PHYSICS

BOOKS - MTG PHYSICS (ENGLISH)

ELECTROMAGNETIC INDUCTION

Mcqs

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 The magnet was held stationary for a few seconds with the north pole in the middle of the solenoid and then withdrawn repidly.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

A. moving toward the solenoid

B. moving into the solenoid

C. at rest inside the solenoid

D. moving out of the solenoid

Answer: D

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2. What is magnetic flux linked with a coil of N turns and cross section area A held with its plane parallel to the field?

A. $\dfrac{NAB}{2}$

B. NAB

C. $\dfrac{NAB}{4}$

D. zero

Answer: D

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3. A square of side x m lies in the x-y plane in a region, when the magntic field is given by $\vec{B} = B_0\left(3\hat{i} + 4\hat{j} + 5\hat{k}\right)$ T, where B_0 is constant. The magnitude of flux passing through the square is

A. $5B_0x^2Wb$

B. $3B_0x^3Wb$

C. $2B_0x^2Wb$

D. B_0x^2Wb

Answer: A

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4. A circular disc of radius $0.2m$ is placed in a uniform magnetic fied of induction $\frac{1}{\pi}\left(\frac{Wb}{m^2}\right)$ in such a way that its axis makes an angle of 60° with B. The magnetic flux linked with the disc is

A. 0.02Wb

B. 0.06Wb

C. 0.08Wb

D. 0.01Wb

Answer: A

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5. Faraday's law are consequence of conservation of

A. charge

B. energy

C. magnetic field

D. both (b) and (c)

Answer: B

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

A. P increases while in Q decreases

B. Q increases while in P decreases

C. both P and Q increases

D. both P and Q decreases

Answer: D

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7. A coil of area $0.4m^2$ has 100 turns. A magnetic field of 0.04 Wb m^{-2} is acting normal to the coil surface. If this magnetic field is reduced to zero in 0.01 s, then the induced emf in the coil is

A. 160V

B. 250 V

C. 270 V

D. 320 V

Answer: A

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8. A coil of area $500 cm^2$ and having 1000 turns is held perpendicular to a uniform field of 0.4 gauss. The coil is turned through 180° in $1/10 \sec$. Calculate the average induced e.m.f.

A. 0.02 V

B. 0.04 V

C. 1.4 V

D. 0.08 V

Answer: B

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9. A long solenoid with 10 turns per cm has a small loop of area $3cm^2$ placed inside, normal to the axis of the solenoid. If the currnet carried by the solenoid changes steadily from 2 A to 4 A in 0.2 s, what is the induced voltage in the loop, while the current is changing?

A. $4.2 \times 10^{-8} V$

B. $2.8 \times 10^{-8} V$

C. $7.3 \times 10^{-6} V$

D. $3.8 \times 10^{-6} V$

Answer: D

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10. An air cored solenoid with length 20 cm area of cross section 20cm2. The current 2 A is suddenly switched off within 10^{-3} s. The average back emf induced across the ends of the open switch in the circuit is (ignore the variation in magnetic field near the ends of the solenoid)

A. 2 V

B. 4 V

C. 3 V

D. 5 V

Answer: B

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11. The magnetic flux through a coil perpendicluar to its plane and directed into paper is varying according to the relation $\phi = (2t^2 + 4t + 6)mWb$. The emf induced in the loop at t=4 s is

A. 0.12 V

B. 2.4 V

C. 0.02 V

D. 1.2 V

Answer: C

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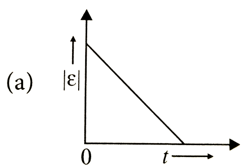
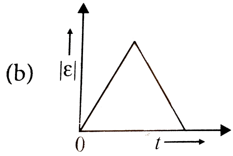
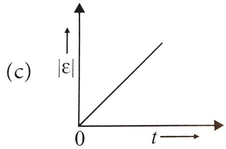
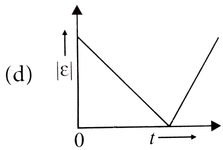
12. A long solenoid 'S' has 'n' turns per meter, with diameter 'a'. At the centre of this coil, we place a smallar coil of 'N' tunrs and diameter 'b' (where b lt a). If the current in the solenoid increase linearly with time, what is the induced emf apperaing in the smaller coil. Plot graph showing nature of variation in emf, if current varies as a function of $mt^2 + C$.

A. 

B. 

C. 

D. 

Answer: C

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13. A conducting circular loop is placed in a uniform magnetic field, $B = 0.025T$ with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of $1mms^{-1}$. The induced emf when the radius is $2cm$ is

A. $2\pi\mu V$

B. $\pi\mu V$

C. $\frac{\pi}{2}\mu V$

D. $2\mu V$

Answer: B

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14. A circular coil of radius 8cm, 400 turns and resistance 2Ω is placed with its plane perpendicular to the horizantal component of the earth's magnetic fiedl. It is rotated about its vertical diameter through 180° in 0.30 s. Horizontal component of earth magnitude of current induced in the coil is approximately

A. $4 \times 10^{-2} A$

B. $8 \times 10^{-4} A$

C. $8 \times 10^{-2} A$

D. $1.92 \times 10^{-3} A$

Answer: B

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15. A square loop of side 12 cm and resistance 0.6Ω is placed vertically in the east-west plane. A uniform magnetic field of 0.10 T is set up across the plane in north-east direction. The magnetic field is decreased to zeroin 0.6 s at steady rate. The magnitude of currnet during this time interval is

A. $1.42 \times 10^{-3} A$

B. $2.67 \times 10^{-3} A$

C. $3.41 \times 10^{-3} A$

D. $4.21 \times 10^{-3} A$

Answer: B

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16. A rectangular coil of 100 turns and size $0.1m \times 0.05m$ is placed perpendicular to a magnetic field of 0.1 T. If the field drops to 0.05 T in 0.05 s, the magnitude of the emf induced in the coil is

A. 0.2 V

B. 0.3 V

C. 0.5 V

D. 0.6 V

Answer: C

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17. A unifrom magnetic field B points vertically up and is slowly changed in magnitude, but not in direction. the rate of change of the magnetic field is α .A conducting ring of radius r and resistance R is held perpendicular to the megnetic field, and is totally inside it. The induced current in the ring is

A. zero

B. $\frac{2\pi eB}{R}$

C. $\frac{r\alpha}{R}$

D. $\frac{\pi r^2\alpha}{R}$

Answer: D

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18. A magnetic field B is confined to a region $r \leq$ a and points out of the paper (the z-axis), r = 0 being the center of the circular region. A charged ring (charge = Q) of radius b and mass m lie in the x-y plane with its center at origin. The ring is free to rotate and is at rest. The magnetic field is brought to zero in time Δt. Find the angular velocity ω of the ring after the field vanishes.

A. $\frac{qBa^2}{2mb}$

B. $\frac{qBa}{2mb^2}$

C. $\frac{2b^2}{qBa^2}$

D. $\frac{qb^2}{2Ba^2}$

Answer: D

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19. A metal ring is held horizontally and bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet

A. equal to g

B. less than g

C. more than g

D. depends of on the diameter of the ring length of magnet

Answer: B

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20. What rule do we use to find the direction of induced current in a conductor moving in a magnetic field?

A. Fleming's left hand rule

B. Fleming's right hand rule

C. Ampere's rule

D. Right hand clasp rule

Answer: B

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21. Lenz's law is a consequence of law of conservation of

A. charge

B. energy

C. induced emf

D. induced currnet

Answer: B

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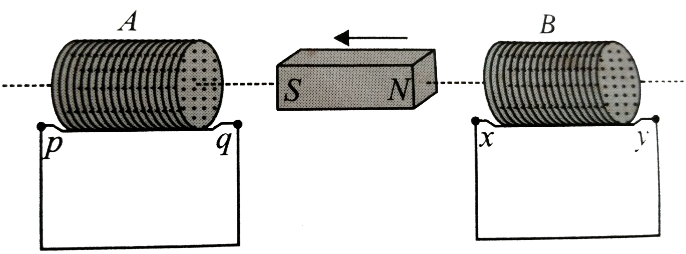
22. The direction of induced currnet in the coils A and B in the situation shown in the figure is



A. p to q in coil A and x to y in coil B

B. q to p in coil A and x to y in coil B

C. p ot q in coil A and y to x in coil B

D. q to p in coil A and y to x in coil B

Answer: B

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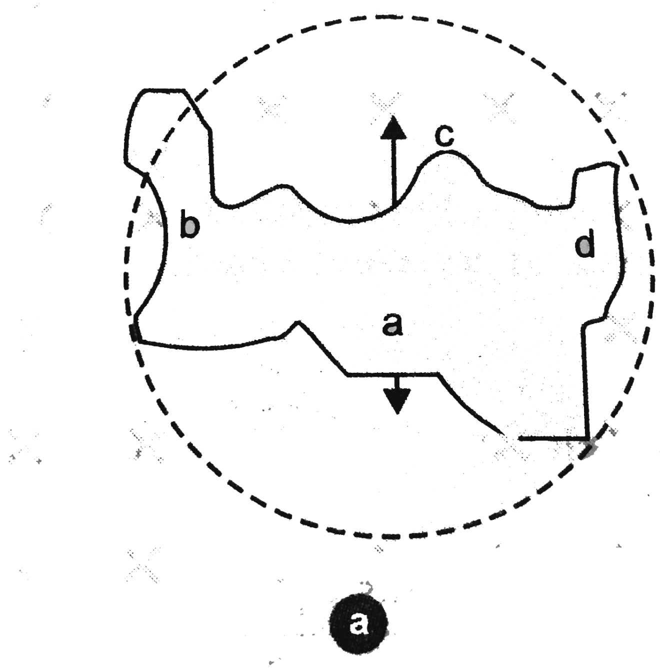
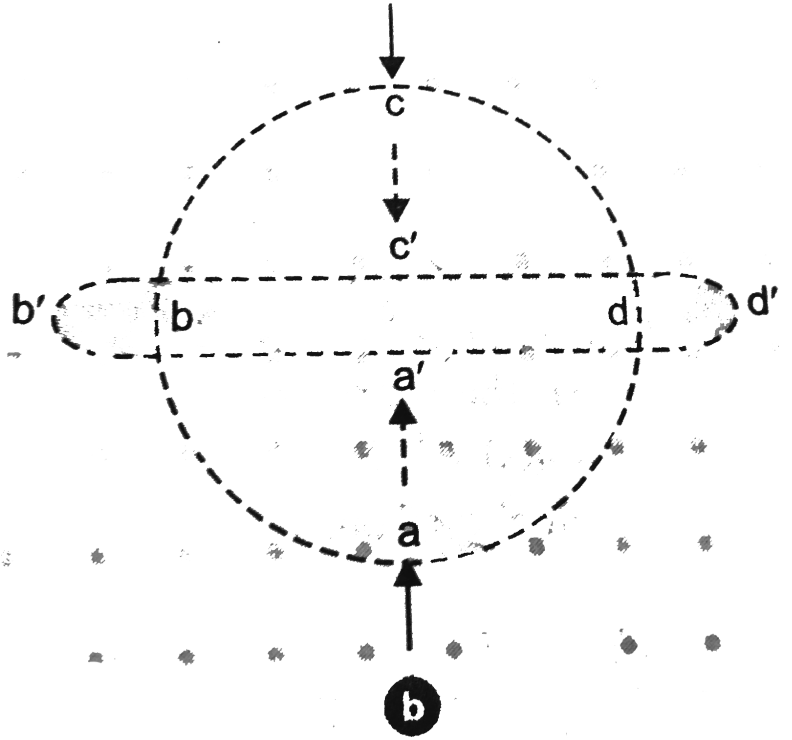
23. Use Lenz's law to determine the direction of induced current in the situation described by Fig. (a) a wire irregular shape turning into a circular shape (b) a circular loop being deformed into a narrow straight wire. The across indicate the magnetic field into the paper and the dots indicate magnetic field out of the paper.





