For More Study Material

For Class 9 Science	Click here
For Class 9 Mathematics	Click here
For Class 10 Science	Click here
For Class 10 Mathematics	Click here
For Class 11 Physics	Click here
For Class 11 Chemistry	Click here
For Class 11 Biology	Click here
For Class 11 mathematics	Click here
For Class 12 Physics	Click here
For Class 12 Chemistry	Click here
For Class 12 Biology	Click here
For Class 12 Mathematics	Click here

C. U. Q

FARADAY'S EXPERIMENT, INDUCED E.M.F & LENZ'S' LAW

1. When ever the flux linked with a coil changes, then

1) current is always induced
2) an emf and a current are always induced
3) an emf is induced but a current is never induced
4) an emf is always induced and a current is induced, when the coil is a closed one

2. Whenever the magnet flux linked with a coil changes, then there is an induced emf in the circuit. This emf lasts

1) For a short time 2) For a long time
3) For ever
4) So long as the change in the flux takes place

3. A magnet is moved towards the coil (i) quickly (ii) slowly then the induced emf is

1) Larger in case (i) 2) Smaller in case (i)
3) Equal in both
4) Larger or smaller depending upon the radius of the coil

4. The laws of electromagnetic induction have been used in the construction of a

1) galvanometer 2) voltmeter
3) electric motor 4) electric generator

5. When a rate of change of current in a circuit is unity, the induced emf is equal to

1) Total flux linked with the coil
2) induced charge
3) Number of turns in the circle
4) Coefficient of self induction

6. A bar magnet is dropped along the axis of copper ring held horizontally. The acceleration of fall is

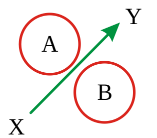
1) Equal to 'g' at the place 2) Less than 'g'
3) More than 'g'
4) Depends upon diameter of the ring and length of the magnet

7. An annular circular brass disk of inner radius 'r' and outer radius 'R' is rotating about an axis passing through its center and perpendicular to its plane with a uniform angular velocity 'ω' in a uniform magnetic filed of induction 'B' normal to the plane of the disk. The induced emf between the inner and outer edge of the annular disk is

1) $\frac{B\omega(r^2+R^2)}{2}$ 2) $\frac{B\omega(R^2-r^2)}{2}$

3) $\frac{B\omega(r-R)}{2}$ 4) $\frac{B\omega(r+R)}{2}$

8. Consider the situation shown in the figure. If the current I in the long straight conducting wire XY is increased at a steady rate then the induced e.m.f.'s in loops A and B will be



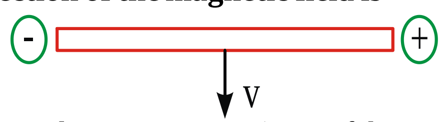
1) clockwise in A, anti clockwise in
2) anti clockwise in A, clockwise in B
3) clockwise in both A and B
4) anti clockwise in both A and B

FLEMING'S RIGHT HAND RULE

9. The direction of the induced e.m.f. is determined by

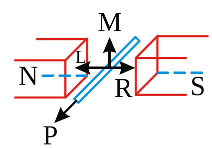
1) Fleming's left hand rule
2) Fleming's right hand rule
3) Maxwell's right hand screw rule
4) Ampere's rule of swimming

10. A wire moves with a velocity "v" through a magnetic field and experiences an induced charge separation as shown. Then the direction of the magnetic field is



1) in to the page 2) out of the page
3) towards the bottom of the page
4) towards the top of the page

11. An electric potential difference will be induced between the ends of the conductor shown in the figure, if the conductor moves in the direction shown by



1) P 2) R
3) L 4) M

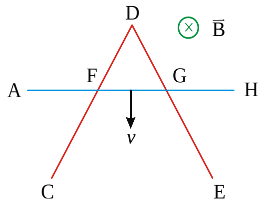
12. A horizontal straight conductor when placed along south-north direction falls under gravity; there is

1) an induced current form south-to-north direction
2) an induced current from north-to-south direction
3) no induced emf along the length of the conductor
4) an induced emf along the length of the conductor

13. Two circular, similar, coaxial loops carry equal currents in the same direction. If the loops are brought nearer, what will happen?

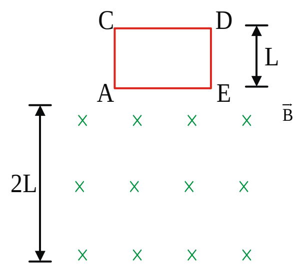
1) Current will increase in each loop
2) Current will decrease in each loop
3) Current will remain same in each loop
4) Current will increase in one and decrease in the other

14. A long conducting wire AH is moved over a conducting triangular wire CDE with a constant velocity v in a uniform magnetic field $\vec{B}$ directed into the plane of the paper. Resistance per unit length of each wire is ρ. Then



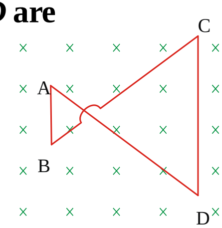
1) a constant clockwise induced current will flow in the closed loop
2) an increasing anticlockwise induced current will flow in the closed loop
3) a decreasing anticlockwise induced current will flow in the closed loop
4) a constant anticlockwise induced current will flow in the closed loop

15. A square coil ***ACDE*** **with its plane vertical is released from rest in a horizontal uniform megnetic field $\vec{B}$ of length 2 L. The acceleration of the coil is**



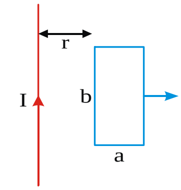
1) less than 'g' for all the time till the loop crosses the magnetic field completely
2) less than 'g' when it enters the field and greater than 'g' when it comes out of the field
3) 'g' all the time
4) less than 'g' when it enters and comes out of the field but equal to 'g' when it is within the field

16. **A conducting wire frame is placed in a magnetic field which is directed into the plane of the paper. The magnetic field is increasing at a constant rate. The directions of induced currents in wires *AB* and *CD* are**



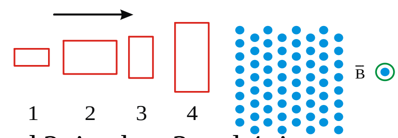
1) B to A and D to C
2) A to B and C to D
3) A to B and D to C
4) B to A and C to D

