Ravi Maths Tuition

Electromagnetic Induction

12th Standard

Physics

Multiple Choice Question 67 x 1 = 67

1) In the relation ϕ = BA cos θ, θ is angle........

(a) which normal to surface area makes with the direction of magnetic field

(b) which magnetic field makes with the surface (c) which is never constant (d) none of the above

2) SI unit of magnetic flux is

(a) henry (b) weber (c) coulomb (d) volt

3) The cause of induced e.m.f. is

(a) magnetic flux (b) magnetic field (c) area (d) change in magnetic flux

4) Choose the wrong statement:

(a) When ever the amount of magnetic flux linked with a circuit changes, an e.m.f. is induced in the circuit.

(b) The induced e.m.f. lasts so long as the change in magnetic flux continues

(c) Large the amount of magnetic flux linked with a circuit, greater is the e.m.f. induced in it.

(d) The direction of induced e.m.f. is given by Lenz's Llaw.

5) Amount of charge induced in a circuit of resistance R is given by

(a) $dQ = (d\phi) \times R$ (b) $dQ = \frac{d\phi}{R}$ (c) $dQ = R^2 d\phi$ (d) $dQ = \frac{d\phi}{R^2}$

6) Which one is not an application of eddy currents?

(a) Magnetic brakes (b) speedometers (c) Induction furnace (d) Transformers

7) Out of the following, choose the correct relation

(a) 1henry = $\frac{1\ volt}{1\ ampere}$ (b) 1henry = $\frac{1\ amp}{1\ volt}$ (c) 1 henry = $\frac{1 volt}{1\ amp/sec}$ (d) 1 henry = $\frac{1 volt}{1\ amp\ .\ sec}$

8) When number of turns of a soleniod is doubled, its self inductance becomes k times, where k =

(a) 2 (b) 1 (c) 8 (d) 4

9) The magnetic flux linked with a coil is ϕ = (3t-2t+1) milliweber. The e.m.f. induced in the coil at t = 1sec is

(a) 4V (b) 4×10^{-3}V (c) 6V (d) 4×10^{3}V

10) A wire of length 2m moves with a speed of 5m/s perpendicular to a magnetic field of induction 0.1 Wb/m^2. The e.m.f. induced in the wire is

(a) 1 V (b) 10 V (c) 5 V (d) 2 V

11) Choose the quality whose SI unit is not ohm.

(a) Resistance (b) Reactance (c) Capaciatnce (d) Impedance

12) Which of the following does not have the dimension of time?

(a) RC (b) $\frac{L}{R}$ (c) $\frac{R}{L}$ (d) $\sqrt{LC}$

13) Phase difference between voltage across L and C in series is

(a) 0° (b) 90° (c) 180° (d) 360°

14) The peak value of alternating e.m.f. in a generator is given by e_0 =

(a) NAB (b) NAB ω (c) NAB v (d) none of these

15) The frequency of a.c. generated depends on

(a) speed of rotation of coil (b) amplitude of a.c (c) size of coil (d) all the above

16) In which of the following appliances, Fleming's right hand rule for direction of induced current is not applicable?

(a) a.c.generator (b) d.c.generator (c) induction motor (d) transformer

17) The split ring arrangement is used by η =

(a) a.c. generator (b) d.c generator (c) choke coil (d) transformer

18) The relation $\frac{E_s}{E_p} = \frac{n_s}{n_p}$ is applied only to

(a) a.c. generator (b) d.c. generator (c) induction coil (d) step up/step down transformer

19) The self inductance L of a solenoid of length l and area of cross-section A, with a fixed numer of turns N increase as

(a) l and A increase (b) l decrease and A increase (c) l increase and A decrease (d) both l and A decrease

20) 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

21) 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

22) 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 magentic 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 componet whose magnitude is decreasing suitably

(d) there is a constant magnetic field in the perpendicular direction.

23) In a uniform magnetic field of induction B, a wire in the form of semicirclr of radius r rotates about the diameter of the circle with angulat frequency. The axis of rotation is perpendicular to the field. If the total resistance of the circuit is R, then the mean power generated per period of rotation is

(a) $\frac{B\pi r^2\omega}{2R}$ (b) $\frac{(B\pi r^2\omega)^2}{8R}$ (c) $\frac{(B\pi r\omega)^2}{2R}$ (d) $\frac{(B\pi r^2\omega)^2}{8R}$

24) A conducting circuit loop is placed in a uniform magnetic field of induction B tesla with its plane normal to the field. Now, the radius of the loop starts sharinking at the rate dr/dt. The induced emf at the instant when the radius is R is:

(a) $\pi r B\left(\frac{dr}{dt}\right)$ (b) $2\pi r B\left(\frac{dr}{dt}\right)$ (c) $\pi r^2\left(\frac{dr}{dt}\right)$ (d) $\left(\frac{\pi r^2}{2}\right)^2\left(\frac{dr}{dt}\right)$

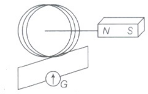
25) A coil having n turns and resistance R is connected with a galvanometer of resistance 4R. This combination is moved in time t seconds from a magnetic flux ϕ_1 Weber to ϕ_2 Weber. The induced current in the circuit is :

(a) $\frac{\phi_2-\phi_1}{5Rnt}$ (b) $\frac{-n(\phi_2-\phi_1)}{5Rt}$ (c) $\frac{-(\phi_2-\phi_1)}{Rnt}$ (d) $\frac{-n(\phi_2-\phi_1)}{Rt}$

26) A physicist works in a laboratory where the magnetic field is 2T. She wears a necklace enclosing area 0.01m^2 in such a way that the plane of the necklace is normal to the field and is having a resistance R = 0.01Ω . Because of power failure, the field decays to 1 T in time 10^{-3} s. Then what is the total heat produced in her necklace?

(a) 10 J (b) 20 J (c) 30 J (d) 40 J

27) Current in the coil is larger



(a) when the magnet is pushed towards the coil faster (b) when the magnet is pulled away the coil faster

(c) Both (a) and (b) (d) Neither (a) nor (b)

28) The instantaneous magnetic flux linked with a coil is given by φ = ($5t^3$ - 100t + 300) Wb. The emf induced in the coil at time t = 2 s is

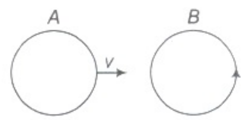
(a) -40V (b) 40V (c) 140V (d) 300V

29) There are two coils 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 inA (b) there is a varying current in A

(d) there is a constant current in the counter clockwise direction in A

(c) there is no current in A



30) A horizontal straight wire 20 m long extending from east to west is falling with a speed of 5.0 ms^{-1} at right angles to the horizontal component of the earth's magnetic field 0.30 x 10^{-4} Wbm^{-2}. The instantaneous value of the emf induced in the wire will be

(a) 6.0 mV (b) 3 mV (c) 4.5 mV (d) 1.5 mV

31) The self-inductance of a coil is 2 mH. The rate of flow of current in it is 10^3 A/S. The induced electromotive force in the coil is

(a) 1V (b) 2V (c) 3V (d) 4V

32) 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

33) If a medium of relative permeability μ_r had been present instead of air, the mutual inductance would be

(a) $M = \mu_r \mu_0 n_1 n_2 \pi r_1 l$ (b) $M = \mu_0 n_1 n_2 \pi r_1^2 l$ (c) $M = \mu_r n_1 n_2 \pi r_1^2 l$

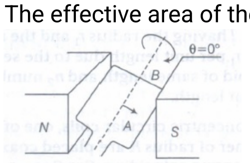
(d) $M = \mu_r \mu_0 n_1 n_2 \pi r_1^2 l$

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

(a) the rates at which currents are changing in the 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

35) The effective area of the coil exposed to the magnetic field lines changes with time, the flux at any time is



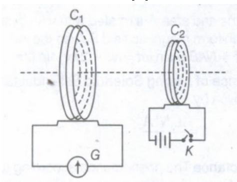
(a) $\phi_B = BA \cot \omega t$ (b) $\phi_B = BA \cos \omega t$ (c) $\phi_B = BA \tan \omega t$

(d) $\phi_B = BA \sec \omega t$

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

(a) $2B_0L^2$ Wb (b) $3B_0L^2$ Wb (c) $4B_0L^2$ Wb (d) $\sqrt{29}B_0L^2$ Wb

37) What will happen with the galvanometer when the tapping key K is pressed?



(a) A momentary deflection (b) A long time deflection (c) No deflection (d) None of the above

38) The magnitude of the induced emf in a circuit is equal to the time rate of change of magnetic flux through the circuit, is statment of

(a) Fleming's right hand rule (b) Fleming's left hand rule (c) Felming's third law

(d) Faraday's law of electromagnetic induction

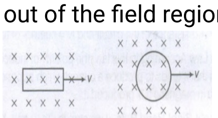
39) The direction of induced current is decided by

(a) Lenz's law (b) Fleming's left hand rule (c) Biot-Savart's law (d) Ampere's law

40) A 50 turns circular coil has a radius of 3 cm, it is kept in a magnetic field acting normal to the area of the coil. The magnetic field B increased from 0.10 T to 0.35 T in 2 ms^{-1}, The average induced emf in the coil is

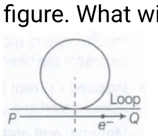
(a) 1.77V (b) 17.7V (c) 177V (d) 0.177V

41) A rectangular loop and a circular loop are moving out of a uniform magnetic field region in the given 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?



(a) Rectangular loop (b) Circular loop (c) Both (a) and (b) (d) Neither (a) nor (b)

42) An electron moves along the line PQ which lies in the same plane as a circular loop of conducting wire as shown in figure. What will be the direction of the induced current in the loop?



(a) Anti-clockwise (b) Clockwise (c) Alternating (d) Non-current will be induced

43) Eddy currents are generated in

(a) insulator (b) conductor (c) Both (a) and (b) (d) Neither (a) nor (b)

44) If the number of turns in a coil becomes doubled, then it self-inductance will become

(a) double (b) halved (c) four times (d) unchanged

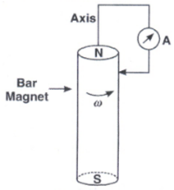
45) The self-induced emf in a coil of 0.4 H self-inductance when current in it is changing at the rate of 50 As^{-1}, is

(a) 8×10^{-4} V (b) 8×10^{-3} V (c) 20V (d) 500V

46) 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 $B = B_0\left(\hat{i}+\hat{k}\right)T$ is present in the region. The flux passing through the loop ABCDEFA (in that order) is.

(a) B_0L^2Wb (b) $2B_0L^2Wb$ (c) $\sqrt{2}B_0L^2Wb$ (d) $4B_0L^2Wb.$

47) A cylindrical bar magnet is rotated about its axis. A wire is connected from the axis and is made to touch the cylindrical surface through a contact. Then

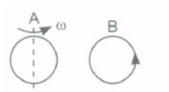


(a) a direct current flows in the ammeter A. (b) no current flows through the ammeter A.

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

(d) a time varying non-sinosoidal current flows through the ammeter A

48) Same as question 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 counterclockwise and the coil A is as shown at this instant, t = 0, is



(a) constant current clockwise. (b) varying current clockwise (c) varying current counterclockwise

(d) constant current counterclockwise

49) When current in a coil changes from 5 A to 2 A in 0.1 s, average voltage of 50 V is produced. The selfinductance of the coil is

(a) 1.67 H (b) 6 H (c) 3 H (d) 0.67 H

50) A coil having 500 sq. loops of side 10 cm is placed normal to magnetic flux which increases at a rate of 1 T/s. The induced emf is

(a) 0.1 V (b) 0.5 V (c) 1V (d) 5V

51) A coil of 100 turns carries a current of 5 mA and creates a magnetic flux of 10^{-5} weber. The inductance is

(a) 0.2 mH (b) 2.0 mH (c) 0.02 mH (d) 0.002 H

52) Lenz's law of electromagnetic induction is as per law of conservation of

(a) energy. (b) momentum angular. (c) charge. (d) electromotive force.

53) The current flows from A to B is as shown in the figure. The direction of the induced current in the loop is

(a) clockwise. (b) anticlockwise. (c) straight line. (d) no induced e.m.f. produced.

54) In a coil of self-induction 5 H, the rate of change of current is 2 As^{-1}. Then emf induced in the coil is

(a) 10V (b) -10V (c) 5V (d) -5V

55) 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.

56) 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

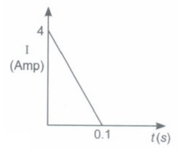
57) The self-inductance of a coil having 500 turns is 50 mH. The magnetic flux through the cross-sectional area of the coil, while current through it is 8 mA, is found to be

(a) 4 x 10^{-4} Wb (b) 0.04 Wb (c) 4 μ Wb (d) 40 m Wb

58) While keeping area of cross-section of a solenoid same, the number of turns and length of solenoid are both doubled. The self-inductance of the coil will be

(a) halved. (b) doubled. (c) 1/4 times the original value (d) unaffected.

59) In a coil of resistance 10π, the induced current developed by changing magnitude of change in flux through the coil is weber is



(a) 8 (b) 2 (c) 6 (d) 4

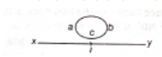
60) A metal ring is held horizontally and bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet is

(a) equal to g. (b) less than g. (c) more than g. (d) first increases then decreases.

61) A coil of resistance 400Ω is placed in a magnetic field. If the magnetic flux Φ linked with the coil varies with times t (see) as $\Phi = 50t^2 + 4$, the current in the coil at t = 2 sec is

(a) 0.5 A (b) 0.1 A (c) 2 A (d) 1 A

62) The direction of induced current in the loop abc is



(a) along abc if I decreases (b) along acb if I increases (c) along abc if I is constant

(d) along abc if I increases

63) A rectangular, a square, a circular and an elliptical loop, all in the X-Y plane, are moving out of a uniform magnetic field with a constant velocity vi. The magnetic field is directed along the negative Z-axis direction. The induced emf, during the passage of these loops, out of the field region, will not remain constant for

(a) any of the four loops (b) the circular and elliptical loops (c) the rectangular, circular and elliptical loops

(d) only the elliptical loops

64) The self-inductance of a solenoid of 600 turns is 108 mH. The self-inductance of a coil having 500 turns with the same length, the same radius and the same medium will be

(a) 95 mH (b) 90 mH (c) 85 mH (d) 75 mH

65) The current in the primary coil of a pair of coils changes from 7 A to 3 A in 0.04 s. The mutual inductance between the two coils is 0.5H. The induced emf in the secondary coil is

(a) 50 V (b) 75 V (c) 100 V (d) 220 V

66) There is a pair of concentric and coplanar conducting loops of radii R_1 and R_2 such that $R_2 = 0.01 R_1$. To which of the following is the mutual inductance M for this pair directly proportional?

(a) $1/R_1^2$ (b) R_1^2 (c) $1/R_1$ (d) R_1

67) A coil of area 100 is kept at an angle of 30° with a magnetic field of 10 T. The magnetic field is reduced to zero in 10s. The induced emf in the coil is

(a) $5\sqrt{3}$ V (b) $50\sqrt{3}$ V (c) 5.0 V (d) 50.0 V

Fill up / 1 Marks 14 x 1 = 14

68) One weber is the amount of........over an area of...........held normal to a uniform................ .

69) Lenz's law is.............with the law..................... .

70) Eddy currents are the currents.................when................changes.

71) If ω is angular frequency of a.c, then the reactance offered by inductance L and capacitance C are X_L =...................and X_C =................... .

72) Self induction of a coil is said to be...........when a current change................through the coil induces.................in the coil.

73) Self inductance of a solenoid varies.............as the.............of total number of turns in the solenoid.

74) Coefficient of mutual inductance of two coils is numerically .... linked with one coil when .... flows through ....

75) When a coil carrying current is........................., it experiences................which....................the coil. This is the principle of..................... .

76) Total number of magnetic lines of force crossing a surface normally is called _________.

77) Relation between S.I. unit and C.G.S. unit of magnetic flux is ___________.

78) Phenomenon of production of induced emf due to change of magnetic flux linked with a closed circuit is known as _________.

79) Direction of induced current is such that it _________ the cause which produces it.

80) Phenomenon of production of induced e.m.f. in a coil when a changing current passes through it is known as _________.

81) When magnetic lines of force are parallel to a closed surface, then the net magnetic flux through the surface is _________.

