

PHYSICS

BOOKS - JEEVITH PUBLICATIONS

PHYSICS (KANNADA ENGLISH)

ELECTROMAGNETIC INDUCTION

One Mark Questions With Answers

1. What is electromagnetic induction ?



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2. When is emf induced in a circuit ?



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3. When is current induced in a circuit ?



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4. State Lenz's law.



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5. State Faraday's law of electromagnetic induction.



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6. Write Faraday's equation of electromagnetic induction.



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7. What is self induction ?



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8. Define self inductance.



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9. Define henry.



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10. What is mutual induction ?



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11. What will be the induced current in a circuit placed in a constant magnetic field ?



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12. Mention the SIU of magnetic flux.



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13. If $\frac{d\Phi_B}{dt}$ represent the rate of change of magnetic flux in a single turn coil then what will be the induced emf in a coil containing 'N' turns ?



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14. Name the type of induced emf associated with a conductor moving in a static magnetic field.





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15. Write the expression for induced emf in a conductor moving in a magnetic field at an angle of θ .



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16. Can a bar magnet in motion exert a force on a stationary charge ?



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17. Give the expression for the magnetic moment linked with a coil (rectangular /circular) moving at right angles to the magnetic field.



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18. If r_1 and r_2 represent radii of two concentric coil ($r_2 > r_1$) then give the expression for the coefficient of mutual inductance for the pair of coils.





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19. Give the expression for maximum induced emf in an ac generator.



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20. Mention the physical quantity in electromagnetism which is an analogue of mass in mechanics.



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Two Marks Questions With Answers

1. State Lenz's law.



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2. Draw a neat labelled diagram of an ac generator or dynamo.



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3. Give the expression for energy required for the maximum current in an inductor.

or Write the expression for maximum energy stored in an inductor.



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4. Differentiate the terms self inductance and inductor.



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5. Say whether self inductance is a vector quantity or not. Write the dimensional formula for self inductance.



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6. Give the expression for the magnetic flux in terms of magnetic flux density and area.



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7. Express the unit 'gauss' (G) in terms of 'tesla' (T) .



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8. Give the expression for joule heat in a rectangular conductor of length ' l ' and resistance ' r ' moved at a speed of ' v ' at right angle to the magnetic field ' B '.



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9. Mention the expression for self inductance of a solenoid . Give the meaning of the symbols used.



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10. If I_1 and I_2 represent currents in a pair of coils, then give the expression for the induced emf in any one coil.



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11. What is the magnetic flux associated with the coil embedded in a constant magnetic field ? Give the meaning of the symbols used.



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Three Marks Questions With Answers

1. What is electromagnetic induction ? Explain.



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2. Give the expression for mutual inductance between a the pair of coaxial solenoids of same length. Give the meaning of the symbols used.



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3. Define self inductance of a solenoid. On what factors does it depend ?



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4. Define mutual inductance between a pair of coil. On what factors does it depend ?



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5. If a spoke is connected between the rim of the wheel and the centre (axlc) and B_{μ} is the earth 's horizontal component of total field perpendicular to the plane of the wheel and the wheel is rotated with an angular speed, then what will be the induced emf between the ends of the spoke ?



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6. What are eddy currents ? Mention two applications of eddy currents.



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Five Marks Questions With Answers

1. Describe experiments to demonstrate electromagnetic induction.



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2. What is meant by alternating current ?

Derive the expression for a sinusoidal e.m.f.

induced in a coil rotating with uniform

angular speed in a uniform magnetic field.



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3. Derive the expression for emf induced in a

straight conductor moving perpendicular to a

uniform magnetic field.



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4. Obtain an expression for energy stored in an inductor connected to a source voltage.



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Numericals With Solutions

1. Two coils wound on the same iron rod so that the flux generated by one also passes

through the other. The primary has 100 turns and the secondary has 200 turns. When a current of 2A flows through the primary, the flux in it is 2.5×10^{-4} Wb. Determine the value of mutual inductance (M) between the coils.



