *s*

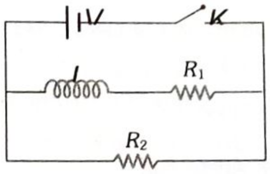
(c) 0.05 *s* (d) 0.1 *s*

35. A coil of inductance 8.4 *mH* and resistance 6 Ω is connected to a 12 *V* battery. The current in the coil is 1.0 *A* in the time (approx.) **[1999]**

(a) 500 *sec* (b) 20 *sec*

(c) 35 *milli sec* (d) 1 *milli sec*

36. In the circuit shown below, the key *K* is closed at $t = 0$. The current through the battery is **[2010]**



(a) $\frac{V(R_1+R_2)}{R_1R_2}$ at $t=0$ and $\frac{V}{R_2}$ at $t=\infty$

(b) $\frac{V(R_1+R_2)}{\sqrt{R_1^2+R_2^2}}$ at $t=0$ and $\frac{V}{R_2}$ at $t=\infty$

(c) $\frac{V}{R_2}$ at $t=0$ and $\frac{V(R_1+R_2)}{R_1R_2}$ at $t=\infty$

(d) $\frac{V}{R_2}$ at $t=0$ and $\frac{V(R_1+R_2)}{\sqrt{R_1^2+R_2^2}}$ at $t=\infty$

37. A coil of wire having finite inductance and resistance has a conducting ring placed coaxially within it. The coil is connected to a battery at time *t*=0, so that a time-dependent current $I_1(t)$ starts flowing through the coil. If $I_2(t)$ is the current induced in the ring and $B(t)$ is the magnetic field at the axis of the coil due to $I_1(t)$, then as a function of time (t>0), the product $I_2(t)\,B(t)$ **[2000]**

(a) Increases with time (b) Decreases with time

(c) Does not vary with time (d) Passes through a maximum

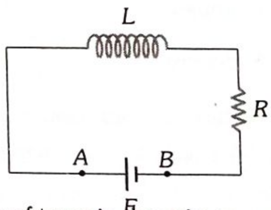
38. An inductor (L=100 *mH*), a resistor ($R = 100\Omega$) and a battery ($E = 100V$) are initially connected in series as shown in the figure. After a long time the battery is disconnected after short circuiting the points *A* and *B*. The current in the circuit 1 *ms* after the short circuit is **[2006]**

(a) e A

(b) 0.1 A

(c) 1 A

(d) 1/e A



39. In a transformer, number of turns in the primary are 140 and that in the secondary are 280. If current in primary is 4A, then that in the secondary is **[2002]**

(a) 4 *A* (b) 2 *A*

(c) 6 *A* (d) 10 *A*

40. A coil is suspended in a uniform magnetic field, with the plane of the coil parallel to the magnetic lines of force. When a current is passed through the coil it starts oscillating; it is very difficult to stop. But if an aluminium plate is placed near to the coil, it stops. This is due to **[2012]**

(a) Development of air current when the plate is placed

(b) Induction of electrical charge on the plate

(c) Shielding of magnetic lines of force as aluminium is a paramagnetic material

(d) Electromagnetic induction in the aluminium plate giving rise to electromagnetic damping

6. NEET/AIPMT

1. According to the Faraday's law of electromagnetic induction which of the following is true **[1993]**

(a) Conservation of charge

(b) Conservation of magnetic flux

(c) Conservation of energy

(d) Newton's law of equal and opposite forces

2. A coil of resistance 400Ω is placed in a magnetic field. If the magnetic flux ϕ (wb) linked with the coil varies with time t (sec) as $\phi = 50t^2 + 4$. The current in the coil at t = 2 sec is **[2012]**

(a) 0.5 *A* (b) 0.1 *A*

(c) 2 *A* (d) 1 *A*

3. A magnetic field of 2×10^{-2} *T* acts at right angles to a coil of area 100 cm^2 with 50 turns. The average emf induced in the coil is 0.1 *V*, when it is removed from the field in time *t*. The value of *t* is **[1992]**