Assertion and reason 21 x 1 = 21

82) **Assertion (A) :** When two coils are wound on each other, the mutual induction between the coils is maximum.
Reason (R) : Mutual induction does not depend on the orientation of the coils.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

83) **Assertion (A)** : An induced emf is generated when magnet is withdrawn from the solenoid.
Reason (R) : The relative motion between magnet and solenoid induces emf
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

84) **Assertion (A) :** An induced current is developed when the number of magnetic lines of force associated with conductor is changed.
Reason (R) : An induced current developJn a conductor moved in a direction parallel to the magnetic field.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

85) **Assertion (A) :** A copper sheet is placed in a magnetic field. If we pull it out of the field or push it into the field, we experience an opposing force.
Reason (R) : According to Lenz's law, eddy current produced in sheet opposes the motion of the sheet
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

86) **Assertion (A) :** Changing magnetic flux can produce induced e.m.f ..
Reason (R) : Faraday established induced e.m.f experimentally
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

87) **Assertion (A) :** Induced e.m.f depends on number of turns and area of the coil.
Reason (R) : Induced e.m.f increases with increase in number of turns of coil.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

88) **Assertion (A)** : Inductance coil are made of copper.
Reason (R) : Induced current is more in wire having less resistance
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

89) **Assertion (A)** : Self-inductance is called the inertia of electricity.
Reason (R) : Self-inductance is the phenomenon, according to which an opposing induced e.m.f is produced in a coil as a result of change in current or magnetic flux linked with the coil
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

90) **Assertion (A) :** When number of turns in a coil doubled, coefficient of self inductance of the coil becomes four times.
Reason (R) : Coefficient of self inductance is proportional to the square of number of turns.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

91) **Assertion (A)** : The coil in the resistance boxes are made by doubling the wire.
Reason (R) : Thick wire is required in resistance box
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

92) **Assertion (A)** : The resistance of a coil for direct current is 5 ohms. An alternating current is sent through it. The resistance will remain same
Reason (R) : The resistance of a coil does not depend upon nature of current.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

93) **Assertion (A)** : Acceleration of a magnet falling through a copper ring decreases.
Reason (R) : The induced current produced in a circuit always flow in such direction that it opposes the change or the cause that produced it.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

94) **Assertion (A)** : An artificial satellite with a metal surface is moving above the earth in a circular orbit. A current will be induced in satellite if the plane of the orbit is inclined to the plane of the equator.
Reason (R) : The current will be i~duced only when the speed of satellite is more than 8 km/sec.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

95) **Assertion (A):** An aircraft flies along the meridian, the potential develops at the ends of its wings.
Reason (R) : Whenever there is change in the magnetic flux e.m.f induces.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

96) **Assertion (A) :** Faraday's law are consequence of conservation of energy.
Reason (R) : The magnitude of the induced emf in a circuit is equal to the rate of change of magnetic flux linked with the circuit.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

97) Assertion (A) : Lenz's law violates the principle of conservation of energy.
Reason (R) : Induced emf always opposes the change in magnetic flux responsible for its production.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

98) Assertion (A) : If the inner solenoid was much shorter than (and placed well inside) the outer solenoid, then we could still have calculated the flux linkage N_1, φ_1
Reason (R) : The inner solenoid is effectively immersed in a uniform magnetic field due to the outer solenoid.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

99) Assertion (A) : Self-inductance is the electromagnetic analogue of mass in mechanics.
Reason (R) : Work needs to be done against the back emf (e) in establishing the current.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

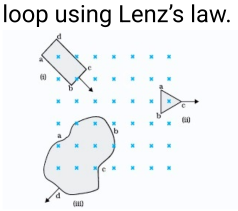
100) Assertion (A) : The quantity L/R possesses dimensions of time.
Reason (R) : To reduce the rate of increase of current through a solenoid, we should increase the time constant (L/R).
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

101) Assertion (A) : An AC generator is based on the phenomenon of self-induction.
Reason (R) : In single coil, we consider self-induction only.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

102) Assertion (A) : Inductance coil are made of copper.
Reason (R) : Induced current is more in wire having less resistance.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

2 Marks 224 x 2 = 448

103) In the 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.



104) 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?

105) When is the magnetic flux crossing a given surface area held in a magnetic field maximum?

106) What is the dimensional formula of magnetic flux ?

107) What is the relation between weber and Maxwell ?

108) A coil intercepts a magnetic flux of 0.2×10^{-2} Wb in 0.1 s. What is the emf induced in the coil ?

109) Does change in magnetic flux induce e.m.f. or current ?

110) A vertical metallic pole falls down through the plane of magnetic meridian. Will any e.m.f. be induced between its ends ?

111) Two straight and parallel wires A and B are being brought towards each other. If current in A be i, what will be the direction of induced current in B? If A and B are being taken away from each other, then ?

112) A train is moving with uniform speed from north to south. Will any induced e.m.f. appear across the ends of its axle ? Will the answer be affected if train moves from east to west ?

113) Name the S.I. units of magnetic flux and magnetic induction.

114) When is magnetic flux linked with a coil held in a magnetic field zero ?

115) The induced e.m.f. is sometimes called back e.m.f. Why ?

116) Why are oscillations of a copper sheet in a magnetic field highly damped ?

117) What causes sparking in the switches when light is put off ?

118) What is the basic cause of induced e.m.f.?

119) Does Lenz's law violet the principle of energy conservation ?

120) 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.

121) Could a current be induced in a coil by rotating a magnet inside the coil ? If so, how ?

122) Is induced electric field conservation or nor conservative ?

123) A glass rod of length l moves with velocity υ in a uniform magnetic field B. What is the e.m.f. induced in the rod?

124) A wheel with a certain number of spokes is rotated in a plane normal to earth's magnetic field so that an e.m.f. is induced between the axle and rim of the wheel. Keeping all other things same, number of spokes is changed. How is the e.m.f. affected ?

125) What are the dimensions of inductance?

126) The self induced emf in a coil when current charges on it is given by.

127) Why is induced emf called back e.m.f. ?

128) What are the dimensions of mutual inductance?

129) How does self inductance of a solenoid change when number of turns is double keeping other parameters same?

130) What are the factors on which self inductance of a coil depend?

131) What is the SI unit of mutual inductance of two coils ?

132) Two inductors $L_1 \ and \ L_2$ sufficient distance apart are connected (i) in series (ii) in parallel. What is their equivalent inductance?

133) What is one henry?

134) Are eddy currents useful or harmful ?

135) Write an expression for self inductance of a long solenoid.

136) Write an expression for mutual inductance of two co-axial solenoids.

137) An artificial satellite with a metal surface is orbiting the earth around the equator : Will the earth's magnetism induce some current in it ?

138) An artificial satellite with a metal surface is orbiting the earth around the poles. Will there be any induced current due to earth's magnetic field ?

139) State whether the following statements are true or false giving reason in brief:
(a) The dimension of (h/e) is the same as that magnetic flux Φ .
(b) The dimensions of electric and magnetic flux are same.
(c) A coil of a metal wire is kept stationary in a non-uniform magnetic field. An e.m.f. is induced in the coil.
(d) An e.m.f. can be induced between the two ends of a straight copper wire when it is moved through a magnetic field.

140) Show that the rate of change of magnetic flux has the same units as induced e.m.f.

141) A circular brass loop of radius a and resistance R is placed with its plane perpendicular to a magnetic field, which varies with time as $B = B_0 sin\omega t.$ Obtain the expression for the induced current in the loop.

142) 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?

143) A solenoid with an iron core and a bulb are connected to a.d.c source. How does the brightness of bulb change when iron core is removed from the solenoid ?

144) How days the mutual inductance of a pair of coils hange when
(i) distance between the coils is increased
(ii) an iron sheet is placed between the two coils ?

145) Can one have an inductance without a resistance ? How about a resistance with an inductance?

146) Explain why resistance coils are usually double wound.

147) In a.c. generator, which rule determines the direction of induced e.m.f.?

148) In d.c. motor, is the supplied voltage alternating?

149) Name the main component which changes an a.c. generator into d.c. generator.

150) Which is the best method of reducing a.c. in a circuit?

151) Name any appliance that can step down d.c. voltage.

152) A d.c. motor acts as generator too. Is it true?

153) In a d.c. motor, do we use slip ring or split ring arrangement and why?

154) A 220 V, 50Hz a.c. source is being used. What is the average e.m.f. over a full cycle? What is the rms voltage?

155) Show that $\left(\frac{L}{R}\right)$ has the dimensions of time.

156) Show that time constant $(\tau = RC)\ of\ R - C$ circuit has the dimensions of time.

157) We can measure d.c. by an ordinary ammeter, but not a.c.Why ?

158) Does the steady current in RL circuit depend upon L?

159) At resonance in an a.c. circuit, what is the value of power factor?

160) At parallel resonance frequency, is current zero or maximum?

161) What is the average power consumed in a circuit consisting of resistanceless inductance?

162) Why cannot we use a.c. for electrolysis?

163) An inductor is connected in series with a bulb to an a.c. source. What happens to brightness of bulb when number of turns in the inductor is reduced?

164) An electromagnet has stored 648 J of magnetic energy, when a current of 9 A exists in its coils. What average e.m.f. is induced if the current is reduced to zero in 0.45 s?

165) A wire in the form of a tightly would 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.

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

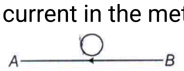
167) If a LC circuit is considered analogous to a harmonically osciallting spring block system, which energy of the LC circuit would be analogous to potential energy and which one analogous to kinetic energy?

168) Can the instantaneous power output of an ac source ever be negative? Can the average power output be negative?

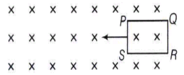
169) Can a straight wire act as an inductor?

170) How can the self-inductance of a given coil having N number of turns, area of cross-section A and length l be increased?

171) The electric current flowing in a wire in the direction from B to A is decreasing. Find out the direction of the induced current in the metallic loop kept near the wire as shown in the figure below

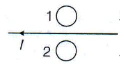


172) The closed loop PQRS of wire is moved into a uniform magnetic field at right angles to the plane of the paper as shown in the figure. Predict the direction of the induced current in the loop.



173) How does the mutual inductance of a pair of coil change when
(i) the distance between the coil is increased and
(ii)the number of turns in the coil is increased?

174) Predict the direction of induced current in metal rings 1 and 2, when current I in the wire is steadily decreasing.



175) How is the mutual inductance of a pair of coil affected when a thin iron sheet is placed between the two coils, Other factor remaining the same?

176) The instantaneous value of current in an AC circuit is $I = 2\sin\left(100\pi t + \pi/3\right) A$. At what first time, the current will be maximum?

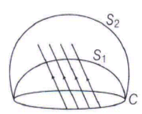
177) A coil is wound on an iron core and locked back on itself so that the core has two sets of closely wound wires in series carrying current in opposite sense. What is its self-inductance?

178) Calculate the quality factor of a series L-C-R circuit with L = 2.0 H, $C = 2\mu F$ and $R = 10\Omega$. Mention the significance of quality factor in L-C-R circuit.

179) A light metal disc on the top of an electromagnet is Thrown up as the current is switched ON. Why? Give reason.

180) Self-induction is called the inertia of electricity Why?

181) Consider a closed loop C in a magnetic field as shown in the figure. The flux passing through the loop is defined by choosing a surface whose edge coincides with the loop and using the formula
ϕ = B_1 dA_1, B_2 dA_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.



182) Resonance frequency of a circuit is v. If the capacitance is made 4 times the initial value, find the change in the resonance frequency.

183) Can we control direct current without much loss of energy? Can a choke coil do so?

184) Write the name of quantities which do not change during transformer operation.

185) Two coils of wire A and B are placed mutually perpendicular. When a current induced is changed in any one coil, will the current induced in another coil?

186) A transformer has 150 turns in its primary and 1000 in secondary. If the primary is connected to 440 V DC supply, what will be the induced voltage in the secondary side?

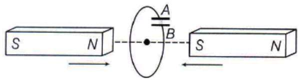
187) It has been that birds fly off from high tension wire when there is current in it. Why?

188) A source of emf e is used to establish a current I through a coil of self-inductance L. Show that the work done by the source to build up the current I is $\frac{1}{2}LI^2$

189) Two concentric circular coils, one of radius r and the other of radius R are placed coaxially with their centres coinciding. For R > > > r, obtain an expression for mutual inductance of the arrangement.

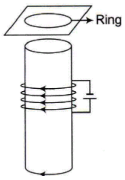
190) A long solenoid with 15 turns per cm has a small loop of area 2.0cm^2 placed inside, normal to the axis of solenoid. If the current carried by the solenoid changes steadily from 2 A to 4A in 0.1s, what is the induced voltage in the loop, while the current is changing?

191) Predict the polarity of the capacitor in the situation described by adjoining figure.Explain the reason too



192) The flux linked with a large circular coil of radius R is 0.5 x 10^{-3} Wb.When a current of 0.5 A flows through a small neighbouring coil of radius r, calculate the coefficient of mutual inductance for the given pair of coils. If the current through the small coil suddenly falls to zero, what would be its effect in the larger coi!?

193) (i) A metal ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. What will be the acceleration of a falling magnet?
(ii) Consider a metal ring kept on top of a fixed solenoid (say on cardboard) (see figure). The center of the ring coincides with the axis of the solenoid. If the current is suddenly switched ON, the metal ring jumps up. Explain.



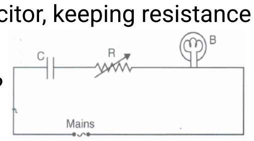
194) A magnetic field in a certain region is given by B = B_0cos $(\omega t)\hat{k}$ and a coil of radius a with resistance R, is placed in the XY-plane with its centre at the origin in the magnetic field as shown in the figure. Find the magnitude and direction of the current at (a, 0, 0) at t = $\frac{\pi}{2\omega}$, t = $\frac{\pi}{\omega}$ and t = $\frac{3\pi}{2\omega}$

195) Why is the coil of dead beat galvanometer wound on a metal frame?

196) A horizontal staright wire of Length L extending from east to west is falling with speed v at right angles to the horizontal component of Earth's magnetic field B.
(i) Write the expression for the instantaneous value of the e.m.f induced in the wire.
(ii) What is the direction of the e.m.f ?
(iii) Which ned of the wire is at the higher potential?

197) State the underlying principle of a transformer. How is the large scale transmission of electric energy long distances done with the use of transformers?

198) A capacitor 'C', a variable resistor 'R' and a bulb 'B' are connected in series to the ac mains in circuit as shown. The bulb glows with some brightness. How will the glow of the bulb change if
(i) a dielectric slab is introduced between the plates of the capacitor, keeping resistance R to be the same;
(ii) the resistance R is increased keeping the same capacitance?



199) How does the mutual inductance of a pair of coils change when
(i) distance between the coils is increased
(ii) number of turns in each coil is decreased?

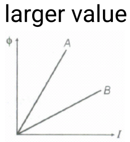
200) Define self-inductance of a coil Write its S.I. unit

201) Define self-inductance of a coil Show that magnetic energy required to build up the current 1 in a coil of self-inductance L is given by $\frac{1}{2}LI^2$

202) Show a plot of variation of alternating emf versus time generated by a loop of wire rotating in a magnetic field.

203) What are eddy currents? write any two applications of eddy current.

204) A plot of magnetic flux (Φ) versus current (I) is shown in the figure for two inductors A and B. Which of the two has larger value of self inductance?



205) Give an example each of a molecular solid and an ionic solid

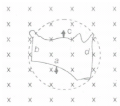
206) How many atoms per unit cell are present in bcc unit cell?

207) How many atoms constitute one unit cell of a face centered cubic crystal?

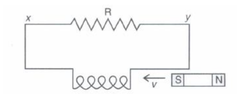
208) "Crystalline solids are anisotropic in nature" what does this statement mean?

209) Two spherical bobs, one metallic and the other of glass, of the same size are allowed to fall freely from the same height above the ground. Which of the two would reach earlier and why?

210) A flexible wire of irregular shape, abcd, as shown in the figure, turns into a circular shape when placed in a region of magnetic field which is directed normal to the plane of the loop away from the reader. Predict the direction of the induced current in the wire.

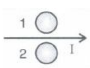


211) A magnet is moving towards a coil with a uniform speed v as shown in the figure. State the direction of the induced current in the resistor R.



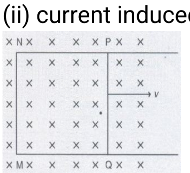
212) State the steady value of the reading of the ammeter in the circuit shown below :

213) Predict the directions of induced currents in metal rings 1 and 2 lying in the same plane where current I in the wire is increasing continuously.



214) Two bar magnets are quickly moved towards a metallic loop connected across a capacitor 'C' as shown in the figure. Predict the polarity of the capacitor.