17. **A rectangular loop of wire with dimensions shown in figure is coplanar with a long wire carrying current 'I'. The distance between the wire and the left side of the loop is r. 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 when the loop is pulled?**



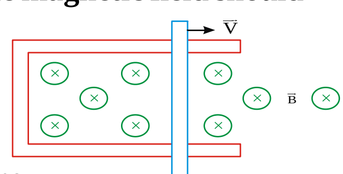
Induced Current	Force on Left side	Force on Right side
a.Cunterclockwise	To the left	To the left
b. Counterclokwise	To the right	To the left
c. Clokwise	To the right	To the left
d. Clockwise	To the left	To the right

18. **The four wire loops shown figure have vertical edge lengths of either $L, 2L$ or $3L$. They will move with the same speed into a region of uniform magnetic field $\vec{B}$ directed out of the page. Rank them according to the maximum magnitude of the induced emf greatest to least.**



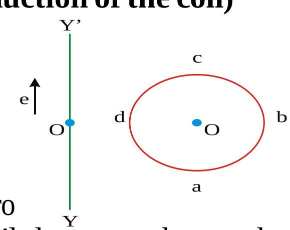
1) 1 and 2 tie, then 3 and 4 tie
2) 3 and 4 tie, then 1 and 2 tie
3) 4,2,3,1   4) 4 then, 2 and 3 tie and then 1

19. **A rod lies across frictionless rails in a uniform magnetic field $\vec{B}$ as shown in figure. The rod moves to the right with speed V. In order to make the induced emf in the circuit to be zero, the magnitude of the magnetic field should**



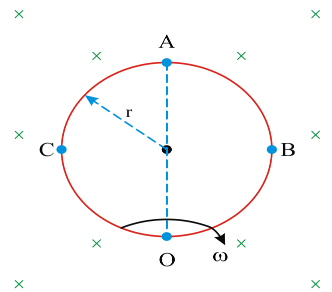
1) not change
2) increase linearly with time
3) decrease linearly with time
4) decrease nonlinearly with time

20. **An electron moves on a straight line path YY' as shown in figure. A coil is kept on the right such that YY' is the plane of the coil. At the instant when the electron gets closest to the coil (neglect self-induction of the coil)**



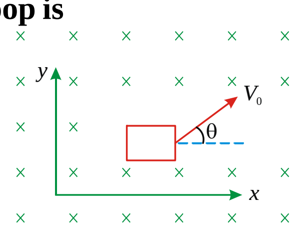
1) The current in the coil flows clockwise
2) The current in the coil flows anticlockwise
3) The current in the coil is zero
4) The current in the coil does not change the direction as the electron crosses point O

21. **In figure, there is a conducting ring having resistance R placed in the plane of paper in a uniform magnetic field B_0. If the ring is rotating in the plane of paper about an axis passing through point O and perpendicular to the plane of paper with constant angular speed ω in clockwise direction, then**



1) point O will be at higher potential than A
2) the potential of point B and C will be different
3) the current in the ring will be zero
4) the current in the ring will be $2B_0\omega r^2 / R$

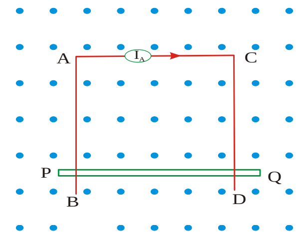
22. **In the space shown a non-uniform magnetic field $\vec{B} = B_0(1+x)(-\hat{k})$ tesla is present. A closed loop of small resistance, placed in the xy plane is given velocity V_0. The force due to magnetic field on the loop is**



1) zero
2) Along $+x$ direction
3) along $-x$ direction
4) along $+y$ direction

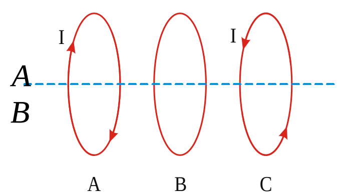
23. **Two identical cycle wheels (geometrically) have different number of spokes connected from centre to rim. One is having 20 spokes and the other having only 10 (the rim and the spokes are resistanceless). One resistance of value R is connected between centre and rim. The current in R will be**
1) double in the first wheel than in the second wheel
2) four times in the first wheel than in the second wheel
3) will be double in the second wheel than that of the first wheel
4) will be equal in both these wheels

24. **AB and CD are fixed conducting smooth rails placed in a vertical palne and joined by a constant current source at its upper end. PQ is a conducting rod which is free to slide on the rails. A horizontal uniform magnetic field exists in space as shown in figure. If the rod PQ is released from rest then,**



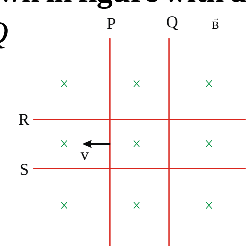
1) the rod PQ will move downward with constant acceleration
2) the rod PQ will move upward with constant acceleration
3) the rod will remain at rest 4) any of the above

25. **Three identical coils A, B and C carrying currents are placed coaxially with their planes parallel to one another. A and C carry current as shown in figure B is kept fixed while A and C both are moved towards B with the same speed. Initially, B is equally seperated from A and C. The direction of the induced current in the coil B is**



1) same as that in coil A
2) same as that in coil B
3) zero
4) none of these

26. **Two identical conductors P and Q are placed on two frictionless rails R and S in a uniform magnetic field directed into the plane. If P is moved in the direction shown in figure with a constant speed, then rod Q**



1)will be attracted towards P
2)will be repelled away from P
3) will remain stationary
4) may be repelled away orattracted towards P

SELF INDUCTION AND MUTUAL INDUCTION

27. **An inductance stores energy in the**
1) electric filed 2) magnetic field
3) resistance of the coil
4) electric and magnetic fields

28. **If 'N' is the number of turns in a coil, the value of self inductance varies as**
1) N^0 2) N 3) N^2 4) N^{-2}

29. **A series combination of L and R is connected to a battery of emf E having negligible internal resistance. The final value of current depends upon**
1) L and R only 2) E and L only
3) E and R only 4) L, R and E only

30. **Two coils of inductances L_1, and L_2 are linked such that their mutual inductance is M**

