Subject : Physics **Topic : Electromagnetic Induction and Alternating Currents** **M.M. : 180**

Have patience all things are difficult before they become easy.

Marking Scheme:
(i) Each question is allotted 4 (four) marks for each correct response.
(ii) ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.

Q.1 An electromagnet has stored 648 J of magnetic energy when a current of 9 A exists in its coils. What average emf is induced if the current is reduced to zero in 0.45 s ?
(A) 320 V (B) 620 V
(C) 260 V (D) 230 V

Q.2 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.

Q.3 The self inductance of a coil having 400 turns is 10mH. The magnetic flux through the cross section of the coil corresponding current 2mA is
(A) 4×10^{-5} Wb (B) 2×10^{-3} Wb
(C) 3×10^{-5} Wb (D) 8×10^{-3} Wb

Q.4 A square of side x m lies in the x-y plane in a region, where the magnetic field is given by $\vec{B} = B_0(3\hat{i} + 4\hat{j} + 5\hat{k})T$, where B_0 is constant. The magnitude of flux passing through the square is
(A) $5B_0x^2$ Wb (B) $3B_0x^2$ Wb
(C) $2B_0x^2$ Wb (D) B_0x^2 Wb

Q.5 The equivalent inductance of two inductors is 2.4 H when connected in parallel and 10 H when connected in series. What is the value of inductances of the individual inductors ?
(A) 8H, 2H (B) 6H, 4H
(C) 5H, 5H (D) 7H, 3H

Q.6 A current of 1A through a coil of inductance of 200 mH is increasing at a rate of 0.5 A s^{-1}. The energy stored in the inductor per second is
(A) 0.5 J s^{-1} (B) 5.0 J s^{-1}
(C) 0.1 J s^{-1} (D) 2.0 J s^{-1}

Q.7 If the self inductance of 500 turns coil is 125mH, then the self inductance of the similar coil of 800 turns is
(A) 48.8 mH (B) 200 mH
(C) 290 mH (D) 320 mH

Q.8 Two conducting circular loops of radii R_1 and R_2 are placed in the same plane with their centres coinciding. If $R_1 > R_2$ the mutual inductance M between them will be directly proportional to
(A) R_1/R_2 (B) R_2/R_1
(C) $\frac{R_1^2}{R_2}$ (D) $\frac{R_2^2}{R_1}$

Q.9 The total charge induced in a conducting loop when it is moved in magnetic field depend on
(A) The rate of change of magnetic flux
(B) Initial magnetic flux only
(C) The total change in magnetic flux and resistance
(D) Final magnetic flux only

Q.10 A square loop of side 12 cm and resistance 0.60Ω is placed vertically in the east-west plane. A uniform magnetic field of 0.10 T is set up across the plane in north-east direction. The magnetic field is decreased to zero in 0.6 s at a steady rate. The magnitude of current during this time interval is
(A) 1.42×10^{-3} A (B) 2.67×10^{-3} A
(C) 3.41×10^{-3} A (D) 4.21×10^{-3} A

Q.11 A rectangular loop of sides 6 cm and 2 cm with a small cut is moving out of a region of uniform magnetic field of magnitude 0.4 T directed normal to the loop. The voltage developed across the cut if velocity of loop is 2 cm s^{-1} in a direction normal to the longer side is
(A) 3.8×10^{-4} V (B) 4.8×10^{-4} V
(C) 2.2×10^{-2} V (D) 3.2×10^{-2} V

Q.12 There is a uniform magnetic field directed perpendicular and into the plane of the paper. An irregular shaped conducting loop is slowly changing into a circular loop in the plane of the paper. Then
(A) Current is induced in the loop in the anti-clockwise direction.
(B) Current is induced in the loop in the clockwise direction.
(C) Ac is induced in the loop.
(D) No current in induced in the loop.

Q.13 A circular copper disc 10 cm in diameter rotates at 1800 revolution per minute about an axis through its centre and at right angles to disc. A uniform field of induction B of 1 Wb m^{-2} is perpendicular to disc. What potential difference is developed between the axis of the disc and the rim ?
(A) 0.023 V (B) 0.23 V
(C) 23 V (D) 2.30 V

Q.14 A conducting ring of radius r is placed in a varying magnetic field perpendicular to the plane of the ring. If the rate at which the magnetic field varies is x, the electric field intensity at any point of the ring is
(A) rx (B) rx/2
(C) 2rx (D) 4r/x

Q.15 A coil of area 0.4 m^2 has 100 turns. A magnetic field of 0.04 Wb m^{-2} is acting normal to the coil surface. If this magnetic field is reduced to zero in 0.01 s, then the induced emf in the coil is
(A) 160 V (B) 250 V
(C) 270 V (D) 320 V

