PHYSICS

BOOKS - KUMAR PRAKASHAN KENDRA PHYSICS (GUJRATI ENGLISH)

ELECTROMAGNETIC INDUCTION

Section A Question Answer

1. Discuss contribution of different scientists in electromagnetic. Define electromagnetic induction.

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2. Which discovery Faraday made public ? Discuss importance of electromagnetic induction.

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3. Discuss Faraday's experiment of bar magnet and coil for generation of electric current in coil.

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4. Discuss Faraday's experiment of two coils for generation of electric current in coil.

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5. Discuss Faraday's experiment which shows that relative motion is not an absolute requirement for electromagnetic induction.

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6. Write the results of Faraday's experiment performed with bar magnet and insulated conducting coil.

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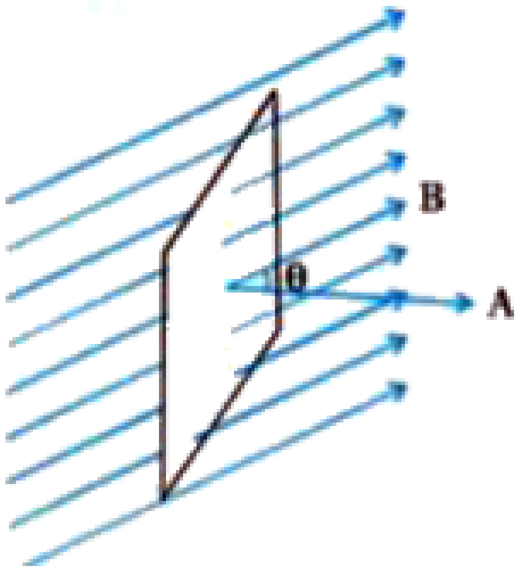
7. Explain the concept of magnetic flux.



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8. State and explain Faraday's law of electromagnetic induction.

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9. On passing current through a solenoid. Which of its end behave as a north pole or south pole explain ?

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10. Prove that the Lenz's law is a specific representation of the law of conservation of energy and state Lenz's law.

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11. Derive the equation E = - Blv of a motional = emf with the help of a suitable example.

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12. Derive equation of induced emf in the rod which is sliding on two sides of U shaped frame placed perpendicular to magnetic field.

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13. Explain the motional emf by the Lorentz force acting on the free charge carriers of conductor.

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14. Which conclusion we can obtain by the fact that emf is induced in stationary conductor placed in time varying magnetic field ? Discuss characteristic of induced electric field.

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15. Prove that mechanical power which needed to move the rod in uniform magnetic field is converted into electrical power.

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16. Derive relation between induced charge and change in magnetic flux.

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17. Derive formula for induced charge and prove that it is independent of rate of change in flux.

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18. Explain eddy current with suitable example, What should be done to decrease the effects of eddy currents ?

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19. Discuss practical applications of eddy currents.

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20. Electromagnetic Damping

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21. Define inductance, give its units and write factors on which its value depends.

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22. Explain mutual induction and derive equation of induced emf.

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23. Give two definitions of mutual inductance, give its units and write factors on which its value depends.

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24. Derive formula for mutual inductance for two very long coaxial solenoids. Also discuss reciprocity theorem.

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25. Explain self induction and obtain equation of self induced emf in a coil.

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26. With the help of L = $\frac{N\phi}{I}$ and $\varepsilon = -L\frac{dI}{dt}$ give two definitions of self inductance.

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27. Calculate the self-inductance for very long solenoid.

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28. Define unit of self-inductance. On which factors self-inductance depends.

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29. Define an inductor. Derive equation of energy $U = \frac{1}{2}LI^2$ stored in inductor.

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30. Write different method to produce induced emf.

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31. Describe the construction and working of an AC generator (an alternator).

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32. Write down formula of induced emf in AC generator and discuss how its vary with time.

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33. Discuss characteristic of induced emf in AC generator.

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34. Discuss the types of AC generator . How much power they deliver ? What is the frequency of AC generator ?

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35. The migratory pattern of bird is one of the mysteries in the field of biology and indeed all of science. Explain this in the term of electromagnetic induction.

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Section A Try Yourself

1. Which scientist established that electricity and magnetism are interrelated ?

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2. Moving charge can produce which field ?

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3. What is electromagnetic induction ?

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4. Write down name of two devices which works on principle of electromagnetic induction.

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5. Is relative motion is absolute condition for induce emf ?

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6. What is the required condition for induce current ?

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7. If we move magnet towards coil with greater velocity then induce current will increase or decrease ?

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8. If iron rod is placed inside coil then what happened to induce current ?

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9. On what factor does induced current depend?

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10. Write the SI unit of magnetic flux.

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11. Write the dimensional formula for magnetic flux.

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12. When surface of sheet is parallel to magnetic field then what is the flux linked with it ?

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13. When does the magnetic flux becomes zero ?

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14. Negative sign in Faraday's law represent which fact ?

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15. VS is unit of which physical quantity ?

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16. If magnetic flux $\phi = (3t^2 - 2t + 5)$ Wb, then what is induced emf at t = 2 s.

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17. Lenz's law is represent which fundamental conservation law ?

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18. If we move magnet towards coil, keeping N pole in front of coil, then that side of coil behave as which pole ?

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19. Write Lenz's law.

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20. If we double the velocity of rod moving in uniform magnetic field, then induces emf will increase by how much time ?

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21. What is motional emf ?

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22. Write equation of induced charge.

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23. Wb/Ω unit is representing which physical quantity ?

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24. On which factor induced charge depend ?

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25. Write equation of mechanical power required to move rod in uniform magnetic field.

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26. When conducting rod moved in magnetic field it will experience a force opposite to its velocity due to which phenomenon ?

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27. What is eddy current ?

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28. Who invented eddy current ?

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29. Electromagnetic Damping

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30. When small magnet is allowed to fall from aluminium pipe, then it will fall with acceleration less then 'g'. Why?

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31. Why self induced emf is known as back emf ?

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32. Calculate the self-inductance for very long solenoid.

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33. Derive formula for mutual inductance for two very long coaxial solenoids. Also discuss reciprocity theorem.

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34. Write type of generator.

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35. In India, AC voltage becomes zero how many time in 1 s ?

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36. Write equation of maximum emf in AC generator

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Section A Hots

1. Give the explanation of reason behind the origin of motional induced emf.

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2. What is Lenz force ?

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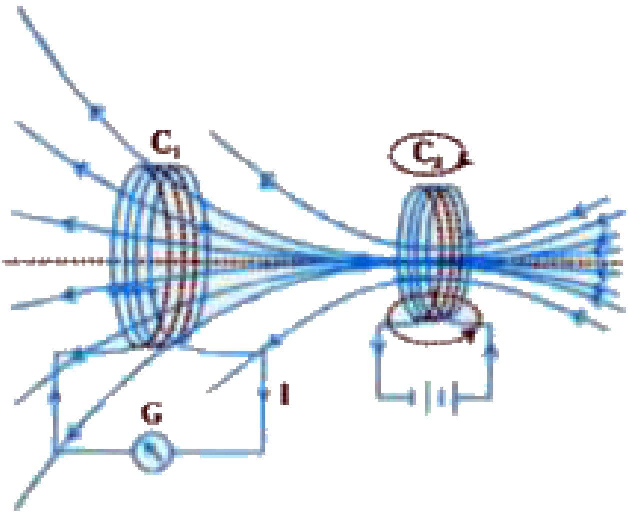
Section B Numerical Textual Illustrations

1. 

Consider Experiment:

(a) What would you do to obtain a large deflection of the galvanometer ?

(b) How would you demonstrate the presence of an induced current in the absence of a galvanometer ?

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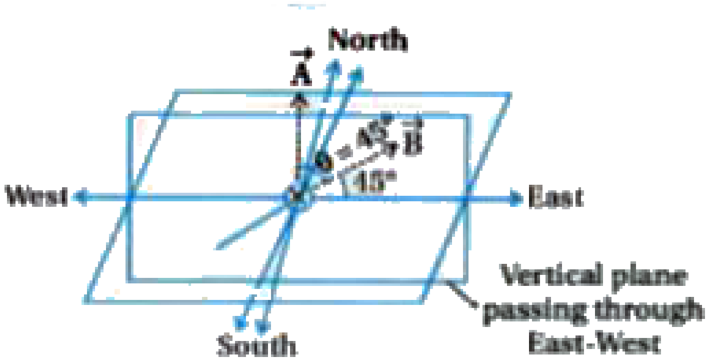
2. A square loop of side 10 cm and resistance 0.5 Ω is placed vertically in the east-west plane. A uniform magnetic field of 0.10 T is set up across the plane in the north-east direction. The magnetic field is decreased to zero in 0.70 s at a steady rate. Determine the magnitudes of induced emf and current during this time-interval.



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3. A circular coil of radius 10 cm, 500 turns and resistance 2Ω is placed with its plane perpendicular to the horizontal component of the earth's magnetic field. It is rotated about its vertical diameter through 180° in 0.25 s.

Estimate the magnitudes of the emf and current induced in the coil. Horizontal component of the earth's magnetic field at the place is 3.0×10^{-5} T.

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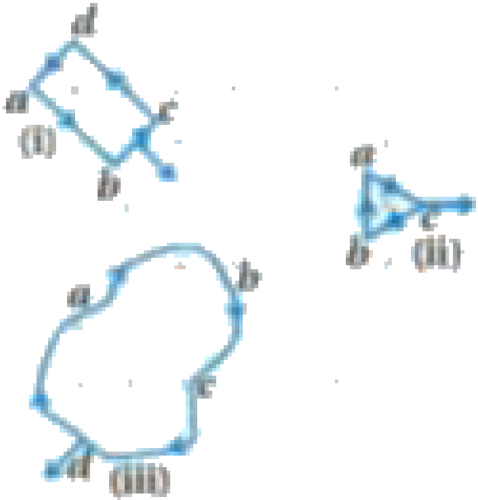
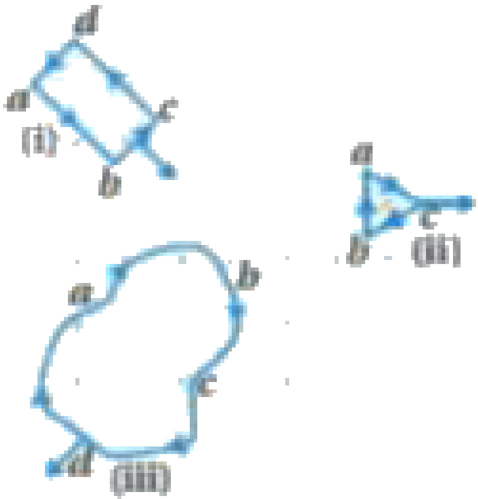
4. Figure shows planar loops of different shapes moving out of or into a region of a magnetic field which is directed normal to the plane of the loop away from the reader. Determine the direction of induced current in each loop using Lenz's law.





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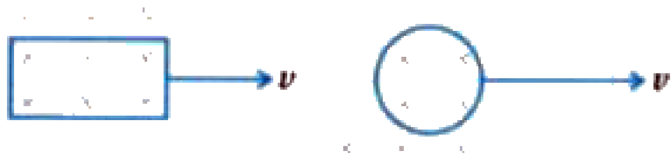
5. (a) A closed loop is held stationary in the magnetic field between the north and south poles of two permanent magnets held fixed. Can we hope to generate current in the loop by using very strong magnets ?

(b) A closed loop moves normal to the constant electric field between the plates of a large capacitor. Is a current induced in the loop (i) when it is wholly inside the region between the capacitor plates (ii) when it is partially outside the plates of the capacitor? The electric field is normal to the plane of the loop.

(c) A rectangular loop and a circular loop are moving out of a uniform magnetic field region (Figure) to a field-free region with a constant velocity v. In which loop do you expect the induced emf to be constant during the passage out of the field region? The field is normal to the loops.



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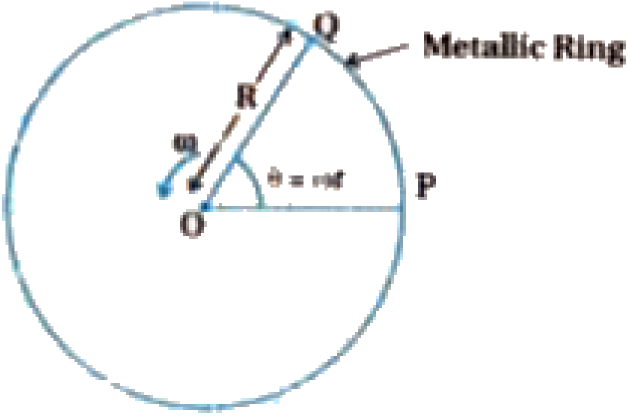
6. A metallic rod of 1 m length is rotated with a frequency of 50 rev/s, with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius 1 m, about an axis passing through the centre and perpendicular to the plane of the ring as per figure. A constant and uniform magnetic field of 1T parallel to the axis is present everywhere. What is the emf between the centre and the metallic ring ?



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7. A wheel with 10 metallic spokes each 0.5 m long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of earth's magnetic field H_E at a place. If H_E=

0.4 G at the place, what is the induced emf between the axle and the rim of the wheel ? Note that 1G=10^{-4} T.

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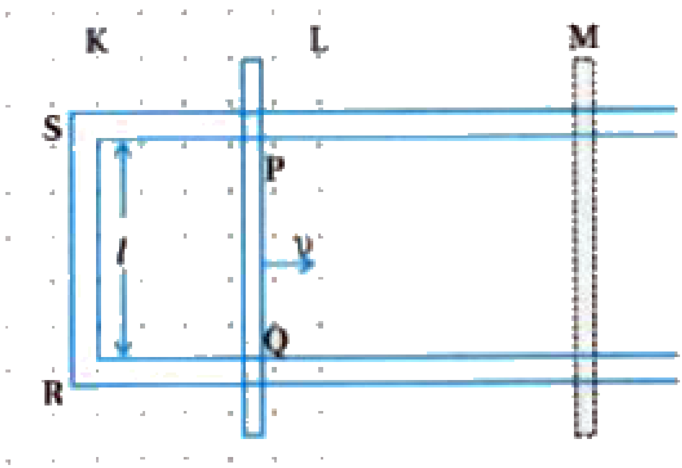
8. Refer to figure the arm PQ of the rectangular conductor is moved from x = 0, outwards. The uniform magnetic field is perpendicular to the plane and extends from x = 0 to x = b and is zero for x $>$ b. Only the arm PQ possesses substantial resistance r.

Consider the situation when the arm PQ is pulled outwards from x = 0 to x = 2b and is then moved back to x = 0 with constant speed v. Obtain expressions for the flux, the induced emf, the force necessary to pull the arm and the power dissipated as Joule heat. Sketch the variation of these quantities with distance.



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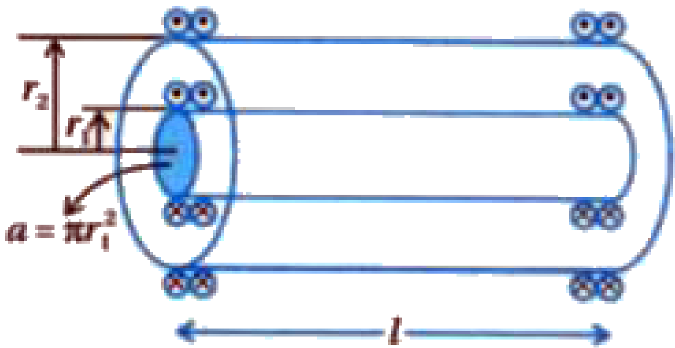
9. Two concentric circular coils, one of small radius r_1 and the other of large radius r_2, such that $r_1 < < r_2$, are placed co-axially with centres coinciding. Obtain the mutual inductance of the arrangement.



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10. (a)Obtain the expression for the magnetic energy stored in a solenoid in terms of magnetic field B, area A and length l of the solenoid.

(b) How does this magnetic energy compare with the electrostatic energy stored in a capacitor ?

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11. Kamla peddles a stationary bicycle. The pedals of the bicycle are attached to a 100 turn coil of area $0.10 m^2$. The coil rotates at half a revolution per second and it is placed in a uniform magnetic field of 0.01 T perpendicular to the axis of rotation of the coil. What is the maximum voltage generated in the coil ?