1) L_1+L_2 2) $\frac{1}{2}(L_1+L_2)$ 3) $(L_1 \pm L_2)$ 4) $\sqrt{L_1 L_2}$

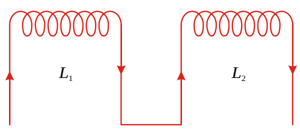
31. **The coefficient of self inductance and the coefficient of mutual inductance have**

1) same units but different dimensions
2) different units but same dimensions
3) different units and different dimensions
4) same units and same dimensions

32. **The mutual inductance between a pair of coils each of 'N' turns is 'M'. If a current is 'I' in the first coil is bought to zero in a time t, then the average emf induced in the second coil is**

1) MI/t 2) Mt/I 3) Mt/IN 4) It/MN

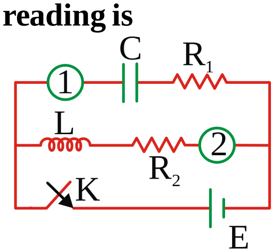
33. **A circuit contains two inductors of self-inductance L_1 and L_2 in series. If M is the mutual inductance then the effective inductance of the circuit shown will be**



1) L_1+L_2 2) L_1+L_2-2M

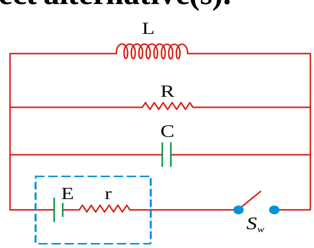
3) L_1+L_2+M 4) L_1+L_2+2M

34. **In the circuit of figure, (1) and (2) are ammeters. Just after key K is pressed to complete the circuit, the reading is**



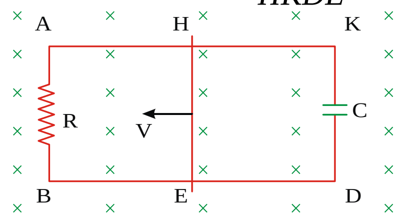
1) maximum in both (1) and (2)
2) zero in both (1) and (2)
3) zero in (1), minimum in (2)
4) maximum in (1), zero in (2)

35. **A pure inductor L, a capacitor C and a resistance R are connected across a battery of emf E and internal resistance r as shown in the figure. Switch S_W is closed at $t=0$, select the correct alternative(s).**



1) current through resistance R is zero all the time
2) current through resistance R is zero at $t=0$ and $t \to \infty$
3) maximum charge stored in the capacitor is CE
4) maximum enrgy stored in the inductor is equal to the maximum energy stored in the capacitor

36. **In the circuit shown in figure, a conducting wire HE is moved with a constant speed v towards left. The complete circuit is placed in a uniform magnetic field $\vec{B}$ perpendicular to the plane of the circuit inwards. The current in $HKDE$ is**

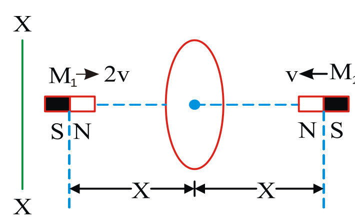


1) clockwise
2) anticlockwise
3) alternating
4) zero

37. **In which of the following cases the emf is induced due to time varying magnetic field (induced field emf)?**
Case I A magnet is moving along the axis of a conducting coil
Case II A loop having varying area (due to moving jumper) is placed in a magnetic field
Case III The resistance of the coil is changing, which is connected to an ideal battery. Case IV A current carrying wire is approaching a conducting ring.

1) I, II and III only 2) I, III and IV only
3) I, II and IV only 4) All the four

38. **A closed conducting ring is placed in between two 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.**



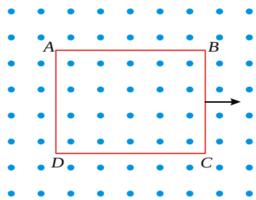
The direction of induced current in the ring as seen from XX from this moment to the moment till bar magnets collide is

1) always clockwise 2) always anticlockwise
3) first clockwise, and then anticlockwise
4) first anti-clockwise, and then clockwise

39. **Two identical ciruclar 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**

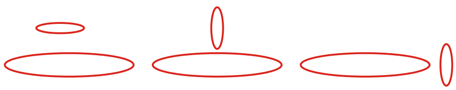
1) remains stationary
2) is attracted by the loop A
3) is repelled by the loop A
4) rotates about its CM, with CM fixed

40. 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. Electric field is induced.



1) in AD, but not in BC
2) in BC, but not in AD
3) neither in AD nor in BC
4) in both AD and BC

41. Two circular coils can be arranged in any of the three situations shown in the figure. Their mutual inducatnce will be



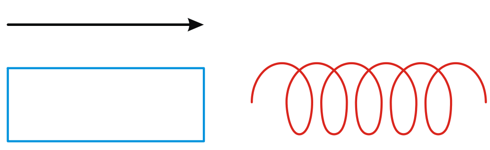
(A) (B) (C)

1) maximum in situation (A) 2)maximum in situation (B)
3) maximum in situation (C) 4) the same in all situations

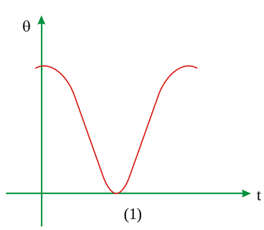
42. As shown in the figure, P and Q are two coaxil conducting loops separated by some distance. When the switch S is closed, a clockwise current I_p flows in P (as seen by E) and an induced current I_{Q_1} flows in Q. The switch remains closed for a long time. When S is opened, a current I_{Q_2} flows in Q. Then the direction I_{Q_1} and I_{Q_2} (as seen by E) are

1) respectively clockwise and anticlockwise
2) both clockwise 3) both anticlockwise
4) respectively anticlockwise and clockwise

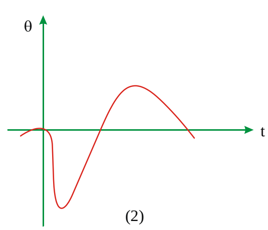
43. The variation of induced emf (e) with time (t) in a coil if



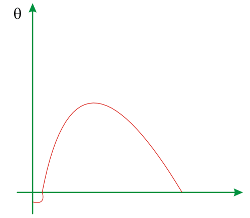
a short bar magnet is moved along axis of the coil shown with a constant velocity is best represented as