A. along abcda

B. along adcba

C. into the plane of the paper

D. out of the plane of the paper

Answer: B

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24. A solenoid is connected to a battery so that a steady current flows through it. If an iron core is inserted into the solenoid, then

A. increase

B. decrease

C. remains same

D. first increase then decrease

Answer: B

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25. Which of the following satements is not correct?

A. whenever the amount of magnetic flux linked with a circuit change, an emf is induced in the circuit.

B. The induced emf so long as the change in magnetic flux continues.

C. The direction of induced emf is give by Lenz's law.

D. Lenz's law is a consequence of the law of conservation of momentum.

Answer: D

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26. 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 anti-clockwise direction

B. currnet is induced in the loop in the clockwise direction.

C. ac is induced in the loop.

D. no current is induced in the loop.

Answer: A

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27. The north pole of a bar magnet is rapidly introduced into a solenoid at one end (say A). Which of the following statements correctly depicts the phenomenon taking place?

A. No induced emf is developed.

B. The end A of the solenoid behaves like a south pole.

C. The end A of the solenoid behaves like north pole.

D. The end A of the solenoid acquires positive potential.

Answer: C

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28. 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

A. clockwise of the positive z-axis

B. anticlockwise of the positive z-axis

C. zero

D. along the magnetic field

Answer: B

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29. A conducting ring is placed in a uniform magnetic field with its plane perpendicular to the field . An emf is induced in the ring if

A. it is rotated about its axis.

B. it is rotated about its diameter.

C. it is not moved.

D. it is given translational motion in the field.

Answer: B

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30. Choose the correct option:

A rectangular coil of copper wires is rotated in a magnetic field. The direction of the induced current changes once in each:

A. one revolution

B. $\frac{1}{2}$ revolution

C. $\frac{1}{4}$ revolution

D. 2 revolution

Answer: C

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31. A conductor is moving with the velocity v in the magnetic field and induced current is I. If the velocity of conductor becomes double, the induced current will be

A. 0.5 I

B. 1.5 I

C. 2 I

D. 2.5 I

Answer: C

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32. A circular coil expands radially in a region of magnetic field and no electromotive force is produced in the coil. This can be because

A. the magnetic field is constant.

B. the magnetic field is in the same plane as the cirular coil and it may or may not vary.

C. the magnetic field has a perpendicular (to the plane of the coil) component whose magnitude is decreasing suitably.

D. both (b) and (c)

Answer: D

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33. A jet plane is travelling west at the speed of $1600 kmh^{-1}$. The voltage difference developed between the ends of the wing having a span of 20m, if the earth's magnetic field at the location has a magnitude of 5×10^{-4} T and the dip angle is 30° is

A. 4.1 V

B. 2.2 V

C. 3.1 V

D. 3.8 V

Answer: D

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34. A rectangular loop of sides 6 cm 2 cm with a samll cut is moving out of a region of uniform magnetic field of magnitude 0.4 T direction normal to the loop. The voltage developed acrss the cut if velocity of loop is $2 cm s^{-1}$ in a direction normal to the longer side is

A. $4.8 \times 10^{-4} V$

B. $1.6 \times 10^{-4} V$

C. $2.2 \times 10^{-2} V$

D. $3.2 \times 10^{-2} V$

Answer: D

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35. In the question number 40, if velocity is normal in the shorter side then voltage developed is

A. $2.3 \times 10^{-4} V$

B. $2.4 \times 10^{-4} V$

C. $4.8 \times 10^{-2} V$

D. $1.6 \times 10^{-2} V$

Answer: D

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36. A copper rod of length L rotates with an angular with an angular speed 'ω' in a uniform magnetic field B. find the emf developed between the two ends of the rod. The field in perpendicular to the motion of the rod.

A. $B\omega l^2$

B. $\frac{1}{2}B\omega l^2$

C. $2B\omega l^2$

D. $\frac{1}{4}B\omega l^2$

Answer: B

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37. A 2 m long metallic rod rotates with an angular frequency $200 \text{ rod } s^{-1}$ about on axis normal to the rod passing through its one end. The other end of the rod is in contact with a circular metallic ring. A constant megnetic field of 0.5 T parallel to axis exises everywhere. The emf developed between the centre and the ring is

A. 100V

B. 200V

C. 300V

D. 400V

Answer: B

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38. A wheel with 20 metallic spokes each of length 8.0 m long is rotated with a speed of 120 revolution per minute in a plane normal to the horizontal component of earth magnetic field H at a place. If $H = 0.4 \times 10^{-4}$ T at the place, then induced emf between the axle the rim of the wheel is

A. $2.3 \times 10^{-4} V$

B. $3.1 \times 10^{-4} V$

C. $2.9 \times 10^{-4} V$

D. $1.61 \times 10^{-4} V$

Answer: D

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39. A circular cpper disc of 10 cm in diameter rotates at 1800 revolution per minute about an axis through its centre and at right angles to disc. A uniform field of induction B of $1 Wb^{-2} m$ is perpendicular to disc. What potential difference is developed between the axis of the disc and the rim?

A. $0.023V$

B. $0.23V$

C. $23V$

D. $230V$

Answer: B

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40. 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 $0.2 \times 10^{-4}T$, then the emf developed between the two ends of hte conductor is

A. $5\mu V$

B. $5mV$

C. $50\mu V$

D. $50mV$

Answer: C

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41. A rod of length l rotates with a uniform angular velocity omega 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 lrod is

A. $\frac{Bl^2\omega}{2}$

B. zero

C. $\left(\frac{Bl^2\omega}{8}\right)$

D. $2Bl^2\omega$

Answer: B

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42. A metallic rod of 1 m length is rotated with a frequency of 50 rev/s, with on end hinged at the centre and the other end at the circumference of a circular metallic ring of radius 1 m, about an axis passing through the centre and perpendicular at to the plane of the ring. A constant uniform magnetic field of 1 T parallel to the axis is persent eveywhere. what is the e.m.f. between the centre and the metallic ring?

A. 157V

B. 117V

C. 127V

D. 137V

Answer: A

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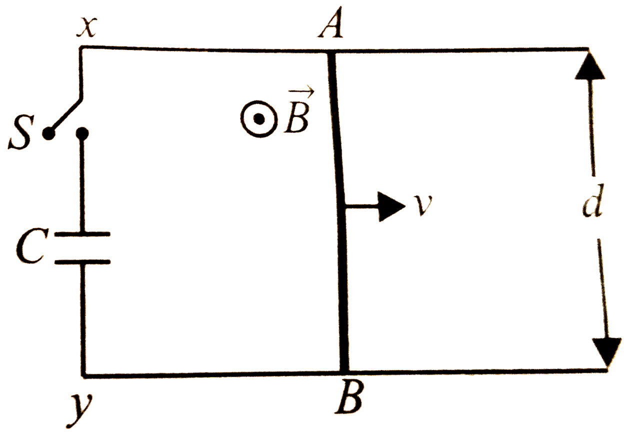
43. A sliding rod AB of resistance R is shown in the figure. Here magnetic field B is constant and is out of the paper. Parallel wires have no resistance and the rod is moving with constant velocity v. The current in the sliding rod AB when switch S is closed at time t=0 is



A. $\frac{vBd}{R}e^{-t/C}$

B. $\frac{vBd}{R}e^{-t/RC}$

C. $\frac{vBd}{R}e^{tRC}$

D. $\frac{vBd}{R}e^{t/RC}$

Answer: B

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44. A conducting metal circular-wire-loop of radius r is placed perpendicular to a magnetic field which varies with time as $B = B_0 e^{-t/\tau}$, where B_0 and τ are constants, at time = 0. If the resistance of the loop is R then the heat generated in the loop after a long time $(t \to \infty)$ is :

A. $\frac{\pi^2 r^4 B_0^4}{2\tau R}$

B. $\frac{\pi^2 r^4 B_0^2}{2\tau R}$

C. $\frac{\pi^2 r^4 B_0^2 R}{\tau}$

D. $\frac{\pi^2 r^4 B_0^2}{\tau R}$

Answer: B

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45. In a uniform magneitc field of induced B a wire in the form of a semicircle of radius r rotates about the diameter of hte circle with an angular frequency ω. The axis of rotation is perpendicular to hte field. If the total resistance of hte circuit is R, the mean power generated per period of rotation is

A. $\frac{B\pi r^2\omega}{2R}$

B. $\frac{\left(B\pi r^2\omega\right)^2}{8R}$

C. $\frac{(B\pi r\omega)^2}{2R}$

D. $\frac{(B\pi r\omega^2)^2}{8R}$

Answer: B

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46. A circular coil of radius 6 cm and 20 turns rotates about its vertical diameter with an angular speed of $40\text{rad}s^{-1}$ in a uniform horizontal magnetic field of magnitude $2 \times 10^{-2}T$. If the coil form a closed loop of resistance 8ω, then the average power loss due to joule heating is

A. $2.07 \times 10^{-3} W$

B. $1.23 \times 10^{-3} W$

C. $3.14 \times 10^{-3} W$

D. $1.80 \times 10^{-3} W$

Answer: A

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47. A circuit area $0.01 m^2$ is kept inside a magnetic field which is normal to its plane. The magentic field changes form 2 tesla 1 tesla to in 1 millisecond. If the resistance of the circuit is 2ω. The rate of heat evolved is

A. $5J/s$

B. $50J/s$

C. $0.05J/s$

D. $0.5J/s$

Answer: B

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48. A metal plate is getting heated . It can be because

A. passing either a direct or alternating current through the plate.

B. placing in time varying magnetic field.

C. placing in a space varying magntic field, but does not vary with time.

D. both (a) and (b) are correct.

Answer: D

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49. Identify the wrong statement.

