# PHYSICS

# BOOKS - BINA LIBRARY PHYSICS (ASSAMESE ENGLISH)

# ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENT

Sample

**1.** A magnetic field of flux density 10T acts normal in a coil of 50 turns having 100cm^2 area.The e.m.f induced if the coil is removed from magnetic field in 0.1 second is

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**2.** Find the magnitude of emf induced in a 200 turn coil with cross sectional area of 0.16 m if the magnetic field through the coll changes

from 0.10 weber/m2 to 0.50 $webe\frac{r}{m^2}$ at a uniform rate over a period of 0.02 second.

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**3.** Write three advantages of friction ?

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**4.** Two rails of a railway track insulated from each other and the ground are connected to a milli voltmeter. What is the reading of

millivoltmeter when the train travels at speed of 180 km/h along the track, given that the horizontal component of earth's magnetic field is $0.2 \cdot 10^{-4}$ wb/m and the rails are separated by 1 meter.

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**5.** In a coil an emf 10V is induced when the current changes at the rate of 20 $AS^{-1}$ Calculate the self-inductance of the coil.

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**6.** Find the mutual inductance between the two coils if a current of 10 ampere in primary coil changes the flux by 500 Wb per turn in the secondary coil of 200 turns. Also, find the induced e.m.f. acorss the ends of the secondary coil if this change occurs in 0.5 sec.

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**7.** What is the instantaneous voltage for an ac supply of 220 volts and 20 Hz?

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**8.** The effective current in a 50 cycle ac circuit is 5 amp. Calculate the value of current $\frac{1}{300}$ second after it was zero.

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**9.** An alternating voltage is represented by V = 240 sin 100 πt V. Find the peak voltage, rms voltage, frequency of the source.

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**10.** An alternating emf given by equation $E=300\sin[(100\pi)t]$ volt is applied to a resistance 100 ohms. Find the rms current through the circuit.

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**11.** What is meant by drag ?

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**12.** A 25 μ F capacitor, a 0.1 henry inductor and a 25 Ω resistor are connected in series with an ac source with voltage. V = 310 sin 314t. (a) What is the frequency of the voltage ? (b) Calculate the reactance and impedance and (c) current in the circuit.

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**13.** A 10 μF capacitor is connected across a 200 V, 50 Hz A.C. supply. Find the peak current

through the circuit

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**14.** An LCR series circuit with L = 100 mH, C = 100 μF.R = 120 Ω is connected to an aC source of emf = $(30V)\sin\left(100S^{-1}\right)$ L Find the impedance and resonant frequency of the circuit.

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**15.** An inductance of 2.0 H, a capacitor of 18 μF and a resistance 200Ω are connected in series in an ac source of peak voltage 20 V. (i) What frequency should be chosen such that current becomes maximum ? (ii) What isthe maximum current ?

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**16.** Is friction a contact force or non-contact force ?

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**17.** How much current is drawn by the primary of a transformer which steps down 220 volts to 22 volts to operate a device with an impedance of 220 Ω ?

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**18.** A transformer with primary to secondary turns ratio of 1 : 2, is connected to an alternator of voltage 200 V. A current of 4 A is

flowing through the primary coil. Calculate the voltage and the current flowing in the secondary.

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## Exercise

**1.** What is electromagnetic induction?

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**2.** State Faraday's law of electromagnetic induction.

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**3.** Write the SI unit of magnetic flux?

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**4.** Write the dimensions of magnetic flux and emf.

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**5.** Name the scientist associated with the direction of induced current.

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**6.** State Lenz's law.

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**7.** A wire cuts across a flux of $0.2x10^{-2}$ weber in 0.12 second. Calculate the emf induced.

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**8.** A metallic wire 1 m in length is moving normally across a field of 0.1T with a speed of $5ms^{-1}$. Find the emf between the ends of the wire.