Q.16 A coil having an area A_0 is placed in a magnetic field which changes from B_0 to $4B_0$ in a time interval t. The e.m.f. induced in the coil will be –
(A) $\frac{3A_0B_0}{t}$ (B) $\frac{4A_0B_0}{t}$
(C) $\frac{3B_0}{A_0t}$ (D) $\frac{4B_0}{A_0t}$

Q.17 A circuit has a resistance of 12 ohm and an impedance of 15 ohm. The power factor of the circuit will be –
(A) 0.8 (B) 0.4
(C) 1.25 (D) 0.125

Q.18 A coil having an area $2m^2$ is placed in a magnetic field which changes from 1 Wb/m^2 to 4 Wb/m^2 in a interval of 2second. The e.m.f. induced in the coil will be
(A) 4 V (B) 3 V
(C) 1.5 V (D) 2 V

Q.19 A coil has 2000 turns and area of 70cm^2. The magnetic field perpendicular to the plane of the coil is 0.3 Wb/m^2 and takes 0.1sec to rotate through 180°. The value of the induced e.m.f. will be –
(A) 8.4V (B) 84V
(C) 42V (D) 4.2 V

Q.20 A coil of 40 Ω resistance has 100 turns and radius 6 mm is connected to ammeter of resistance of 160 ohms. Coil is placed perpendicular to the magnetic field. When coil is taken out of the field, 32 μ C charge flows through it. The intensity of magnetic field will be –
(A) 6.55 T (B) 5.66 T
(C) 0.655 T (D) 0.566 T

Q.21 When a wire loop is rotated in a magnetic field, the direction of induced e.m.f. changes once in each
(A) 1/4 revolution (B) 1/2 revolution
(C) 1 revolution (D) 2 revolution

Q.22 A metal rod of length 2 m is rotating with an angular velocity of 100 rad/sec in a plane perpendicular to a uniform magnetic field of 0.3T. The potential difference between the ends of the rod is –
(A) 30 V (B) 40 V
(C) 60 V (D) 600 V

Q.23 An e.m.f. of 5 volt is produced by a self inductance, when the current changes at a steady rate from 3 A to 2 A in 1 millisecond. Value of self inductance is –
(A) Zero (B) 5 H
(C) 5000 H (D) 5 mH

Q.24 A 50 mH coil carries a current of 2 ampere. The energy stored in joules is –
(A) 1 (B) 0.1
(C) 0.05 (D) 0.5

Q.25 The current passing through a choke coil of 5henry is decreasing at the rate of 2 ampere/sec. The e.m.f. developing across the coil is –
(A) 10 V (B) – 10 V
(C) 2.5 V (D) – 2.5 V

Q.26 Two circuits have mutual inductance of 0.1 H. What average e.m.f. is induced in one circuit when the current in the other circuit changes from 0 to 20 A in 0.02 s –
(A) 240 V (B) 230 V
(C) 100 V (D) 300 V

Q.27 An air core solenoid has 1000 turns and is one metre long. Its cross-sectional area is 10 cm^2. Its self inductance is

(A) 0.1256 mH (B) 12.56 mH

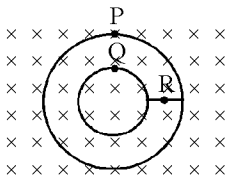
(C) 1.256 mH (D) 125.6 mH

Q.28 In a step-up transformer the voltage in the primary is 220 V and the current is 5A. The secondary voltage is found to be 22000V. The current in the secondary (neglect losses) is

(A) 5 A (B) 50 A

(C) 500 A (D) 0.05 A

Q.29 Figure shows plane figure made of a conductor located in a magnetic field along the inward normal to the plane of the figure. The magnetic field starts increasing. Then choose the incorrect statement related to induced current –



(A) at point P, is anticlockwise

(B) at point Q, is clockwise

(C) at point Q, is anticlockwise

(D) at point R, is zero

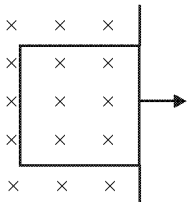
Q.30 A square loop of area 2.5×10^{-3} m^2 and having 100 turns with a total resistance of 100Ω is moved out of a uniform magnetic field of 0.40T in 1 sec. with a constant speed. Then work done, in pulling the loop is 20 × A (in μJ). Find the value of A.