(a) 0.1 *sec* (b) 0.01 *sec*

(c) 1 *sec* (d) 20 *sec*

4. A rectangular coil of 20 turns and area of cross-section 25 *sqcm* has a resistance of 100 *ohm*. If a magnetic field which is perpendicular to the plane of the coil changes at the rate of 1000 *tesla* per second, the current in the coil is **[1992]**

(a) 1.0 *ampere* (b) 50 *ampere*

(c) 0.5 *ampere* (d) 5.0 *ampere*

5. A conducting circular loop is placed in a uniform magnetic field 0.04 *T* with its plane perpendicular to the magnetic field. The radius of the loop starts shrinking at 2 *mm/s*. The induced *emf* in the loop when the radius is 2 *cm* is **[2009]**

(a) 3.2 $\pi\mu V$ (b) 4.8$\pi\mu V$

(c) 0.8 $\pi\mu V$ (d) 1.6 $\pi\mu V$

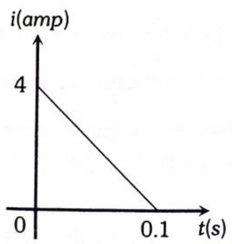
6. In a coil of resistance 10Ω, the induced current developed by changing magnetic flux through it, is shown in figure as a function of time. The magnitude of change in flux through the coil in Weber is **[2012]**

(a) 8

(b) 2

(c) 6

(d) 4



7. A rectangular, a square, a circular and an elliptical loop, all in the $(x - y)$ plane, are moving out of a uniform magnetic field with a constant velocity $\vec{V} = v\hat{i}$. The magnetic field is directed along the negative *z*-axis direction. The induced *emf*, during the passage of these loops, out of the field region, will not remain constant for **[2009]**

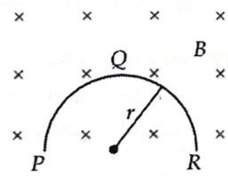
(a) The rectangular, circular and elliptical loops

(b) The circular and the elliptical loops

(c) Only the elliptical loop

(d) Any of the four loops

8. A thin semicircular conducting ring (PQR) of radius *r* is falling with its plane vertical in a horizontal magnetic field B, as shown in figure. The potential difference developed across the ring when its speed is v, is **[2014]**



(a) πrBv and R is at higher potential

(b) $2rBv$ and R is at higher potential

(c) Zero

(d) $Bv\pi r^2/2$ and P is at higher potential

9. A conducting circular loop is placed in a uniform magnetic field, $B = .025\,T$ with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of 1 mms^{-1}. The induced e.m.f. when radius is 2*cm*, is **[2010]**

(a) 2 μV (b) $2\pi\mu V$

(c) $\pi\mu V$ (d) $\frac{\pi}{2}\mu V$

10. A circular disc of radius 0.2 *m* is placed in a uniform magnetic field of induction $\frac{1}{\pi}(Wb/m^2)$ in such a way that its axis makes an angle of 60° with vector $\vec{B}$. The magnetic flux linked with the disc is **[2008]**

(a) 0.08 *Wb* (b) 0.01 *Wb*

(c) 0.02 *Wb* (d) 0.06 *Wb*

11. The magnetic flux through a circuit of resistance *R* changes by an amount $\Delta\phi$ in time Δt. The total independent of quantity of electric charge *Q* which passes during this time through any point of the circuit is given by **[2004]**

(a) $Q = \frac{\Delta\phi}{\Delta t}$ (b) $Q = \frac{\Delta\phi}{\Delta t} \times R$

(c) $Q = -\frac{\Delta\phi}{\Delta t} + R$ (d) $Q = \frac{\Delta\phi}{R}$

12. A copper ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet while it is passing through the ring is **[1996]**

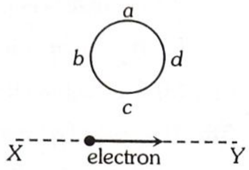
(a) Equal to that due to gravity

(b) Less than that due to gravity

(c) More than that due to gravity

(d) Depends on the diameter of the ring and the length of the magnet

13. An electron moves on a straight line path XY as shown. The abcd is a coil adjacent to the path of electron. What will be the direction of current if any, induced in the coil **[2015]**