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**9.** The magnetic flux through a coil changes from 12 mWb to 6 mWb in 0.01 s. What is the induced emf?

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**10.** If the rate of change of current 2A second induces an emf of 40 mV in the solenoid, what is the self-inductance of this solenoid?

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**11.** What do you mean by self induction of a circuit?

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**12.** Give SI unit of self induction.

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**13.** What are the dimensions of self induction?

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**14.** Explain the phenomenon of self induction.

Define co-efficient of self induction.

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**15.** What is mutual inductance.

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**16.** What are dimensions of mutual inductance?

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**17.** Show that Weber = Volt Second

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**18.** What is motional emf?

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**19.** What is meant by rms value of alterating current?

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**20.** Peak value of emf of an ac source is $\mathcal{E}_0$. What is its rms value ?

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**21.** An alternating emf e = (10 sin 100 πt) volt where t is in second is impressed across a non inductive resistance, R = 10Ω. What is the value of rms current in the circuit?

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**22.** Calculate the total reactance if two inductor of 10mH and 50 mH are connected in series with 10 kHz AC.

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**23.** Write down the expression for capacitive reactance.

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**24.** Calculate the capacitive reactance if 40 mF is connected to a frequency generator of 50 Hz signal.

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**25.** Write three advantages of friction ?

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**26.** Calculate the reactance of capacitance in an AC circuit wherein the input signal has a frequency of 100 Hz and a capacitor has a capacitance of 1000mF in a circuit.

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**27.** What is power dissipation in an ac circuit in which voltage and current are given by : $V = 300 \sin\left(\omega t + \left(\frac{\pi}{r}\right)\right)$ and I = 5 sin ωt?

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**28.** what is power factor of an L-C-R circuit? Explain on the basis of power factor than an ideal inductor is a Wattless component.

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**29.** What is the phase difference between voltage and current in L-C-R circuit at resonance?

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**30.** What is resonance?

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**31.** State the condition of resonance in a series LCR circuit driven by ac voltage.

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**32.** State Faraday's law of electromagnetic induction.

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**33.** State len's Law of electromagnetic induction. Establish that lenz's Law is the manifestation of Law of conservation of energy.

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**34.** A coil having n turns has self inductance L. Deduce the relation, $e = -L \cdot \left( \frac{dI}{dt} \right)$

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**35.** How does energy stored in a inductor?

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**36.** Find the expression for mutual inductance between a pair of co-axial coils.

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**37.** A metal rod of length l is placed normal to a uniform magnetic field B. The rod moves

with velocity v perpendicular to the field. Show that motional emf across its ends is Blv.

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**38.** How do an eddy current generate?

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**39.** Show that the rms value of an ac is $\frac{1}{\sqrt{2}}$ of its peak value.

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**40.** what is power factor of an L-C-R circuit? Explain on the basis of power factor than an ideal inductor is a Wattless component.

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**41.** What are meant by inductive reactance and capacitive reactance of a circuit?

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**42.** Write a short note on sharpness of resonance.

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**43.** What is the advantage of using a transformer for long distance transmission of electrical energy?

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**44.** State Faraday's law of electromagnetic induction.

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**45.** State len's Law of electromagnetic induction. Establish that lenz's Law is the manifestation of Law of conservation of energy.

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**46.** Define Coefficients of self induction write their SI units.

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**47.** Find the expression for mutual inductance between a pair of co-axial coils.

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**48.** Briefly explain the working of A.C. generator.

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**49.** What is virtual ampere? Deduce the relation $I_{mns} = \frac{I_0}{\sqrt{2}}$

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**50.** Prove that average power consumed in an ac circuit is $P_{av} = I_{mns} \cdot V_{mns} \cdot \cos\theta$.

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**51.** A coil of area A, number of turns N and resistance R is rotating in a radial magnetic field B with an angular speed w. What is the maximum power consumed by the coil?