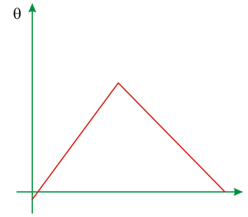
(1)



(2)



(3)

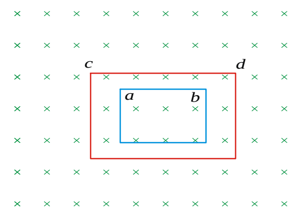


(4)

44. An infinitely long cylinder is kept parallel to an uniform magnetic field B directed along positive z-axis. The direction of induced current as seen from the z-axis will be

1) clockwise of the +ve z-axis
2) anticlockwise of the +ve z-axis
3) zero 4) along the magnetic field

45. 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,



1) $I_1 > I_2$ 2) $I_1 < I_2$
3) I_1 is in the direction ba and I_2 is in the direction cd
4) I_1 is in the direction ab and I_2 is in the direction dc

46. 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

1) development of air current when the plate is placed
2) induction of electrical charge on the plate
3) shileding of magnetic lines of force as aluminium is a paramagnetic material
4) electromagnetic induction in the aluminium plate giving rise to electromagnetic damping

47. Which of the following units denotes the dimensions $\left[ML^2/Q^2\right]$, where Q denotes the electric charge?

1) Wb/m^2 2)henry (H) 3) H/m^2 4)weber (Wb)

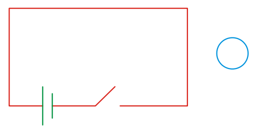
48. A rod of length l rotates with a small but uniform angular velocity ω about its perpendicular bisector. A uniform magnetic field B exists parallel to the axis of rotation. The potential difference between the centre of the rod and an end is

1) zero 2) $1/8\ \omega Bl^2$ 3) $1/2\ \omega Bl^2$ 4) $B\omega l^2$

49. A rod of length l rotates with a uniform angular velocity ω about its perpendicular bisector. A uniform magnetic field B exists parallel to the axis of rotation. The potential difference between the two ends of the rod is

1) zero 2) $1/2\,Bl\omega^2$ 3) $Bl\omega^2$ 4) $2Bl\omega^2$

50. Consider the situation shown in figure . If the switch is closed and after some time it is opened again, the closed loop will show



1) an anticlockwise current-pulse
2) a clockwise current-pulse
3) an anticlockwise current-pulse and then a clockwise current-pulse
4) a clockwise current-pulse and then an anticlockwise current-pulse

51. A bar magnet is released from rest along the axis of a very long, vertical copper tube. After some time the magnet

1) will stop in the tube
2) will move with almost contant speed
3) will move with an acceleration g 4) will oscillate

ASSERTION & REASON

1) Both A and R are true and R is the correct explanation of A
2) Both A and R are true and R is not the correct explanation of A
3) A is true but R is false 4) A is false but R is true.

52. **Assertion :** Magnetic flux is a vector qunatity
Reason: Value of magnetic flux can be positive, negative or zero

53. **Assertion :** Lenz'a law violates the principle of conservation of energy
Reason: Induced emf always oppose the change in magnetic flux responsible for its production

54. **Assertion:** When number of turns in a coil is doubled, coefficient of self-inductance of the coil becomes 4 times.
Reason: This is because $L \propto N^2$

55. **Assertion :** The induced emf and current will be same in two identical loops of copper and aluminium, when rotated with same speed in the same magnetic field.
Reason: Mutual induction does not depend on the orientation of the coils

56. **Assertion :** When two coils are wound on each other, the mutual induction between the coils is maximum.
Reason: Mutual induction does not depend on the orientation of the coils.

57. **Assertion (A):** Only a change in magnetic flux will maintain an induced current in a closed coil.
Reason (R): The presence of large magnetic flux through a coil maintains a current in the coil if the coil is continuous.

58. Magnetic flux in a circular coil of resistance 10Ω changes with time as shown in figure. Symbol $\otimes$ indicates a direction perpendicular to paper inwards. Match the following:

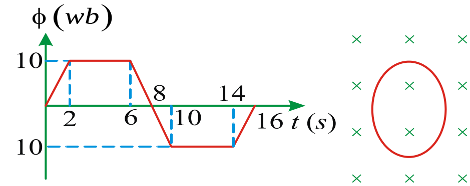


Table - 1	Table-2
1) At 1s is induced current is	p) clockwise
2) At 5s induced current is	q) anticlockwise
3) At 9s induced current is	r) zero
4) At 15s induced current is	s) 2A
	t) None

1) a-q; b-r; c-p; d-q 2) a-p; b-r; c-q; d-p
3) a-r; b-p; c-q; d-q 4) a-p; b-r; c-s; d-q

59. Three coils are placed infront of each other as shown. Currents in 1 and 2 are in same direction, while that in 3 is in opposite direction. Match the following table.

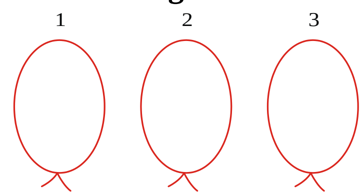


Table - 1	Table - 2
a) When current is increased	p) Current in 1 will increase
b) When current in 2 is increased	q) Current in 2 will increase
c) When current in 3 is increased	r) Current in 3 will increase
	s) None

1) a-r; b-r; c-p,q 2) a-p; b-p; c-q
3) a-q; b-q; c-r 4) a-r; b-q; c-p

C. U. Q - KEY

1) 4	2) 4	3) 1	4) 4	5) 4	6) 2	7) 2	8) 1
9) 2	10) 1	11) 4	12) 3	13) 2	14) 4	15) 4	16) 1
17) 4	18) 4	19) 4	20) 3	21) 3	22) 3	23) 4	24) 4
25) 3	26) 1	27) 2	28) 3	29) 3	30) 4	31) 4	32) 1
33) 4	34) 4	35) 2	36) 4	37) 2	38) 2	39) 3	40) 4
41) 1	42) 4	43) 2	44) 3	45) 4	46) 4	47) 2	48) 2
49) 1	50) 4	51) 2	52) 4	53) 4	54) 1	55) 3	56) 3
57) 3	58) 1	59) 1					

LEVEL - I (C. W)