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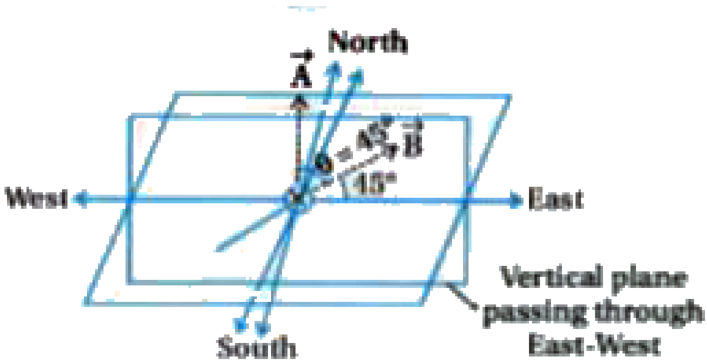
12. A square loop of side 10 cm and resistance 0.5 Ω is placed vertically in the east-west plane. A uniform magnetic field of 0.10 T is set up across the plane in the north-east direction. The magnetic field is decreased to zero in 0.70 s at a steady rate. Determine the magnitudes of induced emf and current during this time-interval.



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13. A square loop of side 10 cm and resistance 0.5 Ω is placed vertically in the east-west plane. A uniform magnetic field of 0.5 T is set up across the plane in the north-east direction. The magnetic field is decreased to zero in 1.4 s at a steady rate. Determine the magnitudes of induced emf and current during this time interval .

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14. A circular coil of radius 10 cm, 500 turns and resistance 2Ω is placed with its plane perpendicular to the horizontal component of the earth's magnetic field. It is rotated about its vertical diameter through 180° in 0.5 s. Estimate the magnitudes of the emf and current induced in the coil. Horizontal component of the earth's magnetic field at the place is 3.0×10^{-5} T.

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15. A circular coil of radius 20 cm, 500 turns and resistance 4Ω is placed with its plane perpendicular to the horizontal component of the earth's magnetic field. It is rotated about its vertical diameter through 180° in 0.25 s. Estimate the magnitudes of the emf and current induced in the coil. Horizontal component of the earth's magnetic field at the place is 3.0×10^{-5} T.

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16. A wheel of radius r having conducting rim and n no. of conducting spokes, rotates in a plane perpendicular to uniform magnetic field B with constant angular speed ω. Prove that emf induced between centre and rim of a wheel is $\frac{1}{2}B\omega R^2$

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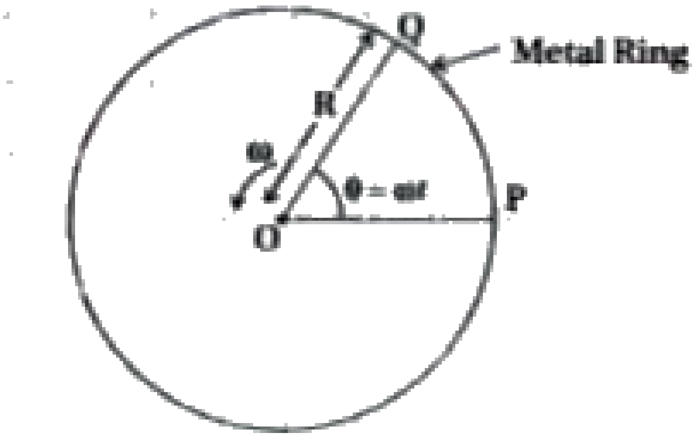
17. One metallic ring of radius 2 m has a conducting rod connected between centre and rim of wheel. It rotates in a plane perpendicular to uniform magnetic field 1 T with frequency $25\frac{\text{rev}}{s}$. Find emf induced across the rod.



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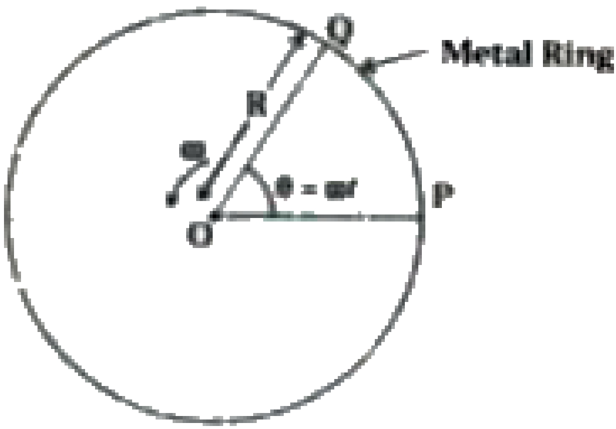
18. One metallic ring of radius 1 m has a conducting rod connected between centre and rim of wheel. It rotates in a plane perpendicular to uniform magnetic field 2 T with frequency $100\frac{\text{rev}}{s}$. Find emf induced across the rod.



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19. A wheel with 100 metallic spokes each 1 m long is rotated with a speed of 120 $\frac{\text{rev}}{\text{min}}$ in a plane normal to the horizontal component of earth's magnetic field H_E at a place. If H_E = 0.4 G at the place, what is the induced emf between the axle and the rim of the wheel ? Note that 1G=10^{-4} T

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20. A wheel with 10 metallic spokes each 1 m long is rotated with a speed of 60 $\frac{\text{rev}}{\text{min}}$ in a plane normal to the horizontal component of earth's magnetic field H_E at a place. If H_E = 0.4 G at the place, what is the induced emf between the axle and the rim of the wheel ? Note that 1 G=10^{-4} T

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21. One U shaped conducting frame is placed in a plane perpendicular to uniform magnetic field B. One conducting rod of mass m and length l is kept perpendicular to parallel sides of this frame. At time t = 0, this rod is pushed perpendicular to its length with initial velocity v_g. Prove that its velocity at the end of time t is $v_t = v_0 \exp\left(\frac{-B^2 l^2}{mR} t\right)$ where R=resistance of external circuit and l=perpendicular distance between two parallel slides .

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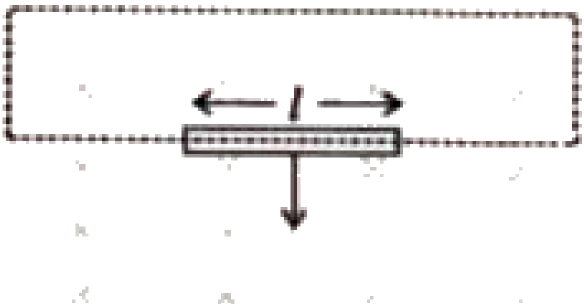
22. As shown in the figure, a conducting rod of length l, mass m and resistance R falls through a magnetic field $\vec{B}$ in a plane perpendicular to plane of figure. Find terminal velocity of rod.



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23. One extremely small and another extremely big square frames are coplanar and concentric with side length l and L respectively. (where L $> >$ l). Find mutual inductance of this system.

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24. One toroid has 1.5×10^4 turns and its axis forms a circle of radius 10 cm. Its cross-section has radius 2 cm. Find inductance of this toroidal ring.

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25. Kamla peddles a stationary bicycle. The pedals of the bicycle are attached to a 100 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 0.05 T perpendicular to the axis of rotation of the coil. What is the maximum voltage generated in the coil ?

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26. Kamla 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 0.005 T perpendicular to the axis of rotation of the coil. What is the maximum voltage generated in the coil ?

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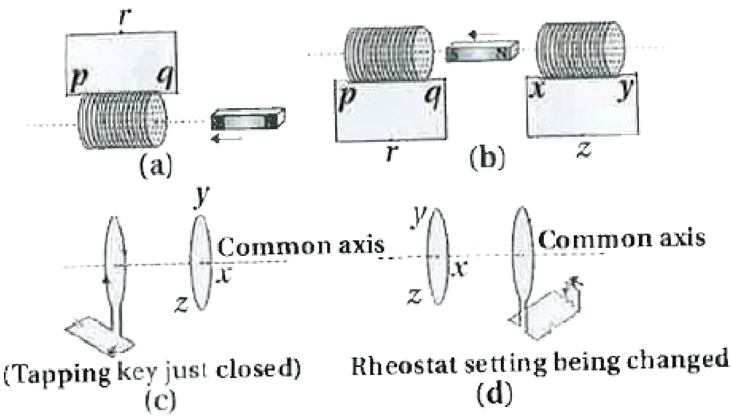
Section B Numerical Numerical From Textual Exercise

1. Predict the direction of induced current in the situations described by the following figures (a) to (d).



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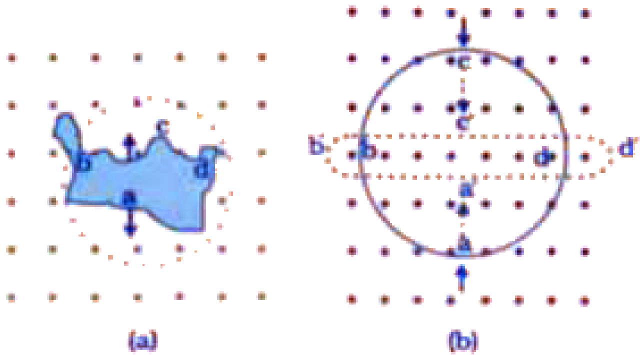
2. Use Lenz's law to determine the direction of induced current in the situations described by figure.

(a) A wire of irregular shape turning into a circular shape,

(b) A circular loop being deformed into a narrow straight wire.



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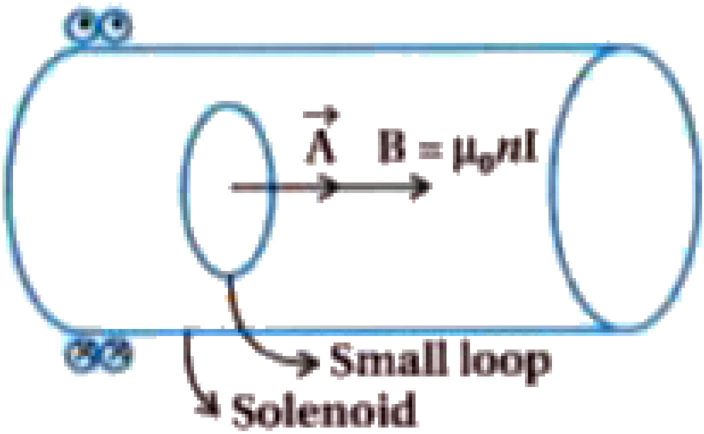
3. A long solenoid with 15 turns per cm has a small loop of area 2.0cm^2 placed inside the solenoid normal to its axis. If the current carried by the solenoid changes steadily from 2.0 A to 4.0 A in 0.1 s, what is the induced emf in the loop while the current is changing ?



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4. A rectangular wire loop of sides 8 cm and 2 cm with a small cut is moving out of a region of uniform magnetic field of magnitude 0.3 T directed normal to the loop. What is the emf developed across the cut if the velocity of the loop is 1cm s^{-1} in a direction normal to the (a) longer side, (b) shorter side of the loop ? For how long does the induced voltage last in each case ?

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5. A 1.0 m long metallic rod is rotated with an angular frequency of 400 rad s^{-1} about an 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 and uniform magnetic field of 0.5 T parallel to the axis exists everywhere. Calculate the emf developed between the centre and the ring.

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6. A circular coil of radius 8.0 cm and 20 turns is rotated about its vertical diameter with an angular speed of 50 rad s^{-1} in a uniform horizontal magnetic field of magnitude 3.0×10^{-2} T. Obtain the maximum and average emf induced in the coil. If the coil forms a closed loop of resistance 10Ω, calculate the maximum value of current in the coil. Calculate the average power loss due to Joule heating. Where does this power come from ?

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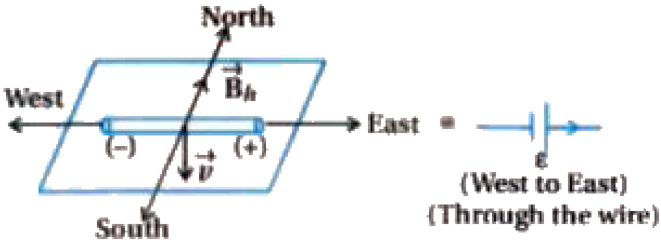
7. A horizontal straight wire 10 m long extending from east to west is falling with a speed of $5.0 \mathrm{m\,s}^{-1}$, at right angles to the horizontal component of the earth's magnetic field, $0.30 \times 10^{-4} \mathrm{Wb\,m}^{-2}$.

(a) What is the instantaneous value of the emf induced in the wire ?

(b) What is the direction of the emf ?

(c) Which end of the wire is at the higher electrical potential ?



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8. Current in a circuit falls from 5.0 A to 0.0 A in 0.1 s. If an average emf of 200 V induced, give an estimate of the self-inductance of the circuit.

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9. A pair of adjacent coils has a mutual inductance of 1.5 H. If the current in one coil changes from 0 to 20 A in 0.5 s, what is the change of flux linkage with the other coil ?

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10. A jet plane is travelling towards west at a speed of 1800 km/h. What is the voltage difference developed between the ends of the wing having a span of 25 m, if the Earth's magnetic field at the location has a magnitude of 5×10^{-4} T and the dip angle is 30°.

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11. Suppose the loop is stationary but the current feeding the electromagnet that produces the magnetic field is gradually reduced so that the field decreases from its initial value of 0.3 T at the rate of 0.02 T s^{-1}. If the cut is joined and the loop has a resistance of 1.6 Ω, how much power is dissipated by the loop as heat ? What is the source of this power ?

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12. A square loop of side 12 cm with its sides parallel to X and Y axes is moved with a velocity of 8cm s^{-1} in the positive x-direction in an environment containing a magnetic field in the positive z-direction. The field is neither uniform in space nor constant in time. It has a gradient of 10^{-3}T cm^{-1} along the negative x-direction (that is it increases by $10^{-3}\mathrm{T\,cm}^{-1}$ as one moves in the negative x-direction), and it is decreasing in time at the rate of $10^{-3}Ts^{-1}$. Determine the direction and magnitude of the induced current in the loop if its resistance is $4.50m\Omega$.

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13. It is desired to measure the magnitude of field between the poles of a powerful loud speaker magnet. A small flat search coil of area

2cm^2 with 25 closely wound turns, is positioned normal to the field direction, and then quickly snatched out of the field region. Equivalently, one can give it a quick 90° turn to bring its plane parallel to the field direction). The total charge flown in the coil (measured by a ballistic galvanometer connected to coil) is 7.5 mC. The combined resistance of the coil and the galvanometer is 0.50 Ω. Estimate the field strength of magnet.

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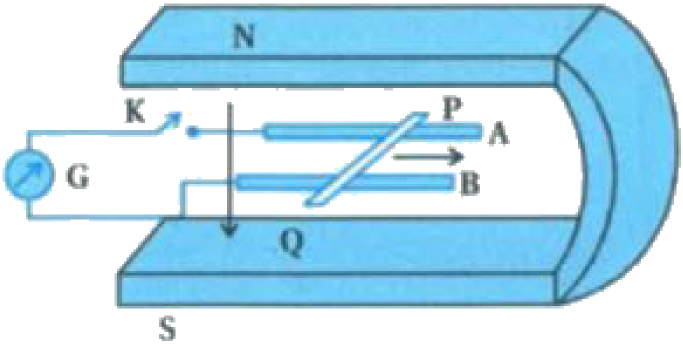
14. Figure shows a metal rod PQ resting on the smooth rails AB and positioned between the poles of a permanent magnet. The rails, the rod, and the magnetic field are in three mutual perpendicular directions. A galvanometer G connects the rails through a switch K. Length of the rod =15 cm, B =0.50 T, resistance of the closed loop containing the rod 9.0 mΩ. Assume the field to be uniform.

(a) Suppose K is open and the rod is moved with a speed of 12cm s^{-1} in the direction shown. Give the polarity and magnitude of the induced emf.



(b) Is there an excess charge built up at the ends of the rods when K is open ? What if K is closed ?

(c) With K open and the rod moving uniformly, there is no net force on the electrons in the rod PQ even though they do experience magnetic force due to the motion of the rod. Explain.

(d) What is the retarding force on the rod when K is closed ?

How much power is required (by an external agent) to keep the rod moving at the same speed (= 12 cm s^{-1}) when K is closed ? How much power is required when K is open?

(f)How much power is dissipated as heat in the closed circuit ? What is the source of this power ?

(g) What is the induced emf in the moving rod if the magnetic field is parallel to the rails instead of being perpendicular ?

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15. An air-cored solenoid with length 30 cm, area of cross-section 25cm^2 and number of turns 500, carries a current of 2.5 A. The current is suddenly switched off in a brief time of 10^{-3} s. How much is the average back emf induced across the ends of the open switch in the circuit ? Ignore the variation in magnetic field near the ends of the solenoid.

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16. (a) Obtain an expression for the mutual inductance between a long straight wire and a square loop of side a as shown in figure.

(b) Now assume that the straight wire carries a current of 50 A and the loop is moved to the right with a constant velocity, v = 10 m/s. Calculate the induced emf in the loop at the instant when x = 0.2 m. Take a = 0.1 m and assume that the loop has a large resistance.

17. A line charge λ per unit length is lodged uniformly onto the rim of a wheel of mass M and radius R. The wheel has light nonconducting spokes and is free to rotate without friction about its axis as per figure. A uniform magnetic field extends over a circular region within the rim. It is given by,

$B = -B_0 k(r \leq a, a < R)$

=0 (otherwise)

What is the angular velocity of the wheel after the field is suddenly switched off ?