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**52.** The equation of an alternating voltage is $V=100\sin 100\pi t$ volt. Find the RMS value of voltage and frequency.

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**53.** If the rms current through a $6.8k\Omega$ resistor is 8mA, Find the rms voltage drop across the resistor.

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**54.** What is the advantage of using a transformer for long distance transmission of electrical energy?

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**55.** State the working principle of a transformer. What is hysteresis loss in transformer?

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**56.** A cylindrical bar magnet is kept along the axis of a circular coil. Will there be a current induced in the coil if the magnet is rotated about its axis? Give reasons.

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**57.** Why do birds fly off high tension when current is switched on?

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**58.** What is an amplitude ?

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**59.** Why are coils in resistance box double wounded?

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**60.** Why is spark produced in the switch off a fan when it is put off?

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**61.** A copper disc is allowed to swing through the two poles of a U-shaped magnet. Explain what you expect to observe.

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**62.** A light bulb is rated at 100W for a 220V supply. Find the peak voltage of the source.

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**63.** A light bulb is rated at 100W for a 220V ac supply. Calculate the resistance of the bulb.

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**64.** A sinusoidal voltage $V = 200 \sin 314t$ is applied to a resistor of $10\Omega$. Calculate r.m.s value of voltage

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**65.** A lamp is connected in series with a capacitor. Predict your observations for de and ac connections.

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**66.** Explain the principle on which the metal detector is used in airport for security reason works.

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**67.** Which surface have more friction – rough or smooth ? Why ?

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**68.** Give two examples where rolling friction is utilized

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**69.** Name the two factors on which the magnitude of frictional force depends.

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**70.** An inductor of reactance 10Ω and resistance 10Ω are connected in series and the combination is connected to 200V, 50Hz supply. Find (i) current through the circuit and (ii) inductance of the coil.

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**71.** A capacitor and resistor are connected in series with an ac source. If the potential difference across C and R are 120 V and 90V respectively and if the rms current of the circuit is 3A, calculate (i) impedance and (ii) power factor of the circuit.

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**72.** Give two methods by which friction is reduced in the wheels of the car.

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**73.** A source of alternating emf of 220 V and 50 Hz is connected in series with a resistance of 200 Ω, an inductance of 100 mH and a capacitance of 30mF. Does the current lead or lag the voltage and by what angle?

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**74.** A rectangular coil having 60 turns and area of 0.4m^2 is held at right angles to a uniform magnetic field of flux density 5×10^−5T. Calculate the magnetic flux passing through it.

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**75.** sinusoidal voltage V = 200 sin 314 t is applied to a resistor of 10Ω. Calculate rms value of voltage, rms value of current and power dissipated in watt.

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**76.** A $3\mu F$ capacitor is connected to a 220V, 50 Hz a.c. source. Calculate the r.m.s value of current through the ckt.

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**77.** A capacitor of 50μF, a resistor of 102 and an inductor L are in series with an ac source of frequency 50Hz. Calculate the value of L if

phase angle between current and voltage is zero.

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**78.** The turns-ratio of a step up transformer is 1:10 and a current of 1.5 A is passed through the primary at 220 V. Obtain the values of voltage and the current in the secondary.

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**79.** Calculate current drawn by the primary of a transformer, which steps down 200V to 20V to operate a device of resistance 20ohm. Assume the efficiency of the transformer to be 80%.

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**80.** When current changes from 3A to 2A in one millisecond a coil produces 5V. Its self inductance is

A. 5100H

B. 5mH

C. 50H

D. 5H

**Answer: B**

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**81.** The co-efficient of mutual inductance when magnetic flux changes by $2 \cdot 10^{-2}$ Wb current changes by 0.01A is

A. 2H

B. 4H

C. 3H

D. 8H

**Answer: A**

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**82.** The mutual inductance of an induction coil is 5H. In the primary coil the current reduces

from 5A to 0 in $10^{-3}s$. What is the induced emf in the secondary coil?