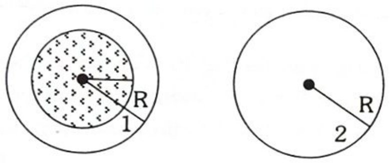
(a) adcb

(b) The current will reverse its direction as the electron goes past the coil

(c) No current induced

(d) abcd

14. A uniform magnetic field is restricted within a region of radius r. The magnetic field changes with time at a rate $\frac{d\vec{B}}{dt}$. Loop 1 of radius $R > r$ encloses the region r and loop 2 of radius R is outside the region of magnetic field as shown in the figure below. Then the e.m.f. generated is **[2016]**



(a) $-\frac{d\vec{B}}{dt}\pi r^2$ in loop 1 and zero in loop 2s

(b) Zero in loop 1 and zero in loop 2

(c) $=\frac{d\vec{B}}{dt}\pi r^2$ in loop 1 and $-\frac{d\vec{B}}{dt}\pi r^2$ in loop 2

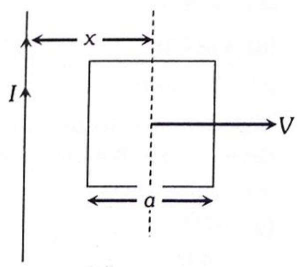
(d) $-\frac{d\vec{B}}{dt}\pi R^2$ in loop 1 and zero in loop 2

15. A long solenoid of diameter 0.1 m has 2×10^4 turn per meter. At the centre of the solenoid, a coil of 100 turns and radius 0.01 m is placed with its axis coinciding with the solenoid axis. The current in the solenoid reduces at a constant rate to 0A from 4A in 0.05s. If the resistance of the coil is $10\pi^2\Omega$, the total charge flowing through the coil during this time is **[2017]**

(a) $32\pi\mu C$ (b) $16\mu C$

(c) $32\mu C$ (d) $16\pi\mu C$

16. A conducting square frame of side 'a' and a long straight wire carrying current I are located in the same plane as shown in the figure. The frame moves to the right with a constant velocity 'V'. The emf induced in the frame will be proportional to **[2015]**



(a) $\frac{1}{(2x-a)^2}$

(b) $\frac{1}{(2x+a)^2}$

(c) $\frac{1}{(2x-a)(2x+a)}$

(d) $1/x^2$

17. When the number of turns in a coil is doubled without any change in the length of the coil, its self inductance becomes **[1992]**

(a) Four times (b) Doubled

(c) Halved (d) Unchanged

18. A current of 2.5 A flows through a coil of inductance $5H$. The magnetic flux linked with the coil is **[2013]**

(a) 0.5 wb (b) 12.5 wb

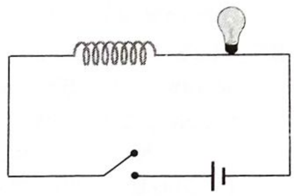
(c) Zero (d) 2 wb

19. A long solenoid has 500 turns. When a current of 2 ampere is passed through it, the resulting magnetic flux linked with each turn of the solenoid is $4\times10^{-3}Wb$. The self-inductance of the solenoid is **[2008]**

(a) 1.0 henry (b) 4.0 henry

(c) 2.5 henry (d) 2.0 henry

20. In the following circuit, the bulb will become suddenly bright if **[1989]**



(a) Contact is made or broken

(b) Contact is made

(c) Contact is broken

(d) Won't become bright at all

21. An e.m.f. of 5 $volt$ is produced by a self inductance, when the current changes at a steady rate from 3 A to 2 A in 1 millisecond. The value of self inductance is **[1993]**

(a) Zero (b) 5 H

(c) 5000 H (d) 5 mH

22. Two coils of self inductances $2mH$ and $8mH$ are placed so close together that the effective flux in one coil is completely linked with the other. The mutual inductance between these coils is **[2006]**

