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UDUPI

CET25P6 ELECTROMAGNETIC INDUCTION

Class 12 - Physics

Time Allowed: 1 hour and 30 minutes **Maximum Marks: 75**

1. When a dc motor operates at 200 V, its initial current is 5A, but when it runs at maximum speed, the current is only 3A. What is its back emf? **[1]**

   a) 80 V b) Zero

   c) 100 V d) 120 V

2. When the current changers from + 2 A to - 2 A in $0 \cdot 05\ s$, an e.m.f. of 8 V is induced in the coil. The coefficient of self-induction of the coil is: **[1]**

   a) $0 \cdot 2\ H$ b) $0 \cdot 1\ H$

   c) $0 \cdot 4\ H$ d) $0 \cdot 8\ H$

3. When current changes from +2A to -2A in 0.05 sec, an emf of 8V is induced in a coil. The coefficient of self inductance of the coil is: **[1]**

   a) 0.8 H b) 0.1 H

   c) 0.2 H d) 0.4 H

4. Two ends of a horizontal conducting rod of length l are joined to a voltmeter. The whole arrangement moves with a horizontal velocity v, the direction of motion being perpendicular to the rod. Vertical component of the earth's magnetic field is B. The voltmeter reads **[1]**

   a) Blv only if the rod moves eastward b) Blv if the rod moves in any direction

   c) Zero d) Blv only if the rod moves westward

5. A small coil of radius r is placed at the centre of a large coil of radius R, where R >> r. The two coils are coplanar. The mutual induction of the coils is proportional to **[1]**

   a) $\frac{r}{R^2}$ b) $\frac{r}{R}$

   c) $\frac{r^2}{R}$ d) $\frac{r^2}{R^2}$

6. If the speed of rotation of a dynamo is doubled, then the induced emf will **[1]**

   a) remain unchanged b) become double

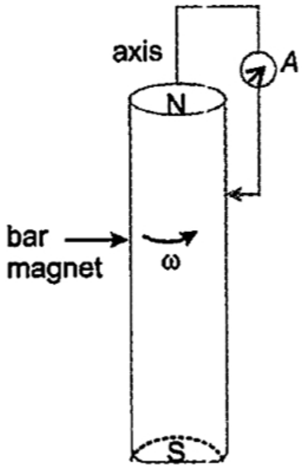
   c) become four times d) become half

7. A coil of resistance 400 Ω is placed in a magnetic field. If the magnetic flux ϕ (Wb) linked with the coil varies with times t (sec) as $\phi = 50t^2 + 4$, the current in the coil at t = 2 sec is: **[1]**

   a) 0.1 A b) 1 A

   c) 0.5 A d) 2 A

8. A cylindrical bar magnet is rotated about its axis (Figure given alongside). A wire is connected from the axis and is made to touch the cylindrical surface through a contact. Then **[1]**



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

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

c) no current flows through the ammeter A.

d) a direct current flows in the ammeter A.

9. The dimensional formula for emf ε in MKS system will be **[1]**

a) $[ML^{-2}Q^{-1}]$

b) $[MLT^{-2}Q^{-2}]$

c) $[ML^{2}T^{-2}Q^{-1}]$

d) $[ML^{2}T^{-1}]$

10. Current in a circuit falls from 5 A to 0 A in 0.1 s. If an average emf of 200 V is induced, the self-inductance of the circuit is **[1]**

a) 5H

b) 4H

c) 2H

d) 3H

11. A planar loop is rotated in a magnetic field about an axis perpendicular to the field. The polarity of induced emf changes once in each: **[1]**

a) 1 revolution

b) $\left(\frac{3}{4}\right)$ revolution

c) $\left(\frac{1}{4}\right)$ revolution

d) $\left(\frac{1}{2}\right)$ revolution

12. The electric fan works on the principle of : **[1]**

a) Both electric motor and dynamo

b) Electric mechanism

c) Electric motor

d) Electric dynamo

13. While keeping the area of cross-section of a solenoid the same, the number of turns and length of the solenoid are both doubled. The self-inductance of the coil will be: **[1]**

a) $\frac{1}{4}$ times the original value

b) halved

c) doubled

d) unaffected

14. The self-inductance of a coil having 500 turns is 50 mH. The magnetic flux through the cross-sectional area of the coil, while the current through it is 8 mA, is found to be: **[1]**

a) 0.04 Wb

b) 4×10^{-4} Wb

c) $4\mu Wb$

d) 40m Wb

15. 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: **[1]**

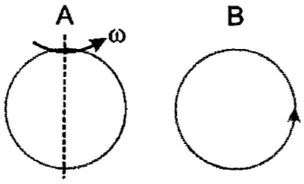
a) equal to g

b) less than g

c) either equal to g or more than g

d) more than g

16. Same as the above problem except the coil A is made to rotate about a vertical axis refer to the 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 **[1]**



a) constant current clockwise.

b) varying current counterclockwise.

c) varying current clockwise.

d) constant current counterclockwise.