A. Eddy currents are produced in a steady magnetic field.

B. Eddy currents can be minimized by using laminated core.

C. Induction furnace uses eddy current to produce heat.

D. Eddy current can be used to produce braking force in moving trains.

Answer: A

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50. Which of the following is not an application of eddy currents?

A. Electric power meters

B. Induction furnace

C. LED lights

D. Magnetic brakes in trains

Answer: C

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51. Induction furnace is based on the heating effect of

A. self induction

B. mutual induction

C. eddy current

D. none of these

Answer: C

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52. The mutual inductance M_{12} of coil 1 with respect to coil 2

A. increase when they are brought nearer.

B. depends on the current passing through the coils.

C. increases when one of then is rotated about an axis.

D. both (a) and (b) are correct.

Answer: A

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53. Two coil are placed close to each other. The mutual inductance of the pair of coils depends upon.

A. medium between the coils

B. distance between the two coils

C. orientation of the two coils

D. all of these

Answer: D

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54. Mutual inductance of two coils can be increased by

A. decreasing the number of turns in the coils

B. increasing the number of turns in the coils

C. winding the coils on wooden cores

D. none of these

Answer: B

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55. Two coils A and B are separated by a certain distance. If a current of 4 A flows through A, a magnetic flux of $10^{-3} Wb$ passes through B (no current through B). If no current passes through A and a current of 2 A passes through B, then the flux through A is.

A. $5 \times 10^{-3} Wb$

B. $4 \times 10^{-4} Wb$

C. $5 \times 10^{-4} Wb$

D. $2 \times 10^{-3} Wb$

Answer: C

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56. A pair of adjacent coils has a mutual inductance of 2.5 H. If the current in one coil changes from 0 of 40 A in 8.0 s, then the change in flux linked with the other coil is.

A. 100 Wb

B. 120 Wb

C. 200 Wb

D. 250 Wb

Answer: A

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57. When the number of turns in the two circular coils closely wound are doubled (in both) their mutual inductance becomes

A. becomes 4 times

B. becomes 2 times

C. becomes $\frac{1}{4}$ times

D. remains unchanged

Answer: A

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58. A short soleniod 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. $\mu_0 \pi b^2 n_1 n_2 L^2$

Answer: C

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59. A 2 m long solenoil with diameter 2 cm and 2000 turns has a secondary coil of 1000 turns wound closely near its midpoint. The mutuat inductance between the two coils is.

A. $2.4 \times 10^{-4} H$

B. $3.9 \times 10^{-4} H$

C. $1.28 \times 10^{-3} H$

D. $3.14 \times 10^{-3} H$

Answer: B

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60. A solenoid of lenght 30 cm with 10 turns per centimetre and area of cross-section $40cm^2$ completely surrounds another co-axial solenoid of same length, area of cross-section $20cm^2$ with 40 turns per centimetre. The mutual inductance of the system is

A. 10 H

B. 8 H

C. 3 mH

D. 30 mH

Answer: C

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61. The 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. $\frac{R_1}{R_2}$

B. $\frac{R_2}{R_1}$

C. $\frac{R_1^2}{R_2}$

D. $\frac{R_2^2}{R_1}$

Answer: D

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62. 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 centre coincide. What is the mutual inductance of the system ?

A. $2\sqrt{2}\frac{\mu_0}{\pi}\frac{l^2}{L}$

B. $8\sqrt{2}\frac{\mu_0}{\pi}\frac{l^2}{L}$

C. $2\sqrt{2}\frac{\mu_0}{2\pi}\frac{l^2}{L}$

D. $2\sqrt{2}\frac{\mu_0 L^2}{\pi l}$

Answer: A

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63. Name the physical quantity which is measured in weber amp^{-1}.

A. self inductance

B. mutual inductance

C. magnetic flux

D. both (a) and (b)

Answer: D

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64. Two coils have self-inductance $L_1 = 4mH$ and $L_2 = 1mH$ respectively. The currents in the two coils are increased at the same rate. At a certain instant of time both coils are given the same power. If I_1 and I_2 are the currents in the two coils, at that instant of time respectively, then the value of (I_1 / I_2) is :

A. $\frac{1}{8}$

B. $\frac{1}{4}$

C. $\frac{1}{2}$

D. 1

Answer: B

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65. In a coil current falls from 5 A to 0 A in 0.2 s. If an average emf of 150 V is induced, then the self inductance of the coil is

A. 4H

B. 2 H

C. 3 H

D. 6 H

Answer: D

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66. If $'N'$ is the number of turns in a coil, the value of self inductance varies as

A. N^0

B. N

C. N^2

D. N^{-2}

Answer: C

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67. The self inductance of a long solenoid cannot be increased by

A. increasing its area of corss section

B. decreasing its length

C. increasing the current through it

D. increasing the number of turns in it

Answer: C

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

A. thickness of coil

B. number of turns in coil

C. coefficinet of self inductance

D. total flux linked with coil

Answer: C

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69. The self inductance of an inductance coil having 100 turns is 20 mH. Calculate the magnetic flux through the cross section of the coil corresponding to a current of 4 milliampere. Also, find the total flux

A. $2 \times 10^{-5} Wb$

B. $4 \times 10^{-7} Wb$

C. $8 \times 10^{-7} Wb$

D. $8 \times 10^{-5} Wb$

Answer: C

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70. The self inductance of a coil having 400 turns is 10 mH. The magnetic flux through the cross section of the coil corresponding to current 2 mA is

A. $4 \times 10^{-5} Wb$

B. $2 \times 10^{-3} Wb$

C. $3 \times 10^{-5} Wb$

D. $8 \times 10^{-3} Wb$

Answer: A

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71. In an inductor of self-inductance L=2 mH, current changes with time according to relation $i = t^2 e^{-t}$. At what time emf is zero ?

A. 4s

B. 3s

C. 2s

D. 1s

Answer: C

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72. The equivalent quantity of mass in electricity is

A. current

B. self inductance

C. potential

D. charge

Answer: B

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73. Two coils of self-inductance $2mH$ 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 coil is

A. 16 mH

B. 10 mH

C. 6 mH

D. 4 mH

Answer: D

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74. If the self inductance of 500 turns coil is 125 mH, then the self inductance of the similar coil of 800 turns is

A. $48.8mH$

B. $200mH$

C. $290mH$

D. $320mH$

Answer: D

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75. The unit of inductance is

A. $\frac{\text{volt} \times \text{ampere}}{\text{second}}$

B. $\frac{\text{ampere}}{\text{volt} \times \text{second}}$

C. $\frac{\text{volt}}{\text{ampere} \times \text{second}}$

D. $\frac{\text{volt} \times \text{second}}{\text{ampere}}$

Answer: D

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76. If the number of turns per units length of a coils of solenoid is doubled , the self- inductance of the soleniod will

A. remain unchanged

B. be halved

C. be doubled

D. become four times

Answer: D

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77. 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. $1:4$

Answer: A

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78. A 10 V battery connected to 5ω resistance coil having inductance 10 H through a switch drives a constant current in the circuit. The switch is suddenly opened and the time taken to open it is 2ms. The average emf induced across the coil is

A. $4 \times 10^4 V$

B. $2 \times 10^4 V$

C. $2 \times 10^2 V$

D. $1 \times 10^4 V$

Answer: D

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79. 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 inductance is

A. 8 H, 2H

B. 6H, 4H

C. 5H, 5H

D. 7H, 3H

Answer: B

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80. Two inductors of inductance L each are connected in series with opposite magnetic fluxes. The resultant inductance is

(Ignore mutual inductance)

A. zero

B. L

C. 2L

D. 3L

Answer: C

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81. The energy stored in an inductor of self-inductance L henry carrying a current of I ampere is

A. $\frac{1}{2}L^2I$

B. $\frac{1}{2}LI^2$

C. LI^2

D. L^2I

Answer: B

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82. A current of 1 A through a coil of inductance of 200 mH is increasing at a rate of $0.5As^{-1}$. The energy stored in the inductor per second is

A. $0.5Js^{-1}$

B. $5.0Js^{-1}$

C. $0.1Js^{-1}$

D. $2.0Js^{-1}$

Answer: C

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83. A $100mH$ coil carries a current of 1 ampere. Energy stored in its magnetic field is

A. $0.5J$

B. $0.05J$

C. 1J

D. $0.1J$

Answer: B

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84. By a change of current from 5 A to 10 A in 0.1 s, the self induced emf is 10 V. The change in the energy of the magnetic field of a coil will be

A. $5J$

B. $6J$

C. $7.5J$

D. $9J$

Answer: C

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85. Two different coils have self-inductances $L_1 = 8mH$ and $L_2 = 2mH$. The current in one coil is increased at a constant rate. The current in the second coil is also increased at the same constant rate. At a certain instant of time, the power given to the two coil is the same. At that time, the current, the induced voltage and the energy stored in the first coil are i_1, V_1 and W_1 respectively. Corresponding values for the second coil at the same instant are i_2, V_2 and W_2 respectively. Then:

A. $\frac{W_2}{W_1} = 8$

B. $\frac{W_2}{W_1} = \frac{1}{8}$

C. $\frac{W_2}{W_1} = 4$

D. $\frac{W_2}{W_1} = \frac{1}{4}$

Answer: C

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86. Describe the principle, construction and working of an AC generator.

A. magaetic effect of current

B. heating effect of current

C. chemical effect of current

D. electromagnetic induction

Answer: D

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87. In an A.C. generator, when the plane of the armature is perpendicular to the magnetic field

A. both the flux linked and induced emf in the coil are zero.

B. the flux linked with it is zero, while induced emf is maximum.

C. flux linked is maximum while induced emf is zero.

D. both the flux and emf have their respective maximum values.

Answer: B

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88. A boy peddles a stationary bicycle the pedals of the bicycle are attached to a 200 turn coil of area $0.10m^2$. The coil rotates at half a revolution per second and it is placed in a uniform magnetic field of 0.02 T perpendicular to the axis of rotation of the coil. The maximum voltage generated in the coil is

A. $1.26V$

B. $2.16V$

C. $3.24V$

D. $4.12V$

Answer: A

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89. An a.c. generator consists of a coil of 100 turns and cross sectional area of $3m^2$, rotating at a constant angular speed of $60 rad / \sec$ in a uniform magnetic field of 0.04 T. The resistance of the coil is 500Ω. Calculate (i) maximum current drawn from the generator and (ii) max. power dissipation in the coil.

