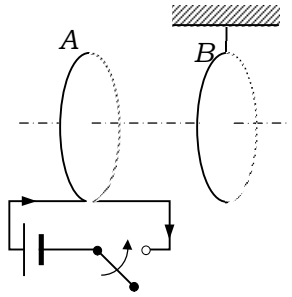
ELECTROMAGNETIC INDUCTION

1. A light bar magnet is released from rest along the axis of a very long, vertical aluminum tube. After sometime the magnet
A) will stop in the tube
B) will move with an acceleration more than g
C) will move with almost constant speed
D) will oscillate up and down

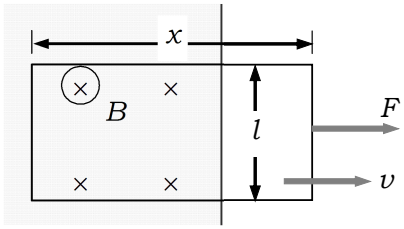
2. A systems S consists of two coils A and B. The coil A carries a steady current I while the coil B is suspended near by as shown in figure. Now if the system is heated so as to raise the temperature (which increases resistance) of two coils steadily then



A) the two coils show attraction
B) the two coils show repulsion
C) there is no change in the position of the two coils
D) Induced current is not possible in the coil B.

3. Two coils of self-inductances L_1 and L_2 are tightly wrapped on over the other. The maximum mutual inductance of the combination will be
A) $L_1 + L_2$
B) $L_1 L_2$
C) $\sqrt{L_1 L_2}$
D) $L_1 L_2 / (L_1 + L_2)$

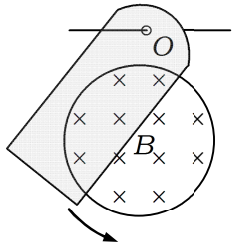
4. A rectangular loop of resistance R, and sides l and x is pulled out of a uniform magnetic field B with a steady velocity v. The necessary force F required for maintaining uniform velocity of withdrawal is



A) Bxl^2v/R
B) B^2l^2v/R
C) $B^2l^2v^2/R$
D) zero

5. A solenoid coil is wound on a frame of rectangular cross-section. If all the linear dimensions of the frame are increased by a factor of two and the number of turns per unit length of the coil remains the same, the self inductance increase by a factor of
A) 4 B) 8
C) 12 D) 16

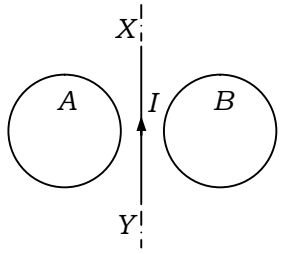
6. A thick strip of copper is mounted as a compound pendulum about *O*. If it is made to swing through a uniform magnetic field *B* normal to the plane of the strip then (neglecting air resistance) it is found that



A) strip swings almost freely
B) motion of the strip is heavily damped
C) strip does not oscillate at all but immediately comes to rest in the vertical position
D) strip swings almost freely but its temperature decreases

7. A copper ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. Then the acceleration of the falling magnet (neglect air resistance) will be
A) equal to *g* B) less than *g*
C) greater than *g* D) zero

8. Consider the situation shown in fig. If the current *I* in the long straight wire *XY* is increased at a steady rate then the induced emf's in loops *A* and *B* will be



A) clockwise in *A*, anticlockwise in *B* B) anti clockwise in *A*, clockwise in *B*
C) clockwise in both *A* and *B* D) anti clockwise in both *A* and *B*

9. An artificial satellite with a metal surface is moving about the earth in a circular orbit. An emf (neglecting declination) will be induced in the satellite, if
A) the plane of the orbit coincides with the equatorial plane
B) the plane of the orbit is inclined to the equatorial plane
C) the plane of the orbit coincides with the equatorial plane and the speed of the satellite is less than 8 $Kmsec^{-1}$
D) no induced emf produced whatever may be the plane of the orbit

10. Two identical solenoid coils, each of self inductance L are connected in series. Their turns are in the same sense, and the distance between them is such that the coefficient of coupling is half. Then the equivalent inductance of the combination is
A) L B) $2L$
C) $3L$ D) $L/2$