17. A copper ring is held horizontally and a magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet is **[1]**

a) more than that due to gravity

b) depends on the diameter of the ring and the length of the magnet

c) less than that due to gravity

d) equal to that due to gravity

18. A magnet is dropped with its north pole towards a closed circular coil placed on a table then **[1]**

a) no current will be induced in the coil.

b) looking from above, the induced current in the coil will be anti-clockwise.

c) the magnet will fall with uniform acceleration.

d) as the magnet falls, its acceleration will be reduced.

19. A horizontal ring of radius r spins about it's axis with an angular velocity ω in a uniform magnetic field of magnitude B. Emf induced in the ring is **[1]**

a) $r^2\omega B$

b) $\pi r^2\omega B$

c) $\pi r^3\omega B$

d) Zero

20. A moving conductor coil produces an induced emf. This is in accordance with: **[1]**

a) Lenz's law

b) Coulomb's law

c) Ampere's law

d) Faraday's law

21. Magnetic field energy stored in a coil is **[1]**

a) $\frac{1}{2}\mathrm{Li}^2$

b) $\frac{1}{2}\mathrm{Li}$

c) Li^2

d) Li

22. The current in a self-inductance L = 40 mH is to be increased uniformly from 1 A to 11 A in 4 milliseconds. The emf induced in the inductor during the process is: **[1]**

a) 440 V

b) 100 V

c) 40 V

d) 0.4 V

23. An ac generator consists of 8 turns of wire, each of area A = 0.0900 m^2, and the total resistance of the wire is 12.0Ω. The loop rotates in a 0.500 T magnetic field at a constant frequency of 60.0 Hz. Maximum induced emf is **[1]**

a) 126 V
b) 116 V
c) 106 V
d) 136 V

24. If the speed of rotation of a dynamo is doubled, then the induced e.m.f. will **[1]**

a) become four times
b) become half
c) become double
d) remain unchanged

25. 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^o in 0.25 s. The current induced in the coil is **[1]**

(Horizontal component of the earth's magnetic field at the place is 3.0×10^{-5} T)

a) 2.9×10^{-3}A
b) 4.9×10^{-3}A
c) 1.9×10^{-3}A
d) 3.9×10^{-3}A

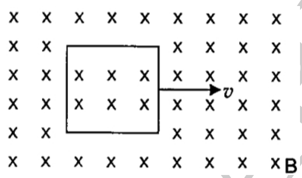
26. Whenever a magnet is moved either towards or away from a conducting coil, an e.m.f is induced, the magnitude of which is independent of **[1]**

a) the number of turns in the coil
b) the resistance of the coil
c) the speed with which, the magnet is moved
d) the strength of the magnetic field

27. In a discharge tube at 0.02 mm, there is formation of **[1]**

a) Faraday's dark space
b) Crooke's dark space and Faraday's dark space
c) none of these
d) Crooke's dark space

28. 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 and into the plane of the loop exists everywhere as in given figure. The current induced in the loop is **[1]**



a) $\frac{Blv}{R}$ clockwise
b) $\frac{2Blv}{R}$ anticlock wise
c) $\frac{Blv}{R}$ anticlockwise
d) zero.