A. $518.4W$

B. 1036W

C. $259.2W$

D. Zero

Answer: A

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Exemplar Problems

1. A square of side L meters lies in the xy-plane in a region, where the magnetic field is given by $= B_0\left(2\hat{i} + 3\hat{j} + 4\hat{k}\right)T,$, where B_0 is constant.

The magnitude of flux passing through the square is

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

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3. The self inductance L of a solenoid of length l and area of cross-section A, with a fixed number of turns N increases as

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Assertion And Reason

1. Assertion : It is more difficult to push a magnet into a coil with more loops.

Reason : Emf induced in the current loop resists the motion oif the magnet.

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2. When current in a coil changes with time, how is the back e.m.f. induced in the coil related to it ?

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3. Asseration: The direction of induced e.m.f. is always such as to oppose the change that causes it. Reason: The direction of induced e.m.f. is given by Lenz's Law.

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

Reason : Magnetic flux is essential to maintain an induced current in the coil.

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5. Assertion : Eddy currents heat up the core and dissipate electrical energy in the form of heat.

Reason : Eddy currents are always undesirable.

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6. Assertion Mutual inductance of two coils depends on the distance between the coils and their orientation.

Reason It does not depend on the magnetic material filled between the coils.

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7. Asseration: 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.

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8. Assertion : In the phenomenon of mutual induction, self induction of each of the coils persists.

Reason : Self induction arises when strength of current in same coil changes. In mutual induction, current is changing in both the individual coils.

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9. Asseration:Induced coil are made of copper.

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

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10. Assertion : The self-inductionce of a long solenoid is proportional to the area of corss-section and length of the solenoid.

Reason : Self inductance of a solenoid is independent of the number of truns per unit length.

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11. Assertion : Sensitive electrical instruments should not be placed in the vicinity of an electromagent.

Reason : Electromagnet can damage the instruments.

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12. Assertion : An electric motor converts electical energy to mechanical energy.

Reason : The working of the motor is based on mutualn induction.

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13. The back emf in a DC motor is maximum when,

View Text Solution

14. Assertion : An important application of electromagnetic induction is ac generator.

Reason : The direction of current changes periodically and therefore the current is called alternating current.

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15. Assertion : An ac generator is based on the self inductance of the coil.

Reason : Self inductance involves two coils.

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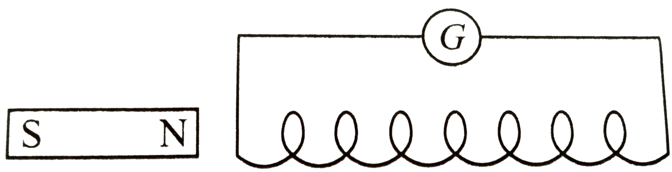
The Experiments Of Faraday And Henry

1. In the figure, galvanometer G gives maximum deflection when



A. magnet is pushed into the coil

B. magnet is rotated into the coil

C. magnet is stationary at the center of the coil

D. number of turns in the coil is reduced

Answer: A

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

A. moving toward the solenoid

B. moving into the solenoid

C. at rest inside the solenoid

D. moving out of the solenoid

Answer: D

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Magnetic Flux

1. What is magnetic flux linked with a coil of N turns and cross section area A held with its plane parallel to the field?

A. $\frac{NAB}{2}$

B. NAB

C. $\frac{NAB}{4}$

D. zero

Answer: D

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2. A square of side x m lies in the x-y plane in a region, when the magntic field is given by $\overrightarrow{B} = B_0\left(3\hat{i} + 4\hat{j} + 5\hat{k}\right)$ T, where B_0 is constant. The magnitude of flux passing through the square is

A. $5B_0x^2Wb$

B. $3B_0x^3Wb$

C. $2B_0x^2Wb$

D. B_0x^2Wb

Answer: A

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3. A circular disc of radius $0.2m$ is placed in a uniform magnetic fied of induction $\frac{1}{\pi}\left(\frac{Wb}{m^2}\right)$ in such a way that its axis makes an angle of 60° with B. The magnetic flux linked with the disc is

A. 0.02Wb

B. 0.06Wb

C. 0.08Wb

D. 0.01Wb

Answer: A

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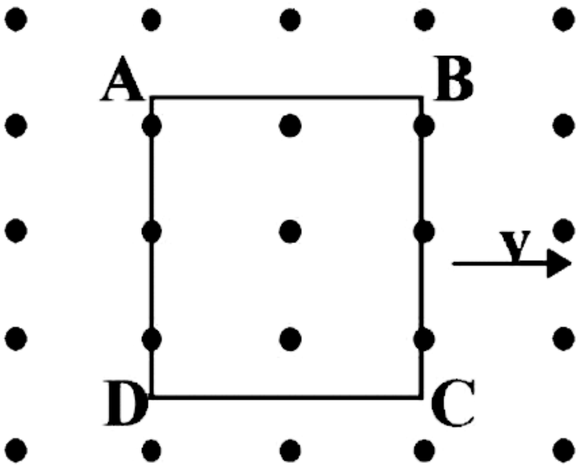
Motional Electromotive Force

1. 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



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

Answer: D

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2. A conductor is moving with the velocity v in the magnetic field and induced current is I. If the velocity of conductor becomes double, the induced current will be

A. 0.5 I

B. 1.5 I

C. 2 I

D. 2.5 I

Answer: C

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3. A circular coil expands radially in a region of magnetic field and no electromotive force is produced in the coil. This can be because

A. the magnetic field is constant.

B. the magnetic field is in the same plane as the cirular coil and it may or may not vary.

C. the magnetic field has a perpendicular (to the plane of the coil) component whose magnitude is decreasing suitably.

D. both (b) and (c)

Answer: D

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4. A jet plane is travelling west at the speed of $1600 km h^{-1}$. The voltage difference developed between the ends of the wing having a span of 20m, if the earth's magnetic field at the location has a magnitude of 5×10^{-4} T and the dip angle is 30° is

A. 4.1 V

B. 2.2 V

C. 3.1 V

D. 3.8 V

Answer: D

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5. A rectangular loop of sides 6 cm 2 cm with a samll cut is moving out of a region of uniform magnetic field of magnitude 0.4 T direction normal to the loop. The voltage developed acrss the cut if velocity of loop is $2cms^{-1}$ in a direction normal to the longer side is

A. $4.8 \times 10^{-4}V$

B. $1.6 \times 10^{-4}V$

C. $2.2 \times 10^{-2}V$

D. $3.2 \times 10^{-2}V$

Answer: D

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6. In the question number 40, if velocity is normal in the shorter side then voltage developed is

A. $2.3 \times 10^{-4} V$

B. $2.4 \times 10^{-4} V$

C. $4.8 \times 10^{-2} V$

D. $1.6 \times 10^{-2} V$

Answer: D

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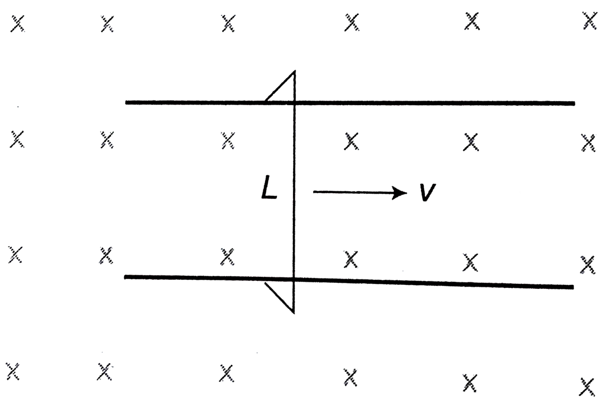
7. Figure shows a wire sliding on two parallel, conducting rails placed at a separation L . A magnetic field B exists in a direction perpendicular to the plane of the rails. What force is necessary to keep the wire moving at a constant velocity V ?



A. evB

B. $\frac{\mu_0 Bv}{4\pi l}$

C. Blv

D. zero

Answer: D

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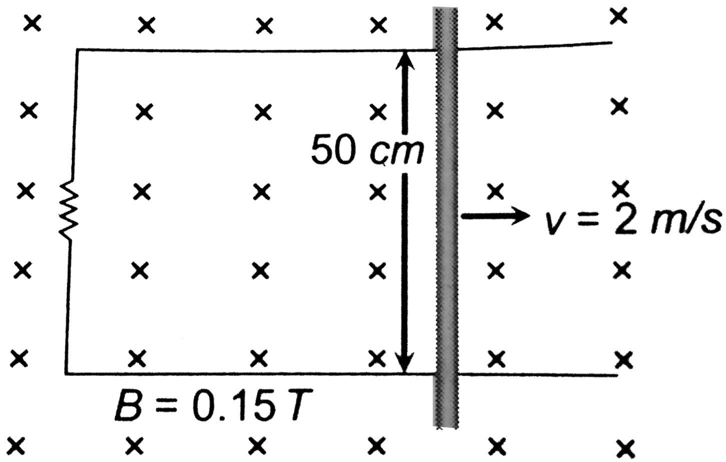
8. As shown in the figure a metal rod makes contact and complete the circuit. The circuite is perpendicular to the magnetic field with $B = 0.15$ tesla. If the resistance is 3Ω force needed to move the rod as indicated with a constant speed of

$2m/\sec$ is



A. $3.75 \times 10^{-3} N$

B. $2.75 \times 10^{-3} N$

C. $6.57 \times 10^{-4} N$

D. $4.36 \times 10^{-4} N$

Answer: A

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9. A copper rod of length L rotates with an angular with an angular speed $'\omega'$ in a uniform magnetic field B. find the emf developed between the two ends of the rod. The field in perpendicular to the motion of the rod.

A. $B\omega l^2$

B. $\frac{1}{2}B\omega l^2$

C. $2B\omega l^2$

D. $\frac{1}{4}B\omega l^2$

Answer: B

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10. A 2 m long metallic rod rotates with an angular frequency $200 \text{ rod } s^{-1}$ about on axis normal to the rod passing through its one end. The other end of the rod is in contact with a circular metallic ring. A constant megnetic field of 0.5 T parallel to axis exises everywhere. The emf developed between the centre and the ring is

A. 100V

B. 200V

C. 300V

D. 400V

Answer: B

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11. A wheel with 20 metallic spokes each of length 8.0 m long is rotated with a speed of 120 revolution per minute in a plane normal to the horizontal component of earth magnetic field H at a place. If $H = 0.4 \times 10^{-4}$ T at the place, then induced emf between the axle the rim of the wheel is

A. $2.3 \times 10^{-4}V$

B. $3.1 \times 10^{-4} V$

C. $2.9 \times 10^{-4} V$

D. $1.61 \times 10^{-4} V$

Answer: D

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12. A circular cpper disc of 10 cm in diameter rotates at 1800 revolution per minute about an axis through its centre and at right angles to disc. A uniform field of induction B of $1 Wb^{-2} m$ is perpendicular to disc. What potential difference is developed between the axis of the disc and the rim?