(a) 4 mH (b) 16 mH

(c) 10 mH (d) 6 mH

23. A 50 mH coil carries a current of 2 $ampere$. The energy stored in joules is **[1992]**

(a) 1 (b) 0.1

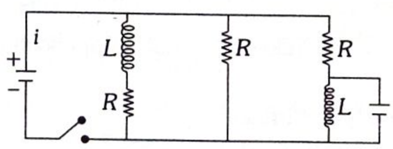
(c) 0.05 (d) 0.5

24. A long solenoid has 1000 turns. When a current of 4A flows through it, the magnetic flux linked with each turn of the solenoid is $4\times10^{-3}Wb$. The self inductance of the solenoid is **[2016]**

(a) 4H (b) 3H

(c) 2H (d) 1H

25. Figure shows a circuit that contains three identical resistors with resistance $R = 9.0\Omega$ each, two identical inductors with inductance $L = 2.0mH$ each and an ideal battery with emf $\varepsilon = 18V$. The current 'i' through the battery just after the switch closed is **[2017]**



(a) 2 mA (b) 0.2 A

(c) 2 A (d) 0 ampere

26. In a region of uniform magnetic induction $B = 10^{-2}$ *tesla*, a circular coil of radius 30 *cm* and resistance π^2 *ohm* is rotated about an axis which is perpendicular to the direction of *B* and which forms a diameter of the coil. If the coil rotates at 200 *rpm* the amplitude of the alternating current induced in the coil is **[1990]**

(a) $4\pi^2$ *mA* (b) 30 *mA*
(c) 6 *mA* (d) 200 *mA*

27. The primary winding of a transformer has 100 turns and its secondary winding has 200 turns. The primary is connected to an ac supply of 120 *V* and the current flowing in it is 10 A. The voltage and the current in the secondary are **[2013]**

(a) 240 *V*, 5 *A* (b) 240 *V*, 10 *A*
(c) 60 *V*, 20 *A* (d) 120 *V*, 20 *A*

28. The primary winding of transformer has 500 turns whereas its secondary has 5000 turns. The primary is connected to an ac supply of 20 V, 50 *Hz*. The secondary will have an output of **[1997]**

(a) 200 V, 50 *Hz* (b) 2 V, 50 *Hz*
(c) 200 V, 500 *Hz* (d) 2 V, 5 *Hz*

29. A transformer is used to light a 100 *W* and 110 *V* lamp from a 220 *V* mains. If the main current is 0.5 amp, the efficiency of the transformer is approximately **[2007]**

(a) 30% (b) 50%
(c) 90% (d) 10%

30. A transformer connected to 220 *volt* line shows an output of 2 *A* at 11000 *volt*. The efficiency is 100%. The current drawn from the line is **[2010]**

(a) 100 *A* (b) 200 *A*
(c) 22 *A* (d) 11 *A*

31. A 220-volt input is supplied to a transformer. The output circuit draws a current of 2.0 ampere at 440 volts. If the efficiency of the transformer is 80%, the current drawn by the primary windings of the transformer is **[2010]**

(a) 5.0 ampere (b) 3.6 ampere
(c) 2.8 ampere (d) 2.5 ampere

32. A transformer having efficiency of 90% is working on 200 *V* and 3 *kW* power supply. If the current in the secondary coil is 6A, the voltage across the secondary coil and the current in the primary coil respectively are **[2014]**

(a) 450 *V*, 13.5 *A* (b) 600 *V*, 15 *A*
(c) 300 *V*, 15 *A* (d) 450 *V*, 15 *A*

33. The primary and secondary coils of a transformer have 50 and 1500 turns respectively. If the magnetic flux ϕ linked with the primary coil is given by $\phi = \phi_0 + 4t$, where ϕ is in webers, *t* is time in seconds and ϕ_0 is a constant, the output voltage across the secondary coil is **[2007]**

(a) 90 volts (b) 120 volts
(c) 220 volts (d) 30 volts

34. Which of the following is not an application of eddy currents **[1989]**

(a) Induction furnace
(b) Galvanometer damping
(c) Speedometer of automobiles
(d) X-ray crystallography

35. Eddy currents are produced when **[1993]**

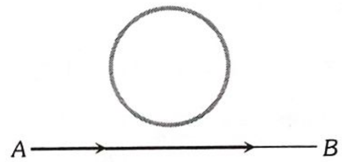
(a) A metal is kept in varying magnetic field
(b) A metal is kept in the steady magnetic field
(c) A circular coil is placed in a magnetic field
(d) Through a circular coil, current is passed

