Electromagnetic Induction

1. Lenz's law is a consequence of the law of conservation of:
   (a) charge (b) mass (c) momentum (d) energy
2. The law of electromagnetic induction have been used in the construction of a:
   (a) galvanometer (b) voltmeter (c) electric motor (d) generator
3. A cylindrical bar magnet is kept along the axis of a circular coil. On rotating the magnet about the axis, the coil will have induced in it:
   (a) a current (b) no current (c) only an em (d) both an emf and a current
4. A horizontal straight conductor when placed along south-north direction falls under gravity; there is:
   (a) an induced current from south to north direction
   (b) an induced current from north to south direction
   (c) no induced emf along the length of the conductor
   (d) an induced emf along the length of the conductor
5. A car moves on a plane road. Induced emf produced across the axle is maximum when it moves:
   (a) at the poles (c) remains stationary
   (b) moves at equator (d) no emf is induced at all
6. A small piece of wire is passed through the gap between the poles of a magnet in 0.1 sec. An emf of 4×10^{-8} volt is indued wire. The magnetic flux between the poles (in weber) is:
   (a) 10 (b) 4×10^{-9} (c) 4×10^{-2} (d) 0.1
7. Flux ϕ (in weber) in a closed circuit of resistance 10 ohm varies with time *t* (in sec) according the equation:
   $$\phi = 6t^2 - 5t + 1$$
   What is the magnitude of the induced current at $t = 0.25$ sec?
   (a) 1.2 A (b) 0.8 A (c) 0.6 A (d) 0.2 A
8. The core of a transformer is laminated so that:
   (a) ratio of voltage in the primary and secondary may be increased
   (b) energy losses due to eddy currents may be minimized
   (c) weight of transformer may be reduced
   (d) rusting may be prevented
9. When two inductors L_1 and L_2 are connected in parallel, the equivalent inductance is:
   (a) $L_1 + L_2$
   (b) between L_1 and L_2
   (c) less then both L_1 and L_2
   (d) none of the above
10. A metallic ring with a cut is held horizontally and a magnet is allowed to fall vertically through the ring. Then, the acceleration of the magnet is:
    (a) equal to g
    (b) less then g

(c) more then g
(d) sometimes less and sometimes more then g

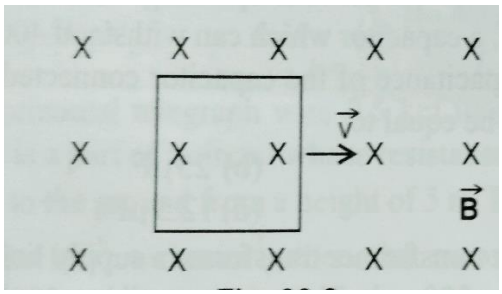
11. A resistance coil is held horizontally and a magnet is allowed to fall vertically through it. Then, the acceleration of the magnet is:
(a) equal to g
(b) non-uniform and less then g
(c) uniform and less then g
(d) more then g

12. A series combination of L and R is connected to a battery of emf E and negligible internal resistance; then the final value of current depends non:
(a) L and R (b) E and L (c) E and R (d) L, R and E

13. A coil of resistance R and inductance L is connected to a battery of E volt emf. The final current in the coil is:
(a) E/R (b) E/L (c) √E/($R^2 + L^2$) (d) √EL/($R^2 + L^2$)

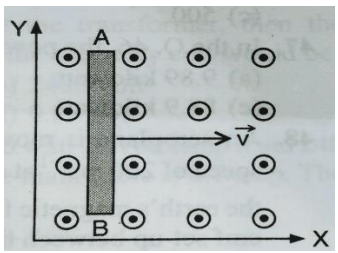
14. When the number of turns in a coil is doubled without any change in the length of the coil, its self-inductance becomes:
(a) four times (b) doubled (c) halved (d) squared

15. A conducting square loop of side L and resistance R moves in its plane with a uniform velocity υ perpendicular to one of its sides. A magnetic induction B, constant in time and space, pointing perpendicular and the into the plane of the loop is:



(a) Blυ/R clockwise
(b) Blυ/R anticlockwise
(c) 2Blυ/R anticlockwise
(d) zero

16. A conductor rod AB moves parallel to x-axis in a uniform magnetic field, pointing in the positive X -direction. The end A of the rod gets:



(a) positive charged (b)negatively charged
(b) neutral (d) first positively charged and then negatively charged

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. A step-up transformer operates on a 230 volt line and supplies to a load of 2 amp. The ratio of primary to secondary windings is 1 : 25. Determine the primary current:
(a) 12.5 amp (b) 50 amp (c) 8.8 amp (d) 25 amp

19. The ratio of turns in the primary and secondary coils of a transformer is 20; then assuming the transformer to be ideal the ratio of their emfs and the ratio of the currents flowing through them are respectively:
(a) 2/1, 1/2 (b) 20/1, 1/20 (c) 1/20, 20/1 (d) 200/1, 1/200