215) A rectangular loop PQMN with movable arm PQMN of length 10 em and resistance 2 Ω is placed in a uniform magnetic field of 0.1 Tesla perpendicular to the plane of the loop as shown in the figure. The resistance, pf the arms MN, NP, and MQ are negligible. Calculate the
(i) emf induced in the arm PQ and
(ii) current induced in the loop when arm PQ is moved with velocity 20 m/s.

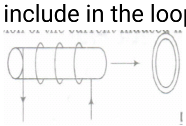


216) Describe a simple experiment (or activity) to show that the polarity of emf induced in a coil is always 1 such that it tends to produce a current which opposes the change e of magnetic flux that produces it.

217) A horizontal straight wire of length L extending I from east to west is falling with speed v at right angles to the horizontal component of Earth' s magnetic field B.
(i) Write the expression for the instantaneous value of the e.m.f. induced in the wire. (ii) What is the direction of the e.m.f. ?
(iii) Which end of the wire is at the higher potential ?

218) A long straight current carrying wire passes normally through the centre of circular loop. If the current through the wire increases, will there be an induced emf in the loop? Justify.

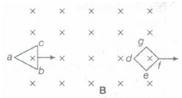
219) The figure shows a current-carrying solenoid moving towards conducting loop. Find the direction of the current include in the loop.



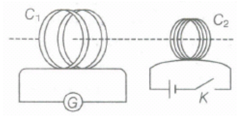
220) On what factors does the magnitude of the emf induced in the circuit due to magnetic flux depend?

221) State the Faraday's law of electromagnetic induction.

222) Two loops of different shapes are moved into a region of uniform magnetic field in the directions marked by arrows as shown in the figure. What is the direction of the induced current in each loop?

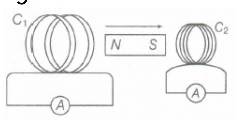


223) A current is induced in coil C_1 due to the motion of current-carrying coil C_2.



(i) Write any two ways by which a large deflection can be obtained in the galvanometer G.
(ii) Suggest an alternative device to demonstrate the induced current in place of a galvanometer.

224) A magnet is quickly moved in the direction indicated by an arrow between two coils C_1 and C_2 as shown in the figure.



What will be the direction of induced current in each coil as seen from the magnet? Justify your answer.

225) State the law that gives the polarity of the induced emf.

226) State Lenz's law. Give one example to illustrate this law. The Lenz's law is a consequence of the principle of conservation of energy. Justify this statement.

227) The motion of copper plate is damped, when it is allowed to oscillate between the two poles of a magnet. What is the cause this damping?

228) Define mutual inductance. Give its SI unit.

229) Mention any two useful applications of eddy currents.

230) The power factor of an AC circuit is 0.5. What is the phase difference between voltage and current the circuit?

231) Plot a graph showing variation of capacitive reactance with the change in the frequency of the AC source.

232) Why is the use of AC voltage preferred over DC voltage? Give two reasons.

233) Define mutual inductance between two long coaxial solenoids. Find out the expression for the mutual inductance of inner solenoid of length I having the radius r_1 and the number of turns n_1 per unit length due to the second outer solenoid of same length and n_2 number of turns per unit length.

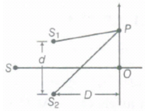
234) Two concentric circular coils $C_1$and C_2, radius r_1 and r_2 ($r_1 < < r_2$) respectively are kept coaxially. If current is passed through C_2, then find an expression for mutual inductance between the two coils.

235) When an AC source is connected across an inductor, show on a graph the nature of variation of the voltage and the current over one complete cycle.

236) The current flowing through a pure inductance 2mR is, 1 = (15 cos 300t)A. What is the
(i) rms and
(ii) average value of current for a complete cycle?

237) A reactive element in an AC circuit causes the current flowing
to lead in phase by $\pi/2$
to lag in phase by $\pi/2$
w.r.t. the applied voltage. Identify the element in each case.

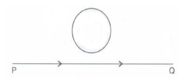
238) The figure shows a double-slit experimental set up for observing interference fringes due to different interference component colors of white light. What would be the predominant color of the fringes observed at the point



O (the central point)

P, where, S_2 P - S_1 P = $\frac{\lambda_b}{2}$? (Here, λ_b is the wavelength of the blue colour).

239) A conducting loop is help above a .current carrying wire 'PQ' as shown in the figure. Depict the direction of the current induced in the loop when the current in the wire PQ is constantly increasing.



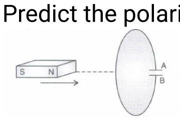
240) State which of the two a capacitor or an inductor, tends to become SHORT when the frequency of the applied alternating voltage has a high value

241) For an ideal conductor, connected across a sinusoidal ac voltage source. State which one of the following quantity is zero:

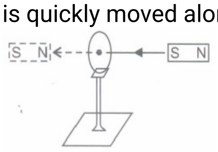
(i) Instantaneous power

(ii) Average power over full cycle of the ac voltage source

242) Predict the polarity of the plate A of the capacitor, when a magnet is moved towards it, as shown in the figure.



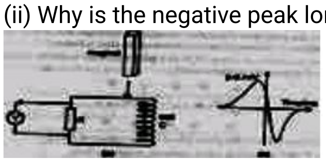
243) Give the direction in which the induced current flows in the coil mounted on an insulating stand when a bar magnet is quickly moved along the axis of the coil from one side to the other as shown.



244) A bar magnet M is dropped so that it falls vertically through the coil C. The graph obtained for voltage produced across the coil vs time is shown in figure (b).

(i) Explain the shape of the graph.

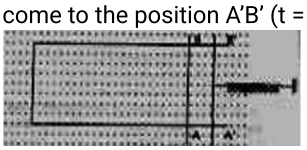
(ii) Why is the negative peak longer than the positive peak?



245) A cylindrical bar magnet is kept along the axis of a circular coil, when the magnet is rotated (a) about its own axis, and (b) about an axis perpendicular to the length of the magnet, in which case the induced emf will be more?

246) How is the mutual inductance of a pair of coils affected when separation between the coils is increased? The number of turns of each coil is increased? A thin iron sheet is placed between the two coils, other factors remaining the same? Explain your answer in each case.

247) A rectangular wire frame, shown below, is placed in a uniform magnetic field directed upward and normal to the plane of the paper. The part AB is connected to a spring. The spring is stretched and released when the wire AB has come to the position A'B' (t = 0). How would the induced emf vary with time? Neglect damping



248) Define self-inductance in terms of work done against the induced emf.

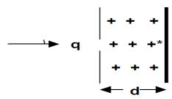
249) A circuit with a vertical copper wire bends as shown supports a small wooden piece W which floats in mercury. What do you expect when key is closed and current flows through the circuit?

250) An electron beam is deflected in a given field. Identify whether an electric field or a magnetic field in the following cases?

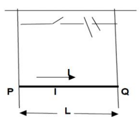
251) Alpha particles (m = 6.68 x 10^{-27} Kg., q = +2e) accelerated through a potential difference V to 2 kV, enter a magnetic field B = 0.2 T perpendicular to their direction of motion. Calculate the radius of their path

252) The above figure shows a horizontal solenoid connected to a battery and a switch. A copper ring is placed on a frictionless track near the solenoid, the axis of the ring being along the axis of the solenoid. What will happen to the ring as the switch is closed? Justify your answer

253) A particle with charge ‘q’ and mass ‘m’ is shot with kinetic energy K into the region between two plates as shown in the figure. If the magnetic field between the plates is B and as shown, how large must B be if the particle is to miss collision with the opposite plate?



254) A bar PQ of mass M is suspended by two wires as shown below. Assume that a uniform magnetic field B is directed into the page. Find the tension in each supporting wire when the current through the bar is I.



255) A bar of mass M is suspended by two springs as shown below. Assume that a magnetic field B is directed out of the page. Each spring has a spring constant K. Describe the bar’s displacement when a current I is sent through it in the direction shown

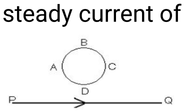
256) An equilateral triangle is formed from a piece of uniform resistance wire. Current is fed into one corner and led out of the other as detailed in the figure below. Show that the current flowing through the sides of the triangle produces no magnetic field at its centre ‘O’ (the intersection of the medians).

257) Determine the separate effects on the induced emf of a generator if (a) the flux per pole is doubled, and (b) the speed of the armature is doubled

258) A 40 Ohm resistor is connected across a 15 V variable frequency electronic oscillator. Find the current through the resistor when the frequency is (a) 100 Hz and (b) 100 kHz. What is the current if the 40 Ohm resistor is replaced by a 2 mH inductor?

259) A magnet is moved in the direction indicated by an arrow between two coils A and B as shown below. Suggest the direction of induced current in each coil L.

260) What is the magnitude of the induced current in the circular loop-A B C D of radius r, if the straight wire PQ carries a steady current of magnitude I ampere?



261) Why is spark produced in the switch of a fan, when it is switched off?

262) Coils in the resistance boxes are made from doubled up-insulated wire. Why?

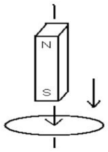
263) A galvanometer connected in an A.C. circuit does not show any deflection. Why?

264) A capacitor blocks D.C. but allows A.C to pass through it. Explain. Why?

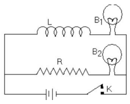
265) Can we use transformer to step up D.C. voltage? If not, why?

266) The algebraic sum of potential drop across the various – elements in LCR circuit is not equal to the applied voltage. Why?

267) A copper ring is held horizontally and bar magnet is dropped through the ring with its length along the axis of the ring. Will the acceleration of the falling magnet be equal to, greater than or less than that due to gravity?



268) The figure shows an inductor L and a resistance R connected in parallel to a battery through a switch. The resistance R Which of the bulbs lights up earlier, when K is closed? Will the bulbs be equally bright after the same time?



269) How does the self inductance of a coil change, when Number of turns in the coil is decreased? An iron rod is introduced into it. Justify your answer in each case

270) Figure shows two electric circuits A and B. Calculate the ratio of power factor of the circuit B to the Power factor of the circuit A

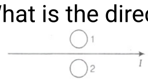
271) When a series combination of a coil of inductance L and a resistor of resistance R is connected across a 12 V-50 Hz supply, a current of 0.5. A flows through the circuit. The current differs in phase from applied voltage by $\frac{\Pi}{3}$ radian. Calculate the value of L and R.

272) An A.C. generator is connected to a sealed box through a pair of terminals. The box may contain R L C or the series combination of any two of the three elements. Measurements made outside the box reveal that E = 75 Sin ωt (in volt) and I = 1.2 sin $\left(\omega t+\frac{\Pi}{5}\right)$ (in ampere)Name the circuit elements.
(i) What is the Power factor of the circuit?
(ii) What is the rate, at which energy is delivered by the generator to the circuit?

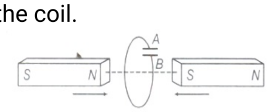
273) Does the current in an A.C. circuit lag, lead or remain in phase with the voltage of frequency υ applied to the circuit when
(i)υ - υ_r, (ii)υ < υ_r, (iii)υ > υ_r
where υ_r is the response frequency

274) Two different coils have self inductance L_1 = 8 mH and L_2 = 2 mH. At a certain instant, the current in the two coils is increasing at the same constant rate and the power supplied to the two coils is same. Find the ratio of
(a) induced voltage
(b) current and
(c) energy stored in the two coils at that instant?

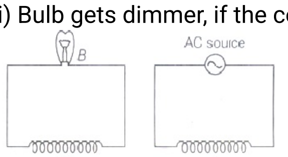
275) What is the direction of induced currents in metal rings 1 and 2, when current I in the wire is increasing steadily?



276) In the figure given, mark the polarity of plates A and B of a capacitor when the magnets are quickly moved towards the coil.



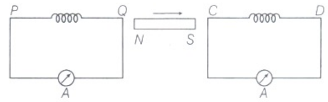
277) A coil Q is connected to low voltage bulb B and placed near another coil P as shown in the figure. Give reasons to explain the following observations
(i) The bulb B lights.
(ii) Bulb gets dimmer, if the coil Q is moved towards left



278) Two identical loops, one of copper and the other of aluminium are rotated with the same angular speed in the same magnetic field. Compare
(i) the induced emf and
(ii) the current produced in the two coils. Justify your answer.

279) State Lenz's law. A metallic rod held horizontally along East-West direction, is allowed to fall under gravity. Will there be an emf induced at its ends? Justify your answer.

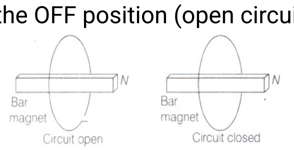
280) A bar magnet is moved in the direction indicated by the arrow between two coils PQ and CD. Predict the directions of induced current in each coil.



281) A rectangular loop of length l and breadth b is placed at distance of x from infinitely long wire carrying current i such that the direction of current is parallel to breadth. If the loop moves away from the current wire in a direction perpendicular to it with a velocity v, what will be the magnitude of emf in the loop?

282) A metallic rod of length L is rotated with angular frequency of ω with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius L, about an axis passing through the centre and perpendicular to the plane of the ring. A constant and a uniform magnetic field B parallel to the axis is present everywhere. Deduce the expression for the emf between the centre and the metallic ring.

283) Consider a magnet surrounded by a wire with an ON/OFF switch as shown in the 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

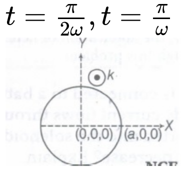


284) A wire in the form of tightly wound solenoid is connected to a DC source and carries a current I. If the coil is stretched, so that there are gaps between successive elements of the spiral coil, will the current increase or decrease? Explain.

285) 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

286) The magnetic flux through a coil perpendicular to the plane is given by $\phi = 5t^3 + 4t^2 + 2t$. Calculate induced emf through the coil at t = 2s.

287) Amagnetic field in a certain region is given by $|\mathbf{B} = B_0 \cos(\omega t)\hat{\mathbf{k}}$ 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 as shown in the figure. Find the magnitude and the direction of the current at (a, 0, 0) at
$t = \frac{\pi}{2\omega}, t = \frac{\pi}{\omega} \text{ and } t = \frac{3\pi}{2\omega}$



288) Define the term self-inductance of a coil. Write its SI unit.

289) Define mutual inductance. Write its SI unit.

290) How does the mutual inductance of a pair of coils change when
(i) distance between the coils is increased and
(ii) number of turns in the coils is increased?

291) Self-induction of an air core inductor increases from 0.01 mH to 10mH on introducing an iron core into it. What is the relative permeability of the core used?

292) 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. Give the dependence of mutual inductance.

293) A 200 turn coil of self-inductance 30 mH carries a current of 5 mA. Find the magnetic flux linked with each turn of the coil.

294) Along solenoid with 15 turns per cm has a small loop of area 2.0 cm^2 placed inside, normal to the axis of solenoid. If the current carried by the solenoid changes steadily from 2A to 4A in 0.1s, what is the induced voltage in the loop, while the current is changing?

295) A coil has a self-inductance of 10 mH.What is the maximum magnitude of the induced emf in the inductor, when a current I = 0.1 sin 200 t ampere is sent through it.

296) The flux linked with a large circular coil of radius R is 0.5 x 10^{-3} Wb. When a current of 0.5 A flows through a small neighbouring coil of radius r, calculate the coefficient of mutual inductance for the given pair of coils. If the current through the small coil suddenly falls to zero, what would be its effect in the larger coil?

297) A solenoid of radius 3 cm and length 1m has 600 turns per metre. Calculate its self-inductance.

298) 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?

299) On what factors does the magnitude of induced emf in a coil depend?

300) If a coil is removed from a magnetic field
(i) slowly and
(ii) rapidly, then in which case, more work will be done?

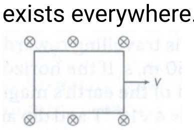
301) Why is a core of transformer laminated?

302) Give any two useful applications of eddy currents.

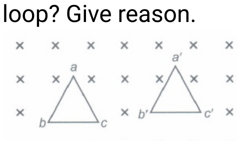
303) How can self-inductance of a given coil having N number of turns be changed, if N is doubled keeping other factors constant?

304) If two coils are very tightly wound over one another, will their mutual inductance increase or decrease as compared to the case when the coils are placed some distance apart?

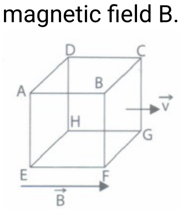
305) A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its sides. A magnetic induction B, constant in time and space, pointing perpendicular to the plane of the loop exists everywhere. What will be the current induced?