A. $0.023V$

B. $0.23V$

C. $23V$

D. $230V$

Answer: B

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13. 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 $0.2 \times 10^{-4} T$, then the emf developed between the two ends of hte conductor is

A. $5 \mu V$

B. $5 mV$

C. $50 \mu V$

D. $50 mV$

Answer: C

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14. A rod of length l rotates with a uniform angular velocity omega 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 lrod is

A. $\frac{Bl^2\omega}{2}$

B. zero

C. $\left(\frac{Bl^2\omega}{8}\right)$

D. $2Bl^2\omega$

Answer: B

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15. A metallic rod of 1 m length is rotated with a frequency of 50 rev/s, with on end hinged at the centre and the other end at the circumference of a circular metallic ring of radius 1 m, about an axis passing through the centre and perpendicular at to the plane of the ring. A constant uniform magnetic field of 1 T parallel to the axis is persent eveywhere. what is the e.m.f. between the centre and the metallic ring?

A. 157V

B. 117V

C. 127V

D. 137V

Answer: A

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Energy Consideration A Quantitative Study

1. A conducting metal circular-wire-loop of radius r is placed perpendicular to a magnetic field which varies with time as $B = B_0 e^{-t/\tau}$, where B_0 and τ are constants, at time = 0. If the resistance of the loop is R then the heat generated in the loop after a long time $(t \to \infty)$ is :

A. $\frac{\pi^2 r^4 B_0^4}{2\tau R}$

B. $\frac{\pi^2 r^4 B_0^2}{2\tau R}$

C. $\frac{\pi^2 r^4 B_0^2 R}{\tau}$

D. $\frac{\pi^2 r^4 B_0^2}{\tau R}$

Answer: B

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2. In a uniform magneitc field of induced B a wire in the form of a semicircle of radius r rotates about the diameter of hte circle with an angular frequency ω. The axis of rotation is perpendicular to hte field. If the total resistance of hte circuit is R, the mean power generated per period of rotation is

A. $\dfrac{B\pi r^2\omega}{2R}$

B. $\dfrac{\left(B\pi r^2\omega\right)^2}{8R}$

C. $\dfrac{(B\pi r\omega)^2}{2R}$

D. $\dfrac{\left(B\pi r\omega^2\right)^2}{8R}$

Answer: B

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3. A circular coil of radius 6 cm and 20 turns rotates about its vertical diameter with an angular speed of $40\text{rad}s^{-1}$ in a uniform horizontal magnetic field of magnitude $2 \times 10^{-2}T$. If the coil form a closed loop of resistance 8ω, then the average power loss due to joule heating is

A. $2.07 \times 10^{-3}W$

B. $1.23 \times 10^{-3}W$

C. $3.14 \times 10^{-3}W$

D. $1.80 \times 10^{-3}W$

Answer: A

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4. A circuit area $0.01m^2$ is kept inside a magnetic field which is normal to its plane. The magentic field changes form 2 tesla 1 tesla to in 1 millisecond. If the resistance of the circuit is 2ω. The rate of heat evolved is

A. $5J/s$

B. $50J/s$

C. $0.05J/s$

D. $0.5J/s$

Answer: B

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Eddy Currents

1. A metal plate is getting heated . It can be because

A. passing either a direct or alternating current through the plate.

B. placing in time varying magnetic field.

C. placing in a space varying magntic field, but does not vary with time.

D. both (a) and (b) are correct.

Answer: D

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2. Identify the wrong statement.

A. Eddy currents are produced in a steady magnetic field.

B. Eddy currents can be minimized by using laminated core.

C. Induction furnace uses eddy current to produce heat.

D. Eddy current can be used to produce braking force in moving trains.

Answer: A

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3. Which of the following is not an application of eddy currents?

A. Electric power meters

B. Induction furnace

C. LED lights

D. Magnetic brakes in trains

Answer: C

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4. Induction furnace is based on the heating effect of

A. self induction

B. mutual induction

C. eddy current

D. none of these

Answer: C

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1. The mutual inductance M_{12} of coil 1 with respect to coil 2

A. increase when they are brought nearer.

B. depends on the current passing through the coils.

C. increases when one of then is rotated about an axis.

D. both (a) and (b) are correct.

Answer: A

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2. Two coil are placed close to each other. The mutual inductance of the pair of coils depends upon.

A. medium between the coils

B. distance between the two coils

C. orientation of the two coils

D. all of these

Answer: D

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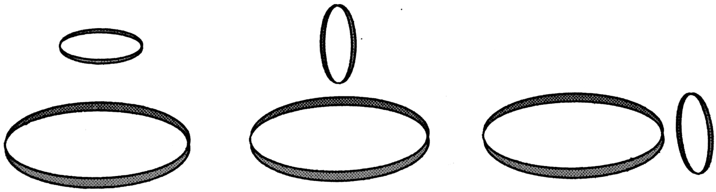
3. Two circular coils can be arranged in any of the three situation shown in the figure. Their mutual inductance will be



A. maximum in situation (i)

B. maximum in situation (ii)

C. maximum in situation (iii)

D. same in all situations

Answer: A

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4. Mutual inductance of two coils can be increased by

A. decreasing the number of turns in the coils

B. increasing the number of turns in the coils

C. winding the coils on wooden cores

D. none of these

Answer: B

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5. Two coils A and B are separated by a certain distance. If a current of 4 A flows through A, a magnetic flux of $10^{-3} Wb$ passes through B (no current through B). If no current passes through A and a current of 2 A passes through B, then the flux through A is.

A. $5 \times 10^{-3} Wb$

B. $4 \times 10^{-4} Wb$

C. $5 \times 10^{-4} Wb$

D. $2 \times 10^{-3} Wb$

Answer: C

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6. A pair of adjacent coils has a mutual inductance of 2.5 H. If the current in one coil changes from 0 of 40 A in 8.0 s, then the change in flux linked with the other coil is.

A. 100 Wb

B. 120 Wb

C. 200 Wb

D. 250 Wb

Answer: A

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7. When the number of turns in the two circular coils closely wound are doubled (in both) their mutual inductance becomes

A. becomes 4 times

B. becomes 2 times

C. becomes $\frac{1}{4}$ times

D. remains unchanged

Answer: A

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8. A short soleniod 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. $\mu_0 \pi b^2 n_1 n_2 L^2$

Answer: C

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9. A 2 m long solenoil with diameter 2 cm and 2000 turns has a secondary coil of 1000 turns wound closely near its midpoint. The mutuat inductance between the two coils is.

A. $2.4 \times 10^{-4} H$

B. $3.9 \times 10^{-4} H$

C. $1.28 \times 10^{-3} H$

D. $3.14 \times 10^{-3} H$

Answer: B

Watch Video Solution

10. A solenoid of lenght 30 cm with 10 turns per centimetre and area of cross-section $40cm^2$ completely surrounds another co-axial solenoid of same length, area of cross-section $20cm^2$ with 40 turns per centimetre. The mutual inductance of the system is

A. 10 H

B. 8 H

C. 3 mH

D. 30 mH

Answer: C

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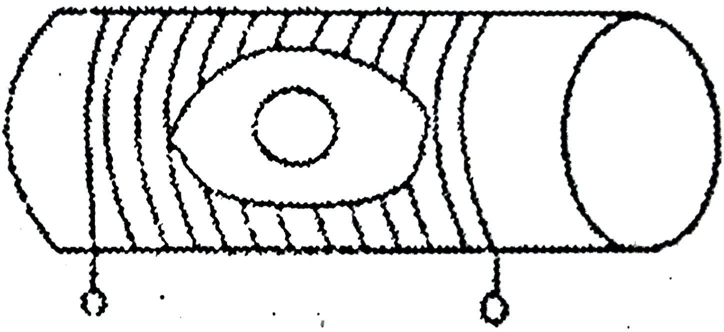
11. A circular coil with a cross-sectional area of $4cm^2$ has 10 turns. It is placed at the center of a long solenoid that has 15 turns/cm and a cross sectional area of $10cm^2$, shown in the figure. The axis of the coil conicides with the axis of the solenoid. What is their mutual inductance?



A. $7.54 \mu H$

B. $8.54 \mu H$

C. $9.54 \mu H$

D. $10.54 \mu H$

Answer: A

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12. The 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. $\frac{R_1}{R_2}$

B. $\frac{R_2}{R_1}$

C. $\frac{R_1^2}{R_2}$

D. $\frac{R_2^2}{R_1}$

Answer: D

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13. 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 centre coincide. What is the mutual inductance of the system ?

A. $2\sqrt{2}\frac{\mu_0}{\pi}\frac{l^2}{L}$

B. $8\sqrt{2}\frac{\mu_0}{\pi}\frac{l^2}{L}$

C. $2\sqrt{2}\frac{\mu_0}{2\pi}\frac{l^2}{L}$

D. $2\sqrt{2}\frac{\mu_0 L^2}{\pi l}$

Answer: A

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14. Name the physical quantity which is measured in weber amp^{-1} .

A. self inductance

B. mutual inductance

C. magnetic flux

D. both (a) and (b)

Answer: D

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15. Two coils have self-inductance $L_1 = 4mH$ and $L_2 = 1mH$ respectively. The currents in the two coils are increased at the same rate. At a certain instant of time both coils are given the same power. If I_1 and I_2 are the currents in the two coils, at that instant of time respectively, then the value of (I_1 / I_2) is :

A. $\frac{1}{8}$

B. $\frac{1}{4}$

C. $\frac{1}{2}$

D. 1

Answer: B

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16. In a coil current falls from 5 A to 0 A in 0.2 s. If an average emf of 150 V is induced, then the self inductance of the coil is

A. 4H

B. 2 H

C. 3 H

D. 6 H

Answer: D

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17. If $'N'$ is the number of turns in a coil, the value of self inductance varies as

A. N^0

B. N

C. N^2

D. N^{-2}

Answer: C

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18. The self inductance of a long solenoid cannot be increased by

A. increasing its area of corss section

B. decreasing its length

C. increasing the current through it

D. increasing the number of turns in it

Answer: C

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

A. thickness of coil

B. number of turns in coil

C. coefficinet of self inductance

D. total flux linked with coil

Answer: C

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20. The self inductance of an inductance coil having 100 turns is 20 mH. Calculate the magnetic flux through the cross section of the coil corresponding to a current of 4 milliampere. Also, find the total flux

A. $2 \times 10^{-5} Wb$

B. $4 \times 10^{-7} Wb$

C. $8 \times 10^{-7} Wb$

D. $8 \times 10^{-5} Wb$

Answer: C

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21. The self inductance of a coil having 400 turns is 10 mH. The magnetic flux through the cross section of the coil corresponding to current 2 mA is

A. $4 \times 10^{-5} Wb$

B. $2 \times 10^{-3} Wb$

C. $3 \times 10^{-5} Wb$

D. $8 \times 10^{-3} Wb$

Answer: A

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22. In an inductor of self-inductance L=2 mH, current changes with time according to relation $i = t^2 e^{-t}$. At what time emf is zero ?