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Section B Numerical Numerical From Darpan Based On Textbook

1. A conducting circular loop is placed in a uniform magnetic field of 0.04 T with its plane perpendicular to the field. Some how, the radius of the loop starts shrinking at a constant rate of 2 mm/s. Find the induced emf in the loop at an instant when the radius becomes 2 cm solution.

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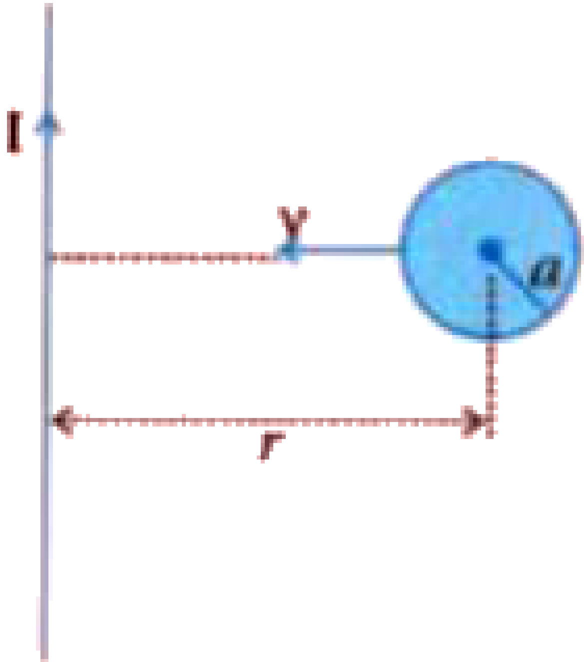
2. As shown in figure, a long wire kept vertically on the plane of paper carries electric current-I. A conducting ring moves towards the wire with velocity v with its plane conducting with the plane of paper. Find the induced emf produced in the ring when it is at a perpendicular distance r from the wire.

Radius of the ring is a and $a << r$.



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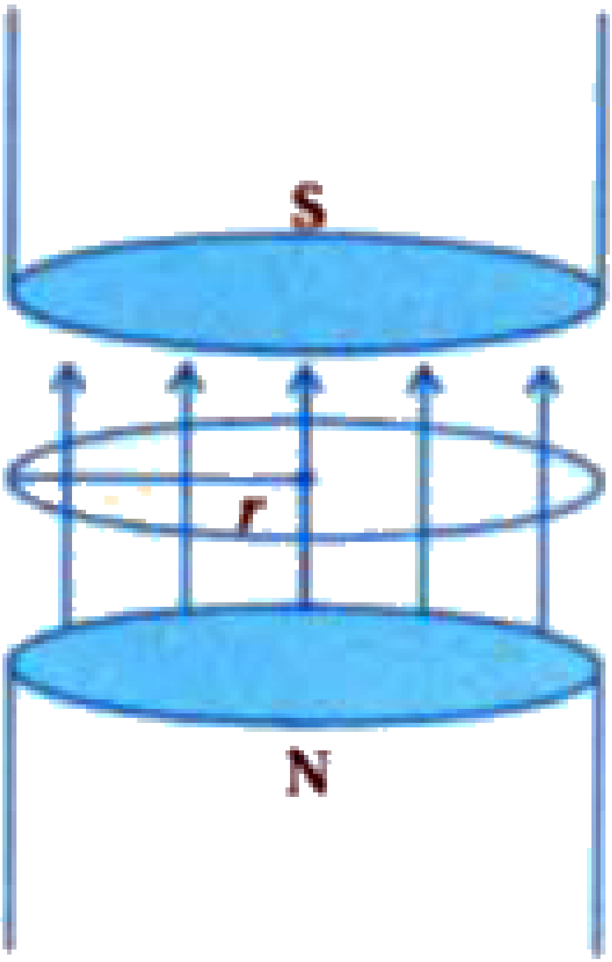
3. A conducting ring of radius r is placed perpendicular inside a time varying magnetic

field as shown in figure. The magnetic field changes with time according to $B = B_0 + \alpha t$ where B_0 and α are positive constants. Find the electric field on the circumference of the ring.



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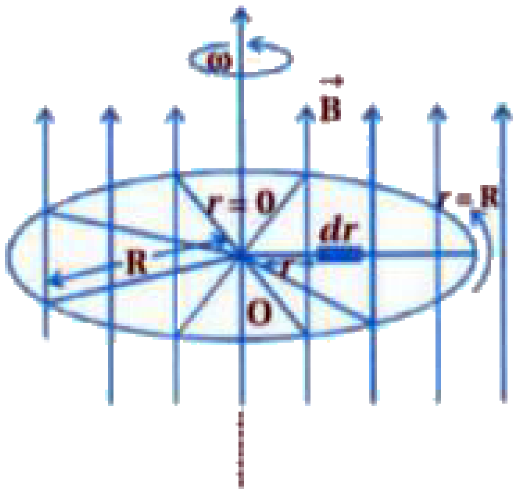
4. A wheel having n conducting concentric spokes is rotating about it geometrical axis with an angular velocity ω, in a uniform magnetic field B perpendicular to its plane prove that the induced emf generated between the rim of the wheel and the center is $\frac{\omega B R^2}{2}$, where R is the radius of the wheel. It is given that the rim of the wheel is conducting.



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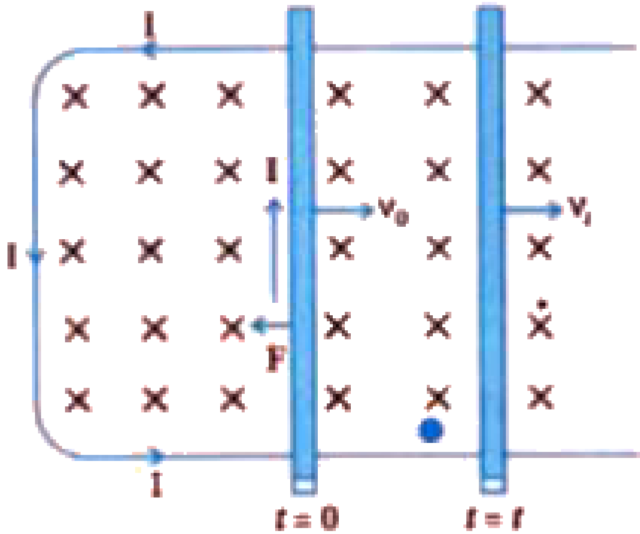
5. A U-shaped conducting frame is placed in a magnetic field B in such a way that the plane of the frame is perpendicular to the field lines.

A conducting rod is supported on the parallel arms of the frame, perpendicular to them and is given a velocity v_0 at time t = 0. Prove that the velocity of the rod at time t will be given by $v_t = v_0 \exp\left(\frac{-B^2 l^2}{mR} t\right)$.



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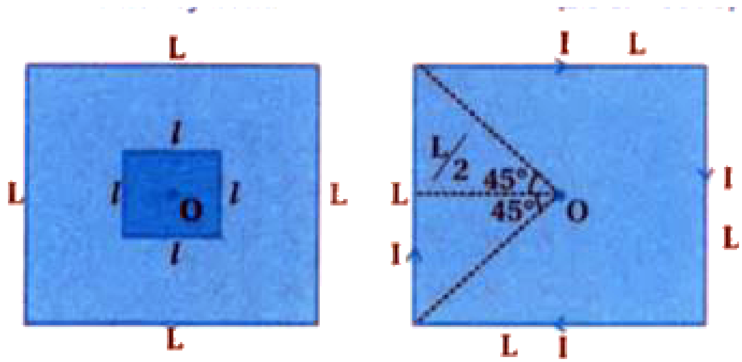
6. A small square loop of wire of side l is placed inside a large square loop of wire of side $L(L >> l)$. The loops are coplanar and their centres coincide. Find the mutual inductance of the system.



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7. A conducting bar of 2m length is allowed to fall freely from a 50m high tower, keeping it aligned along the east-west direction. Find the emf induced in the rod when it is 20 m below the top of the tower. $g = 10\text{ms}^{-2}$. Horizontal component of earth's magnetic field is 0.7×10^{-4} T and angle of dip =60°.

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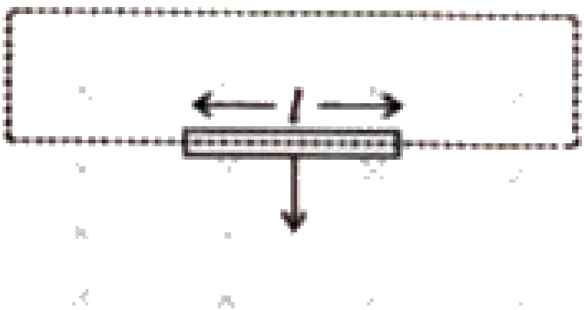
8. As shown in the figure, a conducting rod of length l, mass m and resistance R falls through a magnetic field $\vec{B}$ in a plane perpendicular to plane of figure. Find terminal velocity of rod.



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9. Find the equivalent inductance of two inductors having inductances L_1 and L_2 connected in parallel with the help of appropriate DC circuit.

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10. One toroid has 1.5×10^4 turns and its axis forms a circle of radius 10 cm. Its cross-section has radius 2 cm. Find inductance of this toroidal ring.

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Section C Ncert Exemplar Solution Mcqs

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

A. $2B_0L^2Wb$

B. $3B_0L^2Wb$

C. $4B_0L^2Wb$

D. $\sqrt{29}B_0L^2$ Wb

Answer: C

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2. A loop, made of straight edges has six corners at A(0,0,0), B(L,0,0) ,C(L,L,0), D(0,L,0), E(0,L,L) and F(0,0,L). A magnetic field $\overrightarrow{B} = B_0\left(\hat{i} + \hat{k}\right)T$ is present in the region.

The flux passing through the loop ABCDEFA (in that order) is

A. $B_0 L^2 Wb$

B. $2 B_0 L^2 Wb$

C. $\sqrt{2} B_0 L^2 Wb$

D. $4 B_0 L^2 Wb$

Answer: B

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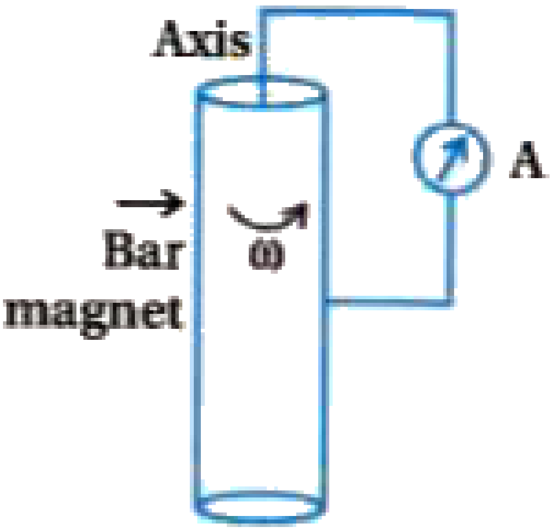
3. A cylindrical bar magnet is rotated about its axis as in figure. A wire is connected from the axis and is made to touch the cylindrical surface through a contact. Then



A. a direct current flows in the ammeter A.

B. no current flows through the ammeter A.

C. an alternating sinusoidal current flows through the ammeter A with a time period $T = \frac{2\pi}{\omega}$

D. a time varying non-sinusoidal current flows through the ammeter A.

Answer: B

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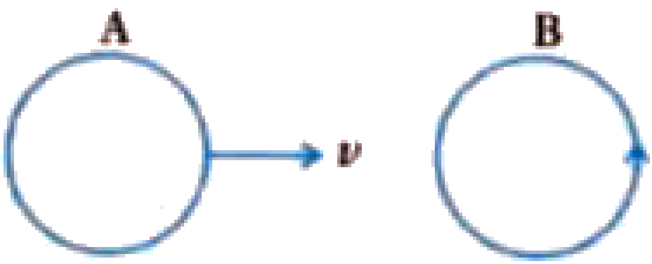
4. There are two coils A and B as shown in figure. A current starts flowing in B as shown, when A is moved towards B and stops when A stops moving. The current in A is counter clockwise. B is kept stationary when A moves. We can infer that



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

B. there is a varying current in A.

C. there is no current in A.

D. there is a constant current in counterclockwise direction in A.

Answer: D

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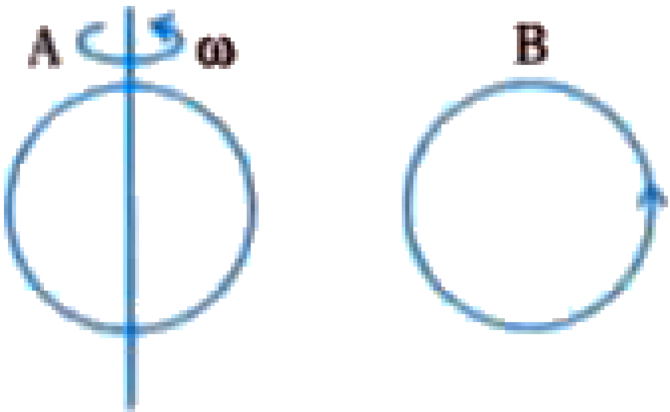
5. Same as problem 4 except the coil A is made to rotate about a vertical axis figure. No current flows in B if A is at rest. The current in coil A, when the current in B (at t = 0) is counter clockwise and the coil A is as shown at this instant, t = 0, is



A. constant current clockwise

B. varying current clockwise.

C. varying current counter clockwise.

D. constant current counter clockwise.

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

A. l and A increase.

B. l decreases and A increases

C. l increases and A decreases.

D. both l and A decrease.

Answer: B

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

A. a direct current is passing through the plate.

B. it is placed in a time varying magnetic field

C. it is placed in a space varying magnetic field, but does not vary with time.

D. a current (either direct or alternating) is passing through the plate.

Answer: A::B::D

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8. An e.m.f is produced in a coil, which is not connected to an external voltage source. This can be due to

A. the coil being in a time varying magnetic field.

B. the coil moving in a time varying magnetic field.

C. the coil moving in a constant magnetic field.

D. the coil is stationary in external spatially varying magnetic field, which does not change with time.

Answer: A::B::C

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

A. increases when they are brought nearer.

B. depends on the current passing through the coils.

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

D. is the same as M_{21} of coil 2 with respect to coil 1.

Answer: A::D

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10. 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 circular 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. there is a constant magnetic field in the perpendicular (to the plane of the coil) direction.

Answer: B::C

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11. Consider a magnet surrounded by a wire with an on/off switch S as shown in figure. If the switch is thrown from the off position (open circuit) to the on position (closed circuit), will a current flow in the circuit ? Explain.

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12. A wire in the form of a tightly wound solenoid is connected to a DC source, and carries a current. If the coil is stretched so that there are gaps between successive elements of the spiral coil, will the current increase or decrease? Explain.

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13. A solenoid is connected to a battery so that a steady current flows through it. If an iron core is inserted into the solenoid, will the current increase or decrease? Explain.

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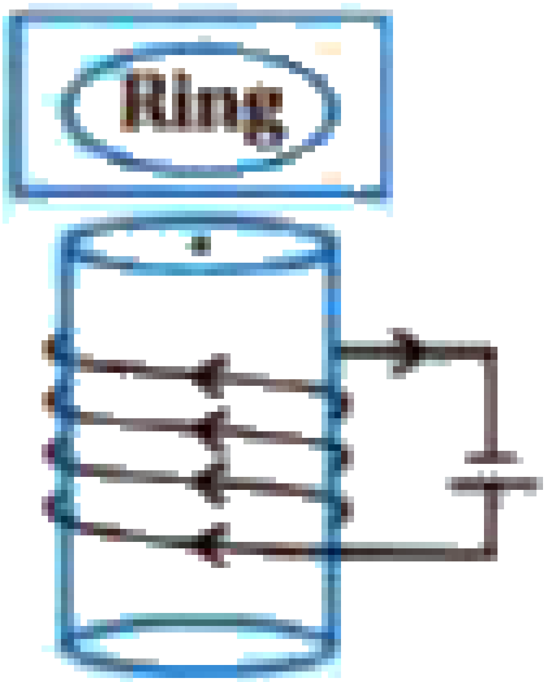
14. Consider a metal ring kept on top of a fixed solenoid (say on a cardboard) as per figure. The centre of the ring coincides with the axis of the solenoid. If the current is suddenly switched on, the metal ring jumps up. Explain.