29. 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 **[1]**

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

30. In a coil of self-induction 5 H, the rate of change of current is 2 A s^{-1}. Then, e.m.f. induced in the coil is **[1]**

a) 10 V
b) -10 V

c) -5 V

d) 5 V

31. A long solenoid has 1000 turns. When a current of 4 A flows through it, the magnetic flux linked with each turn of the solenoid is 4×10^{-3} Wb. The self-inductance of the solenoid is: **[1]**

a) 1 H

b) 4 H

c) 3 H

d) 2 H

32. The self inductance L of a solenoid of length l and area of crosssection A, with a fixed number of turns N increases as **[1]**

a) l increases and A decreases

b) l decreases and A increases

c) Both l and A decrease

d) l and A increase

33. If N is the number of turns in a coil, the value of self-inductance varies as **[1]**

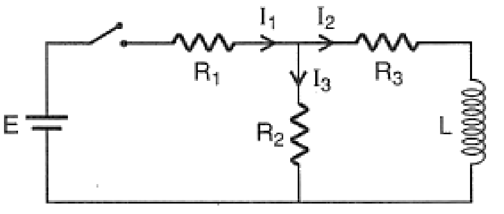
a) N^{-2}

b) N

c) N^0

d) N^2

34. In the circuit shown in the following figure E = 10 V, R_1 = 2 ohm, R_2 = 3 ohm and R_3 = 6 ohm and L = 5 henry. The current I_1 just after releasing the switch is: **[1]**



a) $(\frac{10}{5}) amp$

b) zero

c) $(\frac{10}{4}) amp$

d) $(\frac{10}{12}) amp$

35. A conducting circular loop is placed in a uniform magnetic field, B = 0.025 T with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of 1 mm s^{-1}. The induced emf when the radius is 2 cm, is **[1]**

a) 2μV

b) $\pi\mu$V

c) $2\pi\mu V$

d) $\frac{\pi}{2}\mu$V

36. A long solenoid has 800 turns per meter. A current of 1.6 A flows through it. The magnetic induction at the end of solenoid on its axis is **[1]**

a) $16.0 \times 10^{-4} T$

b) $8.04 \times 10^{-4} T$

c) $4.0 \times 10^{-4} T$

d) $2.0 \times 10^{-4} T$

37. A circular ring of diameter 20 cm has a resistance of 0.01 Ω. The charge that will flow through the ring if it is turned from a position perpendicular to a uniform magnetic field of 2.0 T to a position parallel to the field is about: **[1]**

a) 0.063 C

b) 63 C

c) 0.63 C

d) 6.3 C

38. The magnetic flux through a circuit of resistance R changes by an amount $\Delta\phi$ in a time Δt. Then the total quantity of electric charge Q that passes any point in the circuit during the time Δt is represented by: **[1]**

a) $Q = \frac{\Delta\phi}{\Delta t}$

b) $Q = \frac{1}{R}\frac{\Delta\phi}{\Delta t}$

c) $Q = R\frac{\Delta\phi}{\Delta t}$

d) $Q = \frac{\Delta\phi}{R}$

39. A 100 mH coil carries a current of 1 A. Energy stored in the form of magnetic field is **[1]**

a) $0 \cdot 1\ J$

b) $0 \cdot 5J$

c) $0 \cdot 05\ J$

d) 1 J

40. The SI unit of magnetic flux is: **[1]**

a) Oersted

b) Weber

c) Gauss

d) Tesla

41. In lenz's law, there is conservation of **[1]**

a) Charge

b) Momentum

c) Energy

d) Current

42. Whenever the flux linked with a circuit changes, there is an induced emf in the circuit. This emf in the circuit lasts **[1]**

a) forever

b) as long as the magnetic flux in the circuit changes.

c) for a long duration

d) for a very short duration

43. A coil of wire of a certain radius has 100 turns and a self-inductance of 15 mH. The self-inductance of a second similar coil of 500 turns will be: **[1]**

a) 15 mH

b) 375 mH

c) 45 mH

d) 75 mH

44. An inductor may store energy in **[1]**

a) its magnetic field

b) its electric field

c) both in electric and magnetic fields

d) its coils

45. Expression for the magnetic energy stored in a solenoid in terms of magnetic field B, area A and length l of the solenoid is **[1]**

a) $\frac{\mu_0 A}{2} Bl$

b) $\frac{\mu_0 \pi Bl}{2A}$

c) $\frac{1}{2\mu_0} B^2 Al$

d) $\frac{\pi A}{2lB}$

46. If number of turns per unit length of a coil of a solenoid is doubled, its self-inductance will **[1]**

a) be doubled

b) be halved

c) remain constant

d) be four times

47. A long solenoid of diameter 0.1 m has 2×10^4 turns per metre. At the centre of the solenoid, a coil of 100 turns and radius 0.01 m is placed with its axis coinciding with the solenoid axis. The current in the solenoid reduces at a constant rate to 0 A from 4 A in 0.05 s. If the resistance of the coil is 10 $\pi^2 \Omega$, the total charge flowing through the coil during this time is: **[1]**