306) A triangular loop of wire placed at abc is moved completely inside a magnetic field which is directed normal to the plane of the loop away from the reader to a new position a'b'c', What is the direction of the current induced in the loop? Give reason.

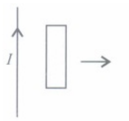


307) Twelve wires of equal length are connected to form a skeleton cube which moves with a velocity v parallel to the magnetic field B. What will be the induced emf in each arm of the cube?



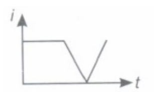
308) A circular loop is moved through the region of uniform magnetic field. Find the direction of induced current (clockwise or anticlockwise) when the loop moves (i) into the field, and (ii) out of the field.

309) A rectangular loop of wire is pulled to the righ, away from the long straight wire through which a steady current flows upwards. What is the direction of induced current in the loop?

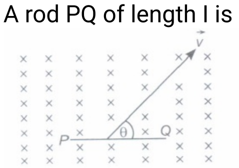


310) When a coil is rotated in a uniform magnetic field at constant angular velocity, will the magnitude of induced emf set up in the coil be constant? Why?

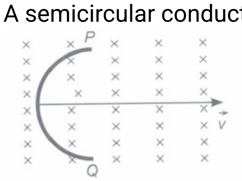
311) The current i in an induction coil varies with time t according to the adjoining graph. Draw the graph of induced emf with time.



312) A rod PQ of length l is moved in uniform magnetic field $\vec{B}$ as shown. What will be the emf induced in it?

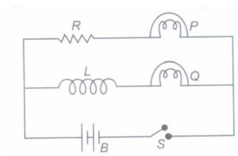


313) A semicircular conductor of radius R is moved in uniform magnetic field $\vec{B}$ as shown. Determine emf induced in it

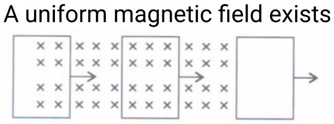


Which end is at higher potential?

314) The given figure shows an inductor L and resistor R connected in parallel to a battery B through a switch S. The resistance of R is the same as that of the coil that makes L. Two identical bulbs, P and Q are put in each arm of the circuit as shown in the figure. When S is closed, which of the two bulbs will light up earlier? Justify your answer.

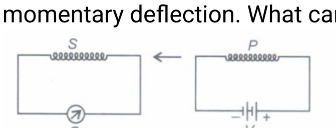


315) A uniform magnetic field exists normal to the plane of the paper over a small region of space.



A rectangular loop of wire is slowly moved with a uniform velocity across the field as shown in figure.
Draw the graph showing the variation of
(i) magnetic flux linked with the loop and
(ii) the induced emf in the loop with time.

316) (i) When primary coil P is moved towards secondary coil S(as shown in the figure below) the galvanometer shows momentary deflection. What can be done to have larger deflection in the galvanometer with the same battery?



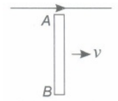
(ii) State the related law.

317) Obtain a relationship between the charge flowing through the circuit and the change in magnetic flux.

318) A conducting rod of length I is moved in a magnetic field of magnitude B with velocity v such that the arrangement is mutually perpendicular. Prove that the emf induced in the rod is $|\varepsilon| = B/v$.

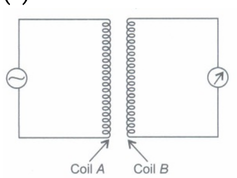
319) (i) How are eddy currents reduced in a metallic core?
(ii) Give two uses of eddy currents.

320) A wire and a rod AB are in the same plane. The rod moves parallel to the wire with the velocity v, then which end of the rod is at higher potential?



321) State Lenz's Law.
A metallic rod held horizontally along east-west direction, is allowed to fall under gravity. Will there be an emf induced at its ends? Justify your answer

322) The circuit arrangement given below shows that when an ac passes through the coil A, the current starts flowing in the coil B.
(i) State the underlying principle involved.
(ii) Mention two factors on which the current produced in the coil B depends.

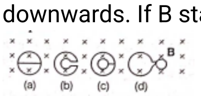


323) Obtain the expression for the mutual inductance of a pair of co-axial circular coils of radii rand R (R > r) placed with their centres coinciding.

324) What is meant by the term 'mutual inductance' of a pair of coils? Obtain an expression for the mutual inductance of two long coaxial solenoids, each of length but having different number of terms N_1 and N_2 and radii r_1 and r_2 ($r_2 > r_1$).

325) State the basic principle behind the working of an AC generator. Briefly describe its working and obtain the expression for the instantaneous value of emf induced.

326) Four shapes made of wires are situated in a magnetic field B, perpendicular to the plane of the paper, directed downwards. If B starts reducing. what will be the directions of the induced currents in these shapes?



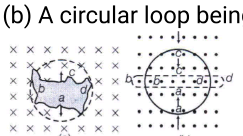
3 Marks 167 x 3 = 501

327) 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 = 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.

328) 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 1 cm 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?

329) 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.

330) Use Lenz's law to determine the direction of induced current in the situations described by Fig.
(a) A wire of irregular shape turning into a circular shape;
(b) A circular loop being deformed into a narrow straight wire



331) 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?

332) (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?

333) 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.

334) 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.

335) 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.

336) A horizontal straight wire 10 m long extending from east to west is falling with a speed of 50 m s^{-1}, at right angles to the horizontal component of the earth's magnetic field, 0.30 x 10^{-4} 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?

337) (i) Define self-inductance. Write its SI unit.
(ii) A long solenoid with 15 turns per cm has a small loop of area 2.0 cm^2 placed inside normal to the 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?

338) 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 feild 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?

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

340) Does current induced in a coil depend on its resistance?

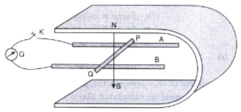
341) An air coil solenoid is connected to an ac source and a bulb. If an iron core is inserted in the solenoid, how does the brightness of the bulb change? Give reason for your answer.

342) Explain why the coils of the resistance box are wound over themselves.

343) Define the term self inductance. Write two factors on which the self inductance of a coil depends.

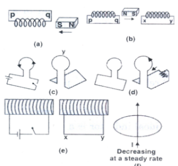
344) You are given two circular loops. How would you orient the loops to have
(i) largest mutual inductance and
(ii) the smallest mutual inductance?

345) Figure shows a metal rod PQ resting on the 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.



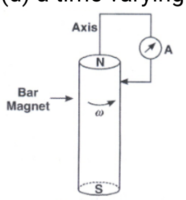
(a) Suppose K is open and the rod moved with a speed of $12 \mathrm{cm} s^{-1}$ in the direction shown. Give the polarity and magnitude of the induced e.m.f.
(b) Is there an excess charge built up at the end of the rods when K is open? What if K is closed?
(c) With K open and the rod moving uniformly, 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?
(e) How much power is required (by an external agent) to keep the rod moving at the same speed (=$12 \mathrm{cm} s^{-1}$) 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 e.m.f. in the moving rod if the magnetic field is parallel to the rails instead of being perpendicular?

346) Predict the direction of induced current in the situations described by the following Fig.



347) 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 $B=B_0\left(\hat{i}+\hat{k}\right) T$ 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) $4 B_0 L^2 Wb.$

348) A cylindrical bar magnet is rotated about its axis. 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 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.



349) 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 increases
(b) l decreases and A increases
(c) l increases and A decreases
(d) both l and A decreases.

350) A magnetic field of flux density 1.0 $Wb m^{-2}$ acts normal to a 80 turn coil of 0.01 m^2 area. Find the induced e.m.f. in the coil, if it is removed from the field in 0.1 s.

351) The magnetic flux through a coil perpendicular to its plane is varying according to the relation $\phi = \left(5t^3 + 4t^2 + 2t - 5\right) Wb$. Calculate the induced current through the coil at t = 2s, if the resistance of the coil is 10Ω.

352) A 30cm long conductor moves normal to a uniform magnetic field of 0.05 T at $20\ ms^{-1}$. Calculate the induced e.m.f.

353) If the a.c main supply is given to be 220V, what would be average e.m.f during a positive half cycle?

354) Write the general equation for instantaneous e.m.f of 50Hz generator whose peak voltage is 200V.

355) A coil has an inductance of $\frac{4}{\pi}H$ and is joined in series with a resistance of 30Ω . Calculate the current flowing in the circuit when connected to a.c mains of $200V$ and frequency $50Hz$.

356) An a.c supply of $10^4 Hz$ and $100V$ is connected across a circuit containing a resistance of 10Ω , an inductance of $1mH$ and capacitance $1\mu F$. Find the value of the capacitance in order than the current may be maximum.

357) A resistor of 12Ω , a capacitor of reactance 14Ω and an inductor of reactance 30Ω are joined in series and placed across a $230\ volt$, $50\ Hz$, supply. Calculate:
(i) the current in the circuit.
(ii) the phase angle between the current and the voltage, and
(iii) power factor.

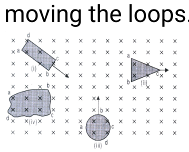
358) An a.c generator consists of a coil of 50 turns and area 2.5 cm^2 rotating at an angular speed off 60 rads^{-1} in a uniform magnetic field B = 30 t between two fixed pole pieces. The resistance of the circuit including that of the coil is 500Ω .
(a) What is the maximum current drawn from the generator?
(b) What is the flux through the coil when the current is zero? What is the flux when the current is maximum?
(c) Would the generator work if the coil were stationary and steady the pole pieces rotated together with the same speed as above?

359) The magnetic flux linked with a coil changes from 0.02 Wb to 0.04 Wb in 0.2 sec. Calculate the average induced e.m.f. in the coil. What will be the e.m.f. if the flux of 0.02 Wb reverses its direction in 2 milli sec?

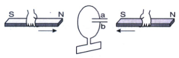
360) A coil has an inductance of 0.03 H. Calculate the e.m.f. induced when current in the coil changes at a rate of $200As^{-1}$

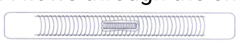
361) A solenoid is 0.5 m long and has radius 0.01 m. If it has 500 turns and is wound on a material of relative permeability 800, calculate the coefficient of self-inductance.

362) Figures below show planes of different shapes moving out of or into a region of magnetic field which included normal to the plane of the loops away from the reader. Determine the direction of induced current in each loop using Lenz's law. Check if you would obtain the same answers by considering magnetic force on the charges inside the moving the loops.



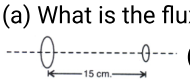
363) Figures ahead show three different orientations of a circuit coil taking in the magnetic field between the poles of a horse-shoe magnet.
(a) Determine the directions of induced current in the coil if the rotation is anticlockwise as viewed by the reader.
(b) In which orientation during rotation (with uniform angular speed) is the induced e.m.f. greatest?

364) Answer the following questions:
(a) A conducting loop is held stationary normal to the field between the N-S poles of a field permanent magnet. By choosing a magnet sufficiently strong, can we hope to generate current in the loop?
(b) A closed conducting loop moves normal to the electric field between the plates of a large capacitor.Is a current induced in the loop when it is
(i) wholly inside the capacitor.
(ii) 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 to the field free region with a constant velocity. In which loop do you expect the induced e.m.f. to be constant during the passage out of the field region? The field is normal to the loops
(d) Predict the polarity of the capacitor in the situation described by the figure below:


365) Figure shows a short solenoid of length 4cm, radius 2.0 cm and number of turns 100 lying inside on the axis of a long solenoid, 80 cm in length and number of turns 1500. What is the flux through the long solenoid if a current 3.0 A flows through the short solenoid? Also obtain the mutual inductance of the two solenoids.


366) A toroidal solenoid with an air core has an average radius of 15 cm, area of cross-section 12 cm^2 and 1200 turns. Obtain the self-inductance of the toroid. Ignore field variation across the cross-section of the toroid. A second coil of 300 turns is wound closely on the toroid above. If the current in the primary coil is increased from zero to 2.0 A in 0.05 s, obtain the induced e.m.f. in the second coil.

367) (a) A circuit contains two inductors in series, with self-inductances L_1 and L_2 and mutual inductance M. Obtain a formula for the equivalent inductance M. Obtain a formula for the equivalent inductance in the circuit.
(b) Two inductors of self-inductances L_1 and L_2 are connected in parallel. The inductors are so far apart that their mutual inductance is negligible. What is the equivalent inductance is negligible. What is the equivalent inductance of the combination?

368) A circular loop of radius 0.3 cm lies parallel to a much bigger circular loop of radius 20 cm. The centre of the small loop is on the axis of the bigger loop. The distance between their centres is 15 cm.
(a) What is the flux linking the bigger loop if a current of 2.0 A flows through the smaller loop?


(b) Obtain the mutual inductance of the two loops.

369) Rita noticed that the transformer in her locality gets damaged quite often leading to long power cuts. She complained to the power distribution company with the help of her father and got the transformer replaced?
(i) What is the principle of a transformer?
(ii) Mention two losses which take place in a transformer.
(iii) Values exhibited by Rita in dealing with the above situation.

370) Mr.Ramesh a physics teacher, was doing an experiment in lab using dry cell battery. The dry cell was weak, giving less voltage, which was not sufficient to give proper reading. One of the students asked, "Sir, can't we step-up the voltage using a transformer?" Teacher replied, "No, we cannot step up DC voltage using step up transformer and explained the reason and working of a transformer". The student then constructed a transformer for his physics project and studied the factors responsible for losses in a transformer.
1. What values are displayed by the student?
2. Why can transformer not be used to step-up DC voltage?

371) Rahul after having lived in US for 12 years returned back to India. He had a discussion with his cousin Sumit on domestic power supply in US and in India.In US domestic power supply is at 110V, 50Hz, whereas in India it is 220V, 50Hz.. Rahul was stressing that US supply is better than Indian supply. Both went to Sumit's father an electrical Engineer and asked his opinion on the issue. He explained that both the supplies have advantages as well as disadvantages.
1. What values are used by Rahul and Summit?
2. Write one advantage and one disadvantage of 220V supply over 110V supply.

372) A coil with an average diameter of 0.02m is placed perpendicular to a magnetic field of 6000 T. If the induced e.m.f. is 11 V when magnetic field is changed to 1000 T in 4 s, what is the number turns in the coil?

373) An air cored solenoid with length 50 cm and area of cross section $28\ cm^2$ has 200 turns and carries a current of **5.0** A. On switching off, the current decreases to zero in 0.1 ms. Find the average e.m.f. induced across the ends of the solenoid.

374) A square copper coil of each side 8 cm consists of 100 turns. The coil is initially in vertical plane, such that the plane of the coil is normal to uniform magnetic field of induction $0.4 Wb\ m^{-2}.$ The coil is turned through 180° about a horizontal axis in 0.2 s. Find the induced e.m.f.

375) The area of a coil of 25 turns is $1.6\ cm^2$ This coil is inserted in 0.3 sec in a magnetic field of $1.8 Wb/m^2$ such that its plane is perpendicular to the flux lines of the field. Calculate the e.m.f. induced in the coil. Also, calculate the total charge that passes through the wire, if its resistance is 10Ω

376) A uniform magnetic field B exists in a direction perpendicular to the plane of a square frame made of copper wire. The wire has a diameter of 2 mm and a total length of 40 cm. The magnetic field changes with time at a steady rate dB/dt=0.02 T/s. Find the current induced in the frame. Resistivity of copper$= 1.7 \times 10^{-8}\ ohm^{-m}$

377) A wire 88 cm long bent into a circular loop is placed perpendicular to the magnetic field of flux density $2.5 Wb\ m^{-2}$. Within 0.5sec, the loop is changed into a square of each side 22 cm and flux density is increased to $3.0 Wb\ m^{-2}.$ Calculate the value of e.m.f. induced.

378) A closely wound rectangular coil of 200 turns and size 0.30 x 0.05 m is placed perpedicular to a magnetic field of induction $0.20\ Wb\ m^{-2}.$ Calculate the induced e.m.f. in the coil, when magnetic induction e.m.f. in the coil, when magnetic induction drops to $0.15\ Wb\ m^{-2}$ in 0.02 s.

379) A circular copper disc of 10cm radius rotates at 20π radian/sec about an axis through its centre and perpendicular to the disc. A uniform magnetic field of 0.2T acts perpendicular to the disc. Calculate the potential difference developed between axis of the disc and the rim. What is the induced current if resistance of disc in 2 ohm?

380) A metre gauge train is running due north with a constant speed of $90 kmh^{-1}$ on a horizontal track. If the vertical component of earth's magnetic field is $3 \times 10^{-5} Wb\ m^{-2},$ calculate the e.m.f. induced across the axle of the train of length 1.25m.