MAGNETIC FLUX & FARADY'S LAWS, INDUCED EMF,CURRENT AND CHARGE

1. A field of strength 5 $\times$ $10^4/\pi$ ampere turns / meter acts at right angles to the coil of 50 turns of area 10^{-2} m^2. The coil is removed from the field in 0.1 second. Then the induced e.m.f in the coil is

1) 0.1 V 2) 0.2 V 3) 1.96 V 4) 0.98 V

2. A coil has 1,000 turns and 500 cm^2 as its area. The plane of the coil is placed at right angles to a magnetic induction field of 2 X 10^{-5} web/m^2. The coil is rotated through 180° in 0.2 seconds. The average emf induced in the coil, in milli volts, is:

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

3. A square loop of side 22cm is changed to a circle in time 0.4 sec with its plane normal to a magnetic field 0.2T. The emf induced is

1) $+6.6mv$ 2) $-6.6mv$

3) $+13.2mv$ 4) $-13.2mv$

4. A coil of 1200 turns and mean area of 500 cm^2 is held perpendicular to a uniform magnetic field of induction $4\times10^{-4}T$. The resistance of the coil is 20 ohms. When the coil is rotated through 180^0 in the magnetic field in 0.1 seconds the average electric current (in mA) induced is :

1) 12 2) 24 3) 36 4) 48

5. A closed coil with a resistance R is placed in a magnetic field. The flux linked with the coil is ϕ. If the magnetic field is suddenly reversed in direction, the charge that flows through the coil will be

1) $\phi/2R$ 2) ϕ/R 3) $2\phi/R$ 4) *zero*

MOTIONAL E.M.F

6. An aeroplane with wing span 50 m is flying horizontally with a speed of 360 km/hr over a place where the vertical component of the earth's magnetic field is 2x10^{-4} Wb/m^2. The potential difference between the tips of the wings would be:

1) 0.1V 2) 1.0V 3) 0.2V 4) 0.01V

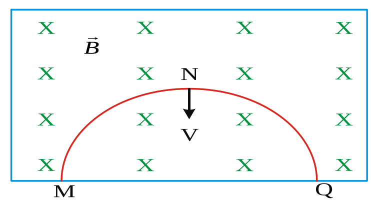
7. The horizontal component of the earth's magnetic field at a place is $3\times10^{-4}T$ and the dip is θ = $\tan^{-1}(4/3)$. A metal rod of length 0.25m placed in the north-south position is moved at a constant speed of 10 cm/s towards the east. The e.m.f induced in the rod will be:

1) zero 2) 1 mV 3) 5 mV 4) 10mV

8. A metal bar of length 1m falls from rest under the action of gravity remaining horizontal with its ends in east-west direction. The induced e.m.f in it at the instant when it has fallen for 10s is (B_H = 1.7 x 10^{-5}T and g = 10ms^{-2})

1) 2.5mV 2) 3.2 mV 3) 1.7mV 4) 0.5mV

9. A thin semicircular conducting ring of radius R is falling with its plane vertical in a horizontal magnetic induction B (figure). At the position MNQ the speed of the ring is V. The potential difference developed across the ring is :



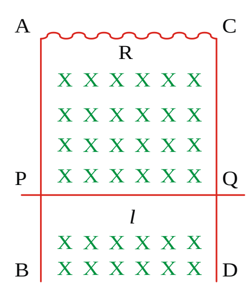
1) zero

2) $BV\pi R^2/V$ and M is at higher potential

3) πRBV and Q is at higher potential

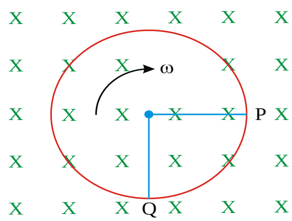
4) 2RBV and Q is at higher potential

10. Two thick rods AB, CD are placed parallel to each other at a distance *l*. their ends are joined to a resistance R. A magnetic field of induction B is applied perpendicular to the plane containing the rods. If the rods are vertical, the terminal uniform velocity of the rod PQ of mass m is given by



1) $\frac{mg.R}{B^2l^2}$ 2) $\frac{mg.R}{Bl}$ 3) $\frac{mg}{BlR}$ 4) $\frac{mgl}{BR}$

11. A conducting ring of radius 'r' is rolling without slipping with a constant angular velocity ω (figure). If the magnetic field strength is B and is directed into the page then the emf induced across PQ is



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

12. A cycle wheel with 64 spokes is rotating with N rotations per second at right angles to horizontal component of magnetic field. The induced e.m.f. generated between its axle and rim is E. If the number of spokes is reduced to 32 then the value of induced e.m.f. will be
1) E 2) 2E 3) E/2 4) E/4

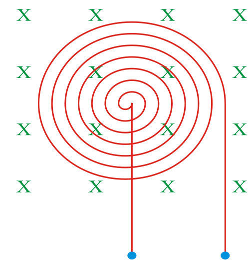
13. A uniform circular metal disc of radius R is rotating about a vertical axis passing through its center and perpendicular to its plane with constant frequency f. If B_H and B_V are horizontal and vertical components of the Earth's magnetic field respectively, then the induced e.m.f between its center and the rim is
1) $\pi B_V fR^2$ 2) $\pi B_H fR^2$ 3) $2\pi B_V fR^2$ 4) Zero

14. A copper disc of diameter 20 cm makes 1200 r.p.m. about its natural axis kept parallel to a uniform magnetic field of 10^{-2} T. The potential difference between the centre and edge of the disc is
1) 6.28×10^{-3} V 2) 62.8×10^{-3} V
3) 0.628×10^{-3} V 4) 0.628 V

15. In an AC generator, a coil with N turns, all of the same area A and total resitance R, rotates with frequency ω in a magnetic field B. The maximum value of emf generated in the coil is
1) $NABR\omega$ 2) NAB 3) $NABR$ 4) $NAB\omega$

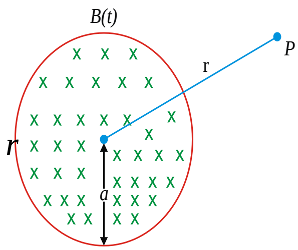
INDUCED ELECTRIC FIELDS

16. A flat circular coil having N turns (tightly wounD) is placed in a time varying magnetic field $B = B_0 \sin \omega t$. The outer radius of the coil is R. Determine the maximum value of the induced emf in the circuit.