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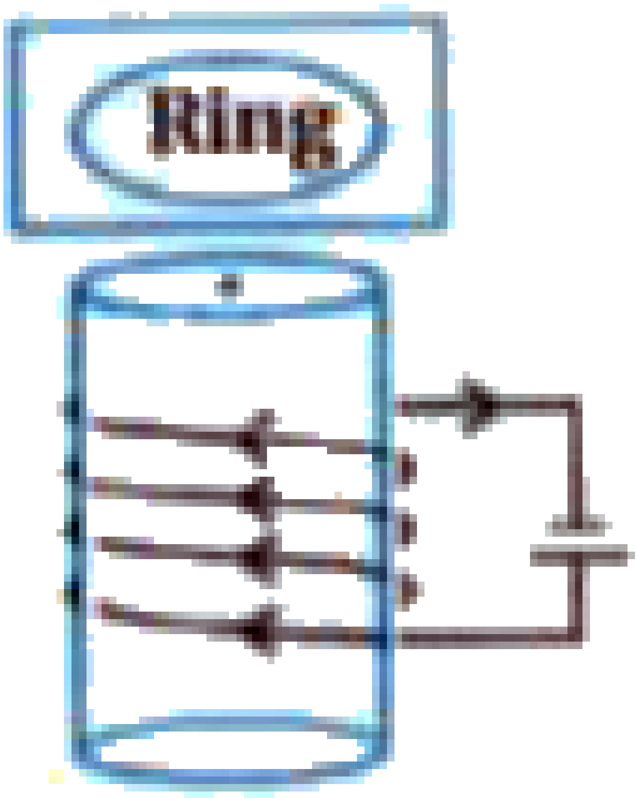
15. Consider a metal ring kept (supported by a cardboard) on top of a fixed solenoid carrying a current I as per figure. The centre of the ring coincides with the axis of the solenoid. If the current in the solenoid is switched off, what will happen to the ring ?



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16. Consider a metallic pipe with an inner radius of 1 cm. If a cylindrical bar magnet of radius 0.8cm is dropped through the pipe, it takes more time to come down than it takes for a similar unmagnetised cylindrical iron bar dropped through the metallic pipe. Explain.

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Section C Ncert Exemplar Solution Short Answer

1. A magnetic field in a certain region is given by $\overrightarrow{B} = B_0 \cos(\omega t)\hat{k}$ and a coil of radius a with resistance R is placed in the xy-plane with its centre at the origin in the magnetic field (see figure). Find the magnitude and the direction of the current at (a, 0, 0) at $t = \frac{\pi}{2\omega}, \frac{\pi}{\omega}$ and $t = \frac{3\pi}{2\omega}$.

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2. Consider a closed loop C in a magnetic field as shown in figure. The flux passing through the loop is defined by choosing a surface whose edge coincides with the loop and using the formula $\phi = \overrightarrow{B}_1 . d\overrightarrow{A}_1 + \overrightarrow{B}_2 . d\overrightarrow{A}_2 + ...$ Now if we choose two different surfaces S_1 and S_2 having C as their edge, would we get the same answer for flux. Justify your answer.

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3. Find the current in the wire for the configuration shown in figure. Wire PQ has negligible resistance. $\vec{B}$, the magnetic field is coming out of the paper. θ is a fixed angle made by PQ travelling smoothly over two conducting parallel wires separated by a distance d.

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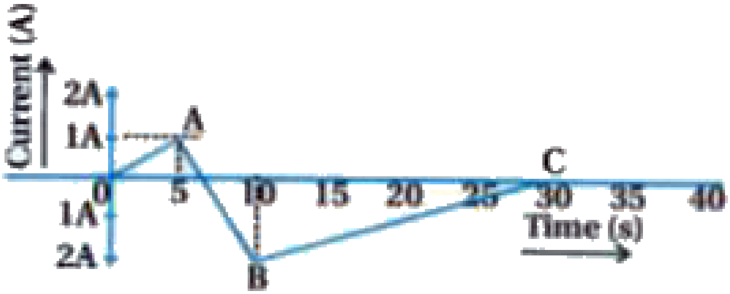
4. 

A (current vs time) graph of the current passing through a solenoid is shown in figure. For which time is the back electromotive force (ε) a maximum. If the back emf at t = 3s is e, find the back emf at 1 = 7 s, 15 s and 40 s. OA, AB and BC are straight line segments.

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5. There are two coils A and B separated by some distance. If a current of 2 A flows through A, a magnetic flux of 10^{-2} Wb passes through B (no current through B). If no current passes through A and a current of 1 A passes through B, what is the flux through A ?

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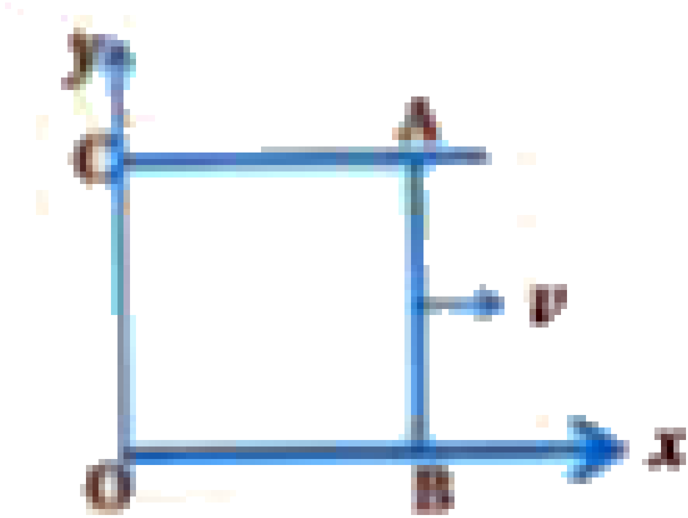
Section C Ncert Exemplar Solution Long Answer

1. A magnetic field $\overrightarrow{B} = B_0 \sin(\omega t)\hat{k}$ covers a large region where a wire AB slides smoothly over two parallel conductors separated by a distance d as in figure. The wires are in the xy-plane. The wire AB (of length d) has resistance R and the parallel wires have negligible resistance. If AB is moving with velocity v, what is the current in the circuit. What is the force needed to keep the wire moving at constant velocity ?



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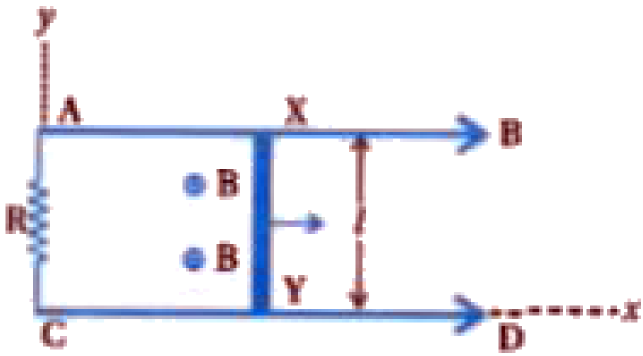
2. A conducting wire XY of mass m and neglibile resistance slides smoothly on two parallel conducting wires as shown in figure.

The closed circuit has a resistance R due to AC. AB and CD are perfect conductors. There is a magnetic field $\vec{B} = B(t)\hat{k}$



(i) Write down equation for the acceleration of the wire XY.

(ii) If $\vec{B}$ is independent of time, obtain v(t), assuming v (0) =u_0.

(iii) For (ii), show that the decrease in kinetic energy of XY equals the heat lost in.

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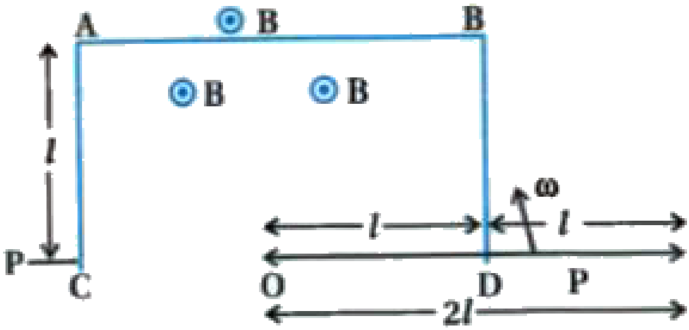
3. ODBAC is a fixed rectangular conductor of negligible resistance (CO is not connected) and OP is a conductor which rotates clockwise with an angular velocity ω as figure. The entire system is in a uniform magnetic field B whose direction is along the normal to the surface of the rectangular conductor ABDC. The conductor OP is in electric contact with ABDC. The rotating conductor has a resistance of λ per unit length. Find the current in the rotating conductor, as it rotates by 180°.



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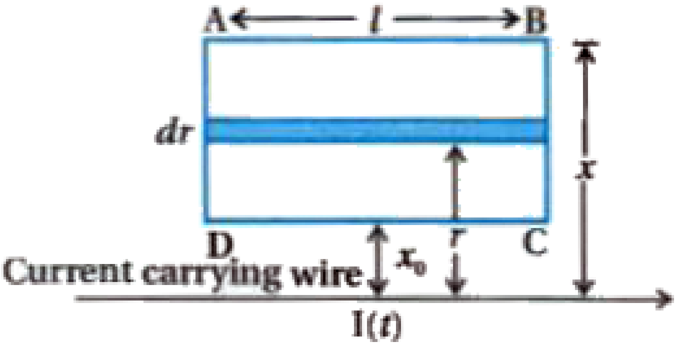
4. Consider an infinitely long wire carrying a current I(t), with $\frac{dI}{dt} = \lambda$ = constant. Find the dt current produced in the rectangular loop of wire ABCD if its resistance is R as in figure.



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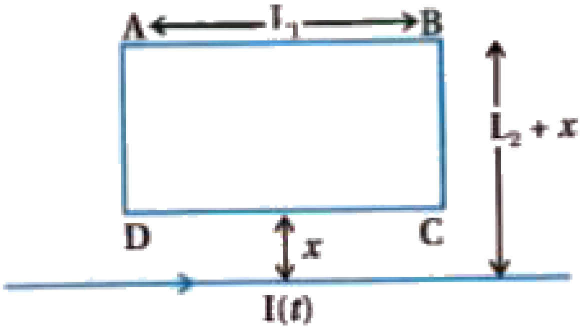
5. A rectangular loop of wire ABCD is kept close to an infinitely long wire carrying a current $I(t) = I_0\left(1 - \frac{t}{T}\right)$ for $0 \leq t \leq T$ and I(0)=0 for t $>$ T as shown in figure. Find the total charge passing through a given point in the loop, in time T. The resistance of the loop is R.



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6. 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 centre of the circular region. A charged ring (charge Q) of radius b, b $>$ a and mass m lies in the xy-plane with its centre at the 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.

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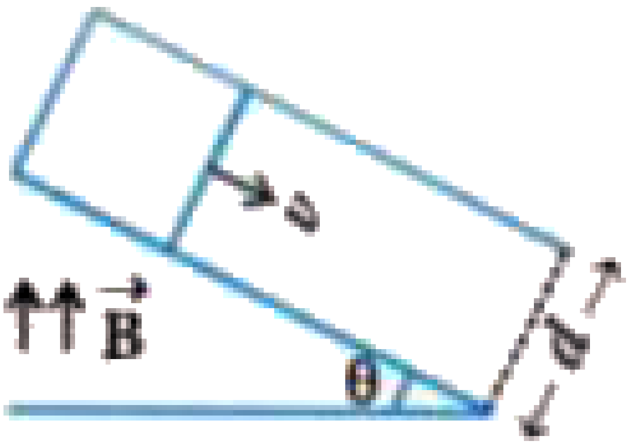
7. A rod of mass m and resistance R slides smoothly over two parallel conducting wires kept sloping at an angle θ with respect to the horizontal as shown in figure. The circuit is closed through a perfect conductor at the top. There is a constant magnetic field $\vec{B}$ along the vertical direction. If the rod is initially at rest, find the velocity of the rod as a function of time.



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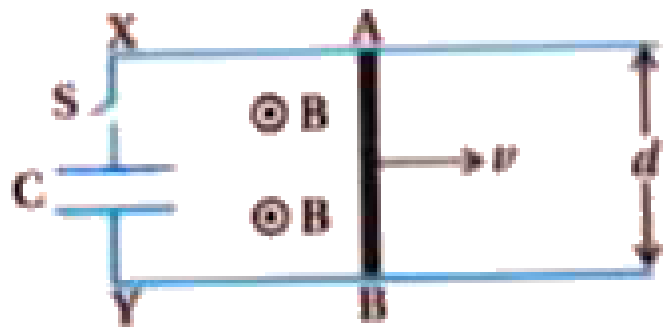
8. Find the current in the sliding rod AB (resistance = R) for the arrangement shown in figure. $\overrightarrow{B}$ is constant and is out of the paper. Parallel wires have no resistance, v is constant. Switch S is closed at time t = 0.



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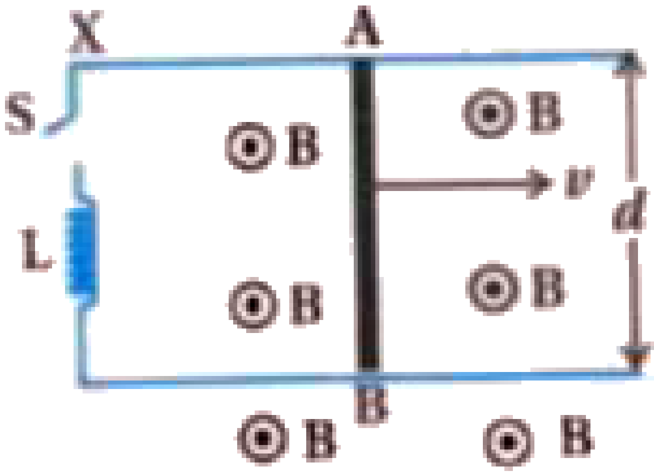
9. Find the current in the sliding rod AB (resistance = R) for the arrangement shown in figure. $\vec{B}$ is constant and is out of the paper. Parallel wires have no resistance, v is constant. Switch S is closed at time t = 0.



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10. A metallic ring of mass m and radius l (ring being horizontal) is falling under gravity in a region having a magnetic field. If z is the vertical direction, the z-component of magnetic field is $B_Z = B_O(I + \lambda z)$. If R is the resistance of the ring and if the ring falls with a velocity v, find the energy lost in the resistance. If the ring has reached a constant velocity, use the conservation of energy to determine v in terms of m, B, λ and acceleration due to gravity g.

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11. A long solenoid 'S' has 'n' turns per meter, with diameter 'a'. At the centre of this coil we place a smaller coil of 'N' turns and diameter 'b' (where b $<$ a). If the current in the solenoid increases 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 $mt^2 + C$.

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Section D Mcqs From Darpan Based On Textbook

1. When a metallic rod falls freely, keeping its length horizontal and parallel to north-south direction, emf induced across it is _____

A. increases with time

B. decreases with time

C. zero

D. remains constant

Answer: C

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2. One magnet is moved towards a coil, first speedily and then slowly. Then amount of electric charge induced would be _____

A. equal in both the cases.

B. more in first case.

C. more in second case.

D. zero in both the case.

Answer: A

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3. Length of one metal rod is 1m. 2T is the intensity of the magnetic field. When this rod is rotating with the frequency of 10 Hz perpendicular to the field line by keeping its one end fixed as centre, induced emf is ......

A. 10πV

B. $20\pi V$

C. $30\pi V$

D. $40\pi V$

Answer: B

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4. _____ rule is used to find the direction of induced current in a conducting wire, moving in a magnetic field.

A. Fleming's left hand

B. Fleming's right hand

C. Ampere's

D. Expanded right hand

Answer: B

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5. When a bar magnet is placed on the axis of a coil with north pole facing the coil, face of coil towards the magnet behaves like ____

A. a north pole

B. a south pole

C. no pole (devoid of magnetism)

D. permanent magnet

Answer: C

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6. When current passing through a coil increases, direction of induced emf is

A. in the direction of existing current.

B. in the opposite direction of existing current

C. perpendicular to the flow of current.

D. indefinite

Answer: B

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7. When a bar magnet is brought closer to a coil, emf generated in the coil does not depend on ______

A. no. of turns

B. velocity of magnet

C. strength of magnetic field of magnet

D. resistance of coil

Answer: D

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8. Faraday's law on electromagnetic induction gives ___

A. direction of induced emf

B. value of induced emf

C. both, value and direction of induced emf

D. change of magnetic flux

Answer: B

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9. The Lenz's force acting on a conducting rod is _____

A. proportional to its velocity

B. proportional to the square of its velocity

C. inversely proportional to its velocity

D. inversely proportional to the square of its velocity

Answer: A

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10. Lenz's law is statement of ____

A. law of conservation of charge

B. law of conservation of current

C. law of conservation of energy

D. law of conservation of momentum

Answer: C

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11. According to the Faraday's law of electromagnetic induction ____

A. electric field is produced due to the change in magnetic flux with time.

B. magnetic flux is produced due to the change in electric field.

C. magnetic field associated with moving charge.

D. none of the above.

Answer: A

12. The direction of induced emf during electro magnetic induction is given by ____

A. Faraday's law

B. Lenz's law

C. Ampere's law

D. Maxwell's law

Answer: B

13. In figure a rectangular loop is being pulled to the right, away from the long straight wire carrying current I in the upward direction. The induced current in the loop is ____

A. zero

B. in clockwise direction

C. in anticlockwise direction

D. None of the above

Answer: B

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14. The earth's magnetic field at a place with zero declination is 3×10^{-4} T. The angle of dip at that place is 30°. A conducting rod is kept is north south direction and is moved at a constant speed of 1 m/s towards east. The emf induced in the rod is ...... (The length of the rod is 10 cm.)