A. 2500V

B. 25000V

C. 2510V

D. zero

**Answer: A**

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**83.** A coil of wire of radius r has 600 turns and a self inductance of 108 mH. The self inductance of similar of 500 turns is

A. 108 mH

B. 90mH

C. 75 mH

D. none of these.

**Answer: C**

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**84.** The average power dissipation in a pure capacitor in ac circuit is

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

B. $CV^2$

C. $2CV^2$

D. Zero

**Answer: D**

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**85.** The average power dissipation on a pure inductor L in an ac circuit is

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

B. $\frac{1}{4}LI^2$

C. Zero

D. $LI^2$

**Answer: C**

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**86.** An oscillator circuit consists of an inductance of 0.5 mH and capacitor of 20μF. The resonance frequency of the circuit is

A. 15.92 Hz

B. 1592 Hz

C. 159.2Hz

D. 15920 Hz.

**Answer: B**

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**87.** A transformer has 2100 tums in primary and 4200 turns in secondary. An' ac source of 120V, 10A is connected to its primary. The secondary voltage and current are-

A. 240V, 5A

B. 120V, 10A

C. 240V, 10A

D. 120V, 20A

**Answer: A**

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**88.** A dynamo acts as a

A. Converter of energy

B. Source of electric charge

C. Source of magnetic charge

D. Source of energy

**Answer: B**

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**89.** Lenz's law is a consequence of the law of conservation of

A. charge

B. momentum

C. energy

D. lines of force

**Answer: C**

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**90.** The phenomenon of electromagnetic induction was discovered by

A. Oersted

B. Ampere

C. Faraday

D. Coulomb.

**Answer: C**

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**91.** If an aC ammeter reads I ampere in an aC circuit, the peak value of the current is

A. I

B. $\frac{I}{\sqrt{2}}$

C. 2I

D. $\sqrt{2} \cdot I$

**Answer: D**

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**92.** In a transformer, energy is transferred from the primary to the secondary by

A. the current in the wires

B. an electric field

C. magnetic field

D. P.D. across the primary

**Answer: C**

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**93.** An electron enters a region with uniform velocity and it moves in the region with the same velocity. In the region

A. there may be electric field, but no magnetic field

B. there may be magnetic field, but no electric field

C. there may be both electric and magnetic field

D. the electric and magnetic field may be in opposite direction.

**Answer: B**

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**94.** An electron of charge e enters a magnetic field B with a velocity v and moves in a circular path of diameter d in the field. When the electron completes one semi-circular path, the work done by the field

A. zero

B. Bevd

C. Bevπd

D. none of these

**Answer: A**

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**95.** A charged particle moves at right angles to a uniform magnetic field and rotates in a

circular path. The frequency of the charge does not depend on

A. speed

B. mass

C. charge of the particle

D. magnetic field

**Answer: A**

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**96.** Energy dissipates in LCR circuit in

A. L only

B. C only

C. R only

D. All of the above

**Answer: C**

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**97.** The working of a dynamo is based on the principle of

A. heating effect of current

B. chemical effect of current

C. magnetic effect of current

D. electromagnetic induction

**Answer: D**

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**98.** The average power dissipation on a pure inductor L in an ac circuit is

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

B. $CV^2$

C. $2CV^2$

D. zero

**Answer: D**

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**99.** A capacitor of capacity C has reactance X. If the capacitance and frequency are doubled, the reactance would be

A. 4X

B. $\frac{X}{2}$

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

D. 2X

**Answer: C**

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**100.** When current changes from + 2A to -2A in 0.05 S, an emf of 8V is induced in the coil. The self inductance of the coil is

A. 0.2H

B. 0.4H

C. 0.8H

D. 0.1H

**Answer: D**

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**101.** Which of the following quantities remain constant in a step down transformer ?

A. current

B. voltage

C. power

D. none of these

**Answer: C**

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