381) A metal disc of radius 200cm is rotated at a constant angular speed of $60\ rad\ s^{-1}$ in a plane at right angles to an external field of magnetic induction $0.05\ Wb\ m^{-2}$. Find the e.m.f induced between the centre and a point on the rim.

382) The distance between the edges of the wings of an aeroplane is 30 metre. It is landing down with a velocity of 300 km/hr. If while landing, the wings of the aeroplane be east-west, find out the potential difference between the edges of the wings. What will happen if the wings are along north south. Take H = 0.4 gauss.

383) A jet plane is travelling west at 450 m/s. If the horizontal component of earth's magnetic field at that place is 4×10^{-4} T and the angle of dip is 30° , find the e.m.f. induced between the ends of wings having a span of 30 m.

384) A circular disc of radius 20cm is rotating with a constant angular speed of 2.0 rad/s in a uniform magnetic field of 0.2 T. Find the emf induced between the centre and rim of the disc. Given magnetic field is along the axis of rotation of disc.

385) An aeroplane is travelling west at the speed of 500 m/s. What is the voltage difference between the ends of the wings 25 m long, if the earth's magnetic field at the location has a magnitude of $5 \times 10^{-4} T$ and dip angle is 30° ?

386) An inductor of 5 H inductance carries a steady current of 2 A. How can a 50 V self induced e.m.f. be made to appear in the inductor?

387) The current in a solenoid of 240 turns, having a length of 12 cm and radius of 2 cm, changes at the rate of $0.8 As^{-1}.$ Find the emf induced in it.

388) Magnetic flux of 5 microweber is linked with a coil when a current of 1mA flows through it. What is self-inductance of the coil?

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

390) If self induction of an air core solenoid increases from 0.04 mH to 16 mH on introducing an iron core into it, what is relative magnetic permeability of the core?

391) A small piece of metal wire is dragged across the gap between the pole pieces of a magnet in 10 s. The magnetic flux between the pole pieces is $8 \times 10^{-4} Wb.$ Find the magnitude of induced e.m.f.

392) A carspark coil developes an induced e.m.f. of 40000 V in the secondary when current in its primary changes from 4A to zero in $10 \mu s.$ What is the mutual inductance of the coil?

393) 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. across the ends of the secondary coil if this change occurs in 0.5 sec.

394) An a.c. generator consists of a coil of 2000 turns each of area and rotating at an angular speed of 200 rpm in a uniform magnetic field of $4.8 \times 10^{-2} T.$ Calculate the peak and rms values of e.m.f. induced in the coil.

395) A flat coil of 500 turns each of area $50 cm^2$ rotates in a uniform magnetic field of at an angular speed of 150 rad/sec. The coil has a resistance of 5Ω . The induced e.m.f. is applied to an external resistance of 10 ohm. Calculate the peak current through the resistance.

396) A coil has 50 turns and its area is.$500\ cm^2$ It is rotating at the rate of 50 r.p.s at right angles to a magnetic field of.$0.5\ Wb/m^2$ Calculate the maximum value of electromotive force developed across the ends of the coil.

397) A generator developes an e.m.f of 120 V and has a terminal potential difference of 115 V, when the armature current is 25 A. What is the resistance of the armature?

398) Compute the mutual inductance for a given pair of coils if increase in current from 2A to 6A in 0.1 s in one causes an induced e.m.f. of 1 V in the other coil.

399) A conducting circular loop is placed in a uniform magnetic field B=0.020 T with its plane perpendicular to the field. Somehow, the radius of the loop starts shrinking at a constant rate of 1.0mm/s. Find the induced e.m.f. in the loop at an instant when the radius is 2 cm?

400) Magadh express takes 16 hours to cover the distance of 960 km between Patna and Ghaziabad. The rails are separated by 130 cm and the vertical component of the earth's magnetic field is $4.0 \times 10^{-5} T.$ (a) Find the average e.m.f. induced across the width of the train.(b) If the leakage resistance between the rails is $100 \Omega,$ find the retarding force on the train due to the magnetic field.

401) A metallic wire bent in the form of a semi-circle of radius 0.1 m is moved in a direction parallel to its plane, but perpendicular to a magnetic field B = 20mT with a vel. of 10 m/s. Find the e.m.f. induced in the wire.

402) What is expression for magnetic energy stored in an inductor. Compare it with the electrostatic energy stored in a capacitor.

403) The resistance of the armature of an electric motor is 55 ohm. The motor draws a current of 2 A when running at 220 V. What is the back e.m.f.?

404) A motor runs at 220 V. The resistance of the armature is 11 ohm. If the back emf produced is 198 V, when at full speed, then calculate the current through armature, when
(i) motor is just switched on and
(ii) motor is at full speed.

405) A transformer has 200 primary turns and 150 secondary turns. If the operating voltage for the load connected to the secondary is measured to be 300 V, what is the voltage supplied to the primary?

406) An a.c. source of internal resistance is 9000Ω to supply current to a load resistor of 10 ohm. How should the source be matched to the load and what is the ratio of the currents passing through the load and the source?

407) A coil of resistance 20 ohm and inductance 0.5H is connected to direct current supply of 200 V. Calculate the rate of increases of current at
(i) the instant of closing the switch,
(ii) at t = L/R seconds after the switch is closed, Also calculate steady value of current in the circuit.

408) A capacitor charged to 10 V is being discharged through a resistance R. At the end of 1s, the voltage across the capacitor is 5V. What will be the voltage after 2s?

409) A capacitor of $2\ \mu\ F$ is connected to 10 V supply through 1 mega ohm resistance. How long will it take the capacitor to charge up to 63.2% of its final charge? Also, calculate the maximum value of charge.

410) A capacitor of $1\ \mu F$ is placed in series with a resistor of 2 mega-ohm and a battery of emf 2 V. Calculate the time after which the charge will grow to 86.47% of its max. value.

411) The equation of a.c. in a circuit is $I = 50\ sin\ 100\ \pi\ t$ Find
(i) frequency of a.c.
(ii) mean value of a.c. over positive half cycle
(iii) rms value of current
(iv) value of current $\frac{1}{300} s$ after it was zero.

412) The instantaneous value of alternating voltage is given by $E = 140\ sin\ 300t$. What is rms value of voltage and frequency of supply?
Take $\pi = 3$ and $\sqrt{2} = 1.4$.

413) The electric current in a circuit is given by $i = i_0\ (t/\tau)$ for some time. Calculate the r.m.s current for the period $t = 0$ to $t = \tau$.

414) An alternating e.m.f of peak value 350 V is applied across an ammeter of resistance 100 ohm. What will be the leading of ammeter?

415) A 100 ohm iron is connected to a 110 V-60 hertz wall plug. What is
(i) peak pot. diff.
(ii) average potential diff. over a half cycle and
(iii) rms current?

416) Alternating emf of $E = 220\ sin\ 100\ \pi t$ is applied to a circuit containing an inductance of $(1/\pi)$ henry. Write equation for instantaneous current through the circuit. What will be the reading of a.c. galvanometer connected in the circuit?

417) A capacitor of capacitance $10 \mu F$ is connected to an oscillator giving an output voltage $E = 10\ sin\ \omega t$ volt. If $\omega = 10$ rad/s, find the peak current and instantaneous current.

418) When a series combination of inductance and resistance are connected with a 10 V, 50 Hz a.c. source, a current of 1 A flows in the circuit. The voltage leads the current by a phase angle of $\pi/3$ radian. Calculate the values of resistance and inductance.

419) An a.c. voltage of 100 V, 50 Hz is connected across a 20 ohm resistor and 2 mH inductor in series. Calculate
(i) impedance of the circuit,
(ii) rms current in the circuit.

420) A inductor inductance 100 mH is connected in series with a resistance, a variable capacitance and an ac source of frequency 2.0 kHz. What should be the value of the capacitance so that maximum current may be drawn into the circuit?

421) A series LCR circuit with $C = 80\ \mu F,\ L = 5.0\ H$ and $R = 40 \Omega$ is connected to a variable frequency 240 V a.c. source. Calculate
(i) angular frequency of the source which drives the circuit in resonance.
(ii) current at the resonating frequency.
(iii) rms pot. drop across the capacitor.

422) An $e.m.f.\ E = 100\ sin\ 314\ t$ is applied across pure capacitor of $637\ \mu F$. Calculate the instantaneous power P and maximum energy stored in the capacitor.

423) Find the natural frequency of a circuit containing inductance of $100\ \mu\ H$ and a capacity of $0.01\ \mu\ F$. To which wavelength, its response will be maximum? For how long will the oscillations continue?

424) A coil of resistance $15\ \Omega$ and inductance 10 H is connected across a 90 V dc supply. Determine the value of current after 2 sec. What is the energy stored in the mag. field at that instant?

425) A coil of inductance 1.0 H and resistance $100\ \Omega$ is connected to a battery of $e.m.f\ 12V$. Find the energy stored in the magnetic field associated with the coil at an instant 10 ms after the circuit is switched on?

426) The dielectric strength of air is $3.0 \times 10^6 V/m$. A parallel-plate air capacitor has area $20cm^2$ and plate separation 1.0 mm. Find the maximum $r.m.s$ voltage of an ac source which can be safely connected to this capacitor?

427) Current in a circuit falls from 5.0 A to 0.0A in 0.1s. If an average e.m.f. of 200V is induced, give an estimate of the self inductance of the circuit?

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

429) (i) State Faraday's law of electromagnetic induction.
(ii) A jet plane is travelling west at the speed of 1800 km/h. What is the voltage difference developed between the ends of the wing 25m long, if the earth's magnetic field at the location has a magnitude of 5.0×10^{-4} T and the dip angle is 30° ?

430) Suppose the loop in Q.4 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 0.02T/sec. If the cut is joined and loop has a resistance of 1.6Ω , how much power is dissipated by the loop as heat? What is the source of this power?

431) A 100 resistor is connected to a 220V, 50Hz ac supply.
(a) What is the rms value of current in the circuit?
(b) What is the net power consumed over a full cycle?

432) A coil of 0.01 henry inductance and 1 ohm resistence is connected to 200 volt, 50Hz ac supply. Find the impedance of the circuit and time lag between max. alternating voltage and current.

433) Explain why the reactance provided by a capacitor to an alternating current decreases with increasing frequency.

434) Explain why the reactance offered by an inductor increases with increasing frequency of an alternating voltage.

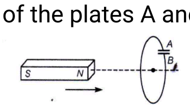
435) A horizontal telephone wire 1km long is lying along east-west in earth's magnetic field. It falls freely to the ground from a height of 10m. Calculate the e.m.f. induced in the wire on striking the ground. Given horizontal component of earth's field is 0.32 gauss.

436) A 20 V, 750 Hz source is connected to a series combination of R = 100Ω , C = 10μ F and L = 0.1803H. Calculate the time in which resistance will get heated by $10^\circ C$, if thermal capacity of the material = 2 J/$^\circ C$.

437) A choke is needed to operate an arc lamp at 160 V, 50Hz. The lamp has a resistence of 5Ω when running at 10A. Calculate inductance of the choke coil. If the same arc lamp is to be operated on 160V d.c., what additional resistance is required? Compare the power losses in both cases.

438) Calculate the instantaneous voltage for AC supply of 220V and 50Hz.

439) In the given figure, a bar magnet is quickly moved towards a conducting loop having a capacitor. Predict the polarity of the plates A and B of the capacitor.



440) A wire of length 0.3 m moves with a speed of 20 m/s perpendicular to the magnetic field of induction 1 Wb/m^2 .calculate the induced emf.

441) What is the self-inductance of a solenoid of length 40 cm, area of cross-section 20 cm^2 and total number of turns is 800?

442) The current flowing in the two coil of self-inductance $L_1 = 16\ mH$ and $L_2 = 12\ mH$ are increasing at the same rate. If the power supplied to the two coils are equal, find the ratio of
(i) induced voltages
(ii) the currents and
(iii) the energies stored in the coil at a given instant.

443) A step-up transformer is operated on a 2.5 kV line. It supplies a load with 20 A. The ratio of the primary winding to the secondary is 10:1. If the transformer is 90% efficient, calculate

(i) the power output

(ii) the voltage and

(iii) the currrent in the secondary.

444) An AC generator consists of coil of 100 turns and cross-sectional area of 3 m^2, rotating at a constant angular speed of 60 rad s^{-1} in a uniform magnetic field 0.04 T. The resistance of the coil is $500\ \Omega$. Calculate

(i) maximum current drawn from the generator and

(ii) maximum power dissipation of the coil.

445) An inductor L of inductances X_L is connected in series with a bulb B and an AC source.How would brightness of the bulb change when

(i) number of turns in the inducer is reduced

(ii) an iron rod is reactance $X_C = X_L$ is inserted in series in the circuit. Justify your answer in each case.

446) A rectangular loop an area $20cm \times 30cm$ is placed in magnetic field of 0.3T with its plane

(i) normal to the field

(ii) inclined 30^0 to the field and

(iii) parallel to the field.

Find the flux linked with the coil in each case.

447) A $100\mu F$ capacitor in series with a $40\ \Omega$ resistance is connected to a 110V, 60 Hz supply.

(i) What is the maximum current in the circuit?

(ii) What is the time lag between the current maximum and the voltage maximum?

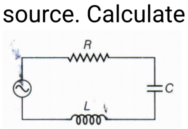
448) (i) When an AC source is connected to an ideal capacitor.Show that the average power supplied by the source over a complete cycle is zero.

(ii) A lamp is connected in series with a capacitor in series with a capacitor. Predict your observation when the system is connected first across a Dc and then an AC source. What happens in each, if the capacitance of the capacitor is reduced?

449) (i) A rod of length l is moved horizontally with a uniform velocity ν in a direction perpendicular to its length through which a uniform magnetic field is acting vertically downward. Derive the expression for the emf induced across the ends of the rod.

(ii) How does one understand this motional emf by invoking the Lorentz force acting on the free charge carriers of the conductor? Explain.

450) The figure shows a series L-C-R circuit with L = 10.0H, $C = 40\mu F$, $R = 60\Omega$ connected to variable 240V source. Calculate

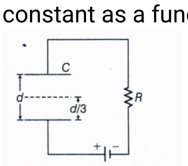


(i) the angular frequency of the source which drives the circuit at resonance.

(ii) the current at the resonating frequency.

(iii) the rms potential drop across the inducer at resonance.

451) A parallel plate capacitor C with plates of unit area and separations d is filled with a liquid of dielectric constant K = 2. The level of liquid is d/3 initially. Suppose the liquid level decreases at a constant speed v. What will be the time constant as a function of time t?

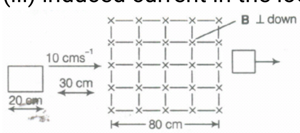


452) Find the value of the phase lag/lead between the current and voltage in the given series LCR circuit. Without making any other change, find the value of the additonal capacitor, such that when suitably joined to the capacitor (C = 2muF) as shown. What would make the power factor of this circuit as unity?

453) Define the term 'mutual inductance' between the two cells Obtain the expression for mutual inductance of a pair of long coaxial solenoids each of length l and radii r_1 and r_2 ($r_2 >> r_1$) Total number of turns in the two solenoids are N_1 and N_2 respectively

454) (i) Describe a simple experiment (or activity) to show that the polarity of emf induced in a coil is always such that it tends to produce a current which opposes the change of magnetic flux that produces it.
(ii)The current flowing through an induction of self inductance L is continuosly increasing. Plot a graph showing the variation of
1. Magnetic flux versus the current
2. Induced emf versus dI/dt
3. Magnetic potential energy stored versus the current.

455) A square loop of side 20 cm is initially kept 30 cm away from a region of uniform magnetic field of 0.1 T as shown in the figure. It is then moved towards the right with a velocity of 10 cm S^{-1} till it goes out of the field. Plot a graph showing the variation of
(i) magnetic flux (ϕ) through the loop with time (t).
(ii) induced emf (ε) in the loop with time t.
(iii) induced current in the loop, if it has resistance of 0.1Ω.



456) Consider the motion of a charged particle of mass m and charge q moving with velocity v in a magnetic field B.
(i) If v is perpendicular to B, then show that its describes a circular path having angular frequency c.o = qB/ m.
(ii) If the velocity v has a component parallel to the magnetic field B, then trace the path described by the particle. Justify your answer.

457) (i) Define the term 'self-inductance' and write its SI unit.
(ii) Obtain the expression for the mutual inductance of two long co-axial solenoids S_1 and S_2 wound one over the other, each of length L and radii r_1 and r_2 and n_1 and n_2 number of turns per unit length, when a current I is set up in the outer solenoid S_2.