A. $15 \mu V$

B. $15 m V$

C. 0.15V

D. 1.5V

Answer: A

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15. A helicopter is moving in upward direction with speed of 10 m/s. If the length of the helicopter is 10 m and the horizontal component of magnetic field of earth is $1.5 \times 10^{-3} \frac{\text{Wb}}{m^2}$ then the induced emf produced across the foremost (nose) and end part (tail) of the helicopter will be ____

A. 0.15 V

B. 125 V

C. 130 V

D. 5 V

Answer: A

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16. A conducting rod of length l and velocity v moves in a magnetic field B. If ρ is the resistivity of the material of rod, then the induced current produced in the rod is _____

A. $\frac{BvA\sin\theta}{\rho}$

B. $\frac{BvA}{\rho}$

C. $\frac{BvA\cos\theta}{\rho}$

D. 0

Answer: B

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17. The distance between two extreme points of two wings of an Aeroplane is 50 m. It is flying at a speed of 360 km/hr in horizontal direction. If the vertical component of earth's magnetic field at that place is $2 \times 10^{-4} \text{Wb m}^{-2}$, the induced emf between these two end points is _____ V.

A. 0.1

B. 1

C. 0.2

D. 0.001

Answer: B

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18. A D.C. motor working on 200V have initial current of 5A but when it attained maximum velocity, the current obtained is 3A. What will be its Back emf ?

A. 0V

B. 80 V

C. 120 V

D. 200 V

Answer: B

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19. A straight line conductor of length 0.4 m is moved with a speed of 7 m/s perpendicular to a magnetic field of intensity 0.9 Wb/m^2. The induced emf across the conductor is ____

A. 1.26 V

B. 2.52 V

C. 5.04 V

D. 25.2 V

Answer: B

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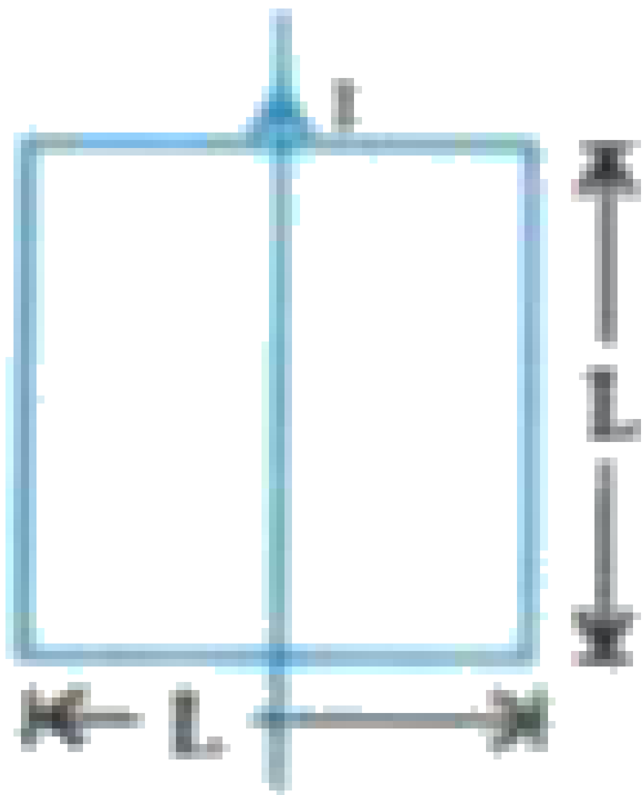
20. A square (each side of length L) wire loop is kept with a long straight wire carrying current I. The emf induced in the square loop is _____



A. zero

B. 2Bvl

C. $\frac{\mu_0 I}{2\pi y}$

D. Bvl

Answer: A

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21. A coil of surface area 100 cm^2 having 50 turns is held perpendicular to the magnetic field of intensity 0.02 $\mathrm{Wb\,m}^{-2}$. The resistance of the coil is 2 Ω . If it is removed from the magnetic field in 1s, the induced charge in the coil is ____

A. 5 C

B. 0.5 C

C. 0.05 C

D. 0.005 C

Answer: D

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22. 5×10^{-4} field lines are passing through a coil 1000 turn in certain time interval, the electromotive force of 5V is produced then the time interval will be _____

A. 1 s

B. 0.1 s

C. 0.01 s

D. 0.001 s

Answer: B

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23. A coil of 50 turns is pulled in 0.02 s fron between the poles of a magnet, where its are: includes magnetic flux of 31×10^{-6} Wb to the place, where its area includes 1×10^{-6} Wb. The average emf is ____

A. 7.5×10^{-2}V

B. 7.5×10^{-3} V

C. 0

D. 7.5×10^{-4} V

Answer: A

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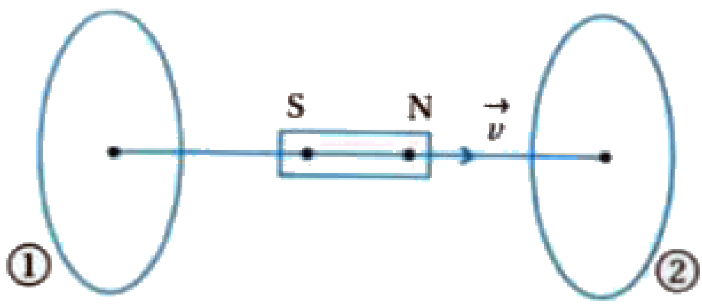
24. Two conducting coils are kept parallel to each other so that they have a common axis as shown in the figure. Now a bar magnet moves with velocity $\vec{v}$ towards coil (2) as shown in figure, then _____



A. the north pole is induced on the face of coil (1) towards the magnet.

B. the south pole is induced on the face of coil (1) towards the magnet.

C. the south pole is induced on the face of coil (2) towards the magnet.

D. the north pole is induced on the face of coil (2) towards the magnet.

Answer: B

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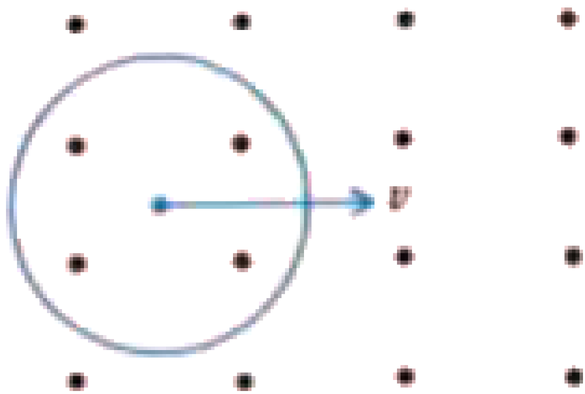
25. A circular loop enters a uniform magnetic field as shown in the figure. The current induced in the coil ____



A. is zero

B. in clockwise direction

C. in anticlockwise direction

D. in the direction pointing out of the page

Answer: B

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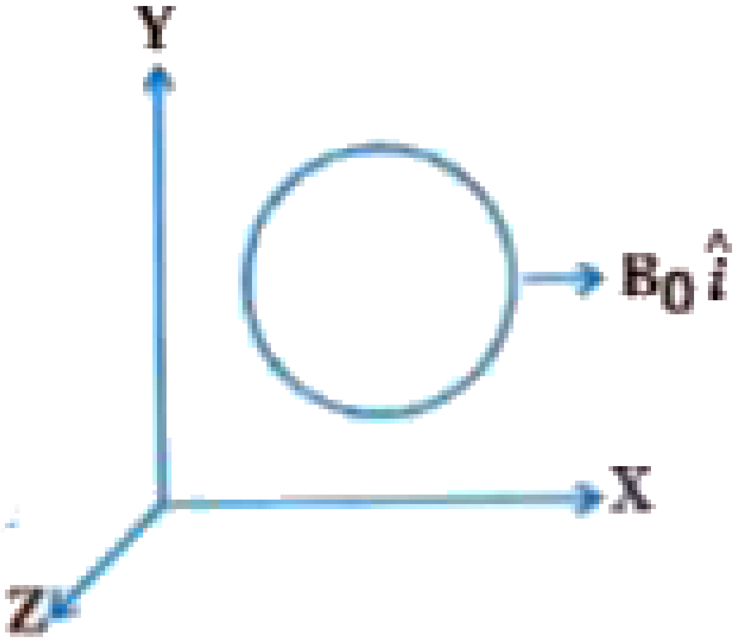
26. A coil of area A is placed in the X-Y plane. A uniform magnetic field $B_0\hat{i}$ established. The emf induced in the coil is ____



A. clockwise

B. anticlockwise

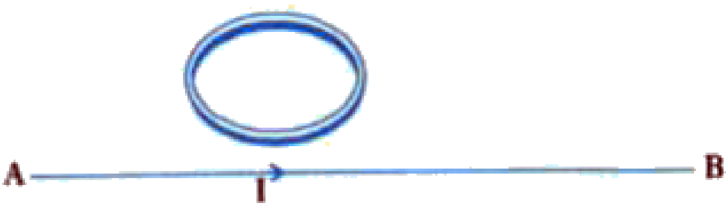
C. zero

D. depends on the value of A

Answer: C

Watch Video Solution

27. The current flows from A to B in a straight wire as shown in figure and it is decreasing with time. The induced current in loop placed near to it ____



A. In clockwise direction

B. In anticlockwise direction

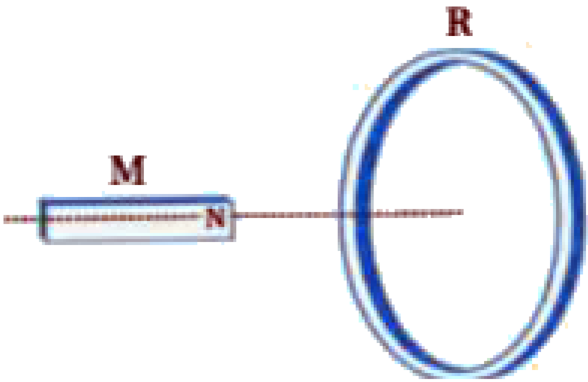
C. Will not be produced

D. Nothing can be said

Answer: B

Watch Video Solution

28. As shown in fig. a conducting ring R is placed on the axis of a bar magnet M. The plane of R is perpendicular to the axis M can move along this axis ____



A. M will repel R when it is moving towards R

B. M will attract R when it is moving towards R

C. M will repel R when moving towards as well as away from R

D. M will attract R when it is moving towards as well as away from R

Answer: A

Watch Video Solution

29. A conducting circular loop is expanding in a magnetic field of 2T uniformly so that rate of increase of its radius R is 1 cm/s. Find the induced emf in the loop when its radius is 20 cm. The field is perpendicular to the plane of the loop.

A. $0.2\pi \times 10^{-2}$ V

B. $0.8\pi \times 10^{-2}$ V

C. 2.0 V

D. $0.1\pi \times 10^{-2}$ V

Answer: B

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30. A coil has an area of $0.05m^2$ and has 800 turns. After placing the coil in a magnetic field of strength $4 \times 10^{-5} \mathrm{Wb/m^2}$ perpendicular to the field the coil is rotated through 90° in 0.1 s. The average emf induced is ____

A. zero

B. 0.016 V

C. 0.01 V

D. 0.032 V

Answer: B

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31. A rod of 5m length is moving perpendicular to uniform magnetic field of intensity $2 \times 10^{-4} \mathrm{Wb/m^2}$. If the acceleration of rod is $2ms^{-2}$, th rate of increase of the induced emf is____

A. $20 \times 10^{-4} \mathrm{V/sec^2}$

B. $20 \times 10^{-4} V$

C. 20×10^{-4} Vs

D. 20×10^{-4} V/s

Answer: D

Watch Video Solution

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

A. $\frac{BR}{A}$

B. $\frac{AB}{R}$

C. ABR

D. $\frac{B^2A}{R}$

Answer: B

Watch Video Solution

33. A magnet is moving towards a coil along its axis and the emf induced in the coil is ε. If the coil also starts moving towards the magnet with the same speed, the induced emf will be ____

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

B. ε

C. 2ε

D. 4ε

Answer: C

Watch Video Solution

34. Magnitude of emf produced in a coil, when magnet is inserted in the coil does not depend upon ___ no of turns in the coil

A. no of turns in the coil

B. magnetic moment of a magnet

C. speed of magnet

D. resistance of a coil

Answer: D

Watch Video Solution

35. One cylindrical bar magnet, kept on the axis of one circular coil. Now if this magnet is rotated about this axis, then ____

A. current will flow in the coil.

B. current will not flow in the coil.

C. only emf will be induced.

D. emf and current both will be induced.

Answer: B

Watch Video Solution

36. The flux linked per each turn of a coil of N turns changes from ϕ_1 to ϕ_2. If the total resistance of the circuit including the coil is R. The induced charge in the coil is ____

A. $\dfrac{N(\phi_2 - \phi_1)}{t}$

B. $\dfrac{N(\phi_2 - \phi_1)}{R}$

C. $\dfrac{N(\phi_2 - \phi_1)}{Rt}$

D. $N(\phi_2 - \phi_1)$

Answer: B

Watch Video Solution

37. Radius of a conducing wire r and its plane is perpendicular to magnetic field B. If the conductors is stretched and made in shape of square in its plane and in time t, then induced a emf ε is _____

A. $\frac{\pi B r^2}{t}\left(1-\frac{\pi}{10}\right)$

B. $\frac{\pi B r^2}{t}\left(1-\frac{\pi}{8}\right)$

C. $\frac{\pi B r^2}{t}\left(1-\frac{\pi}{6}\right)$

D. $\frac{\pi B r^2}{t}\left(1-\frac{\pi}{4}\right)$

Answer: D

Watch Video Solution

38. Area vector of a coil of $5 \times 10^{-3} m^2$ makes an angle of 0° with a uniform magnetic field. If from this position the coil is rotated in 0.5 sec., so that the angle made by area vector with the field becomes 90°. Find the average emf induced in the coil. The magnetic field intensity is 0.3 T. Number of turns in the coil is 500.

A. 1.5 V

B. 2.5 V

C. 1.4 V

D. 1.3 V

Answer: A

Watch Video Solution

39. A conducting bar of 3m length is allowed to fall freely from 80m high tower, keeping it aligned along the East-West direction. Find the emf induced in the rod when it is 20m below the top of tower.

$g = 10ms^{-2}$, $B_h = 0.7 \times 10^{-4}$T and angle of deep = 60° .

A. 2.5 mV

B. 2.1 mV

C. 2.7 mV

D. 1.2 mV

Answer: B

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40. The flux linked per each turn of coil of 5×10^3 turns changes from 0.4×10^{-3} Wb to 0.6×10^{-3} Wb in 0.2 sec. If the total resistance of circuit including the coil is 20 Ω , find the change induced charge in coil.

A. 0.01 m c

B. 1.5 m c

C. 0.05 m c

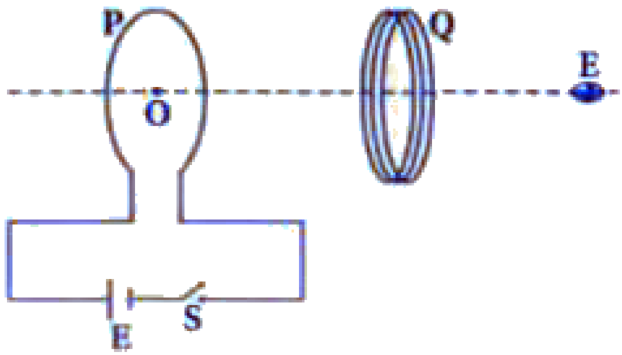
D. 0.08 m c

Answer: C

Watch Video Solution

41. As shown in the figure, P and Q are two coaxial conducting loops separated by some distance. When the switch S is closed, a clockwise current I_P flows in loop P (As seen by E) and an induced current I_Q flows in loop

Q. In which direction this induced current I_Q will flow as seen by E ?



A. clockwise

B. anticlockwise

C. towards P to E

D. towards Q to P

Answer: B

Watch Video Solution

42. The north pole of horizontal bar magnet is being brought closer to vertical, conducting plane, along perpendicular direction the induced current in the conducting plane is

_____

A. clockwise

B. anticlockwise

C. horizontal

D. vertical

Answer: B

Watch Video Solution

43. The mutual inductance of the system of two coils is 5 mH. The current in the first coil varies according to the equation $I = I_0 \sin \omega t$, where I_0 = 10 A and $\omega = 100\pi \text{rad s}^{-1}$. The value of maximum induced emf in the second coil is ____

A. $2\pi V$

B. $5\pi V$

C. πV

D. $4\pi V$

Answer: B

Watch Video Solution

44. A wheel with 10 metallic spokes each 0.5 m long rotated with a speed of $120\frac{\text{rev}}{\text{min}}$ in a plane normal to the horizontal component of earth's magnetic field B_h at a place. If B_h = 0.4G at the place, what is the induced emf between the axle and the rim of the wheel ? (1 G = 10^{-4} T)

A. 0V

B. 0.628 mV

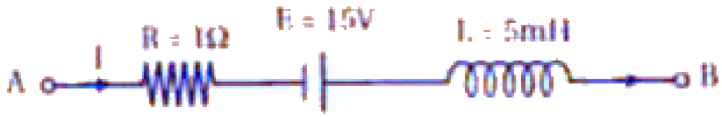
C. 0.628 μV

D. $62.8\mu V$

Answer: D

Watch Video Solution

45. The network shown in figure is a part of the circuit. (The battery has negligible resistance)



At a certain instant the current I = 5A and is decreasing at a rate of $10^3 As^{-1}$. What is the potential difference between point B and A ?