36. The core of a transformer is laminated so that **[1990, 2006]**

(a) Ratio of voltage in the primary and secondary may be increased
(b) Rusting of the core may be stopped
(c) Energy losses due to eddy currents may be reduced
(d) Change in flux is increased

7. AIIMS

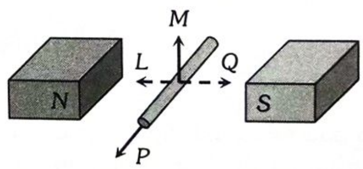
1. An electron moves along the line *AB*, which lies in the same plane as a circular loop of conducting wires as shown in the diagram. What will be the direction of current induced if any, in the loop **[1982, 2001]**



(a) No current will be induced
(b) The current will be clockwise
(c) The current will be anticlockwise
(d) The current will change direction as the electron passes by

2. An electric potential difference will be induced between the ends of the conductor shown in the diagram, when the conductor moves in the direction **[1982]**

(a) *P*
(b) *Q*
(c) *L*
(d) *M*



3. A conducting ring of radius 1 *meter* is placed in an uniform magnetic field *B* of 0.01*telsa* oscillating with frequency 100*Hz* with its plane at right angles to *B*. What will be the induced electric field **[2005]**

(a) π *volt/m* (b) 2 *volt/m*
(c) 10 *volt/m* (d) 62 *volt/m*

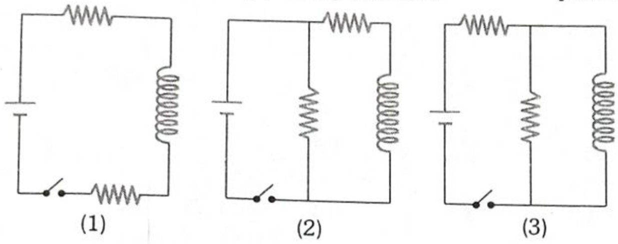
4. The current passing through a choke coil of 5 henry is decreasing at the rate of 2 *ampere/sec*. The e.m.f. developing across the coil is **[1997]**

(a) 10 *V* (b) – 10 *V*
(c) 2.5 *V* (d) – 2.5 *V*

5. What is the coefficient of mutual inductance when the magnetic flux changes by $2 \times 10^{-2} Wb$ and change in current is 0.01*A* **[2002]**

(a) 2 *henry* (b) 3 *henry*
(c) $\frac{1}{2}$ *henry* (d) Zero

6. The figure shows three circuits with identical batteries, inductors, and resistors. Rank the circuits, in the decreasing order, according to the current through the battery (i) just after the switch is closed and (ii) a long time later **[2007]**



(a) (i) $i_2 > i_3 > i_1$ $(i_1 = 0)$ (ii) $i_2 > i_3 > i_1$

(b) (i) $i_2 < i_3 < i_1$ $(i_1 \neq 0)$ (ii) $i_2 > i_3 > i_1$

(c) (i) $i_2 = i_3 = i_1$ $(i_1 = 0)$ (ii) $i_2 < i_3 < i_1$

(d) (i) $i_2 = i_3 > i_1$ $(i_1 \neq 0)$ (ii) $i_2 > i_3 > i_1$

7. If rotational velocity of a dynamo armature is doubled, then induced e.m.f. will become **[2000]**

(a) Half (b) Two times

(c) Four times (d) Unchanged

8. A transformer is based on the principle of **[1998]**

(a) Mutual inductance (b) Self inductance

(c) Ampere's law (d) Lenz's law

9. Quantity that remains unchanged in a transformer is **[1999]**

(a) Voltage (b) Current

(c) Frequency (d) None of the above

10. In transformer, core is made of soft iron to reduce **[1998]**

(a) Hysteresis losses

(b) Eddy current losses

(c) Force opposing electric current

(d) None of the above

11. In a step-up transformer, the turn ratio is 1 : 2. A Leclanche cell (e.m.f. 1.5V) is connected across the primary. The voltage developed in the secondary would be **[2000]**

(a) 3.0 V (b) 0.75 V

(c) 1.5 V (d) Zero

8. Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below:

(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of the assertion.