11. A coil having n turns and area A is initially placed with its plane normal to the magnetic field B. It is then rotated through 180^o in 0.2 sec. The emf induced at the ends of the coils is
A) $0.1nAB$ B) nAB
C) $5\ nAB$ D) $10\ nAB$

12. The back emf in a DC motor is maximum when
A) the motor has picked up maximum speed
B) the motor has just started moving
C) the speed of motor is still on the increase
D) the motor has just been switched off

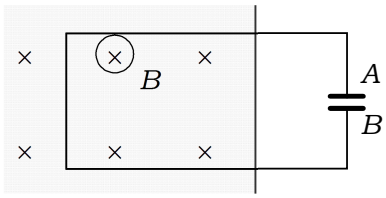
13. Through an inductance coil of L = 0.2H, an a.c. current of 2 ampere is passed first with frequency n_1 and then with frequency n_2. The ratio of the maximum value of induced emf $\left(e_1/e_2\right)$ in the coil, in the two cases is
A) n_1/n_2 B) n_2/n_1
C) n_1^2/n_2^2 D) n_2^2/n_1^2

14. A thin copper wire of length 100 m is wound as a solenoid of length l and radius r. Its self inductance is found to be L. Now if the same length of wire is wound as a solenoid of length l but of radius $r/2$, then its self inductance will be
A) $4L$ B) $2L$
C) L D) $L/2$

15. A conducting circular loop is placed in a uniform magnetic field B = 40 mT with its plane perpendicular to the field. If the radius of the loop starts shrinking at a constant rate of 2 mms^{-1}, then the induced emf in the loop at an instant when its radius is 1.0 cm is
A) $0.1\pi\mu$ V B) $0.2\ \pi\mu$ V
C) $1.0\ \pi\mu$ V D) $1.6\ \pi\mu$ V

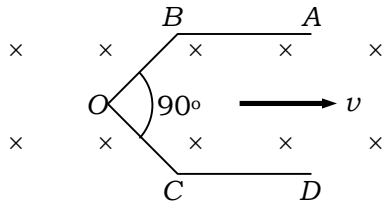
16. A coil of 10 H inductance has a 5Ω resistance and is connected to a 5 V battery in series. The current in ampere, in the circuit 2 seconds after the circuit is switched on is
A) 1 A B) $\left(1-1/e\right)$ A
C) $(1-e)$ A D) $1/e$ A

17. The plates A and B of capacitor are connected to a conducting loop as shown in figure. The magnetic field is into the page. If the field increases at a steady rate, then



A) plate A becomes positively charged
B) plate B becomes positively charged
C) both plates becomes positively charged
D) neither plates becomes positively charged

18. A conductor $ABOCD$ moves along its bisector with a velocity of 1 ms^{-1} through a perpendicular magnetic field of 1 Wbm^{-2}, as shown in figure. If all the four sides are of 1m length each, then the induced emf between points A and D is



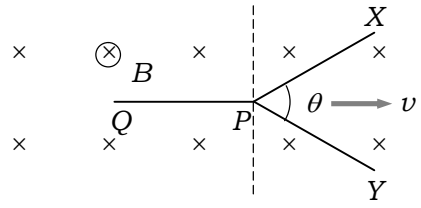
A) zero
B) 1.41 V
C) 0.71 V
D) none of the above

19. If N is the number of turns in a coil, the value of self inductance varies as
A) N°
B) N
C) N^{2}
D) N^{-2}

20. Whenever the magnetic flux linked with a coil changes, there is produced an induced emf in the circuit. The emf lasts
A) for a short time
B) for a long time
C) for ever
D) so long as the change in flux takes place

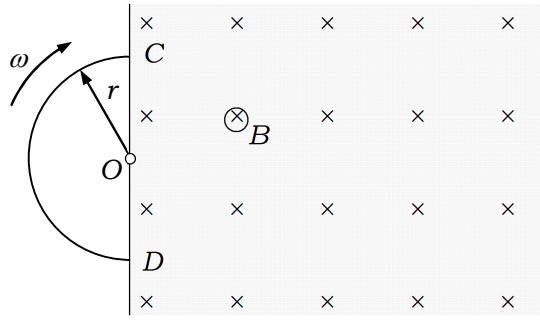
21. The coefficient of mutual inductance of the two coils is 5 H. The current through the primary coil is reduced to zero value from 3 A in 1 milli second. Induced emf in the secondary coils is
A) zero
B) 1.67 KV
C) 15 KV
D) 600 V