A. 5V

B. 10V

C. 15V

D. 0V

Answer: C

Watch Video Solution

46. A short circuited coil is placed in a time varying magnetic field. Electrical power is dissipated in the form of Joule heat due to the current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be ....

A. halved

B. the same

C. doubled

D. quadrupled

Answer: B

Watch Video Solution

47. A rod of 5 cm length is moving perpendicular to uniform magnetic field of intensity $2 \times 10^{-4}\mathrm{Wbm}^{-2}$. If the acceleration of rod is $2ms^{-2}$, the rate of increasing of the induced emf is ....

A. $20 \times 10^{-4} Vs^{-2}$

B. $20 \times 10^{-4} V$

C. 20×10^{-4} Vs

D. $2 \times 10^{-5} Vs^{-1}$

Answer: D

Watch Video Solution

48. Dimensional formula of magnetic flux is ....

A. $M^1L^2T^{-2}A^{-1}$

B. $M^1L^0T^{-2}A^{-2}$

C. $M^0L^{-2}T^{-2}A^3$

D. $M^1L^2T^{-2}A^3$

Answer: A

Watch Video Solution

49. I amount of current is passed through a coil with N turns. Magnetic flux linked with the coil is ......

A. LI

B. NLI

C. $\frac{NI}{L}$

D. N^2LI

Answer: B

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50. Magnetic flux linked with one closed conducting loop is $\phi = t^2 + 3t - 7$. Then graph of $\varepsilon \rightarrow t$ would be a ..... (All the values are in SI units)

A. circle

B. parabola

C. ellipse

D. straight line

Answer: D

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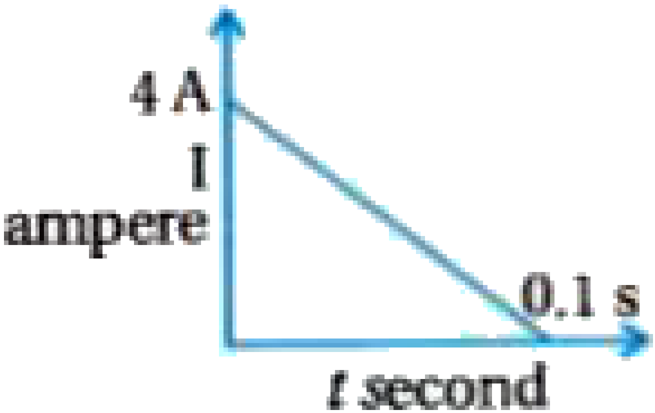
51. 

Above is the graph of current induced in a coil of resistance 10 Ω , because of change of magnetic flux, versus time. Then change of magnetic flux is .... Wb.

A. 8

B. 2

C. 0

D. 6

Answer: B

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52. Magnetic flux linked with one coil changes with time t is $\phi = xt^2$. If emf induced at t=3s is 9 V then value of x = ...

A. 0.66 $\mathrm{Wb\,s}^{-2}$

B. 1.5 $\mathrm{Wb\,s}^{-2}$

C. $-0.66\mathrm{Wb\,s}^{-2}$

D. $-1.5\mathrm{Wb\,s}^{-2}$

Answer: D

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53. One coil with 40 turns and $4\mathrm{cm}^2$ area of cross-section is kept perpendicular to one uniform magnetic field of flux density B. When this loop is pulled out of magnetic field suddenly, 2×10^{-4} C electric charge flows through it. If resistance of this coil is 80Ω then B= ____ $\mathrm{Wb/m^2}$.

A. 0.5

B. 1

C. 1.5

D. 2

Answer: B

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54. 2 A current is passed through a solenoid which has 5 cm diameter, 10 turns and 10 cm length. Now, near to one of its two ends, a circular loop of radius 2 cm is kept perpendicular to axis of solenoid. Then magnetic flux passing through this loop is ...... Wb. ($\mu_0 = 4\pi \times 10^{-7} TmA^{-1}$ and take π° =10)

A. 3.2×10^{-8}

B. 3.2×10^{-7}

C. 3.2×10^{-9}

D. 3.2×10^{-6}

Answer: B

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55. A circular loop of radius R is placed in the uniform magnetic field. The value of magnetic field changes is given by equation $B = B_0 e^{-\frac{t}{\tau}}$. Where B_0 and τ are constants. The emf induced in the coil is ____

A. $\pi^2 B_0 e^{-\frac{t}{\tau}} \times 10^{-2}$ V

B. $\dfrac{\pi R^2 B_0}{\tau} e^{-\frac{t}{\tau}}$

C. $\pi^2 B_0 \tau e^{-\frac{t}{\tau}}$

D. None of these

Answer: B

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56. $\vec{B}$ is the magnetic field perpendicular to the plane of the coil, then flux linked with coil is given by ϕ = ... [Area of coil =A]

A. $\phi = AB$

B. $\phi = 0$

C. $\phi = \overrightarrow{A} \times \overrightarrow{B}$

D. $\phi = AB\sin 0^\circ$

Answer: A

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57. When α is the angle between plane of the coil and magnetic field $\overrightarrow{B}$, flux linked with the coil is given by ϕ =____

A. AB

B. $\left|\vec{A} \times \vec{B}\right|$

C. $AB\cos\alpha$

D. $\vec{A} \times \vec{B}$

Answer: B

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58. A magnetic field in a certain region is given by $\vec{B} = \left(40\hat{\imath} - 18\hat{k}\right)G$. How much flux passes through a 5.0cm^2 area of the loop, if the loop lies flat on the XY Plane ? 1G (gauss) = 10^{-4} T.

A. -900 nWb

B. -9 Wb

C. zero

D. 90 Wb

Answer: A

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59. A solenoid 600 mm long has 50 turns on it and its wound on an iron rod 7.5 mm radius. Find the flux through the solenoid when the current in it is 3A. The relative permeability of iron is 600.

A. 1.66 Wb

B. 1.66 nWb

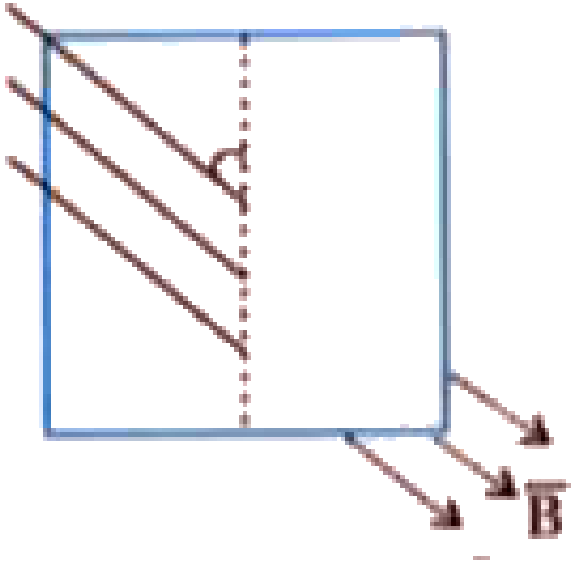
C. 1.66 mWb

D. 1.66 μ Wb

Answer: C

Watch Video Solution

60. A square loop of size 2 cm is lying on a horizontal surface. A uniform magnetic field of 0.4 T is directed downward at an angle of 30° to the vertical as shown in the Fig. The flux linked is _____ Wb.



A. 8×10^{-4}

B. 8

C. 8×10^{-5}

D. 16×10^{-5}

Answer: C

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61. Unit of magnetic flux density is ____

A. $\frac{V}{\sec}$

B. $\frac{\text{Wb}}{m^2}$

C. $\frac{\text{Wb}}{\sec}$

D. none of these

Answer: B

Watch Video Solution

62. A magnetic field in a certain region is given by $\vec{B} = \left(40\hat{i} - 18\hat{k}\right)G$. How much flux passes through a 5.0cm^2 area of the loop, if the loop lies flat on the XY Plane ? 1G (gauss) = 10^{-4} T.

A. -900 nWb

B. -9 Wb

C. zero

D. 90 Wb

Answer: A

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63. Eddy currents were invented by ...... scientist.

A. Lenz

B. Faraday

C. Foucault

D. Maxwell

Answer: C

Watch Video Solution

64. When eddy currents are produced in the conductor, electrons in that conductor _____

A. do not move

B. move on the paths of minimum resistance (known as eddies)

C. move on the paths of maximum resistance

D. move on random paths

Answer: B

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65. Lenz force acting on a conducting rod moving in a magnetic field is ____

A. proportional to length.

B. proportional to square of length.

C. inversely proportional to length.

D. inversely proportional to square of length.

Answer: B

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66. One metallic plate, oscillates perpendicular to magnetic field between two flat unlike magnetic poles,____

A. there is no effect on oscillations of plate.

B. eddy currents are produced in the plate which makes oscillations faster.

C. eddy currents are produced in the plate which makes oscillations of plate slower.

D. plane of oscillations of plate changes.

Answer: C

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67. Eddy currents are produced, when____

A. by heating the metal

B. a metal is kept in varying magnetic field.

C. a metal kept in electric field.

D. a metal kept in steady magnetic field.

Answer: C

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68. Eddy currents are produced ___

A. only within the body of the conductor

B. only on the surface of the conductor

C. both in the body and surface of the conductor.

D. only at the corners of the conductor

Answer: C

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69. Eddy current do not cause........

A. damping

B. heating

C. sparking

D. loss of energy

Answer: C

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70. Induction furnace is based on the heating effect of .....

A. eddy current

B. magnetic field

C. electric field

D. gravitational field

Answer: A

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71. A square conducting coil of area $100 \mathrm{cm}^2$ is placed normally inside a uniform magnetic field of $10^3 \mathrm{Wbm}^{-2}$. The magnetic flux linked with the coil is ___ Wb .

A. 10

B. 10^{-5}

C. 10^5

D. 0

Answer: A

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72. Self inductance of a solenoid is directly proportional to ___

A. current passing through solenoid.

B. its length.

C. its area of cross-section.

D. reciprocal of its area of cross-section.

Answer: C

Watch Video Solution

73. Dimensional formula of self inductance is ......

A. $M^{1}L^{1}T^{-2}A^{-2}$

B. $M^{1}L^{2}T^{-1}A^{-2}$

C. $M^{1}L^{2}T^{-2}A^{-2}$

D. $M^{1}L^{2}T^{-2}A^{-1}$

Answer: C

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74. When current passing through a coil is made doubled, its self inductance ......

A. becomes doubled

B. becomes half

C. becomes one fourth

D. remains constant

Answer: D

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75. Two identical coils, each with self inductance L, are connected in series and kept very close. Turns wound in these coils have opposite sense of winding. Then resultant inductance of this connection is ......

A. L^2

B. $2L$

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

D. zero

Answer: D

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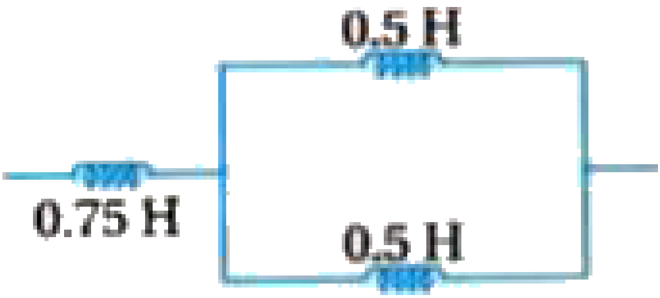
76. 

Equivalent self inductance of above arrangement is ____

A. 1.0 H

B. 1.75 H

C. 0.75 H

D. 0.25 H

Answer: A

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77. Series combination of 10Ω resistance and 5 cm long solenoid having 5 mH self inductance are connected to 10 V battery. Current passing through solenoid in steady state is ___

A. 5A

B. $1A$

C. $2A$

D. zero

Answer: B

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78. Two coils have a mutual inductance of 0.005H. The current changes in the first coil according to equation $I = I_0 \sin \omega t$, where I_0

= 10A and $\omega = 100\pi$ rad/sec. The maximum value of emf in the second coil is ___

A. 2π

B. 5π

C. π

D. 4π

Answer: B

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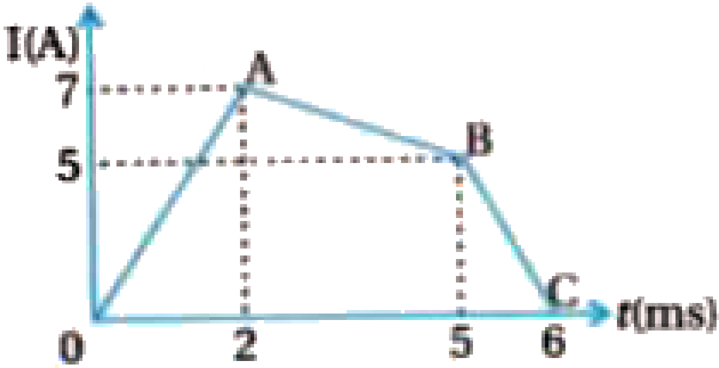
79. 

For an inductor having self inductance 4.6 H, emf induced in it for time interval from 5 ms to 6 ms is ......

A. zero

B. 10^3 V

C. -23×10^3 V

D. 23×10^3 V

Answer: D

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80. Find mutual inductance of two coaxial solenoids of equal length 30 cm with inner one surrounded by bigger one. Their area of cross section are 20cm^2 and 40cm^2. They have windings of 40 turn/cm and 10 turn/cm.

A. 10 H

B. 8 H

C. 3mH

D. 30mH

Answer: C

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81. A coil of resistance 20Ω and self-inductance 5 H connected with battery 100 V. What will be the value of energy stored ?

A. 31.25 J

B. 62.5 J

C. 125 J

D. 250 J

Answer: B

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82. The unit of inductance is equivalent to .....

A. $\frac{\text{Volt-Ampere}}{\text{second}}$

B. $\frac{\text{Volt}}{\text{Ampere-second}}$

C. $\frac{\text{Volt-second}}{\text{Ampere}}$

D. $\frac{\text{Ampere}}{\text{Volt-second}}$

Answer: C

Watch Video Solution

83. A solenoid has radius r and length l carries a current I. If the number of its turns is 200, the energy stored in the solenoid is .....

A. $\frac{N^2A^2I}{2\pi r}$

B. $\frac{N^2AI^2}{\mu_0 r}$

C. $\frac{\mu_0 N^2 AI^2}{2l}$

D. 0

Answer: C

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84. Current I is following through a toroidal solenoid of radius r, length l and area A. If the number of turns of toroidal solenoid is N, then energy stored in the toroidal solenoid is .....

A. $\frac{1}{2}\frac{\mu_0 N^2 A I^2}{\pi r}$

B. $\frac{1}{8}\frac{\mu_0 N^2 A I^2}{\pi r}$

C. $\frac{1}{6}\frac{\mu_0 N^2 A I^2}{\pi r}$

D. $\frac{1}{4}\frac{\mu_0 N^2 A I^2}{\pi r}$

Answer: D

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85. If N is the number of turns in a coil, the value of self inductance varies as $\propto$ _____

A. N^0

B. N

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

D. N^2

Answer: D

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86. If number of turns in a coil is increased from 10 to 100, its inductance becomes .... times the original value.

A. 10

B. 100

C. $\frac{1}{10}$

D. 25

Answer: B

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87. Two inductors each of self-inductance L is connected in parallel. If the value of equivalence, inductance of the connection is 5 mH, then the value of L is ____

A. $\frac{L}{4}$

B. 10mH

C. L

D. 4mH

Answer: B

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88. Mutual inductance of system of two coils is 0.3 H. If the current in the one coil is changed from 10A to 40A in 0.01 sec, the average induced emf in the other coil is ...... volt.