458) Define mutual inductance between a pair of coils. Derive an expression for the mutual inductance of two long coaxial solenoids of same length wound one over the other.

459) Draw a schematic sketch of an AC generator describing its basic elements. State briefly its working principle. Show a plot of variation of
(i) magnetic flux and
(ii) alternating emf versus time generated by a loop of wire rotating in a magnetic field.

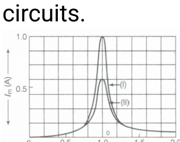
460) Deduce an expression for the mutual inductance of two long coaxial solenoids but having different radii and different number of turns.

461) A voltage V = V_0 sin ωt is applied to a series L-C-R circuit. Derive the expression for the average power dissipated over a cycle. Under what conditions is
(i) no power dissipated even through the current flows through the circuit
(ii) maximum power dissipated in the circuit?

462) A series L-C-R circuit is connected to an AC source. Using the phasor diagram, derive the expression for the impedance of the circuit. Plot a graph to show the variation of current with frequency of the source, explaining the nature of its variation.

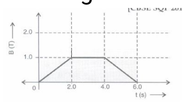
463) An AC voltage, V = V_0 sin rot is applied across a pure capacitor, C. Obtain an expression for the current I in the circuit and hence obtain the capacitive reactance of the circuit and the phase of the current flowering with respect to the applied voltage.

464) The graphs shown here depict the variation of current Irms with angular frequency ωt for two different series L-C-R circuits.



Observe the graphs carefully. State the relation between L and C values of the two circuits when the current in the two circuits is maximum. Indicate the circuit for which power factor is higher quality factor Q is larger. Give the reasons for each case.

465) The magnetic field through a single loop of wire, 12 cm in radius and 8.5Ω resistance, changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop. Plot induced current as a function of time



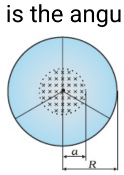
466) Define the term self-inductance of a solenoid. Obtain the expression for the magnetic energy stored in an inductor of self-inductance L to build up a current I through it.

467) (a) Define self-inductance of a coil and hence write the definition of 'Henry'.
(b) Write any two factors each on which the following depends
(i) Self-inductance of a coil.
(ii) Mutual inductance of a pair, of coils

468) Derive the expression for the magnetic energy stored in a solenoid in terms of magnetic field B, area A and length 1of the solenoid carrying a steady current I. How does this magnetic energy per unit volume compare with the electrostatic energy density stored in a parallel plate capacitor?

469) A 200 mH (pure) inductor and a 5μ F(pure) capacitor are connected one by one, across a sinusoidal ac voltage source V-[70.7 sin (1000 t)] voltage obtain the expressions for the current in each case.

470) 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 non-conducting spokes and is free to rotate without friction about its axis A uniform magnetic field extends over a circular region within the rim. It is given by,
B = – B0 k (r ≤ a; a < R)
= 0 (otherwise)
What is the angular velocity of the wheel after the field is suddenly switched off?

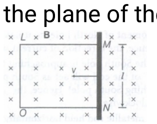


471) How does one understand this motional emf by invoking the Lorentz force acting on the free charge carriers of the conductor? Explain.

472) A metallic rod of length I is rotated with a frequency v with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius r, about an axis passing through the centre and perpendicular to the plane of the ring.
A constant uniform magnetic field B parallel to the axis is present everywhere. Using Lorentz force, explain how emf is induced between the centre and the metallic ring and hence obtain the expression for it?

473) A rectangular loop of area 20 cm x 30 cm is placed in magnetic field of 0.3 T with its plane
(i) normal to the field
(ii) inclined 30° to the field and
(iii) parallel to the field.
Find the flux linked with the coil in each case.

474) A rectangular conductor LMNO is placed in a uniform magnetic field of 0.5 T. The field is directed perpendicular to the plane of the conductor.



When the arm MN of length 20 cm is moved towards left with a velocity of 10ms^{-1}, calculate the emf induced in the arm. Given, the resistance of the arm to be 5Ω (assuming that other arms are of negligible resistance), find the value of the current in the arm.

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

476) Starting from the expression for the energy, $W = \frac{1}{2}LI^2$ stored in a solenoid of self-inductance. L to build up the current I, obtain the expression for the magnetic energy in terms of the magnetic field B, area A and length l of the solenoid having n number of turns per unit length. Hence, show that the energy density is given by $B^2/2\mu_0$

477) The current through two inductors of self-inductance 12mH and 30 mH is increasing with time at the same rate. Draw graphs showing the variation of the
(i) emf induced with the rate of change of current in each inductor.
(ii) energy stored in each inductor with the current flowing through it. Compare the energy stored in the coils, if the power dissipated in the coils is the same.

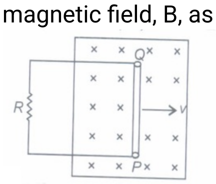
478) (ii) Why is choke coil needed in the use of fluorescent tubes with AC mains?

479) State the principle of an AC generator and explain its working with the help of a labelled diagram. Obtain the expression for the emf induced in a coil having N turns each of cross-sectional area A, rotating with a constant angular speed to in a magnetic field (B), directed perpendicular to the axis of rotation.

480) An AC generator consists of coil of 100 turns and cross-sectional area of 3 m^2, rotating at a constant angular speed of 60 rad s^{-1} in a uniform magnetic field 0.04 T. The resistance of the coil is 500Ω. Calculate
(i) maximum current drawn from the generator and
(ii) minimum power dissipation of the coil.

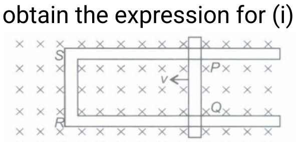
481) State Lenz's Law. Does it violate the principle of conservation of energy. Justify your answer.

482) A conducting rod, PQ, of length l, connected to a resistor R, is moved at a uniform speed, v, normal to a uniform magnetic field, B, as shown in the figure.



(i) Deduce the expression for the emf induced in the conductor.
(ii) Find the force required to move the rod in the magnetic field.
(iil) Mark the direction of induced current in the conductor.

483) Figure shows a rectangular loop conducting PQRS in which the arm PQ is free to move. A uniform magnetic field acts in the direction perpendicular to the plane of the loop. Arm PQ is moved with a velocity v towards the arm RS. Assuming that the arms QR, RS and SP have negligible resistances and the moving arm PQ has the resistance r, obtain the expression for (i) the current in the loop (ii) the force and (UI) the power required to move arm PQ.



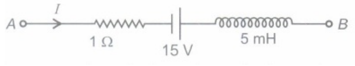
484) An aeroplane is flying horizontally from west to east with a velocity of 900 kml/hour. Calculate the potential difference developed between the ends of its wings having a span of 20 m. The horizontal component of the Earth's magnetic field is 5 x 10^{-4} T and the angle of dip is 30°.

485) A circular coil of cross-sectional area 200 cm^2 and 20 turns is rotated about the vertical diameter with angular speed of 50 rad s^{-1} in a uniform magnetic field of magnitude 3.0 x 10^{-2} T. Calculate the maximum value of the current in the coil

486) The magnetic flux linked with a closed circular loop of radius 20 cm and resistance 2 Ω at any instant of time is Φ = 4t + 3.
where Φ is in milliweber and time 't' in sec.
Find (i) flux linked with a loop at 1 = 3 s
(b) induced emf at t = 2 s and
(iii) plot a graph between
(a) Φ and t (b) ε and t

487) A horizontal conducting rod 10 m long extending from east to west is falling with a speed 5.0 ms^{-1} at right angles to the horizontal component of the Earth's magnetic field, 0.3 x 10-4 Wb m^{-2}. Find the instantaneous value of the emf induced in the rod.

488) The network shown in the figure is part of a complete circuit. If at a certain instant of time the current (I) is 5A and is decreasing at a rate of 10^3 A/s, find out VB - VA.



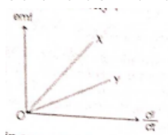
489) The currents flowing in the two coils of self-inductance L_1 = 16 mH and L_2 = 12 mH are increasing at the same rate. If the power supplied to the two coils are equal, find the ratio of
(i) induced voltages,
(ii) the currents and
(iii) the energies stored in the two coils at a given instant.

490) The magnetic flux threading a coil changes from 12 x 10^{-3} Wb to 6 x 10^{-3} Wb in 0.01 s. Calculate the induced emf.

491) If a rate of change of current of 4 AS^{-1} induces an emf of 20 mV in a solenoid, what is the self-inductance of the solenoid?

492) (i) State the principle on which AC generator works. Draw a labelled diagram and explain its working.
(ii) A conducting rod held horizontally along East-West direction is dropped from rest from a certain height near the Earth's surface. Why should there be an induced emf across the ends of the rod? Draw a plot showing the instantaneous variation of emf as a function of time from the instant it begins to fall.

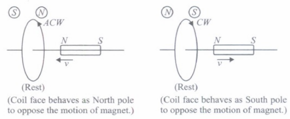
493) (i) The figure shows the variation of induced emf as a function of rate of change of current for two identical solenoids X and Y. One is air cored and the other is iron cored. Which one of them is iron cored? Why?



(ii) Obtain an expression for self-inductance of a long solenoid of length L. and cross-sectional area A having N turns.

Case Study Questions 12 x 4 = 48

494) Lenz's law states that the direction of induced current in a circuit is such that it opposes the change which produces it. Thus, if the magnetic flux linked with a closed circuit increases, the induced current flows in such a direction that magnetic flux is created in the opposite direction of the original magnetic flux. If the magnetic flux linked with the closed circuit decreases, the induced current flows in such a direction so as to create magnetic flux in the direction of the original flux.



(i) Which of the following statements is correct?

(a) The induced e.m.f is not in the direction opposing the change in magnetic flux so as to oppose the cause which produces it.

(b) The relative motion between the coil and magnet produces change in magnetic flux.

(c) Emf is induced only if the magnet is moved towards coil.

(d) Emf is induced only if the coil is moved towards magnet

(ii) The polarity of induced emf is given by

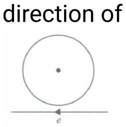
(a) Ampere's circuital law (b) Biot-Savart law

(c) Lenz's law (d) Fleming's right hand rule

(iii) Lenz's law is a consequence of the law of conservation of

(a) charge (b) mass (c) momentum (d) energy

(iv) Near a circular loop of conducting wire as shown in the figure, an electron moves along a straight line. The direction of the induced current if any in the loop is



(a) variable (b) clockwise

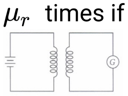
(c) anticlockwise (d) zero

(v) Two identical circular coils A and B are kept in a horizontal tube side by side without touching each other. If the current in coil A increases with time, in response, the coil B.

(a) is attracted by A (c) is repelled

(c) is repelled (d) rotates

495) Mutual inductance is the phenomenon of inducing emf in a coil, due to a change of current in the neighbouring coil. The amount of mutual inductance that links one coil to another depends very much on the relative positioning of the two coils, their geometry and relative separation between them. Mutual inductance between the two coils increases μ_r times if the coils are wound over an iron core of relative permeability μ_r .



(I) A short solenoid of radius a, number of turns per unit length nI' and length L is kept coaxially inside a very long solenoid of radius b, numbdr of turns per unit length n_2• What is the mutual inductance of the system?

(a) $\mu_0 \pi b^2 n_1 n_2 L$ (b) $\mu_0 \pi a^2 n_1 n_2 L^2$ (c) $\mu_0 \pi a^2 n_1 n_2 L$ (d) $\mu_0 \pi b^2 n_1 n_2 L^2$

(ii) If a change in current of 0.01 A in one coil produces a change in magnetic flux of 2 x $l0^{-2}$ weber in another coil, then the mutual inductance between coils is

(a) 0 (b) 0.5 H (c) 2 H (d) 3 H

(iii) Mutual inductance of two coils can be increased by

(a) decreasing the number of turns in the coils

(b) increasing the number of turns in the coils

(c) winding the coils on wooden cores

(d) none of these

(iv) When a sheet of iron is placed in between the two co-axial coils, then the mutual inductance between the coils will

(a) increase (b) decrease

(c) remains same (d) cannot be predicted

(v) The SI unit of mutual inductance is

(a) ohm (b) mho (c) henry (d) none of these

496) Currents can be induced not only in conducting coils, but also in conducting sheets or blocks. Current is induced in solid metallic masses when the magnetic flux threading through them changes. Such currents flow in the form of irregularly shaped loops throughout the body of the metal. These currents look like eddies or whirlpools in water so they are known as eddy currents. Eddy currents have both undesirable effects and practically useful applications. For example it causes unnecessary heating and wastage of power in electric motors, dynamos and in the cores of transformers.

(I) The working of speedometers of trains is based on

(a) wattless currents **(b) eddy currents**

(c) alternating currents **(d) pulsating currents**

(ii) Identify the wrong statement

(a) Eddy currents are produced in a steady magnetic field

(b) Induction furnace uses eddy currents to produce heat.

(c) Eddy currents can be used to produce braking force in moving trains

(d) Power meters work on the principle of eddy currents.

(iii) Which of the following is the best method to reduce eddy currents?

(a) Laminating core **(b) Using thick wires**

(c) By reducing hysteresis loss **(d) None ofthese**

(iv) The direction of eddy currents is given by

(a) Fleming's left hand rule **(b) Biot-Savart law**

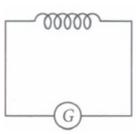
(c) Lenz's law **(d) Ampere-circuital law**

(v) Eddy currents can be used to heat localised tissues of the human body. This branch of medical therapy is called

(a) Hyperthermia **(b) Diathermy**

(c) Inductothermy **(d) none of these**

497) When a current I flows through a coil, flux linked with it is $\phi = LI,$ where L is a constant known as self-inductance of the coil. Any change in current sets up an induced emf in the coil. Thus, self-inductance of a coil is the induced emf set up in it when the current passing through it changes at the unit rate. It is a measure of the opposition to the growth or the decay of current flowing through the coil. Also, value of self-inductance depends on the number of turns in the solenoid, its area of cross-section, and the relative permeability of its core material.



(I) The inductance in a coil plays the same role as

(a) inertia in mechanics **(b) energy in mechanics**

(c) momentum in mechanics **(d) force in mechanics**

(ii) A current of 2.5 A flows through a coil of inductance 5 H. The magnetic flux linked with the coil is

(a) 0.5 Wb **(b) 12.5 Wb** **(c) zero** **(d) 2 Wb**

(iii) The inductance L of a solenoid depends upon its radius R as

(a) $L \propto R$ (b) $L \propto 1/R$ (c) $L \propto R^2$ (d) $L \propto R^3$

(iv) The unit of self-inductance is

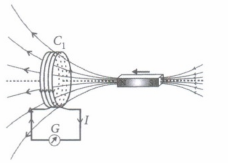
(a) weber ampere **(b) weber^{-1} ampere** **(c) ohm second** **(d) farad**

(v) The induced e.m.f in a coil of 10 henry inductance in which current varies from 9 A to 4 A in 0.2 second is

(a) 200 V **(b) 250 V** **(c) 300 V** **(d) 350 V**

498) In year 1820 Oersted discovered the magnetic effect of current. Faraday gave the thought that reverse of this phenomenon is also possible i.e., current can also be produced by magnetic field. Faraday showed that when we move a magnet towards the coil which is connected by a sensitive galvanometer. The galvanometer gives instantaneous deflection showing that there is an electric current in the loop.

Whenever relative motion between coil and magnet takes place an emf induced in coil. If coil is in closed circuit then current is also induced in the circuit. This phenomenon is called electromagnetic induction.



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

(a) moving towards the solenoid **(b) moving into the solenoid**
(c) at rest inside the solenoid **(d) moving out of the solenoid.**

(ii) Two similar circular loops carry equal currents in the same direction. On moving the coils further apart, the electric current will

(a) remain unaltered **(b) increases in one and decreases in the second**
(c) increase in both **(d) decrease in both**

(iii) A closed iron 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 the diameter of the ring and length of magnet**

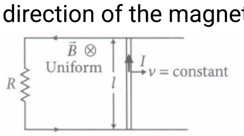
(iv) Whenever there is a relative motion between a coil and a magnet, the magnitude of induced emf set up in the coil does not depend upon the

(a) relative speed between the coil and magnet **(b) magnetic moment of the coil**
(c) resistance of the coil **(d) number of turns in the coil**

(v) A coil of metal wire is kept stationary in a non-uniform magnetic field

(a) an emf and current both are induced in the coil **(b) a current but no emf is induced in the coil**
(c) an emf but no current is induced in the coil **(d) neither emf nor current is induced in the coil**

499) The emf induced across the ends of a conductor due to its motion in a magnetic field is called motional emf. It is produced due to the magnetic Lorentz force acting on the free electrons of the conductor. For a circuit shown in figure, if a conductor of length l moves with velocity v in a magnetic field B perpendicular to both its length and the direction of the magnetic field, then all the induced parametres are possible in the circuit.