22. A conducting wire in the shape of Y, with each side of length l is moving in a uniform magnetic field B, with a uniform speed v as shown in fig. The induced emf at the two ends X and Y of the wire will be



A) zero
B) $2Blv$
C) $2Blv\sin\left(\theta/2\right)$
D) $2Blv\cos\left(\theta/2\right)$

23. In figure *CODF* is a semicircular loop of a conducting wire of resistance *R* and radius *r*. It is placed in a uniform magnetic field *B*, which is directed into the page (perpendicular to the plane of loop). The loop is rotated with a constant angular speed ω about an axis passing through the centre *O*, and perpendicular to the page. Then induced current in the wire loop is

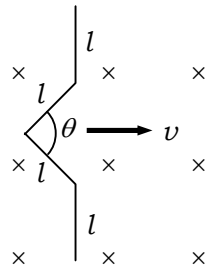


A) zero
B) $Br^2\omega/R$
C) $Br^2\omega/2R$
D) $B\pi r^2\omega/2R$

24. A magnetic needle is placed parallel to a magnetic field. The amount of work done in rotating the coil by an angle of 60° is *W* units. Then the torque required to keep the needle in the displaced position is
A) W
B) $\sqrt{3}W$
C) $\left(\sqrt{3}/2\right)W$
D) $W/2$

25. An athlete is running at a speed of 30 kmh^{-1} towards east, holding a 3 m metallic rod horizontally. The horizontal component of earth magnetic field in this region is 3×10^{-4} tesla and the angle of dip is 30°. Then the emf induced across the ends of the rod is
A) 7.5 mV
B) 4.3 mV
C) zero
D) 13 mV

26. Four pieces each of length *l*, of a conducting rod are joined as shown in the figure. The rod is placed in a downward magnetic field *B*. If the rod is moved towards right with a uniform velocity *v*, then the induced emf across the two ends of the rod is



A) Blv B) 4 Blv

c) 2 $Blv\sin\left(\theta/2\right)$ D) 2 $Blv\left(1+\sin\theta/2\right)$

27. A small circular coil of radius 1 cm and number of turns 100 is placed inside a long solenoid of radius 5 cm and number of turns 8 per cm. The axis of the coil is parallel to the solenoid axis. Then the coefficient of mutual inductance of the two coils is (in milli henry)
A) 0.032 B) 0.064
C) 0.016 D) zero

28. A small square loop of wire of side l is placed inside a large square loop of wire of size L ($L > l$). The loops are coplanar and their centers coincide. The mutual inductance of the system is proportional to
A) l/L B) l^2/L
C) L/l D) L^2/l

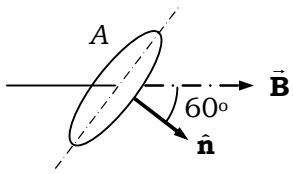
29. An ac generator consists of a coil of 200 turns, 10 cm in diameter. If the coil rotates at 500 rpm in a magnetic field of 0.25T, then the maximum induced emf
A) 20.6 V B) 51.7 V
C) 4.1 V D) none of the above

30. Two coils have a mutual inductance of 5 mH. If the current in the first coil changes by 3 A in 0.02 second, then the induced emf in the second coil is
A) –0.75 V B) –0.75 mV
C) –1.5 V D) –750 V

31. A circular coil of radius r and number of turns n is placed at the centre of a big circular coil of radius R and number of turns N. Both the coils are coplanar. If $R >> r$, and M is the conductance of the pair of coils, then M is proportional to
A) nNr/R B) nNr^2/R
C) nNr^2/R^2 D) nr^2/NR^2

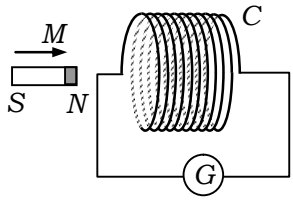
32. A circular coil of conducting wire has an area A and number of turns N. It is lying in a vertical plane, in a region where uniform magnetic field B exist, with field direction normal to the coil plane. If the coil is rotated about a vertical axis by an angle π in 0.5 seconds, then the value of the emf induced at the ends of the coil is
A) 4 NAB B) 4π NAB
C) 8 NAB D) 8π NAB