A. 9

B. 900

C. 9000

D. 90000

Answer: B

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89. The flux linked with each turn of coil is 0.1 Wb and total number of turns is 1000. If current passing through coil is 10 amp, then self inductance of coil is ...... mH

A. 0.1

B. 10

C. 10^4

D. 10^{-4}

Answer: C

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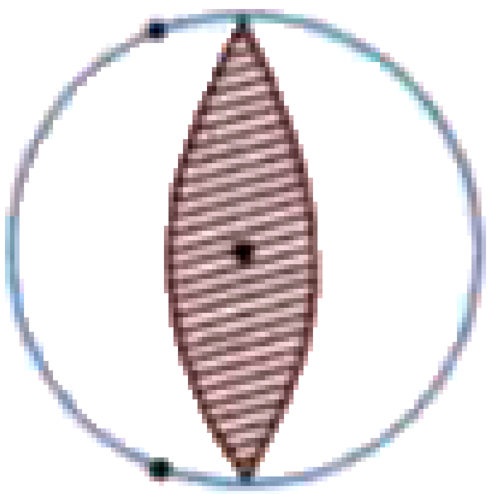
90. As shown in the figure, the planes of two concentric coils are mutually perpendicular. The mutual inductance of this system is ....



A. $\mu_0 N^2 A$

B. $\dfrac{\mu_0 N A}{L}$

C. zero

D. none of zero

Answer: C

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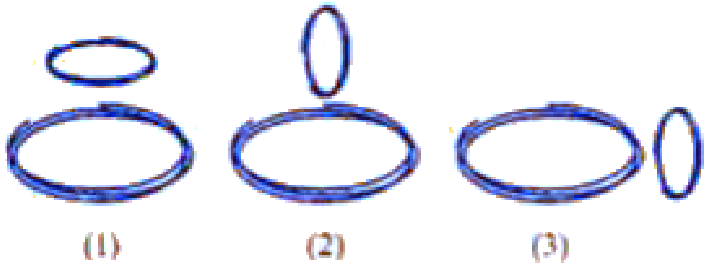
91. Two circular coils can be arranged in any of the three situations as shown in figure. Their mutual inductance (M) will be ..



A. Maximum in situation (1)

B. Maximum in situation (2)

C. Maximum in situation (3)

D. The same in all situations.

Answer: A

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92. X and Y coils are joined in a circuit in such a way that when the change of current in X in 2A, the change in the magnetic flux in Y is 0.4 Wb. The mutual induction of the system of two coils is .... H.

A. 0.8

B. 0.4

C. 0.2

D. 5

Answer: C

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

A. 25 mH

B. 25×10^{-3} mH

C. 50×10^{-3} mH

D. 50×10^{-3} H

Answer: A

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94. Mutual inductance of two coils can be increased by _____

A. decreasing the number of turn in the coils.

B. increasing the number of turn in the coils.

C. winding the coils on wooden cores

D. none of the above.

Answer: B

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95. Self inductance of straight conducting wire is ______

A. zero

B. infinity

C. very large

D. very small

Answer: A

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96. When current is increasing in the coil, the direction of induced emf is ..... the direction of current.

A. same as

B. normal to

C. opposite to

D. none of above

Answer: C

Watch Video Solution

97. The self-inductance of a coil increases when the coil is wound on a soft iron core, because ....

A. soft iron has a very high permittivity.

B. soft iron has a very low permittivity.

C. soft iron has a very high permeability.

D. soft iron has a very low permeability.

Answer: C

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98. The frequency of A.C. mains in India is ..... Hz.

A. 30

B. 50

C. 60

D. 70

Answer: C

Watch Video Solution

99. Energy stored in the choke coil is in the form of ____

A. heat

B. electric energy

C. magnetic energy

D. electromagnetic energy

Answer: C

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100. The self-inductance of two solenoids A and B having equal length are same. If the number of turns in two solenoids A and B are 100 and 200 respectively the ratio of the radii of their cross section will be ....

A. $2:1$

B. $1:2$

C. $1:4$

D. $4:1$

Answer: A

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101. One electric generator produces power at 220 V potential difference. Its internal resistance is r = 10 Ω . Find power wasted in external resistance R = 100 Ω

A. 484 W

B. 400 W

C. 441 W

D. 369 W

Answer: B

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102. In one A.C. generator, brushes connected with slip rings become positive and negative alternatively at the regular interval of 10 ms.

Then angular frequency of this A.C. voltage would be ....

A. 50

B. 100

C. 50π

D. 100π

Answer: D

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103. Working principle of electric motor is to convert ......

A. ac into dc.

B. ac into dc.

C. ac and dc mutually.

D. ac into mechanically.

Answer: D

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104. Voltage obtained in one A.C. generator $V = V_0 \cos \omega t$. If V_0 = 10 volt and frequency v=50 Hz then voltage at time $t = \frac{1}{600} s$ wiil be

_____

A. 10 V

B. 5 V

C. $5\sqrt{3}V$

D. 1V

Answer: C

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105. A circular coil with radius 10 cm and 10 no. of tightly wound identical turns is kept perpendicular to uniform magnetic field 2×10^{-4}G intensity. Now, it is rotated with angular velocity $2\pi \text{rad s}^{-1}$ about an axis passing through it but perpendicular to magnetic field. Then, at ....s, least time magnetic flux passing through it becomes half of maximum magnetic flux.

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

B. $\frac{1}{12}$

C. $\frac{1}{6}$

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

Answer: C

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106. A generator produces a voltage that is given by V = 240 sin 120t, where t is in second the frequency of voltage is .... Hz.

A. 20

B. 180

C. 40

D. 19

Answer: D

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107. If an A.C. current of frequency 50 Hz is flowing through a conducting wire, then how many time does the current becomes zero in one second ?

A. 25 times

B. 50 times

C. 75 times

D. 100 times

Answer: D

Watch Video Solution

108. A coil having N turns and area A is rotating in uniform magnetic field then at time t, the magnetic flux associated with the coil is given by $\phi = NAB\cos\omega t$. In the first rotation at time t = . . s, the induced emf is obtained maximum.

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

B. $\frac{T}{8}$

C. $\frac{T}{4}$ and $\frac{3T}{4}$

D. $\frac{T}{16}$

Answer: C

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109. In an AC generator, the brushes in contact with the step rings alternatively become positive and negative in the time interval of 5 ms. What is the frequency of the voltage generated ?

A. 200 Hz

B. 100 Hz

C. 50 Hz

D. 10 Hz

Answer: B

Watch Video Solution

110. The equation of A.C. voltage is given by V = 158 sin 200πt. The value of voltage at time $t = \frac{1}{400}$ sec is ...... V.

A. -79

B. 79

C. -158

D. 158

Answer: D

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111. A coil with resistance $8\ \Omega$ and having 8 turns is connected with a galvanometer having resistance 8 times the resistance of coil. In 4 ms, if magnetic flux linked with this loop changes from 12×10^{-5} Wb to 18×10^{-5} Wb then current induced in the loop will be ......

A. 1.6 A

B. 1.6×10^{-6} A

C. 1.6×10^{-3} A

D. 1.6×10^{-4} A

Answer: C

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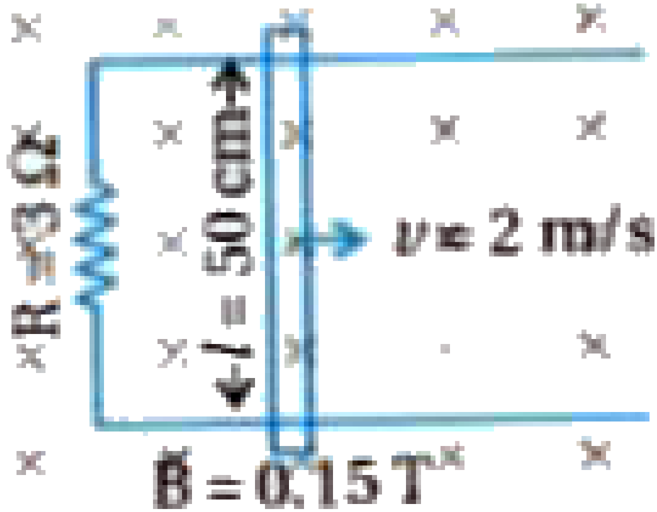
112. 

For the situation shown in the figure, what should be the value of force required to move the rod with constant velocity v = 2 m/s ?

A. 3.75×10^{-3} N

B. 3.75×10^{-2} N

C. 3.75×10^{2} N

D. 3.75×10^4 N

Answer: A

Watch Video Solution

113. For one coil, kept in 1T external magnetic field, current passing through it increases from 1 A to 2 A in 2×10^{-3} s. Meanwhile time rate of change of its area is found to be 5 $\frac{m^2}{ms}$. Then the self inductance of the coil is ____

A. 2 H

B. 5 H

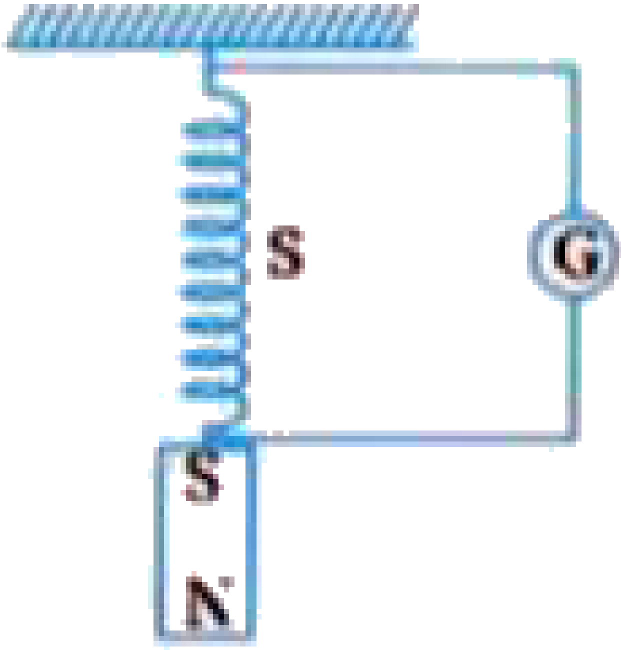
C. 10 H

D. 20 H

Answer: C

Watch Video Solution

114. As shown in figure a bar magnet suspended by a conducting spring is made to oscillate up and down. Then ....



A. deflection of galvanometer is zero.

B. the deflection of galvanometer is on one side.

C. the deflection of galvanometer is on both sides with increasing values with time.

D. the deflection of galvanometer is on both sides with decreasing values with time.

Answer: D

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115. Length of one metal rod is 1m. 2T is the intensity of the magnetic field. When this rod is rotating with the frequency of 10 Hz perpendicular to the field line by keeping its one end fixed as centre, induced emf is ......

A. 10πV

B. $20\pi V$

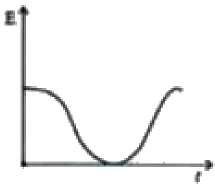
C. $30\pi V$

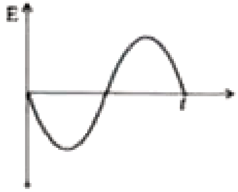
D. $40\pi V$

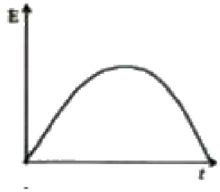
Answer: B

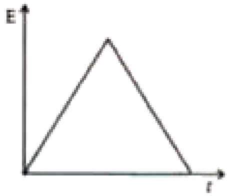
Watch Video Solution

116. The variation of induced emf E with time t in a coil when a short bar magnet is moved along its axis with constant velocity as shown in below fig. which fig. is best represented as ?

A. 

B. 

C. 

D. 

Answer: A::C::D

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117. Current of 2A passing through a coil of 100 turns gives rise to a magnetic flux of 5×10^{-3} Wb per turn. The magnetic energy associated will coil is ____

A. 5×10^{-3} J

B. 0.5×10^{-3} J

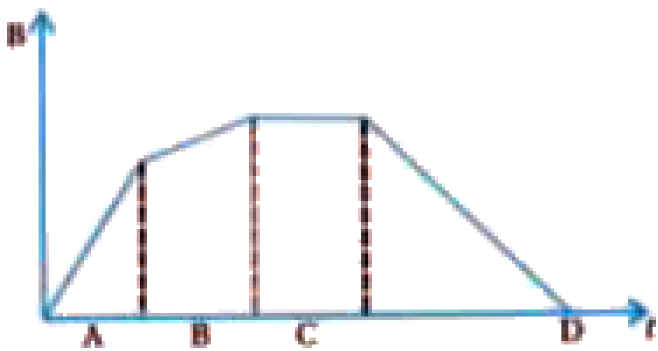
C. 5 J

D. 0.5 J

Answer: D

Watch Video Solution

118. A graph shown in the figure represents the variation of uniform magnetic field with time. If this field linked with a conducting loop completely and its perpendicular to the plane of the coil. In which time interval of induced emf in the coil is maximum ?



A. A

B. B

C. C

D. D

Answer: A

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119. In AC generator, induced emf is zero at time t = 0. The induced emf at time $\frac{\pi}{2\omega}$ is ____

A. $+V_m$

B. $-V_m$

C. zero

D. $+2V_m$

Answer: A

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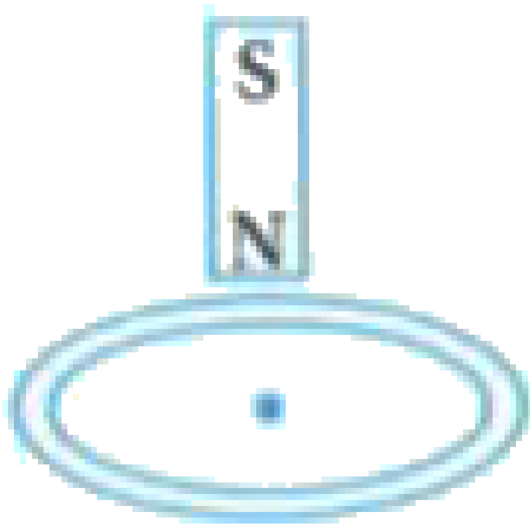
120. As shown in fig. a metal ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet is ......



A. equal to g

B. less than g

C. more than g

D. depends on diameter of ring and length of magnet

Answer: B

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121. A conducting loop of resistance R is pulled in a uniform magnetic field $\overrightarrow{B}$, with uniform velocity $\overrightarrow{v}$ (see fig.). During this process it is found that ....

A. the temperature of the loop remains constant

B. the temperature of the loop decreases

C. the temperature of the loop increases

D. none of these above.

Answer: C

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Section D Mcqs Mcqs Asked In Competitive Exams

1. Three pure inductance each of 3 H are connected as shown in figure. The equivalent inductance of this connection between points

A and B is ......

A. 1 H

B. 2 H

C. 3 H

D. 9 H

Answer: A

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

A. the rates at which currents are changing in two coils

B. relative position and orientation of the two coils

C. the materials of the wires of the coils.

D. the currents in the two coils

Answer: B

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3. When electric current in a coil steadily changes from +2 A to -2 A is 0.05 s, an induced emf of 0.8 V is generated in it. Then the self Inductance of the coil is .... H.