20. Two coils X and Y are placed in a circuit such that the current changes by 4 amp in coil X and the magnetic flux changes by 0.4 weber in Y. The value of mutual inductance of the coils and its unit (in henry) is:
(a) 0.2 (b) 5 (c) 0.8 (d) 0.1

21. Two coils of self-inductances L_1 and L_2 are placed so close to each other that the effective flux in one coil is completely linked with the other; then the mutual inductance M between them is given by:
(a) $M = \sqrt{L_1 L_2}$ (b) $M = L_1 - L_2$ (c) $M = L_1 / L_2$ (d) $M = L_1 / L_2$

22. A long solenoid of length L, cross-section A having N_1 turns has wound about its centre a small coil of N_2 turns. Then, the mutual inductance of the two circuits is:
(a) $\mu_0 A(N_1/N_2)/L$ (b) $\mu_0 A(N_1/N_2)/L$ (c) $\mu_0 A N_1/N_2 L$ (d) $\mu_0 A N^2_1 N_2/L$

23. The primary winding of a 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:
(a) 200 V, 50 Hz (b) 200 V, 500 Hz (c) 2 V, 50 Hz (d) 2 V, 5 Hz

24. A solenoid of length 1 meter has self inductance L henry. if number of turns are doubled, its self inductance:
(a) remains same (c) becomes 4L henry
(b) becomes 3L henry (d) becomes $L/\sqrt{2}$ henry

25. A metal disc of radius R rotates with an angular velocity ω about an axis perpendicular to its plane passing through its centre in a magnetic field of induction B acting perpendicular to the plane of the disc. The induced emf between the rim and the axis of the disc is:
(a) $-B\pi R^2$ (b) $-2B\pi^2 R^2/\omega$ (c) $-B\pi R^2\omega$ (d) $-B\pi R^2\omega/2$

26. A capacitor C is charged by a battery of emf V_0 volt. The battery is then disconnected a pure inductor of L henry is connected across it so that LC oscillation are set up. Then, the frequency of oscillations is:
(a) $2\pi\sqrt{LC}$ (b) $1/2\pi\sqrt{LC}$ (c) $\pi/2\sqrt{L/C}$ (d) $\pi/2\sqrt{C/L}$

27. If rotational velocity of a dynamo armature is doubled, then induced emf will become:

(a) half (b) two times (c) four times (d) unchanged

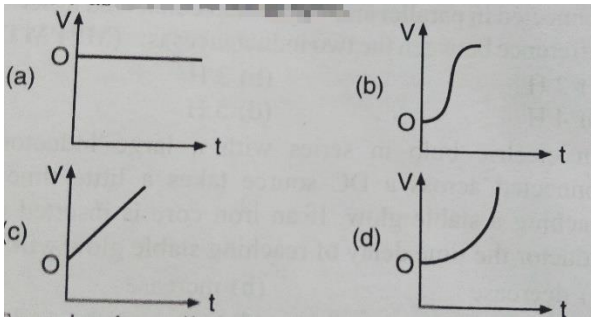
28. Use of eddy currents is done in the following except:
    (a) moving coil galvanometer
    (b) electric brakes
    (c) induction motor
    (d) dynamo

29. A step-down transformer transforms 220 volt to 11 volt. If the currents in primary and secondary coils are 5A and 90A respectively, efficiency of transformer is:
    (a) 70% (b) 40% (c) 20% (d) 90%

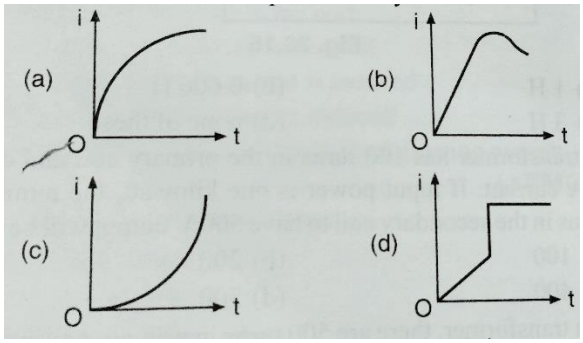
30. The self-inductance of a coil is:
    (a) directly proportional to the current flowing through it
    (b) independent of current
    (c) inversely proportional to current
    (d) inversely proportional to the square of number of turns

31. The magnetic induction at a point on the axis of a magnet is proportional to:
    (a) r (b) r^{-2} (c) r^{-3} (d) r^3

32. A circular coil is falling under the action of gravity in a constant magnetic field of the earth. If the plane of the coil remains horizontal, the induced emf V in the coil varies with time *t* as shown in the graphs :



33. When a battery is connected across a series combination of self inductance L and resistance R, the variation in the current *i* with time *t* is best represented by:
    (a) (c)