A. 4s

B. 3s

C. 2s

D. 1s

Answer: C

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23. The equivalent quantity of mass in electricity is

A. current

B. self inductance

C. potential

D. charge

Answer: B

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24. Two coils of self-inductance $2mH$ 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 coil is

A. 16 mH

B. 10 mH

C. 6 mH

D. 4 mH

Answer: D

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25. If the self inductance of 500 turns coil is 125 mH, then the self inductance of the similar coil of 800 turns is

A. $48.8mH$

B. $200mH$

C. $290mH$

D. $320mH$

Answer: D

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26. The unit of inductance is

A. $\frac{\text{volt} \times \text{ampere}}{\text{second}}$

B. $\frac{\text{ampere}}{\text{volt} \times \text{second}}$

C. $\frac{\text{volt}}{\text{ampere} \times \text{second}}$

D. $\frac{\text{volt} \times \text{second}}{\text{ampere}}$

Answer: D

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27. If the number of turns per units length of a coils of solenoid is doubled , the self- inductance of the soleniod will

A. remain unchanged

B. be halved

C. be doubled

D. become four times

Answer: D

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28. 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. $1:4$

Answer: A

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29. A 10 V battery connected to 5ω resistance coil having inductance 10 H through a switch drives a constant current in the circuit. The switch is suddenly opened and the time taken to open it is 2ms. The average emf induced across the coil is

A. $4 \times 10^4 V$

B. $2 \times 10^4 V$

C. $2 \times 10^2 V$

D. $1 \times 10^4 V$

Answer: D

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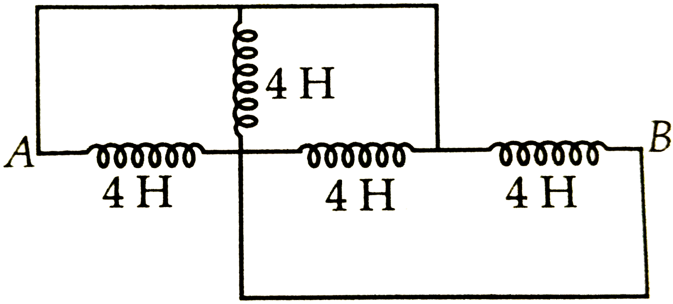
30. The equivalent inductance between A and B is



A. 1H

B. 4H

C. 0.8H

D. 16H

Answer: A

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31. 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 inductance is

A. 8 H, 2H

B. 6H, 4H

C. 5H, 5H

D. 7H, 3H

Answer: B

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32. Two inductors of inductance L each are connected in series with opposite magnetic fluxes. The resultant inductance is

(Ignore mutual inductance)

A. zero

B. L

C. 2L

D. 3L

Answer: C

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33. The energy stored in an inductor of self-inductance L henry carrying a current of I ampere is

A. $\frac{1}{2}L^2I$

B. $\frac{1}{2}LI^2$

C. LI^2

D. L^2I

Answer: B

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34. A current of 1 A through a coil of inductance of 200 mH is increasing at a rate of $0.5 As^{-1}$. The energy stored in the inductor per second is

A. $0.5 Js^{-1}$

B. $5.0 Js^{-1}$

C. $0.1 Js^{-1}$

D. $2.0 Js^{-1}$

Answer: C

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35. A $100mH$ coil carries a current of 1 ampere. Energy stored in its magnetic field is

A. $0.5J$

B. $0.05J$

C. 1J

D. $0.1J$

Answer: B

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36. By a change of current from 5 A to 10 A in 0.1 s, the self induced emf is 10 V. The change in the energy of the magnetic field of a coil will be

A. $5J$

B. $6J$

C. $7.5J$

D. $9J$

Answer: C

Watch Video Solution

37. Two different coils have self-inductances $L_1 = 8mH$ and $L_2 = 2mH$. The current in one coil is increased at a constant rate. The current in the second coil is also increased at the same constant rate. At a certain instant of time, the power given to the two coil is the same. At that time, the current, the induced voltage and the energy stored in the first coil are i_1, V_1 and W_1 respectively. Corresponding values for the second coil at the same instant are i_2, V_2 and W_2 respectively. Then:

A. $\frac{W_2}{W_1} = 8$

B. $\frac{W_2}{W_1} = \frac{1}{8}$

C. $\frac{W_2}{W_1} = 4$

D. $\frac{W_2}{W_1} = \frac{1}{4}$

Answer: C

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Ac Generator

1. Describe the principle, construction and working of an AC generator.

A. magaetic effect of current

B. heating effect of current

C. chemical effect of current

D. electromagnetic induction

Answer: D

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2. In an A.C. generator, when the plane of the armature is perpendicular to the magnetic field

A. both the flux linked and induced emf in the coil are zero.

B. the flux linked with it is zero, while induced emf is maximum.

C. flux linked is maximum while induced emf is zero.

D. both the flux and emf have their respective maximum values.

Answer: B

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3. A boy peddles a stationary bicycle the pedals of the bicycle are attached to a 200 turn coil of area $0.10m^2$. The coil rotates at half a revolution per second and it is placed in a uniform magnetic field of 0.02 T perpendicular to the axis of rotation of the coil. The maximum voltage generated in the coil is

A. $1.26V$

B. $2.16V$

C. $3.24V$

D. $4.12V$

Answer: A

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4. An a.c. generator consists of a coil of 100 turns and cross sectional area of $3m^2$, rotating at a constant angular speed of $60 rad / \sec$ in a uniform magnetic field of 0.04 T. The resistance of the coil is 500Ω. Calculate (i) maximum current drawn from the generator and (ii) max. power dissipation in the coil.

A. $518.4W$

B. 1036W

C. $259.2W$

D. Zero

Answer: A

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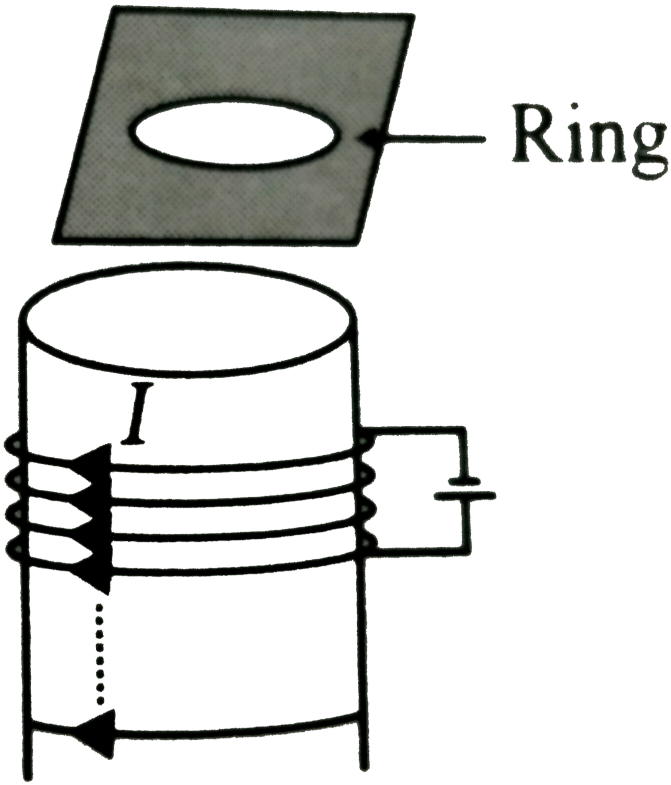
Higher Order Thinking Skills

1. A metal ring kept (supported by a card borad) on the top of a fixed soleniod carry a current I as shown in figure. The center of the ring coincides with the axis of the solenoid. If the current in the soleniod is switched off, then



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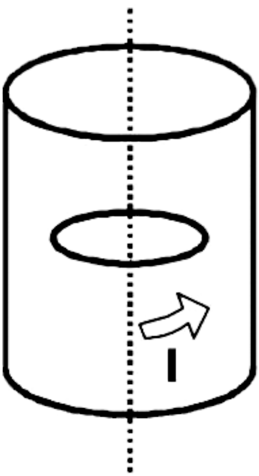
2. A long circular tube of length $10m$ and radius $0.3m$ carries a current I along its curved surface as shown . A wire - loop of resistance $0.005 ohm$ and of radius $0.1m$ is placed inside the tube its axis coinciding with the axis of the tube . The current varies as $I = I_0 \cos(300t)$ where I_0 is constant. If the magnetic moment of the loop is $N\mu_0 I_0 \sin(300t)$, then 'N' is



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3. A current carrying infinitely long wire is kept along the diameter of a circular wire loop, without touching it, the correct statements(s) is(are)

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4. The magnetic field of a cylindrical magnet that has a pole-face radiu 2.8 cm can be varied sinusoidally between mininmum value 16.8 T and maximum value 17.2 T at a frequency of $\frac{60}{\pi}Hz$. Cross section of the magnetic field created by the magnet is shown. At a radial distance of 2 cm from the axis, find the amplitude of the electric field (in mNC^{-1}) induced by the magnetic field variation.

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5. 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

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6. A solenoid has an inductance of 10 henty and a resistance of 2 ohm. It is connected to a 10 volt battery. How long will it take for the magnetic energy to reach $1/4$ of its maximum value?

A. 3.5s

B. 2.5s

C. 5.5s

D. 7.5s

Answer: b

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7. Find the inductance of a unit length of two parallel wires, each of radius a, whose centers are a distance d apart and carry equal currents in opposite direction. Neglect the flux within the wire.