(c) If assertion is true but reason is false.

(d) If the assertion and reason both are false.

(e) If assertion is false but reason is true.

1. Assertion : Eddy current is produced in any metallic conductor when magnetic flux is changed around it.

Reason : Electric potential determines the flow of charge.

2. Assertion : The quantity L/R possesses dimensions of time.

Reason : To reduce the rate of increase of current through a solenoid, we should increase the time constant (L/R).

3. Assertion : Faraday's laws are consequence of conservation of energy.

Reason : In a purely resistive ac circuit, the current lags behind the e.m.f. in phase.

4. Assertion : Only a change in magnetic flux will maintain an induced current the coil.

Reason : The presence of large magnetic flux through a coil maintains a current in the coil if the circuit is continuous.

5. Assertion : In electric circuits, wires carrying currents in opposite directions are often twisted together.

Reason : If the wires are not twisted together, the combination of the wires forms a current loop, The magnetic field generated by the loop might affect adjacent circuits or components

6. Assertion : Inductance coil are made of copper.

Reason : Induced current is more in wire having less resistance.

7. Assertion : An emf $\vec{E}$ is induced in a closed loop where magnetic flux is varied. The induced $\vec{E}$ is not a conservative field.

Reason : The line integral $\vec{E}.\vec{dl}$ around the closed loop is non zero.

8. Assertion : A spark occurs between the poles of a switch when the switch is opened.

Reason : Current flowing in the conductor produces magnetic field.

9. Assertion : Lenz's law violates the principle of conservation of energy.

Reason : Induced e.m.f. always opposes the change in magnetic flux responsible for its production.

10. Assertion : An artificial satellite with a metal surface is moving above the earth in a circular orbit. A current will be induced in satellite if the plane of the orbit is inclined to the plane of the equator.

Reason : The current will be induced only when the speed of satellite is more than 8 km/sec.

11. Assertion : A transformer cannot work on dc supply.

Reason : dc changes neither in magnitude nor in direction.

22. Electromagnetic Induction – ns ers e s

1. Faraday's and Lenz's Law

1	c	2	c	3	d	4	b	5	d
6	a	7	b	8	b	9	a	10	b
11	c	12	b	13	b	14	b	15	d
16	c	17	d	18	a	19	d	20	a
21	b	22	b	23	a	24	c		

2. Motional EMI

1	d	2	d	3	b	4	b	5	c
6	b	7	a	8	a	9	b	10	d
11	a	12	c	13	d	14	c	15	d
16	c	17	d						

3. Static EMI

1	b	2	a	3	b	4	a	5	a
6	d	7	b	8	c	9	b	10	d
11	d	12	b	13	d	14	a	15	d
16	d	17	c	18	a	19	a	20	b
21	c	22	d	23	d	24	c	25	a
26	b								

4. Application of EMI (Dynamo, Transformer...)

1	c	2	c	3	c	4	a	5	a
6	c	7	b	8	c	9	b	10	c

5. IIT-JEE/AIEEE

1	d	2	d	3	b	4	c	5	d
6	c	7	d	8	d	9	d	10	b
11	b	12	c	13	d	14	d	15	d
16	b	17	c	18	d	19	b	20	b
21	d	22	c	23	c	24	a	25	a
26	a	27	b	28	a	29	b	30	c
31	a	32	b	33	d	34	d	35	d
36	c	37	d	38	d	39	b	40	d

6. NEET/AIPMT

1	c	2	a	3	a	4	c	5	a
6	b	7	b	8	b	9	c	10	c
11	d	12	b	13	b	14	a	15	c
16	c	17	a	18	b	19	a	20	c
21	d	22	a	23	b	24	d	25	c
26	c	27	a	28	a	29	c	30	a
31	a	32	d	33	b	34	d	35	a
36	c								

7. AIIMS

1	c	2	d	3	b	4	a	5	a
6	a	7	b	8	a	9	c	10	a
11	d								

8. Assertion & Reason

1	b	2	b	3	c	4	c	5	c
6	a	7	a	8	b	9	e	10	c
11	a								