1) $\pi R^2 NB_0\omega$ 2) $3\pi R^2 NB_0\omega$
3) $\frac{\pi R^2 NB_0}{\omega}$ 4) $\frac{\pi R^2 NB_0\omega}{3}$

17. 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 electirc field at point p at a distance r from the centre of the circular region



1) is zero 2) decreases as $1/r$
3) increases as r
4) decreases $1/r^2$

SELF INDUCTION & MUTUAL INDUCTION

18. A coil has self inductance of 0.01H. The current through it is allowed to change at the rate of 1A in 10^{-2}s. The induced emf is
1) 1V 2) 2V 3) 3V 4) 4V

19. The average self-induced emf in a $25mH$ solenoid when the current in it falls from 0.2 A to 0 A in 0.01 second, is
1) 0.05 V 2) 0.5 V 3) 500 V 4) 50 V

20. Two inductors each of inductance L are joined in parallel. Their equivalent inductance is
1) zero 2) 2L 3) L/2 4) L

21. A coil of 100 turns with a current of 5A produced a magnetic flux of 1 μ Wb and each turn of the coil. The coefficient of self induction is
1) 10 μ H 2) 20 μ H 3) 30 μ H 4) 40 μ H

22. In an inductance coil the current increases from zero to 6 ampere in 0.3 second by which an induced e.m.f. of 60 volt is produced in it. The value of coefficient of self-induction of coil is
1) 1 henry 2) 1.5 henry
3) 2 henry 4) 3 henry

23. Two coils are at fixed locations. When coil 1 has no current and the current in coil 2 increases at the rate of 15.0 A/s, the emf in coil 1 is 25.0 mV, when coil 2 has no current and coil 1 has a current of 3.6 A, the flux linkage in coil 2 is

1) 16 mWb 2) 10 mWb
3) 4.00 mWb 4) 6.00 mWb

D.C TRANSIENT CIRCUITS

24. A coil of inductance 0.20 H is connected in series with a switch and a cell of emf 1.6 V. The total resistance of the circuit is 4Ω. What is the initial rate of growth of the current when the switch is closed?

1) $0.050As^{-1}$ 2) $0.40As^{-1}$ 3) $0.13As^{-1}$ 4) $8.0As^{-1}$

25. Two inductance coils made of different metal wires are having the same inductance. But their time constants are in the ratio 1 : 2. Then the ratio of their resistances is

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

26. The time constant of an inductor is τ_1. When a pure resistor of $R\Omega$ is connected in series with it, the time constant is found to decrease to τ_2. The internal resistance of the inductor is

1) $\frac{R\tau_2}{\tau_1-\tau_2}$ 2) $\frac{R\tau_1}{\tau_1-\tau_2}$ 3) $\frac{R(\tau_1-\tau_2)}{\tau_1}$ 4) $\frac{R(\tau_1-\tau_2)}{\tau_2}$

LEVEL - I (C. W) - KEY

01) 1 02) 2 03) 2 04) 2 05) 3 06) 2 07) 2
08) 3 09) 4 10) 1 11) 1 12) 1 13) 1 14) 1
15) 4 16) 4 17) 2 18) 1 19) 2 20) 3 21) 2
22) 4 23) 4 24) 4 25) 4 26) 1

LEVEL-I (C. W) - HINTS

1. $B=\mu_0 H=\frac{\mu_0\times5\times10^4}{\pi}$

$e=\frac{NBA}{time}=\frac{50\times2\times10^{-2}\times10^{-2}}{0.1}$ =0.11

2. $e=\frac{2NBA}{t}$

3. $e=-B\frac{\Delta A}{\Delta t}$

4. $E=\frac{2NBA}{t},\ i=\frac{E}{R}$

5. $q=\frac{d\phi}{R}$

6. $e=B_H lv$

7. $e=B_V lv\ \tan\theta=\frac{B_V}{B_H}$

8. $e=B_H lv$ where $v=gt$

10. $mg=Bil$ and $i=\frac{Blv_T}{R}$

11. $|\vec{E}|=\frac{Bl^2}{2}\omega,\quad l=\sqrt{2}r$

12 .E.M.F is independent of no of spokes here.

13. $e=\frac{1}{2}BR^2\omega$ where $\omega=2\pi f$

14. $e=\frac{1}{2}BR^2\omega$ where $\omega=2\pi f$

15. The emf generated would be maximum when flux(cutting) would be maximum i.e., angle betweena area vector of coil and magnetic field is 0^0. The emf generated is given by [as a function of time]

$e=NBA\omega\cos\omega t\ \Rightarrow e_{max}=NAB\omega$

17. $\int\vec{E}.\vec{dl}=\left|\frac{d\phi}{dt}\right|;\ =S\left|\frac{dB}{dt}\right|$

or $E(2\pi r)=\pi a^2\left|\frac{dB}{dt}\right|$ for $r\ge a$; $\therefore E=\frac{a^2}{2r}\left|\frac{dB}{dt}\right|$

$\therefore$ induced electric field $\propto\frac{1}{r}$; for $r\le a$

$E(2\pi r)=\pi r^2\left|\frac{dB}{dt}\right|$ or $E=\frac{r}{2}\left|\frac{dB}{dt}\right|$ or $E\propto r$

At $r=a,\ E=\frac{a}{2}\left|\frac{dB}{dt}\right|$

Therefore, variation of E with r (distance from centre) will be as follows

18. $e=L\frac{di}{dt}$

19. $e=L\frac{di}{dt}$

20. $L_p=\frac{L_1L_2}{L_1+L_2}$

21. $n\phi=L\,i$

22. $e=-L\left(\frac{di}{dt}\right)$

23. Coefficient of mutual inductance M is given by

$$|M| = \frac{e_1}{(di_2/dt)} = \frac{\phi_2}{i_1}$$

$$\therefore \phi_2 = \frac{e_1 i_1}{(di_2/dt)} = \frac{(25.0\times10^{-3})(3.6)}{(15)}$$