33. A coil of area $A = 0.5\ m^2$ is situated in a uniform magnetic field $B = 4.0\ Wbm^{-2}$ and makes an angle of 60° with respect to the magnetic field as shown in figure. The value of the magnetic flux through the area A would be equal to



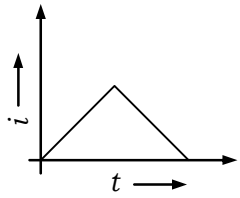
A) 2 Webber
B) 1 Webber
C) 3 Webber
D) $\left(\frac{3}{2}\right)$ Webber

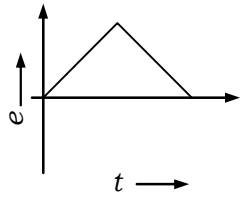
34. When a magnet M is pushed in and out of a circular coil C connected to a very sensitive galvanometer G as shown in figure, with frequency f

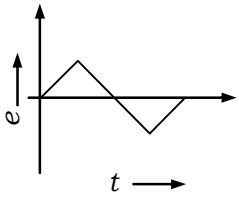


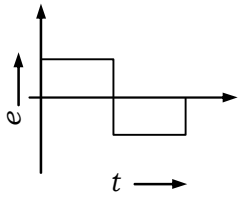
A) Constant deflection will be observed in the galvanometer
B) Visible small variation will be observed in the galvanometer if f is about 50 Hz
C) Oscillation in the deflection will be seen clearly when f = 1 or 2 Hz
D) No variation in the deflection will be seen even when f = 1 or 2 Hz.

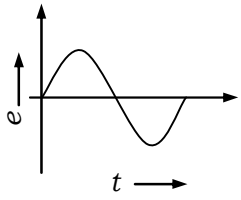
35. The current I in an inductance coil varies with time t according to the graph shown in fig. Which one of the following plots shows the variation of voltage in the coil with time



A)


B)


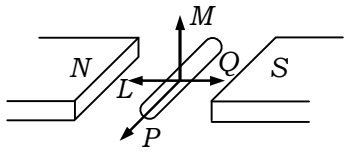
C)


D)


36. Flux φ (in water) in a closed circuit of resistance 10 Ω varies with time t (in sec) according to the equation: $\varphi = 6t^2 - 5t + 1$. What is the magnitude of the induced current at t = 0.25 s?
A) 1.2 A B) 0.8 A
C) 0.6A D) 0.2 A

37. A conducting rod of length L is falling with velocity v perpendicular to a uniform horizontal magnetic field B, the potential difference between its two end will be
A) $2BLv$ B) BLv
C) $\frac{1}{2}BLv$ D) $(BLv)^2$

38. A potential difference will be induced between the ends of the conductor shown in figure. When conductor moves in the direction



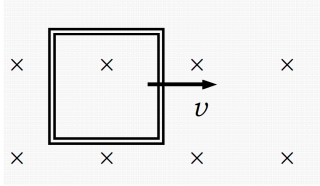
A) P B) Q
C) L D) M

39. The two rails of a railways track, insulated from each other and the ground, are connected to a mili-voltmeter. What is the reading of the mili-voltmeter when a train travels at a speed of 20 ms^{-1} along the track, given that the vertical component of earth's magnetic field is 0.2×10^{-4} Wbm^{-2} and the rails are separated by 1 m.
A) 4 mV B) 0.4 mV
C) 80 mV D) 10 mV

40. An airplane with wing span 50 m is flying horizontally with a speed of 360 km hr^{-1} over a place where the vertical component of the earth's magnetic field is 2×10^{-4} Wbm^{-2}. The potential difference between the tips of the wings would be
A) 0.1 V B) 1.0 V
C) 0.2 V D) 0.01 V

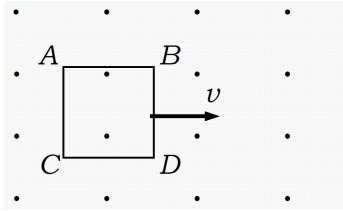
41. A car moves up a plane road. The induced emf in the axle connecting the two wheels is maximum, when it moves:
A) At the poles B) At equator
C) Remains stationary D) No emf is induced at all

42. 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 loop exists everywhere. The current induced in the loop is