A. $\frac{\mu_0}{2\pi} In\left(\frac{d-a}{a}\right)$

B. $\frac{\mu_0}{\pi} In\left(\frac{d-a}{a}\right)$

C. $\frac{3\mu_0}{\pi} In\left(\frac{d-a}{a}\right)$

D. $\frac{3\mu_0}{3\pi} In\left(\frac{d-a}{a}\right)$

Answer: b

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8. A condenser of capacity C is charged to a potential difference of V_1. The plates of the condenser are then connected to an ideal inductor of inductance L. The current through the inductor when the potential difference across the condenser reduces to V_2 is

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Ncert Exemplar

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

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

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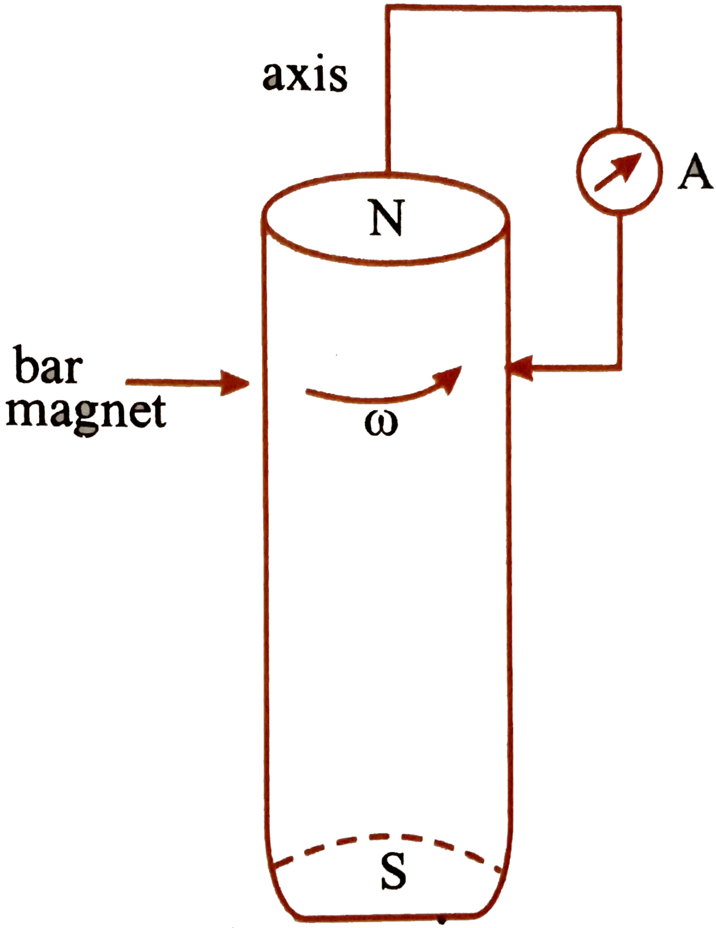
3. A cylindrical bar magnet is rotated about its axis (Figure). A wire is connect from the axis and is made to touch the cylindrical surface through a contact.

Then



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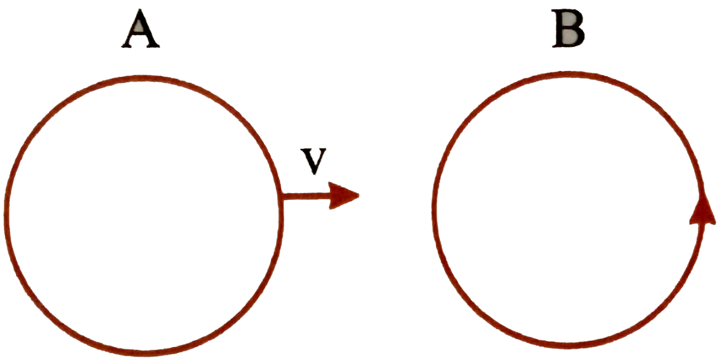
4. There are two coils A and B as shown in Figure. A current starts flowing in B as shown, when A is moved towards B and stops when A stops moving. The current in B is counterclockwise. B is kept stationary when A moves. We can infer that



A. there is a constant current in the counter clockwise direction in A.

B. there is a constant current in the clockwise direction in A.

C. there is a varying current in A.

D. there is no current in A.

Answer: d

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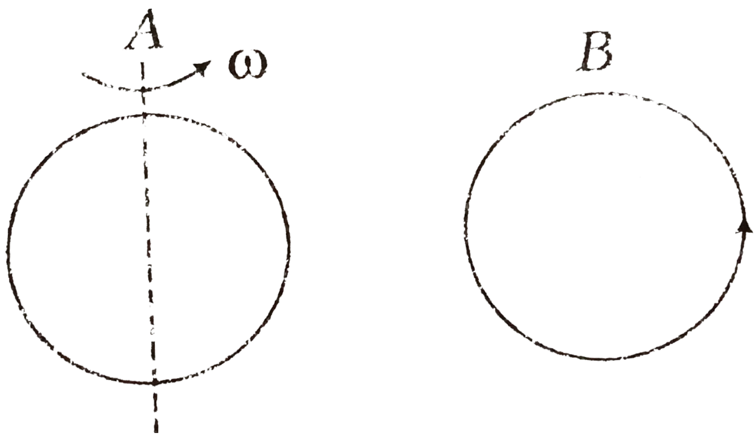
5. Same as above problem except, the coil A is made to rotate about a vertical axis (figure). No current flows in B, if A is at rest. The current in coil A, when the current in B (at t = 0) is counter-clockwise and the coil A is as shown at this instant, t = 0, is



A. constant current clockwise.

B. varying current clockwise.

C. varying current clockwise.

D. constant current counterclockwise.

Answer: a

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6. The self inductance L of a solenoid of length l and area of cross-section A, with a fixed number of turns N increases as

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Others

1. Faraday's law are consequence of conservation of

A. charge

B. energy

C. magnetic field

D. both (b) and (c)

Answer: B

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

A. P increases while in Q decreases

B. Q increases while in P decreases

C. both P and Q increases

D. both P and Q decreases

Answer: D

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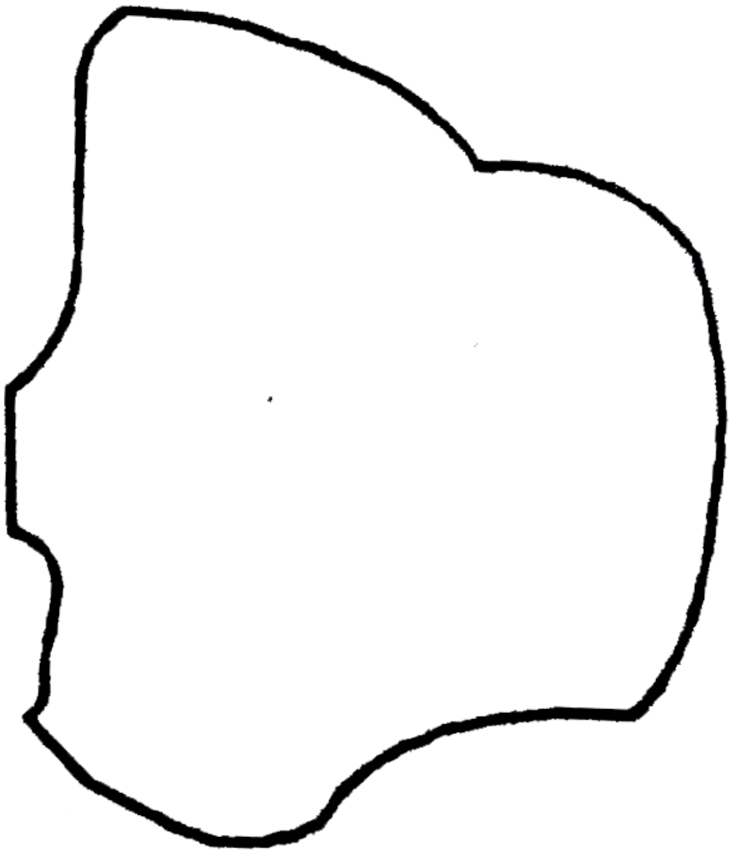
3. As a result of change in the magnetic flux linked to the closed loop shown in the fig, an e.m.f. V volt is induced in the loop. The work done (joule) in taking a charge Q coulomb once along the loop is



A. qV

B. zero

C. 2qV

D. $\frac{qV}{2}$

Answer: A

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4. A coil of area $0.4m^2$ has 100 turns. A magnetic field of 0.04 Wb m^{-2} is acting normal to the coil surface. If this magnetic field is reduced to zero in 0.01 s, then the induced emf in the coil is

A. 160V

B. 250 V

C. 270 V

D. 320 V

Answer: A

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5. A coil of area $500cm^2$ and having 1000 turns is held perpendicular to a uniform field of 0.4 gauss. The coil is turned through 180° in $1/10\sec$. Calculate the average induced e.m.f.

A. 0.02 V

B. 0.04 V

C. 1.4 V

D. 0.08 V

Answer: B

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6. A long solenoid with 10 turns per cm has a small loop of area $3cm^2$ placed inside, normal to the axis of the solenoid. If the currnet carried by the solenoid changes steadily from 2 A to 4 A in 0.2 s, what is the induced voltage in the loop, while the current is changing?

A. $4.2 \times 10^{-8} V$

B. $2.8 \times 10^{-8} V$

C. $7.3 \times 10^{-6} V$

D. $3.8 \times 10^{-6} V$

Answer: D

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7. An air cored solenoid with length 20 cm area of cross section 20cm2. The current 2 A is suddenly switched off within 10^{-3} s. The average back emf induced across the ends of the open switch in the circuit is (ignore the variation in magnetic field near the ends of the solenoid)

A. 2 V

B. 4 V

C. 3 V

D. 5 V

Answer: B

View Text Solution

8. The magnetic flux through a coil perpendicluar to its plane and directed into paper is varying according to the relation $\phi = \left(2t^2 + 4t + 6\right)mWb$. The emf induced in the loop at t=4 s is

A. 0.12 V

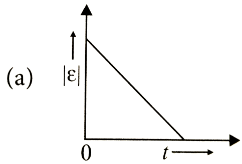
B. 2.4 V

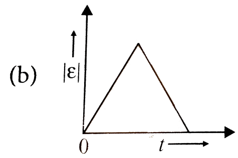
C. 0.02 V

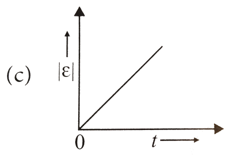
D. 1.2 V

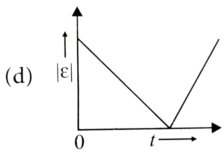
Answer: C

9. A long solenoid 'S' has 'n' turns per meter, with diameter 'a'. At the centre of this coil, we place a smallar coil of 'N' tunrs and diameter 'b' (where b lt a). If the current in the solenoid increase linearly with time, what is the induced emf appearing in the smaller coil. Plot graph showing nature of variation in emf, if current varies as a function of $mt^2 + C$.

A. 

B. 

C. 

D. 