24. $V = RI + L\frac{dI}{dt}$, at $t=0, I=0$, thus we have

$$\frac{dI}{dt} = \frac{V}{L} = \frac{1.6}{0.2} = 8A/s$$

25. $\frac{t_1}{t_2} = \frac{R_2}{R_1}$

26. $\tau_1 = \frac{L}{r}$; $\tau_2 = \frac{L}{R+r}$ Solve for r from the above equations

LEVEL - I (H. W)

MAGNETIC FLUX AND MOTIONAL EMF

1. In a coil of area 10cm^2 and 10 turns with magnetic field directed perpendicular to the plane and is changing at the rate of 10^8 gauss/ second. The resistance of the coil is 20Ω. The current in the coil will be

1) 0.5A 2) 5A 3) 50A 4) 5 x 10^8A

2. A magnetic flux of 500 micro-webers passing through a 200 turns coil is reversed in 20×10^{-3} seconds. The average emf induced in the coil in volts, is :

1) 2.5 2) 5.0 3) 7.5 4) 10.0

3. A rectangular coil of 200 turns and area 100 cm^2 is kept perpendicular to a uniform magnetic field of induction 0.25 tesla. If the field is reversed in direction in 0.01 second, the average induced emf in the coil is

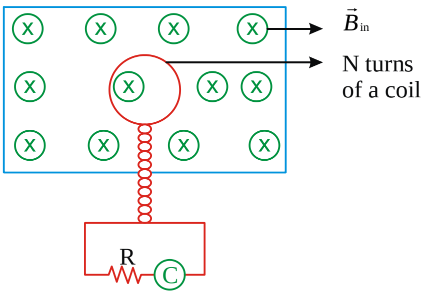
1) 10^6 V 2) 10^4 V 3) 10^2 V 4) zero

4. A coil having an area $2m^2$ is placed in a magnetic field which changes from 1Wb/m^2 to 4Wb/m^2 in an interval of 2 second.The average e.m.f. induced in the coil will be

1) 4V 2)3V 3)1.5V 4)2V

5. A flip coil consists of N turns of circular coils which lie in a uniform magnetic field. Plane of the coils is perpendicular to the magnetic field as shown in figure. The coil is connected to a current integrator which measures the total charge passing through it. The coil is turned through 180^0 about the diameter. The charge passing through the coil is

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



6. A conductor AB of length l moves in xy plane with velocity $\vec{v} = v_0(\hat{i} - \hat{j})$. A magnetic field $\vec{B} = B_0(\hat{i} + \hat{j})$ exists in the region. The induced emf is

1) zero 2) $2B_0lv_0$ 3) B_0lv_0 4) $\sqrt{2}B_0lv_0$

7. To measure the field 'B' between the poles of an electromagnet, a small test loop of area 1 cm^2, resistance 10 Ω and 20 turns is pulled out of it. A galvanometer shows that a total charge of $2\mu C$ passed through the loop. The value of 'B' is

1) 0.001 T 2) 0.01 T 3) 0.1 T 4) 1.0 T

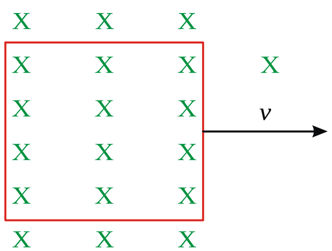
8. A thin circular ring of area A is perpendicular to uniform magnetic field of induction B. A small cut is made in the ring and a galvanometer is connected across the ends such that the total resistance of circuit is R. When the ring is suddenly squeezed to zero area, the charge flowing through the galvanometer is

1) $\frac{BR}{A}$ 2) $\frac{AB}{R}$ 3) ABR 4) $\frac{B^2A}{R^2}$

9. 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 (four times) and wire radius halved, the electrical power dissipated would be
1) halved 2) the same 3) doubled 4) quadrupled

MOTIONAL E.M.F

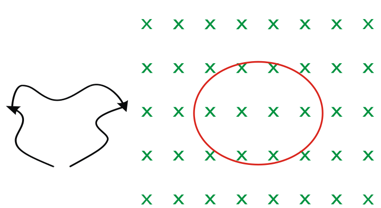
10. A conducting square looop of side L and resistance R movesin its plane with a uniform velocity v perpendicular to one of tis sides. A magnetic induction B, constant in time and space, pointing perpendicular to and into the plane of the loop exists every where.



The current induced in the loop is
1) BLv/R clock wise
2) BLv/R anticlockwise
3) $2BLv/R$ anticlockwise 4) zero

11. A metal rod moves at a constant velocity in a direction perpendiuclar 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.
1) The entire rod is at the same electric potential
2) There is an electric field in the rod
3) The electric potential is highest at the centre of the rod and decrease towards its ends
4) The electric potential is lowest at the centre of the rod and increases towards its ends

12. A thin flexible wire of length L is connected to two adjacent fixed points and carries a current I in the clockwise direction, as shown in the figure. When the system is put in a uniform magnetic field of strength B going into the plane of the paper, the wire takes the shape of a circle. The tension in the wire is



1) IBL 2) $\frac{IBL}{\pi}$ 3) $\frac{IBL}{2\pi}$ 4) $\frac{IBL}{4\pi}$

SELF INDUCTION & MUTUAL INDUCTION

13. A coil has an inductance of 0.05H and 100 turns and 0.02A current is passed through it. Flux linked with coil is
1) 10^{-2} Wb 2) 10^{-3} Wb 3) 10^{-4} Wb 4) 10^{-5} Wb

14. A current of 2 A is increasing at the rate of 4 A/s through a coil of inductance 2 H. The energy stored in the inductor per unit time is
1) 2 W 2) 1 W 3) 16 W 4) 4 W

15. The current decays from 5 A to 2 A in 0.01s in a coil. The emf induced in a coil nearby it is 30V. The mutual inductance between the coils is
1) 1.0 H 2) 0.1 H 3) 0.001 H 4) 10 H

16. A varying current in a coil change from 10A to 0A in 0.5sec. If the average emf induced in the coil is 220V, the self inductance of the coil is
1) 5H 2) 6 H 3) 11H 4) 12 H

17. An air - cored solenoid is of length 0.3m, area of cross section $1.2\times10^{-3}m^{-2}$ and has 2500 urns. Around its central section, a coil of 350 turns is wound. The solenoid and the coil are electrically insulated from each other. Calculate the emf induced in the coil if the initial current of 3A in the solenoid is reversed in 0.25s.
1)0.1056V 2)1.056V
3)10.56V 4) 0.01056V

18. A solenoid of length 50cm with 20 turns per centimetre and area of cross-section $40cm^2$ completely surrounds another coaxial solenoid of the same length, area of cross-section $25cm^2$ with 25 turns per centimetre. Calculate the mutual inductance of the system.
1) 9.7 mH 2) 7.9 mH 3) 8.9 mH 4) 6.8 mH

19. The current in a coil is changed from 5A to 10A in 10^{-2}s. An emf of 50mV is induced in coil near by it. The mutual inductance of two coils is
1) 100 μ H 2) 200 μ H
3) 300 μ H 4) 400 μ H

20. **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**

1) l/L 2) l^2/L 3) L/l 4) L^2/l

L-R AND C-R CIRCUITS (D.C.)