(i) Direction of current induced in a wire moving in a magnetic field is found using

(a) Fleming's left hand rule **(b) Fleming's right hand rule**
(c) Ampere's rule **(d) Right hand clasp rule**

(ii) A conducting rod of length l is moving in a transverse magnetic field of strength B with velocity v. The resistance of the rod is R. The current in the rod is

(a) $\frac{Blv}{R}$ **(b) Blv** **(c) zero** (d) $\frac{B^2v^2l^2}{R}$

(iii) A 0.1 m long conductor carrying a current of 50 A is held perpendicular to a magnetic field of 1.25 mT. The mechanical power required to move the conductor with a speed of 1 m s^{-1} is

(a) 62.5 mW **(b) 625 mW** **(c) 6.25 mW** **(d) 12.5 mW**

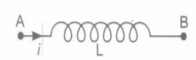
(iv) A bicycle generator creates 1.5 V at 15 km/hr. The EMF generated at 10 km/hr is

(a) 1.5 volts **(b) 2volts** **(c) 0.5volts** **(d) 1 volt**

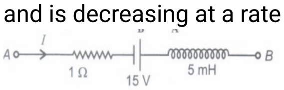
(v) The dimensional formula for emf E in MKS system will be

(a) $[ML^2 T^{-3} A^{-1}]$ (b) $[ML^2 T^{-1} A]$ (c) $[ML^2 A]$ (d) $[MLT^{-2} A^{-2}]$

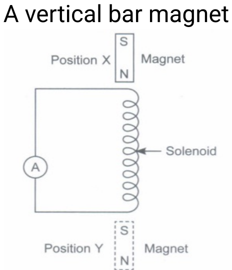
500) An inductor is simply a coil or a solenoid that has a fixed inductance. It is referred to as a choke. The usual circuit notation for an inductor is as shown.



Let a current i flows through the inductor from A to B. Whenever electric current changes through it, a back emf is generated. If the resistance of inductor is assumed to be zero (ideal inductor) then induced emf in it is given by
$e = V_B - V_A = -L\frac{di}{dt}$
Thus, potential drops across an inductor as we move in the direction of current. But potential also drops across a pure resistor when we move in the direction of the current.
The main difference between a resistor and an inductor is that while a resistor opposes the current through it, an inductor opposes the change in current through it.
Now -answer the following questions.
(i) How does inductor behave when
(a) a steady current flow through it?
(b) a steadily increasing, current flows through it?
(c) a steadily decreasing current flows through it?
(ii) The network shown in the figure is part of a complete circuit. If at a certain instant of time the current (I) is 5A and is decreasing at a rate of 10^{3} A/s, find out V_B - V_A.



501) A solenoid is held in a vertical position. The solenoid is connected to a sensitive, centre-zero ammeter.
A vertical bar magnet is held stationary at position X just above the upper end ofthe solenoid as shown.



The magnet is released and it falls through the solenoid. During the initial stage of the fall, the sensitive ammeter shows a small deflection to the left
(i) Explain why the ammeter shows a deflection.
(ii) The magnet passes the middle point of the solenoid and continues to fall. It reaches position Y. Describe and explain what is observed on the ammeter as the magnet falls from the middle point of the solenoid to position Y.
(iii) Suggest two changes in the apparatus that would increase the initial deflection of the ammeter

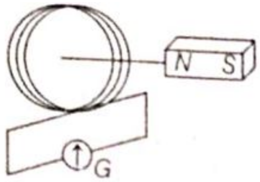
502) A very small circular loop of area 5 x 10^{-4} cm^2 with resistance 4Ω is placed such that it is concentric and in the same plane with another loop of radius 10 cm. A constant current of 2A is passed in the bigger loop, which is rotated with angular speed of ω rad S^{-1}, about its diameter. The magnetic field produced due to the bigger loop provides magnetic flux, which is linked with smaller loop.
(i) Determine magnetic field at the centre.
(ii) Determine magnetic flux linked with smaller loop.
(iii) What is the value of induced emf and current in the smaller loop as a function of time.

503) According the Faraday's first law, whenever the amount of magnetic flux linked with a circuit changes, an emf is induced in it. Induced current is determined by the rate at which the magnetic flux changes.

Mathematically, the magnitude of the induced emf in a circuit is equal to the rate of change of magnetic flux through the circuit.

Induced emf ∞ Rate of change of magnetic flux

(i) On the basis of Faraday's law, current in the coil is larger



(a) when the magnet is pushed towards the coil faster
(b) when the magnet is pulled away the coil faster
(c) Both (a) and (b)
(d) Neither (a) nor (b)

(ii) The flux linked with a circuit is given by ϕ = t^3 + 3t - 7. The graph between time (X-axis) and induced emf (Y-axis) will be a
(a) straight line through the origin
(b) straight line with positive intercept
(c) straight line with negative intercept
(d) parabola not through the origin

(iii) Wire loop is rotated in a magnetic field. The frequency of change of direction of the induced emf is
(a) once per revolution
(b) twice per revolution
(c) four times per revolution
(d) six times per revolution

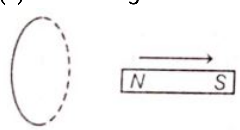
(iv) The instantaneous magnetic flux linked with a coil is given by ϕ = ($5t^3$ - 100t + 300) Wb. the emf induced in the coil at time t = 2 s is
(a) - 40 V (b) 40 V (c) 140 V (d) 300 V

(v) A copper disc of radius 0.1 m is rotated about its centre with 20 rev/s in a uniform magnetic field of 0.1T with its plane perpendicular to the field. The emf induced across the radius of the disc is
(a) $\frac{\pi}{20}V$ (b) $\frac{\pi}{10}$ V (c) 20 π mV (d) None of these

504) Lenz's law states that the direction of induced current in a circuit is such that it opposes the cause which produces it. Thus, if the magnetic flux linked with a closed circuit increases, then the induced current flows in the circuit in such a direction that the magnetic flux through the circuit decreases. It is based on conservation of energy principle in which mechanical energy is transformed into electrical energy.

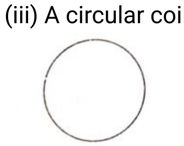
(i) What is the conservation principle on which Lenz's law depends ?

(ii) A bar magnet is moved away from the coil as shown in figure



What is the direction of induced current in the coil when it is seen from magnet side.

(iii) A circular coil and a current carrying wire is arranged as shown in figure.



What is the direction of induced current in the coil ?

(iv) When a coil is placed facing a moving magnet towards it, then which rule is responsible to determine the polarity of magnetic dipole as a current carrying loop ?

505) Self induction of a coil is a property by virtue of which it opposes any change in the strength of current through it by inducing an emf in the same coil. When a current I flow through the coil, then flux linked with it is given by ϕ = LI, where L is a constant known as coefficient of self induction of the coil. The emf induced across an inductor carrying a current I is, $e = L \cdot \frac{dI}{dt}$ The self inductance of a long solenoid is given by $L = \frac{\mu_0 N^2 A}{l}$

(i) Which property of the coil plays the same role as inertia in mechanics ?

(ii) Write the unit of coefficient of self induction in terms of tesla (T).

(iii) How the inductance of a solenoid depends on its radius ?

(iv) A current of 3A flows through a coil of inductance 5H. Find the magnetic flux linked with the coil ?

5 Marks 113 x 5 = 565

506) A circular coil of radius 10 cm, 500 turns and resistance 2 Ω 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 x 10^{-5} T.

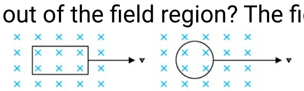
507) (a) A closed loop is held stationary in the magnetic field between the north and south poles of two permanent magnets held fixed. Can we hope to generate current in the loop by using very strong magnets?

(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

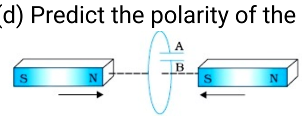
(i) when it is wholly inside the region between the capacitor plates

(ii) when it is partially outside the plates of the capacitor? The electric field is normal to the plane of the loop.

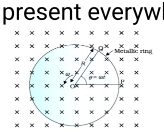
(c) A rectangular loop and a circular loop are moving out of a uniform magnetic field region (Fig. 6.8) to a field-free region with a constant velocity v. In which loop do you expect the induced emf to be constant during the passage out of the field region? The field is normal to the loops.



(d) Predict the polarity of the capacitor in the situation described by Fig.



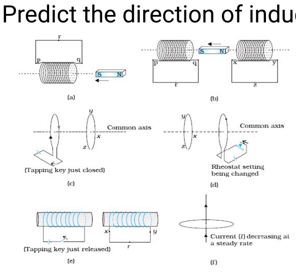
508) A metallic rod of 1 m length is rotated with a frequency of 50 rev/s, with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius 1 m, about an axis passing through the centre and perpendicular to the plane of the ring (Fig). A constant and uniform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



509) (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?

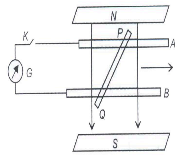
510) Predict the direction of induced current in the situations described by the following Figs (a) to (f).



511) A long solenoid with 15 turns per cm has a small loop of area 2.0 cm^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?

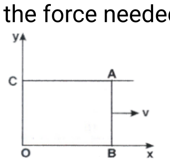
512) Distinguish between reactance and impedance. When a series combination of a coil of inductance L and a resistor of resistance R is connected across a 12 V, 50 Hz supply, a current of 0.5 A flows through the circuit. The current differs in phase from applied voltage by $\frac{\pi}{3}$ radian. Calculate the value of L and R.

513) The figure given below shows a metal PQ resting on the smooth rail 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, the resistance of the closed-loop containing the rod = $9.0 m\Omega$. Assume the field to be uniform.

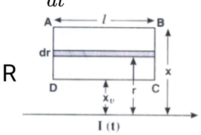


(a) Suppose K is open the rod is moved with a speed of 12 cm s^{-1} in the direction shown in the figure. Give the polarity and magnitude of the induced emf.
(b) Is there an excess charge built up at the ends of the rods when K is open? What if K is closed?
(c) With K open and the rod is moving uniformly, 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?
(e) 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?

514) A magnetic field $\vec{B} = B_0 \sin(\omega t)\hat{k}$ covers a large region where a wire AB slides smoothly over two parallel conductors separated by a distance d. The wires are in the x-y 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?

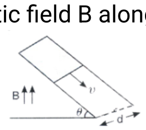


515) Consider an infinitely long wire carrying a current I (t), with $\frac{dI}{dt} = \lambda = constant.$ Find the current produced in the rectangular loop of wire ABCD if its resistance is R

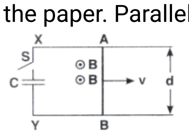


516) A magnetic field $\vec{B}$ is confined to a region $r \leq a$ and points out of the paper (the z-axis), $r = 0$ being the centre of the circular region. A charged ring (charge = Q) of radius b, $b > a$ and mass m lies in the x-y plane with its centre at the origin. The ring is free to rotate and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

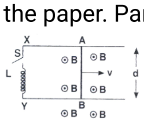
517) A rod of mass m and resistance R slides smoothly over two parallel perfectly conducting wires kept sloping at an angle θ with respect to the horizontal. The circuit is closed through a perfect conductor at the top. There is a constant magnetic field B along the vertical direction. If the rod is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



518) Find the current in the sliding rod AB (resistance=R) for the arrangement shown in Fig. 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.



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



520) A long solenoid 'S' has 'N' turns per metre, with diameter 'a'. At the centre of this coil, we place a smaller coil of 'N' turns and diameter 'b' (where $b(mt^2 + C)$

521) 1MW power is to be delivered from a power station to a town 10 km away. One uses a pair of Cu wires of radius 0.5 cm for this purpose. Calculate the fraction of ohmic losses to power transmitted if
(i) power is transmitted at 220 V.Comment on the feasibility of doing this.
(ii) a step-up transformer is used to boost the voltage to 11000 V, power transmitted, then a step-down transformer is used to bring voltage to 220 V.
$(\rho_{Cu} = 1.7 \times 10^{-8}\ SI\ unit)$

522) Define electromagnetic induction, magnetic flux linked with a given area and magnetic induction. What are their units? When is magnetic flux taken (i) positive and (ii) negative.

523) State Lenz's law and illustrate it with experiment.

524) Show that Lenz's law is a direct consequence of law of conservation of energy.

525) What is the difference between electric field produced by stationary charges and moving charges?

526) What are conservative and non-conservative fields?

527) What do you mean by quality factor or Q value of resonance circuit?

528) A rectanglar loop of area 20cm 30cm is held in a magnetic field of 0.3 T with its plan inclined at
(i) 30° to the field
(ii) parallel to the field. Find magnetic flux linked with the coil in each case.

529) A mahnetic field of flux density 10 T acts normal to a coil of 50 turns having 50cm^2 area. Find emf induced if the coil is removed from the magnetic field in 0.1sec.

530) The magnetic flux through a coil is varying according to the relation ϕ = (5t^3+4t^2+2t-5). Calculate the induced current through the coil at t = 2s, if resistance of coil is 5 ohm.

531) A railway track running north south has two parallel rails 1.0m aprt. Calculate the e.m.f. induced between the rails when a train passes at a speed of 90 km h^{-1}. Horizontal component od earth's magnetic field at that place is 0.3$\times$ 10^{-4} T and angle of dip is 60° .

532) A wheel with 8 metallic spokes each 50 cm long is rotated with a speed of 120 rev/min in a plane normal to horizontal component field at the place is 0.4 G and angle of dip is 60° . Calculate the emf induced between the axle and rim of the wheel. How is the emf affected if number of spokes is increased?

533) An aircraft with a wingspan of eastward direction at a constant altitude in the northern hemisphere, where the vertical component of earth's magnetic field is 1.75$\times$ 10^{-5}T. Find the e.m.f. that develops between the tips of the wings.

534) A cycle wheel has 12 metallic spokes, each 0.2 m long. It makes 60 revolutions in 1 minute in a plane normal to earth's magnetic field of 0.4$\times$ 10^4 T. Calculate the induced e.m.f. between the axle and rim of the wheel.

535) An avarage induced e.m.f. of 0.4V appears in a coil when current in it is changed from 10A in one direction to 10A in opposite direction in 0.40 second. Find the coefficient of the coil.

536) A solenoid of length 40cm, area of cross section 20cm^2 and total number of turns 800 is is connected to a source that supplies current changing at the rate of 0.2 A/s. What is the emf induced across the solenoid?

537) A solenoid of radius 3 cm and length 1m has 600 turns per metre. What is its self-inductance? Will the value of self-inductance change if it is wound on an iron piece?

538) Magnetic flux of 20μ Wb is linked with a coil when current of 5 mA is flown through it. What is the self inductance of the coil?

539) Magnetic field of 2$\times$ 10^{-2} Wb m^{-2} is acting at right angle to a coil of 1000 cm having 50 turns. The coil is removed from the field in $\frac{1}{10}$ second. Find the magnitude of induced e.m.f.

540) An e.m.f. of 0.5 V is developed in the secondary coil, when current in primary coil changes from 5.0 A to 2.0 A in 300 millisec. Calculate the mutual inductance of two coils.

541) A solenoid of 200 turns is wound over a length of 0.3m. The area of cross section is $1.2\times$ 10 m^2. Around its central section, a coil of 300 turns is closely wound. If an initial current of 2 A is reversed in 0.25s, find the e.m.f. induced in the coil.

542) Two coils have mutual inductance of 1.5 H. If current in primary coil is raised to 5 A in one millisecond after closing the circuit, what is the emf induced in the secondary coil?

543) A solenoid of length 50cm with 20 turns per am and area of cross section 40cm^2 completely surrounds another co-axial solenoid of the same length, area of cross section 25cm^2 with 25 turns per cm. Calculate the mutual inductance of the system.

544) Two co-axial circular coils of radii 50cm and 5cm are separated by a distance of 50 cm and carry currents 3A and 2A respectively. Calculate the mutual inductance of the two coils.

545) When a current of 10 ampere is flowing through a resistance of 20 ohm and inductance of 10 henry, the battery is switched off. Find
(i) current after 0.4 sec
(ii) the time the current takes to fall to 60% of its initial value.