34. A solenoid of resistance 50Ω and inductance 5mH is connected to 200 V battery. Calculate the maximum energy stored.
    (a) 4 mJ (b) 0.4 mJ (c) 40 mJ (d) 400 mJ

35. If coil is open, then L and R become:
(a) ∞, 0 (b) 0, ∞ (c) ∞, ∞ (d) 0, 0

36. An inductance L and a resistance R are connected in series with a battery of emf ε. The maximum rate at which the energy is stored in the magnetic field is:
(a) $\varepsilon^2/4R$ (b) $\varepsilon^2/2R$ (c) $2R/\varepsilon$ (d) $4R/\varepsilon$

37. Fleming's left and right hand rules are used in:
(a) DC motor and AC generator
(b) DC generator and AC motor
(c) DC motor and DC generator
(d) both rules are same, any one can be used

38. The net magnetic flux through any closed surface, kept in a magnetic field is:
(a) zero (b) $\mu_0/4\pi$ (c) $4\pi\mu_0$ (d) $4\mu_0/\pi$

39. 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) 0.4 (d) 2.5 (e) 0.8

40. The inductance of a coil is L = 10 H and resistance R = 5Ω. If applied voltage of battery is 10 V and it switches off in 1 millisecond, find induced emf of inductor:
(a) 2×10^4 V (b) 1.2×10^4 V (c) 2×10^{-4} V (d) none of these

41. The work done in establishing current *I* in a coil of self-inductance L:
(a) LI^2 (b) $LI^2/2$ (c) $LI^2/\sqrt{2}$ (d) $\sqrt{2}\,LI^2$

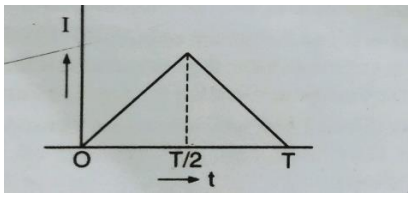
42. The current through a coil of self-inductance L = 2 mH is given by $I = t^2e^{-t}$ at time *t*. How long it will take to make the emf zero?
(a) 1 s (b) 2 s (c) 3 s (d) 4 s

43. The magnetic flux across a loop of resistance 10Ω is given by $\phi = 5t^2 - 4t + 1$ weber. How much current is induced in the loop after 0.2 sec?
(a) 0.4 A (b) 0.2 A (c) 0.04 A (d) 0.02 A

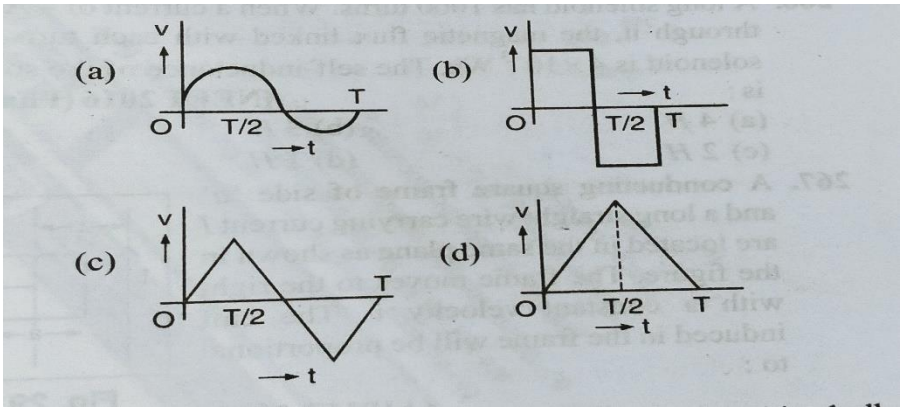
44. A fully charged capacitor C with initial charge q_0 is connected to a coil of self-inductance L at t = 0. The time at which the energy is stored equally between the electric and the magnetic fields is:
(a) $\pi\sqrt{LC}$ (b) $\pi/4\sqrt{LC}$ (c) $2\pi\sqrt{LC}$ (d) $\sqrt{LC}$

45. Two solenoids of equal number of turns have their lengths and the radii in the same ratio 1 : 2. The ratio of their self-inductances will be:
(a) 1 : 2 (b) 2 : 1 (c) 1 : 1 (d) 1 : 4 (e) 1 : 3

46. The current (*I*) in the inductance is varying with time according to the plot shown in figure.



Which one of the following is the correct variation of voltage with time in the coil?



Answers :-

1. (d)
2. (d)
3. (b)
4. (c)
5. (a)
6. (b)
7. (d)
8. (b)
9. (c)
10. (a)
11. (b)
12. (c)
13. (a)
14. (b)
15. (d)
16. (a)
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31. (c)
32. (c)
33. (a)
34. (c)
35. (b)
36. (a)
37. (c)
38. (a)
39. (e)
41. (b)
42. (b)
43. (b)
44. (b)
45. (a)
46. (b)

20.(d) 40. (a)