A. 0.2

B. 0.4

C. 0.8

D. 0.1

Answer: D

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4. A coil having n turns and resistance RΩ is connected with a galvanometer of resistance 4 RΩ . This combination is moved in time t seconds from a magnetic field W_1 Weber to W^2 Weber. The induced current in the circuit is ____

A. $\frac{W_2 - W_1}{5Rnt}$

B. $-\frac{n(W_2 - W_1)}{5Rt}$

C. $-\frac{W_2 - W_1}{Rnt}$

D. $-\frac{n(W_2 - W_1)}{Rt}$

Answer: B

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5. In a uniform magnetic field of induction B a wire in the form of a semicircle of radius r rotates about the diameter of the circle with angular frequency ω. The axis of rotation is perpendicular to the field. If the total resistance of the 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. $\frac{\left(B\pi r\omega\right)^2}{2R}$

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

Answer: B

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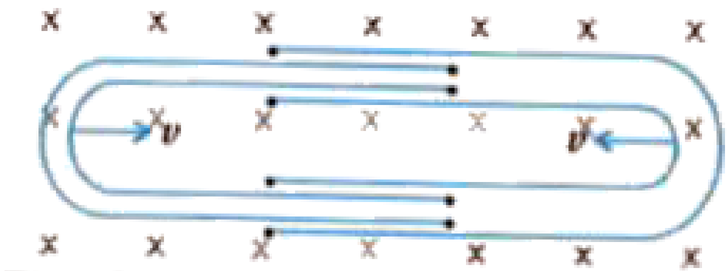
6. One conducing U tube can be slide inside another as shown in figure, maintaining electrical contacts between the tubes. The magnetic field B is perpendicular to the plane of the figure. If each tube moves towards the other at a constant speed v, then the emf induced in the circuit in terms of B, l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



A. zero

B. 2Blv

C. Blv

D. $-Blv$

Answer: B

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7. Which of the following units denotes the dimension $M^1L^2Q^{-2}$? (where Q denotes the electric charge)

A. $\frac{H}{m^2}$

B. Wb

C. $\frac{Wb}{m^2}$

D. H(Henry)

Answer: D

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8. The flux linked with a coil at any instant 't' is given by $\phi = 10t^2 - 50t + 250$. The induced emf at t=3s is ____

A. 10 V

B. 190 V

C. $-190V$

D. $-10V$

Answer: D

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

$\left[\mu_0 = 4\pi \times 10^{-7} \text{TmA}^{-1}\right]$

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

B. $2.4\pi \times 10^{-5}$ H

C. $4.8\pi \times 10^{-4}$ H

D. $4.8\pi \times 10^{-5}$ H

Answer: A

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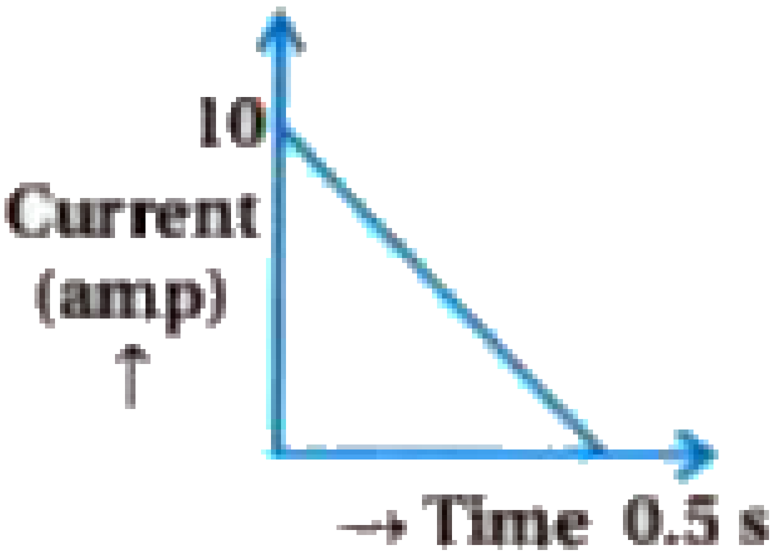
10. In a coil of resistance 100 Ω , a current is induced by changing the magnetic flux through it as shown in the figure. The magnitude of change in flux through the coil is ....



A. 250 Wb

B. 275 Wb

C. 200 Wb

D. 225 Wb

Answer: A

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11. A planar loop of wire rotates in a uniform magnetic field. Initially at t =0, the plane of the loop is perpendicular to the magnetic field. If it rotates with a period of 10 s about an axis in its plane, then the magnitude of induced emf will be maximum and minimum, respectively at

A. 2.5 s, 5 s

B. 5s , 7.5 s

C. 2.5 s , 7.5 s

D. 10s, 5s

Answer: A

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12. The given loop is kept in a uniform magnetic field perpendicular to the plane of the loop. The field changes from 1000 Gauss to 500 Gauss in 5 seconds. The average induced emf in the loop is

A. $28\mu V$

B. $30\mu V$

C. $48\mu V$

D. $56\mu V$

Answer: D

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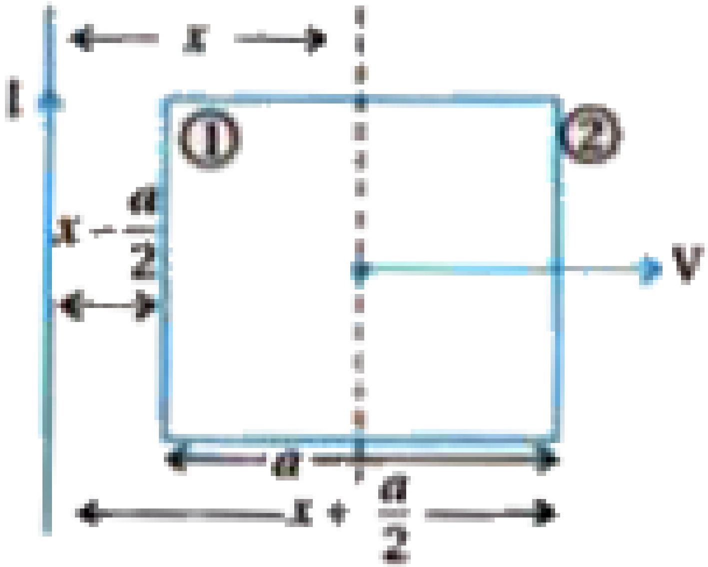
13. A conducting square frame of side 'a' and a long straight wire carrying current I are located in the same plane as shown in the figure. The frame moves to the right with a constant velocity 'V'. The emf induced in the frame will be proportional to :



A. $\frac{1}{x^2}$

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

C. $\frac{1}{(2x+a)}$

D. $\left(\frac{1}{(2x-a)}-\frac{1}{2x+a}\right)$

Answer: D

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

A. No current induced

B. In abcd direction

C. In adcb direction

D. The current will reverse its direction as the electron goes past the coil

Answer: D

Watch Video Solution

15. A long solenoid has 1000 turns. When a current of 4 A flows through it, the magnetic flux linked with each turn of the solenoid is

4×10^{-3} Wb. The self-inductance of the solenoid is

A. 3H

B. 2H

C. 1H

D. 4H

Answer: C

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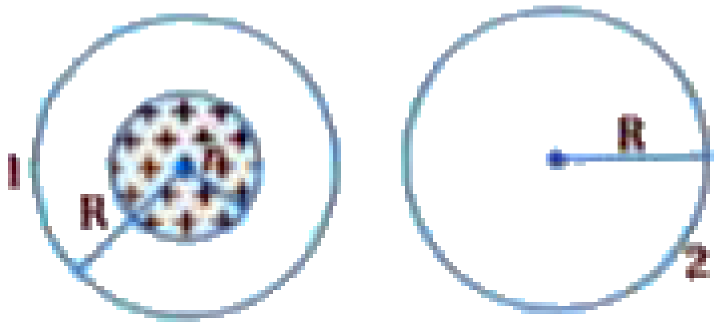
16. A uniform magnetic field is restricted within a region of radius r. The magnetic field changes with time at a rate $\frac{d\vec{B}}{dt}$. Loop 1 of radius R $>$ r encloses the region r and loop 2 of radius R is outside the region of magnetic field as shown in the figure below. Then the emf generated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



A. In loop-1 $-\frac{d\overrightarrow{B}}{dt}\pi R^2$ and in loop-2 zero

B. In loop-1 $-\frac{d\overrightarrow{B}}{dt}\pi r^2$ and in loop-2 zero

C. Zero in both loop

D. In loop-1 $-\frac{d\overrightarrow{B}}{dt}\pi r^2$ and in loop=2 - $\frac{d\overrightarrow{B}}{dt}\pi r^2$

Answer: B

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17. A circular coil of radius 10 cm, 500 turns and resistance 2Ω is placed with its plane, perpendicular to the horizontal component of the earth's magnetic field. It is rotated about its vertical diameter through 180° in 0.25 s. The induced e.m.f. in the coil is ..... (Take $H_E = 3.0 \times 10^{-5}$ T)

A. 6.6×10^{-4} V

B. 1.4×10^{-2} V

C. 2.6×10^{-2} V

D. 3.8×10^{-3} V

Answer: D

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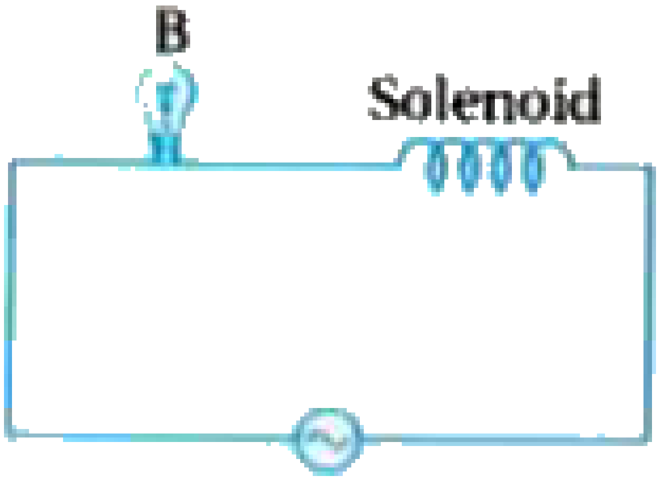
18. A bulb connected in series with an air-cored solenoid is lit by an a.c. source. If a soft iron core is introduced in the solenoid.



A. The bulb stops glowing

B. The bulb will glow brighter.

C. There is no change in glow of bulb.

D. The bulb will become dimmer.

Answer: D

Watch Video Solution

19. Inside a parallel plate capacitor the electric field E varies with time as t^2. The variation of induced magnetic field with time is given by ......

A. t^2

B. no variation

C. t^3

D. t

Answer: D

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20. The magnetic potential energy stored in a certain inductor is 25 mJ, when the current in the inductor is 60 mA. This inductor is of inductance.

A. 13.89 H

B. 0.138 H

C. 1.389 H

D. 138.88 H

Answer: D

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21. A 800 turn coil of effective area $0.05m^2$ is kept perpendicular to a magnetic field 5×10^{-5} T. When the plane of the coil is rotated by 90° around any of its coplanar axis in 0.1 s, the emf induced in the coil will be

A. 0.02 V

B. 2 V

C. 0.2 V

D. 2×10^{-3} V

Answer: A

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22. In which of the following devices, the eddy current effect is not used ?

A. electric heater

B. induction furnace

C. magnetic braking in train

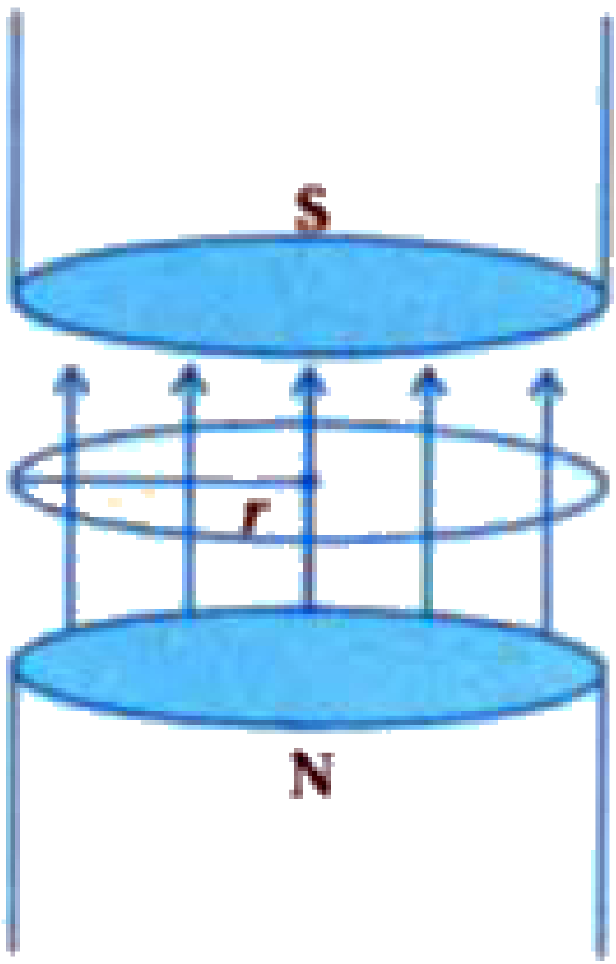
D. electromagnet

Answer: A

Watch Video Solution

23. A conducting ring of radius r is placed perpendicular inside a time varying magnetic field as shown in figure. The magnetic field changes with time according to $B = B_0 + \alpha t$

where B_0 and α are positive constants. Find the electric field on the circumference of the ring.



A. $-\pi\alpha r^2$

B. $-\pi\alpha r$

C. $-\pi\alpha^2 r^2$

D. $-\pi\alpha^2 r$

Answer: A

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24. A conducting coil having 500 turns has cross sectional area $0.15m^2$. A magnetic field of strength 0.2 T linked perpendicular to this area changes to 1.0 T in 0.4 sec. The induced emf produced in the coil will be ..... volt.

A. 10.0

B. 15.0

C. 75.0

D. 150.0

Answer: D

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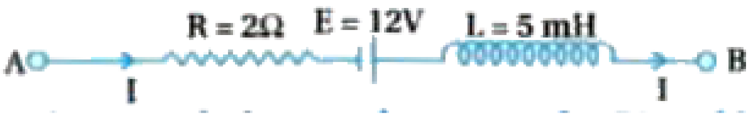
25. The network shown in figure is a part of the circuit. (The battery has negligible resistance)



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

A. 8.0 V

B. 8.5 V

C. 10 V

D. 15 V

Answer: B

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26. A rod of 10 cm length is moving perpendicular to uniform magnetic field of intensity $5 \times 10^{-4} \mathrm{Wb/m^2}$. If the acceleration of the rod is $5 \mathrm{m/s^2}$, then the rate of increase of induced emf is ....

A. $2.5 \times 10^{-4} V s^{-1}$

B. 25×10^{-4} Vs

C. 20×10^{-4} Vs

D. $20 \times 10^{-4} \text{Vs}^{-1}$

Answer: A

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27. Select incorrect unit of self inductance

A. Mho-second

B. $\frac{\text{Weber}}{\text{Amp}}$

C. $\frac{\text{Volt-second}}{\text{Ampere}}$

D. Ohm-second

Answer: A

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28. The number of turns in the coil of an A.C. generator are 100 and its cross-sectional area is $2.5m^2$. The coil is revolving in a uniform magnetic field of strength 0.3 T with the uniform angular velocity of 60 rad s^{-1}. The value of maximum value produced is ...... kV.

A. 4.5

B. 2.25

C. 6.75

D. 1.25

Answer: A

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29. If R and L denote resistance and inductance respectively which of the following has dimension of time ?

A. $\frac{L}{R}$

B. $\frac{R}{L}$

C. $\sqrt{\frac{R}{L}}$

D. $\sqrt{\frac{L}{R}}$

Answer: A

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30. Two inductors each of inductance L are connected in parallel. One more inductor of value 5 mH is connected in series of this configuration then the effective inductance is 15 mH. The value of L is .... mH.

A. 10

B. 5.0

C. 2.5

D. 20

Answer: D

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31. A coil having 200 turns has a surface of 0.15 m^2. A magnetic field of strength 0.2 T applied perpendicular to this changes to 0.6 T in 0.4 s. then the induced emf in the coil is .... V.

A. 45

B. 30

C. 15

D. 60

Answer: B

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32. A wheel of radius 2m having 8 conducting concentric spokes is rotating about its geometrical axis with an angular velocity of 10 rad/s in a uniform magnetic field of 0.2T perpendicular to its plane. The value of induced emf between the rim of the wheel and centre is V

A. 2

B. 6

C. 4

D. 8

Answer: C

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33. A coil of surface area 200 cm^2 having 25 turns is held perpendicular to the magnetic field of intensity $0.02 \mathrm{Wb/m^2}$. The resistance of the coil is 1Ω if it is removed from the magnetic field in 1s, the induced charge in the coil is ..... C.

A. 1

B. 0.01

C. 0.1

D. 0.001

Answer: B

Watch Video Solution

34. A wheel of radius 2m having 8 conducting concentric spokes is rotating about its geometrical axis with an angular velocity of 10 rad/s in a uniform magnetic field of 0.2T perpendicular to its plane. The value of induced emf between the rim of the wheel and centre is V

A. 2

B. 6

C. 4

D. 8

Answer: C

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35. A coil of surface area 200 cm^2 having 25 turns is held perpendicular to the magnetic field of intensity $0.02 \mathrm{Wb/m}^2$. The resistance of the coil is 1Ω if it is removed from the magnetic field in 1s, the induced charge in the coil is ..... C.

A. 1

B. 0.01

C. 0.1

D. 0.001

Answer: B

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36. Dimensional formula of mutual inductance is ....

A. $M^1L^2T^{-2}A^{-2}$

B. $M^1L^2T^{-2}A^{-1}$

C. $M^1L^{-2}T^2A^2$

D. $M^{-1}L^{-2}T^2A^{-1}$

Answer: A

Watch Video Solution

37. The magnitude of the induced emf is equal to the time rate of change of ......

A. magnetic force

B. electric flux

C. magnetic flux

D. electric force

Answer: C

Watch Video Solution

38. Which one of the following is an equation of magnetic energy density ?

A. $\frac{1}{2}\mu_0 B^2$

B. $\frac{B^2}{2\mu_0}$

C. $\frac{2B^2}{\mu_0}$

D. $\frac{B^2}{\mu_0}$

Answer: B

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