Answer: C

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10. A conducting circular loop is placed in a uniform magnetic field, $B = 0.025T$ with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of $1mms^{-1}$. The induced emf when the radius is $2cm$ is

A. $2\pi\mu V$

B. $\pi\mu V$

C. $\frac{\pi}{2}\mu V$

D. $2\mu V$

Answer: B

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11. A circular coil of radius 8cm, 400 turns and resistance 2Ω is placed with its plane perpendicular to the horizantal component of the earth's magnetic fiedl. It is rotated about its vertical diameter through 180° in 0.30 s. Horizontal component of earth magnitude of current induced in the coil is approximately

A. $4 \times 10^{-2} A$

B. $8 \times 10^{-4} A$

C. $8 \times 10^{-2} A$

D. $1.92 \times 10^{-3} A$

Answer: B

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12. A square loop of side 12 cm and resistance 0.6Ω is placed vertically in the east-west plane. A uniform magnetic field of 0.10 T is set up across the plane in north-east direction. The magnetic field is decreased to zeroin 0.6 s at steady rate. The magnitude of currnet during this time interval is

A. $1.42 \times 10^{-3} A$

B. $2.67 \times 10^{-3} A$

C. $3.41 \times 10^{-3} A$

D. $4.21 \times 10^{-3} A$

Answer: B

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13. A rectangular coil of 100 turns and size $0.1m \times 0.05m$ is placed perpendicular to a magnetic field of 0.1 T. If the field drops to 0.05 T in 0.05 s, the magnitude of the emf induced in the coil is

A. 0.2 V

B. 0.3 V

C. 0.5 V

D. 0.6 V

Answer: C

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14. A unifrom magnetic field B points vertically up and is slowly changed in magnitude, but not in direction. the rate of change of the magnetic field is α .A conducting ring of radius r and resistance R is held perpendicular to the megnetic field, and is totally inside it. The induced current in the ring is

A. zero

B. $\dfrac{2\pi eB}{R}$

C. $\dfrac{r\alpha}{R}$

D. $\dfrac{\pi r^2\alpha}{R}$

Answer: D

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15. A magnetic field B is confined to a region $r \leq$ a and points out of the paper (the z-axis), r = 0 being the center of the circular region. A charged ring (charge = Q) of radius b and mass m lie in the x-y plane with its center at origin. The ring is free to rotate and is at rest. The magnetic field is brought to zero in time Δt. Find the angular velocity ω of the ring after the field vanishes.

A. $\frac{qBa^2}{2mb}$

B. $\frac{qBa}{2mb^2}$

C. $\frac{2b^2}{qBa^2}$

D. $\frac{qb^2}{2Ba^2}$

Answer: D

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16. A metal ring is held horizontally and bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet

A. equal to g

B. less than g

C. more than g

D. depends of on the diameter of the ring length of magnet

Answer: B

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17. What rule do we use to find the direction of induced current in a conductor moving in a magnetic field?

A. Fleming's left hand rule

B. Fleming's right hand rule

C. Ampere's rule

D. Right hand clasp rule

Answer: B

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18. Lenz's law is a consequence of law of conservation of

A. charge

B. energy

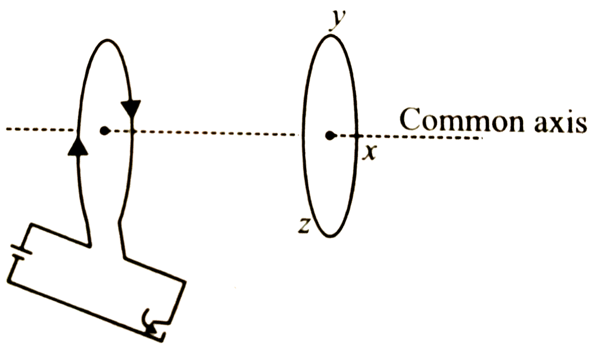
C. induced emf

D. induced currnet

Answer: B

Watch Video Solution

19. The direction of induced currnet in the right loop in the situation shown by the given figure is



(Tapping key just closed)

A. along th common axis

B. along xzy

C. along xyz

D. none of these

Answer: C

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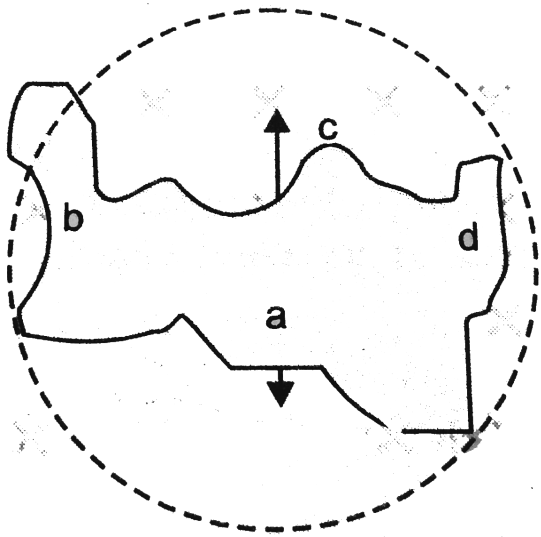
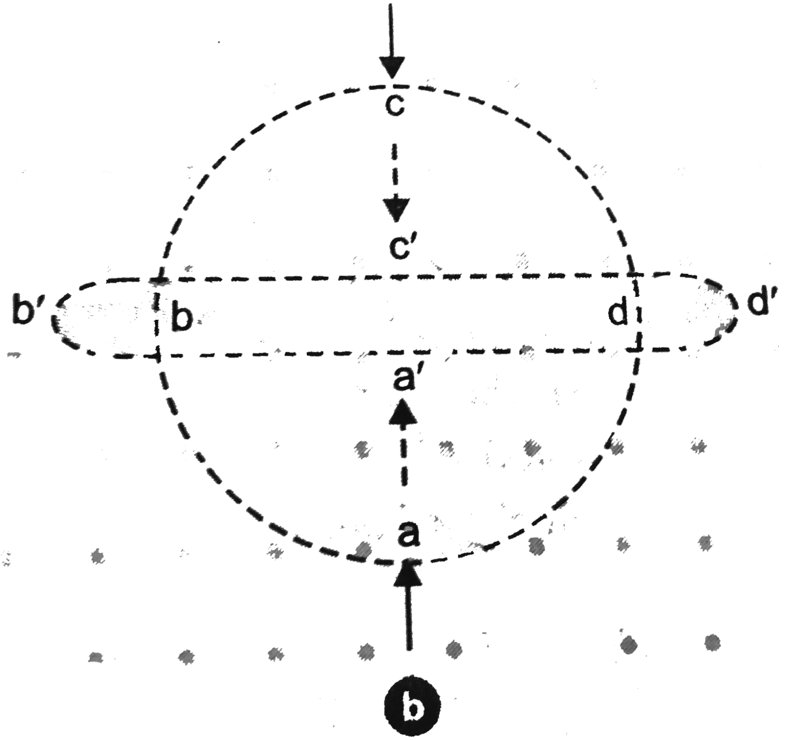
20. Use Lenz's law to determine the direction of induced current in the situation described by Fig.

(a) a wire irregular shape turning into a circular shape (b) a circular loop being deformed into a narrow straight wire. The across indicate the magnetic field into the paper and the dots indicate magnetic field out of the paper.



a



A. along abcda

B. along adcba

C. into the plane of the paper

D. out of the plane of the paper

Answer: B

Watch Video Solution

21. A solenoid is connected to a battery so that a steady current flows through it. If an iron core is inserted into the solenoid, then

A. increase

B. decrease

C. remains same

D. first increase then decrease

Answer: B

Watch Video Solution

22. Which of the following satements is not correct?

A. whenever the amount of magnetic flux linked with a circuit change, an emf is induced in the circuit.

B. The induced emf so long as the change in magnetic flux continues.

C. The direction of induced emf is give by Lenz's law.

D. Lenz's law is a consequence of the law of conservation of momentum.

Answer: D

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23. 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 anti-clockwise direction

B. currnet is induced in the loop in the clockwise direction.

C. ac is induced in the loop.

D. no current is induced in the loop.

Answer: A

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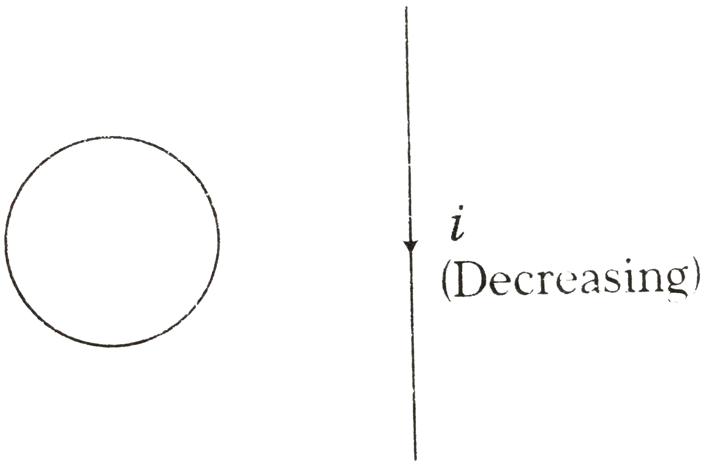
24. A circular loop is placed near a current carrying conductor as shown in figure. Find the direction of induced current, if the current, in the wire is decreasing.



A. clockwise

B. anticlockwise

C. changing

D. nothing can be said

Answer: B

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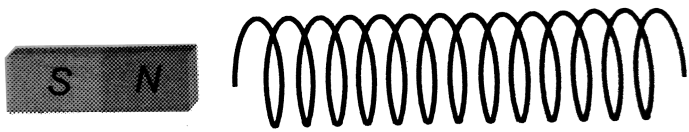
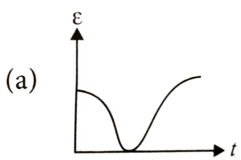
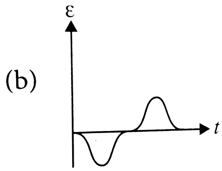
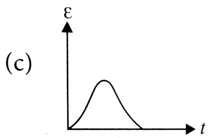
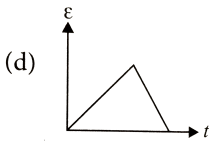
25. The variation of induced emf (E) with time (t) in a coil if a short bar magnet is moved along its axis with a constant velocity is best represent as



A. 

B. 

C. 

D. 

Answer: B

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26. The north pole of a bar magnet is rapidly introduced into a solenoid at one end (say A).

Which of the following statements correctly depicts the phenomenon taking place?

A. No induced emf is developed.

B. The end A of the solenoid behaves like a south pole.

C. The end A of the solenoid behaves like north pole.

D. The end A of the solenoid acquires positive potential.

Answer: C

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27. 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

A. clockwise of the positive z-axis

B. anticlockwise of the positive z-axis

C. zero

D. along the magnetic field

Answer: B

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28. A conducting ring is placed in a uniform magnetic field with its plane perpendicular to the field . An emf is induced in the ring if

A. it is rotated about its axis.

B. it is rotated about its diameter.

C. it is not moved.

D. it is given translational motion in the field.

Answer: B

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29. Choose the correct option:

A rectangular coil of copper wires is rotated in a magnetic field. The direction of the induced current changes once in each:

A. one revolution

B. $\frac{1}{2}$ revolution

C. $\frac{1}{4}$ revolution

D. 2 revolution

Answer: C

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