21. **A coil is connected to a battery of 12 V emf and negligible internal resistance. The current in the solenoid grows to 63% of its final steady state value in 0.3 s. If the final steady state current is 0.6 A, the inductance of the solenoid is**

1) 0.6 H 2) 6.0 H 3) 0.015 H 4) 0.15 H

22. **A coil of inductane 8.4mH and resistance 6Ω is connected to a 12V battery. The current in the coil is 1A at approximately the time**

1) 500 s 2) 20 s 3) 35 ms 4) 1 ms

23. **An ideal coil of 10H is connected series with a resistance of 5Ω and a battery of 5V.2s after the connection is made, the current flowing (in ampere) in the circuit is**

1) $(I-e)$ 2) e 3) e^{-I} 4) $(I-e^{-1})$

LEVEL-I (H. W) - KEY

01) 2 02) 4 03) 3 04) 2 05) 4 06) 1 07) 2
08) 2 09) 4 10) 4 11) 2 12) 3 13) 4 14) 3
15) 2 16) 3 17) 1 18) 2 19) 1 20) 2 21) 2
22) 4 23) 4

LEVEL-I - (H. W) - HINTS

1. $i=\frac{1}{R}NA\frac{dB}{dt} = \frac{1}{20}\times 10\times 10^{-3}\times 10^4$

2. $e=N\frac{d\phi}{dt}$

3. $e=\frac{-NA(B_2-B_1)}{time} = \frac{-NA(-B-B)}{time}=\frac{2NAB}{time}$

4. $e=A\frac{dB}{dt}$

5. Initial flux through the coil, $\phi_{Bi}=+NBA$

Final flux through the coil, $\phi_{Bi}=+NBA$

When the coil is turned through 180^0 its flux reverses; the angle between magnetic field and area vector is reversed.

$\Delta\phi_B=\phi_{Bf}-\phi_{Bi}=-NBA-(NBA)=-2NBA$

$Q=\frac{\Delta\phi_B}{R}=\frac{2NBA}{R}$

6. $\vec{l},\vec{v}$ and $\vec{B}$ are coplanar.

7. $q=\frac{e}{R}dt=\frac{(B_1-B_2)NA}{R}$

$2\mu c=\frac{(B-0)20\times 10^{-4}}{10}=0.01T$

8. $Q=\frac{\Delta\phi}{R}-\frac{\phi_2-\phi_1}{R}=\frac{BA-0}{R}=\frac{BA}{R}$

$=6\times 10^{-3}=6\text{mWb}$

9. Power $P=\frac{e^2}{R}$

Here, $e=induced\ emf=-\left(\frac{d\phi}{dt}\right) where\ \phi=NBA$

$e=-NA\left(\frac{dB}{dt}\right)$; Also, $R\propto\frac{1}{r^2}$

Where R= resistance , r= radius, l=length

$\therefore P\propto N^2r^2$; $\therefore\frac{P_2}{P_1}=4$

10. Net change in magnetic flux passing through the coil is zero.

$\therefore$ Current(of emf) induced in the loop is zero

11. A motional emf, $e=Blv$ is induced in the rod. Or we can say a potential difference is induced between the tow ends of the rod AB,with A at higher potential and B at lower potential. Due to this potential difference, there is an electric field in the rod.

12. $L=2\pi R$; $\therefore R=\frac{L}{2\pi}$; $2T\sin(d\theta)=d\theta$

For small angles, $\sin(d\theta)=d\theta$

$\therefore 2T(d\theta)=I(dL)B\sin 90^0; =I(2R.d\theta).B$

$\therefore T=IRB=\frac{ILB}{2\pi}$; $\therefore$ Correct option is (c)

13. $n\phi=Li$

14. $U=\frac{1}{2}Li^2$; $P=\frac{dU}{dt}$

15. $e=-M\left(\frac{di}{dt}\right)$

16. $E=L\times\frac{di}{dt}$

17. $M=\frac{\mu_0 N_1N_2A_2}{l}$

18. $M = \frac{\mu_0 N_1 N_2 A_2}{l}$

19. $E = M \times \frac{di}{dt}$

20. Magnetic field produced by a current i in a large square loop at its centre

$B \propto \frac{i}{L}$ say $B = K\frac{i}{L}$

$\therefore$ Magnetic flux linked with smaller looop,

$\phi = B.S$ $\phi = \left(K\frac{i}{L}\right)\left(l^2\right)$

Therefore, the mutual inductance

$M = \frac{\phi}{i} = K\frac{l^2}{L}$ or $M \propto \frac{l^2}{L}$

21. $\tau = \frac{L}{R} = \frac{L\,i}{V}$

22. The current-time $(i-t)$ equation in $L-R$ circuit is given by [Growth of current in $L-R$ circuit]

$i = i_0\left(1-e^{-i/t_L}\right)------(i)$

Where $i_0 = \frac{V}{R} = \frac{12}{6} = 2A$ and $t_L = \frac{L}{R} = \frac{8.4\times10^{-3}}{6}$

and $i = 1A$; $t = ?$

Substituting these values in Eq. (i), we get

$t = 0.97\times10^{-3}s$ or $t = 0.97\,ms$ $t = 1ms$

23. $I_0 = \frac{E}{R} = 1A$; $\tau = \frac{L}{R} = \frac{10}{5} = 2s$; $\therefore\left(I = 1-e^{-1}\right)A$