(A) 5

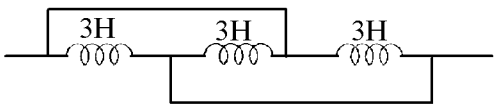
(B) 2

(C) 4

(D) 3



Q.31 Resultant inductance of the circuit will be



(A) 3 H (B) 9 H

(C) 1 H (D) 7.5 H

Q.32 A coil having n turns and resistance RΩ is connected with a galvanometer of resistance 4RΩ. This combination is moved in time t seconds from a magnetic field W_1 weber to W_2 weber. The induced current in the circuit is

(A) $-\frac{(W_2 - W_1)}{5\,R\,n\,t}$ (B) $-\frac{n\,(W_2 - W_1)}{5\,R\,t}$

(C) $-\frac{(W_2 - W_1)}{R\,n\,t}$ (D) $-\frac{n\,(W_2 - W_1)}{R\,t}$

Q.33 In an LCR series a.c. circuit, the voltage across each of the components, L, C and R is 50 V. The voltage across the LC combination will be –

(A) 50 V (B) $50\sqrt{2}$

(C) 100 V (D) 0 V (zero)

Q.34 In a LCR circuit capacitance is changed from C to 2C. For the resonant frequency to remain unchanged, the inductance should be changed from L to

(A) 4 L (B) 2 L

(C) L/2 (D) L/4

Q.35 A coil of inductance 300 mH and resistance 2Ω is connected to a source of voltage 2 V. The current reaches half of its steady state value in

(A) 0.05 s (B) 0.1 s

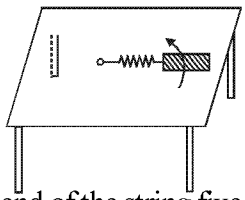
(C) 0.15 s (D) 0.3 s

Q.36 The self inductance of the motor of an electric fan is 10 H. In order to impart maximum power at 50 Hz, it should be connected to a capacitance of –

(A) 4μF (B) 8μF

(C) 1μF (D) 2μF

Q.37 A metallic rod of length ℓ is tied to a string of length 2ℓ and made to rotate with angular speed ω on a horizontal table with one end of the string fixed. If there is a vertical magnetic field 'B' in the region, the e.m.f. induced across the ends of the rod is –



(A) $\frac{2B\omega\ell^2}{2}$ (B) $\frac{3B\omega\ell^2}{2}$

(C) $\frac{4B\omega\ell^2}{2}$ (D) $\frac{5B\omega\ell^2}{2}$

Q.38 An ac generator consists of a coil of 200 turns each of area 80 cm^2 and rotating at an angular speed of 200 rpm in a uniform magnetic field of 4.8×10^{-2} T. The rms values of emf induced in the coil is

(A) 22.68 V (B) 11.37 V

(C) 7.39 V (D) 18.67 V

Q.39 In series LCR circuit voltage drop across resistance is 8volt, across inductor is 6 volt and across capacitor is 12 volt. Then –

(A) Voltage of the source will be leading current in the circuit

(B) Voltage drop across each element will be less than the applied voltage

(C) Power factor of circuit will be 4/3

(D) None of these

Q.40 A power transmission line feeds input power at 2400 V to a step down transformer with its primary winding having 4000 turns. What should be the number of turns in the secondary windings in order to get output power at 240 V ?

(A) 400 (B) 420

(C) 424 (D) 436

Q.41 The output of a step-down transformer is measured to be 24 V when connected to a 12 watt light bulb. The value of the peak current is

(A) $\frac{1}{\sqrt{2}}$A (B) $\sqrt{2}$A

(C) 2A (D) $2\sqrt{2}$A

Q.42 Which of the following combinations should be selected for better tuning of an LCR circuit used for communication ?

(A) R = 20 Ω, L = 1.5 H, C = 35 μF

(B) R = 25 Ω, L = 2.5 H, C = 45 μF

(C) R = 15 Ω, L = 3.5 H, C = 30 μF

(D) R = 25 Ω, L = 1.5 H, C = 45 μF

Q.43 A transformer is used to light 140 W, 24 V lamp from a 240 V ac mains. If the main current is 0.7A, the efficiency of the transformer is

(A) 63.8% (B) 74%

(C) 83.3% (D) 48%

Q.44 For an LCR circuit, the power transferred from the driving source to the driven oscillator is $P = I^2Z \cos\phi$. Then

(A) The power factor $\cos\phi \geq 0$, $P \geq 0$

(B) The driving force can give no energy to the oscillator (P = 0) in some cases.

(C) The driving force cannot syphon out (P<0) the energy out of oscillator

(D) All of these

Q.45 If the rms current in a 50 Hz ac circuit is 5A, the value of the current 1/300 seconds after its value becomes zero is

(A) $5\sqrt{2}$A (B) $5\sqrt{\frac{3}{2}}$A

(C) $\frac{5}{6}$A (D) $\frac{5}{\sqrt{2}}$A