546) A 20 mH coil is connected in series with a 2kΩ resistor and a 12V battery. Calculate.
(i) time constant of the circuit,
(ii) time during which current decays to 10% of its maximum value.

547) If the effective value of current in 50Hz a.c.circuit is 5.0 A, what is
(i) peak value of current
(ii) mean value of current over half a cycle
(iii) value of current 1/3000s after it was zero?

548) In an a.c. circuit, the rms voltage is $100\sqrt{2}V$. Find the peak value of voltage and its mean value during a positive half cycle.

549) A 100 iron is connected to 220V, 50 cycle wall plug. What is
(i) peak pot.diff.
(ii) average pot.diff.over half cycle
(ii) rms current?

550) Find the maximum value of current when inductance of two henry is connetced to 150 volt, 50 cycle supply.

551) A coil has an inductance of 1H. At what frequency will it have a reactance of 3142 ohm?

552) A capacitor of 1μ F is connected to an a.c. source of e.m.f. E = 250sin 100π t. Write an equation for instantaneous current through the circuit and given reading of a.c. ammeter connected in the circuit.

553) A 1.5 μ F capacitor has a capacitive reactance of 12 Ω . What is the frequency of the source? If frequency of source is doubled, what will be the capacitative reactance?

554) A coil has an inductance of 1 henry.
(a) At what frequency will it have a reactance of 3142 ohm?
(b) What should be the capavity of a condenser which has the same reactance at that frequency ?

555) A 15.0 μ F capacitor is connected to a 220 V, 50Hz source. Find the capacitative reactance and the current in the circuit. If the frequency is doubled, what happens to the capacitative reactance and current?

556) A 60 V-10 W electric lamp is to be run on 100 V-60Hz mains. Calculate the inductance of the choke coil to achieve the same result, calculate its value.

557) A resistor of 200 ohm and a capacitor of 15.0 μ F are connected in series to a 220V, 50Hz a.c. source.
(a) Calculate the current in the circuit
(b) Calculate the r.m.s. voltage across the resistor and the capacitor. Is the algebraic sum of these voltages more than the source voltage? If yes, resolve the paradox.

558) A 120V, 60Hz power source is connected across an 800Ω non inductive resistance and an unknown capacitance in series. The voltage drop across the resistor is 102V.
(a) What is the voltage drop across the capacitor?
(b) What is the reactance of the capacitor?

559) A capacitor of 100μ F and a coil of resistance 50 ohm and inductance 0.5 H are connected in series with a 110V - 50hz source. Calculate the rms value of current in the circuit.

560) A resistor of 100, inductance of 1H and a capacitor of capacitance 10.13$\times$ 10^{-6} F are in series. This combination is connected to an A.C. source of 200V, 50Hz. Find the current in the circuit and the P.D. across the resistor.

561) A series LCR circuit with L = 4.0H, C = 100μ F and R = 60Ω is connected to a variable frequency 240V source. Calculate
(i) angular frequency of the source which drives the circuit in resonance,
(ii) current at the resonating frequency,
(iii) rms potential drop across the inductor at resonance.

562) A 2μ F capacitor, 100 ohm resistor and 8H inductor are connected in series with an a.c.source. What should be the frequency of source for which the current drawn in the circuit is maximum? If peak value of emf of the source is 200V, find the maximum current, inductive reactance, capacitive reactance, total impedance, peak value of current in the circuit. What is the phase relation between voltage across inductor and resistor? Also, give the phase relation between voltage across inductor and capacitor.

563) (a) Obtain an expression for 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?

564) A metallic ring of mass m and radius l 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_0(1+λ 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.

565) Lenz's law gives us the direction of current induced in a circuit. According to this law, the polarity of induced e.m.f. is always such that is opposes the change in megnetic flux responsible for its production. It means if e.m.f. induced is such as to oppose the increase in magnetic flux. The reverse is also true.
Read the above passage and answer the following questions:
(i) Does Lenz's law violate the principle of conservation of energy?
(ii) Name any other rule for finding the direction of induced current.
(iii) What does Lenz's law imply in day to day life?

566) Faraday established that an e.m.f. can be induced in a coil by changing the amount of magnetic flux ϕ linked with the coil. As $\phi BA\ cos\theta$ =BA cos, therefore, three methods of inducing e.m.f. are by changing magnetic field B or by changing area A or by changing relative orientation θ of the coil w.r.t. the magnetic field.
Read the above passage and answer the following questions:
(i) Have you heard of a battery-less flashlight? How does it work?
(ii) Can you operate a typical cell phone from the hip movements of the person?
(iii) What do you know about gas-electric hybrid autos?

567) Ajit had a high tension tower erected erected on his farm land. He kept complaining to the authorities to remove it as it was occupying a large portion of his land. His uncle who was a teacher, explained to him the need for erecting these towers for efficient transmission of power. As Ajit realized its significance, he stopped complaining.
Read the above passage and answer the following questions:
(a) Why is it necessary to transport power at high voltages?
(b) A low power factor implies larger power los. Explain.
(c) Write two values each, displayed by Ajit and his uncle.

568) Ram is a student of class X in a village school. His uncle gifted him a bicycle with a dynamo fitted in it. He was very excited to get it. While cucling during night, he could light the bulb and see the objects on the road. He, however did not know how this device works. He asked this question to his teacher. The teacher considered it an opportunity to explain the working to the whole class.
Answer the following questions:
(i) State the principle and working of a dynamo.
(ii) Write two values each displayed by Ram and his shool teacher.

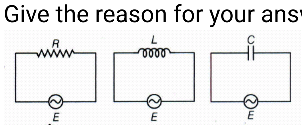
569) Self- inductance is the property of a coil by virtue of which the coil oppose any change in the strength of current flowing through it by inducing an emf in itself. The induced emf is also called back emf. Self-inductance represents electric inertia which is measured in terms of coefficient of self-inductance(L). We can show that

L = $L = \frac{\phi}{I}$ = $\frac{-e}{\triangle I/\triangle t}$

Read the above passage and answer the following questions:
(i) How does the self-inductance of a coil represent its electric inertia?
(ii) An emf of 100μ V is induced in a coil when the current in it changes from 5A to 1A in 0.4s.
Find the self-inductance of the coil.

570) Aarushi wanted to perform an experiment of Faraday's law of electromagnetic induction. She told her father to bring some of the instruments such as a torch bulb, a coil and a bar magnet. She connected the bulb with the two terminals of the coil. And to check for induced emf, she moved the bar magnet back and forth near to the coil. The bulb started to glow. All her mother, father and elder brother surprised of this activity.
(i) What are the values displayed by Aarushi?
(ii) Give the Faraday's law of electromagnetic induction?
(iii) Write the equation to calculate induced emf of a coil of N number of turns?

571) (i) What do you understand by sharpness of resonance in a series L-C-R circuit? Derive an expression for Q-factor of the circuit.
(ii) Three electrical circuits having AC sources of variable frequency are shown in the figures. Initally, the current following in each of these is same.If the frequency of the applied AC source is increased, how will the current flowing in these circuits be affected?
Give the reason for your answer.



572) One morning an old man walked bare-foot to replace the fuse wire in kit kat fitted with the power supply mains for his house. Suddenly he screamed and collapsed on the floor. His wife cried loudly for help. His neighbour's son Anil heard the cries and rushed to the place with shoes on. He took a wooden baton and used it to switch OFF the main supply. Answer the following questions:
What is the voltage and frequency of mains supply in India?
These days most of the electrical devices we use require AC voltage. Why?
Can a transformer be used to step-up DC voltage?
Write two qualities displayed by Anil by his action.

573) A group of students while coming from the school noticed a box marked "Danger HT 2200 V" at a substation in the main street. They did not understand the utility of a such high voltage, while they argued, the supply was only 220 V. They asked their teacher this question the next day. The teacher thought it to be an important question and therefore explained to the whole class.
Answer the following questions:
(i) What device is used to bring the high voltage down to low voltage of AC current and what is the principle of its working?
(ii) Is it possible to use this device for bringing down the high DC voltage to the low voltage? Explain.
(iii) Write the values displayed by the students and the teacher.

574) Imran on entering the airport was asked to remove the contents from his pant and shirt pockets, his hand bags and luggage were also checked by airport authorities by using a metal detector. Imran got annoyed and argued with the airport authority asking the reasons for such procedure. The authority tells him that all the passengers and their belongings will be checked for a security check to ensure safe travel.
(a) What s the value that impacts us in the above scenario?
(b) Briefly explain the working principle of a metal detector.

575) (a) A series LCR circuit is connected to an a.c. source of variable frequency. Draw a suitable phasor diagram to deduce the expressions for the amplitude of the current and phase angle.
(b) Obtain the condition at resonance. Draw a plot showing the variation of current with the frequency of a.c. source for two resistances R_1 and R_2 ($R_1 > R_2$). Hence define the quality factor, Q and write its role in the tuning of the circuit.

576) Describe briefly, with the help of a labelled diagram, the basic elements of an A.C. generator. State its underlying principle. Show diagrammatically how an alternating emf is generated by a loop of wire rotating in a magnetic field. Write the expression for the instantaneous value of the emf induced in the rotating loop

577) (i) Explain the meaning of the term mutual inductance. Consider two concentric circular coils, one of the radius r_1 and the other of radius $r_2(r_1 < r_2)$ placed coaxially with centres coinciding with each other. Obtain the expression for the mutual inductance of the arrangement.
(ii) A rectangular coil of area A, having number of turns N is rotated at f revolutions per second in a uniform magnetic field B, the field being perpendicular to the coil. Prove that the maximum emf induced in the coil is $2\pi fNBA$.

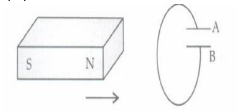
578) An AC source of voltage $V = V_0$ sin rot is connected to a series combination of L, C and R. Use the phasor diagram to obtain expressions for impedance of the circuit and phase angle between voltage and current. Find the condition when current will be in phase with the voltage. What is the circuit in the condition called?

579) Draw a labelled diagram of a step-down transformer. State the principle of its working.
Express the turn ratio in terms of voltages.
Find the ratio of primary and secondary currents in terms of turn ratio in an ideal transformer.
How much current is drawn by the primary of a transformer Connected to 220 V supply when it delivers power to a 110 V-550 W refrigerator?

580) Write the function of a transformer, State its principle of working with the help of a diagram. Mention various energy losses in this device.
The primary coil of an ideal step up transformer has 100 turns and transformation ratio is also 100. The input voltage and power are respectively 220 V and 1100 W. Calculate
a. number of turns in secondary
b. current in primary
c. voltage across secondary
d. current in secondary
e. power in secondary

581) Sushil is in the habit of charging his mobile and then leaving the charger connected through the mains with the switch on.
When his sister Asha pointed it out him, he replied there was no harm as the mobile had been disconnected. Asha then explained to him and convinced him, how the energy was still being wasted as the charger was continuously consuming energy. Answer the following questions.
What values did Asha display in convincing her brother?
What measures in your view, should be adopted to minimise the wastage of electric energy in your households?
Imagine an electric appliance of 2 W, left connected to the mains for 20 hours. Estimate the amount of electrical energy wasted.

582) (a) State Lenz's law. Use it to predict the polarity of the capacitor in the situation given below



(b) A jet plane is traveling towards west at a speed of 1800 km/h

(i) Estimate 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 x10^{-4} T and dip angle is 30^{o}

(ii) How will the voltage developed be affected if the jet changes its direction from west to the north?

583) Isabella used an induction stove and explains to her neighbour that due to shortage of LPG one must utilize other sources that are available to produce heat energy; being a Physics teacher Isabella, explains that the oil companies are trying their best to meet the demands for LPG and that as a good citizen one must use other sources wherever feasible. Isabella uses an induction stove having a value of 7 H inductor and the flow of current from 10 A to 7-A in 9 x 10^{-2} seconds.

(i) In the above, what is the quality, you find in the Physics teacher?

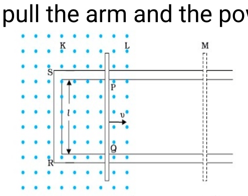
(ii) Calculate the emf generated in the above?

584) (i) Define mutual inductance and write its S.l. unit.

(ii) Derive an expression for the mutual inductance of two long co-axial solenoids of same length wound one over the other.

(iii) In an experiment, two coils C_1 and C_2 are placed close to each other. Find out the expression for the emf induced the coil cl due to a change in the current through the coil $C_{2.}$

585) Refer to Fig 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.



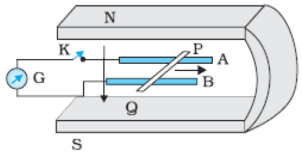
586) A circular coil of radius 8.0 cm and 20 turns is rotated about its vertical diameter with an angular speed of 50 rad s^{-1} in a uniform horizontal magnetic field of magnitude 3.0 x 10^{-2} T. Obtain the maximum and average emf induced in the coil. If the coil forms a closed loop of resistance 10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

587) 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 x 10^{-4} T and the dip angle is 30°.

588) A square loop of side 12 cm with its sides parallel to X and Y axes is moved with a velocity of 8 cm 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} T cm^{-1} as one moves in the negative x-direction), and it is decreasing in time at the rate of 10^{-3} T s^{-1}. Determine the direction and magnitude of the induced current in the loop if its resistance is 4.50 mΩ.

589) 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 2 cm^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.

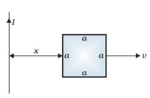
590) shows a metal rod PQ resting on the smooth rails AB and positioned between the poles of a permanent magnet. The rails, the rod, and the magnetic field are in three mutual perpendiculardirections. A galvanometer G connects the rails through a switch K. Length of the rod = 15 cm, B = 0.50 T, resistance 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 12 cm s^{-1} in the direction shown. Give the polarity and magnitude of the induced emf.



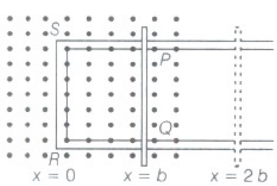
(b) Is there an excess charge built up at the ends of the rods when K is open? What if K is closed?
(c) With K open and the rod moving uniformly, there is no net force on the electrons in the rod PQ even though they do experience magnetic force due to the motion of the rod. Explain.
(d) What is the retarding force on the rod when K is closed?
(e) 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?

591) An air-cored solenoid with length 30 cm, area of cross-section 25 cm^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.

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



593) State Faraday's law of electromagnetic induction. Figure shows a rectangular conductor PQRS in which the conductor PQ is free to move in a uniform magnetic field B perpendicular to the plane of the paper. The field extends from x = 0 to x = b and is zero for x > b. Assume that only the arm PQ possesses resistance r. When the arm PQ is pulled outward from x = 0 to x =2h and
is then moved backward to x = 0 with constant speed v,obtain the expressions for the flux and the induced emf. Sketch the variation of these quantities with distance $0 \leq x \leq 2b$



594) (iii) In an experiment, two coils C_1 and C_2 are placed close to each other. Find out the expression for the emf induced in the coil C_1 due to a change in the current through the coil C_2.

595) A conducting rod held horizontally along East-West direction is dropped from rest from a certain height near the Earth's surface. Why should there be an induced emf across the ends of the rod? Draw a plot showing the instantaneous variation of emf as a function of time from the instant it begins to fall.

596) State the working of AC generator with the help of a labelled diagram. The coil of an AC generator having N turns, each of area A, is rotated with a constant angular velocity ω . Deduce the expression for the alternating emf generated in the coil. What is the source of energy generation in this device?

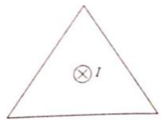
597) A long solenoid of radius 4 cm, length 400 cm carries a current of 3 A. The total number of turns is 100. Assuming ideal solenoid, find the flux passing through a circular surface having centre on axis of solenoid of radius 3 cm and is perpendicular to the axis of solenoid

(i) inside and

(ii) at the end of solenoid.

598) A magnetic field of flux density 10 T acts normally to the coil of 50 turns having 100 cm^2 area. Find emf induced, if the coil is removed from the magnetic field in 0.15 s.

599) A current carrying straight wire passes inside a triangular coil as shown in figure. The current in the wire is perpendicular to paper inwards. Find the direction of the induced current in the loop, if current in the wire is increased.



600) A wire of length 0.3m moves with a speed of 20 m/s perpendicular to the magnetic field of induction 1 Wb/m^2. Calculate the induced emf.

601) A square metal wire loop of side 20 cm and resistance 2Ω is moved with a constant velocity v_0 in a uniform magnetic field of induction B = 1 Wb/m^2 as shown in the figure. The magnetic field lines are perpendicular to the plane of the loop. The loop is connected to a network of resistance each of value 5Ω. The resistances of the lead