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2. A pair of adjacent coils have a mutual inductance of 0.25 H . If the current in the primary change from zero to 2A in 0.05 sec.,

what is the average induced emf in the secondary ?



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3. A solenoid 0.70 m in length and of 2100 turns has a radius 4.5×10^{-2} m. A second coil of 750 turns is wound over the middle part of the solenoid. Find the self inductance of the solenoid and mutual inductance between the two coils.



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4. A solenoid having a core of cross - section $4 \times 10^{-4} m^2$, half air and half iron ($\mu_r = 500$) is 0.22m long. If the number of turns in it is 1000, then calculate the self inductance.



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5. The current in a coil of 20 mH changes from 2.5 A to 3A to in $\frac{1}{100}$ second. Find the induced emf.



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6. Current in a coil changes from 4A to 0A in 0.1 s. If the average emf induced is 100 volts, what is the self inductance of the coil ?



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7. Calculate the self inductance of a solenoid of length 0.30 m containing 1000 turns and having area of cross section 36cm^2 .



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8. Calculate the induced emf in the solenoid , if the current decreases at the rate of $100AS^{-1}$ and having self inductance of a solenoid $15.08mH$.



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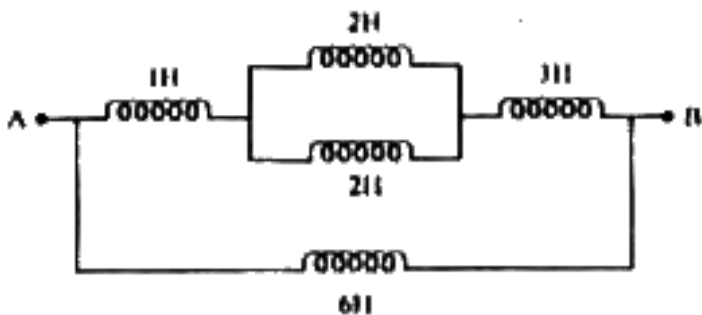
9. A small dc motor operating at 200 V draws a current of 5.0 A at its full speed of $100\pi rads^{-1}$. The resistance of the armature of the motor is 10Ω . Determine the back emf

of the motor. Obtain the power input, power output and efficiency of the motor.



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10. Calculate the equivalent inductance between A and B from the following circuit.



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11. A square metal wire loop of side 0.10 m and resistance 1Ω is moved at a constant velocity ν_0 in a uniform magnetic field of induction $B = 2\text{Wbm}^{-2}$ as shown in the figure . The magnetic field lines are \perp to the plane of the loop directed into the paper. The loop is connected to a network of resistors each of value 3Ω . The resistance of lead wires OS and PQ are negligible . what should be the speed ν_0 of the loop so as to have a steady current of 1mA in the loop ? Also indicate the direction of current in the loop .



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12. 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, then what is the induced emf in the loop while the current is changing ?



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13. 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 voltage developed across the cut if the velocity of the loop is 1 cm s^{-1} in a direction normal to the : (i) longer side? For how long does the induced voltage last?



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14. 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 voltage developed across the cut if the velocity of the loop is 1 cm s^{-1} in a direction normal to the :

(ii) shorter side of the loop ? For how long does the induced voltage last ?



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15. A circular coil of radius 8.0 cm and 20 turns, is rotated about its vertical diameter with an angular speed of 50rads^{-1} in a uniform horizontal magnetic field of magnitude $3.0 \times 10^{-2}\text{T}$. 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 loss due to joule heating. Where does this power come from?



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

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



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17. A horizontal straight wire 10 m long extending from east to west is falling with a

speed of $5.0ms^{-1}$ at right angles to the horizontal component of the Earth's magnetic field $0.30 \times 10^{-4}Wb \ m^{-2}$.

(b) What is the direction of the emf ?



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

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



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19. 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 . What is the average back emf induced across the ends of the open switch in the circuit ?



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