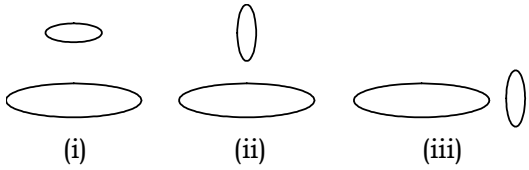
A) $\frac{BVL}{R}$, clockwise
B) $\frac{BVL}{R}$, anti clockwise
C) $\frac{2BVL}{R}$, anti clock wise
D) zero

43. 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 figure. An electric field is induced



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*

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

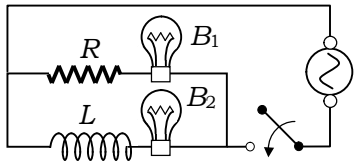


A) maximum in situation (i)
B) maximum in situation (ii)
C) maximum in situation (iii)
D) the same in all situations

45. A small square loop of a slide l is placed inside a large loop of wire L (>> l). The loops are coplanar and their centers coincide. The mutual inductance of the system is proportioned to

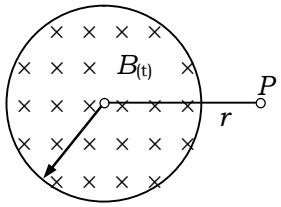
A) $\left(l/L\right)$
B) $\left(l^2/L\right)$
C) $\left(L/l\right)$
D) $\left(L^2/l\right)$

46. Figure shows two bulbs B_1 and B_2, resistor R and inductor L. When the switch S is turned off



A) Both B_1 and B_2 die out with some delay
B) Both B_1 and B_2 die out with some delay
C) B_2 die out promptly but B_1 with some delay
D) B_1dies out promptly but B_2 with some delay.

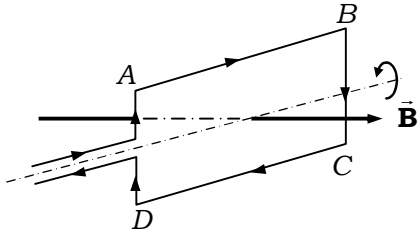
47. A uniform but time-varying magnetic field $B_{(t)}$ exists in a circular region of radius a and is direction into the plane of the paper, as shown figure. The magnitude of the electric field at point P at a distance r from the center of the circular region



A) is zero
B) decreases as $1/r$
C) increases as r
D) decrease as $1/r^2$

48. A steady voltage is applied to a dc motor. The armature winding resistance is equal to R. The maximum useful power of the motor is
A) $\frac{V^2}{R}$
B) $\frac{V^2}{2R}$
C) $\frac{V^2}{4R}$
D) $\frac{3V^2}{4R}$

49. A rectangle coil $ABCD$ is rotated anticlockwise with a uniform angular velocity about an axis as shown in figure. The axis of rotation of the coil as well as the magnetic field B are horizontal. The induced emf in the coil would be minimum when.



A) The plane of coil is horizontal
B) The plane of coil is vertical
C) The plane of coil makes an angle of 45° with the direction of the magnetic field
D) The plane of coil makes an angle of 30° with the field

50. Power is transmitted from a powerhouse on high voltage AC because
A) the rate of transmission is faster at high voltage
B) it is more economical due to less power loss
C) the life of current carrying wire is prolonged
D) a precaution against theft of transmission line

Answer to Electromagnetic Induction

01. C)	*02.* A)	*03.* C)	*04.* B)	*05.* B)	*06.* B)	*07.* B)	*08.* A)	*09.* B)	*10.* C)
11. D)	*12.* A)	*13.* A)	*14.* C)	*15.* D)	*16.* B)	*17.* B)	*18.* B)	*19.* C)	*20.* D)
21. C)	*22.* C)	*23.* C)	*24.* B)	*25.* B)	*26.* D)	*27.* A)	*28.* B)	*29.* A)	*30.* A)
31. B)	*32.* A)	*33.* B)	*34.* C)	*35.* C)	*36.* D)	*37.* B)	*38.* A)	*39.* B)	*40.* B)
41. A)	*42.* D)	*43.* D)	*44.* D)	*45.* B)	*46.* D)	*47.* B)	*48.* C)	*49.* B)	*50.* B)