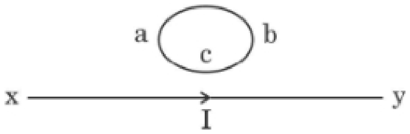
a) $32\pi\mu$C

b) $32\mu C$

c) $16\mu C$

d) $16\pi\mu C$

48. The direction of induced current in the loop abc is: **[1]**



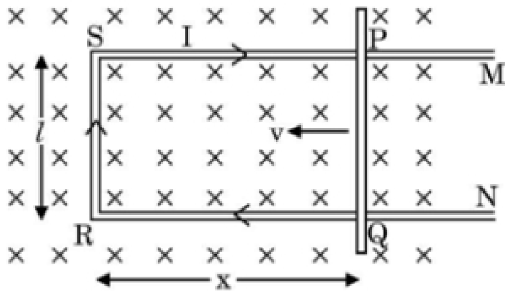
a) along abc if I is constant

b) along abc if I increases

c) along abc if I decreases

d) along acb if I increases

49. Figure shows a rectangular conductor PSRQ in which movable arm PQ has a resistance **r** and resistance of PSRQ is negligible. The magnitude of emf induced when PQ is moved with a velocity $\vec{v}$ does **not** depend on: **[1]**



a) resistance (r)

b) velocity $(\vec{V})$

c) length of PQ

d) magnetic field $(\vec{B})$

50. The polarity of induced emf is defined by **[1]**

a) Fleming's right hand rule

b) Lenz's law

c) Biot-Savart's law

d) Ampere's circuital law

51. Two identical circular coaxial coils A and B, arranged in vertical planes parallel to each other, carry currents in the same direction. If the distance between the coils is decreased at a constant rate, the current: **[1]**

a) increases in both A and B.

b) increases in A and decreases in B.

c) remains same in both A and B.

d) decreases in both A and B.

52. A straight line conductor of length 0.4 m is moved with a speed of 7 ms^{-1} perpendiculars to the magnetic field of intensity 0.9 Wbm^{-2}. The induced emf across the conductor is **[1]**

a) 5.24 V

b) 25.2 V

c) 2.52 V

d) 1.26 V

53. When the current in a coil changes from 8A to 2A in 3×10^{-2} second, the emf induced in the coil is 2 volt. The self-inductance of the coil, in millitienry, is **[1]**

a) 5

b) 20

c) 10

d) 1

54. The phase difference between the flux linked with a Coil rotating in a uniform magnetic field and induced emf produced in it is: **[1]**

a) $\frac{-\pi}{6}$

b) $\frac{\pi}{2}$

c) $\frac{\pi}{3}$

d) π

55. Assume that a motor in which the coils have a total resistance of 10Ω is supplied by a voltage of 120 V. When the motor is running at its maximum speed, the back emf is 70 V. Current in the coils when the motor is turned **[1]**

on and when it has reached maximum speed are

a) 16 A, 5 A
b) 14 A, 5 A
c) 12 A, 4 A
d) 12 A, 5 A

56. 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 $\mathbf{B} = B_o(\hat{\mathbf{i}} + \hat{\mathbf{k}})\mathrm{T}$ is present in the region. The flux passing through the loop ABCDEFA (in that order) is **[1]**

a) $2 B_o L^2$Wb
b) $4 B_o L^2$Wb
c) $\sqrt{2} B_o L^2$Wb
d) $B_o L^2$Wb

57. If the rotational velocity of dynamo armature is doubled, then induced emf will become: **[1]**

a) two times
b) half
c) unchanged
d) four times

58. A thin circular ring of area A is held perpendicular to a uniform magnetic field of induction B. A small cut is made in the ring and a galvanometer is connected across its ends in such a way that the total resistance of the circuit is R. When the ring is suddenly squeezed to zero area, the charge flowing through the galvanometer is **[1]**

a) $\frac{B^2A}{R^2}$
b) ABR
c) $\frac{AB}{R}$
d) $\frac{BR}{A}$

59. A square loop of wire of each side 50 cm is kept so that its plane makes an angle θ with a uniform magnetic field of induction IT. The magnetic field is withdrawn in 0.1 s. It is found that the induced emf across the loop is 125 mV. The angle θ is: **[1]**

a) 30^o
b) 60^o
c) 90^o
d) 45^o

60. A coil of cross-sectional area 400 cm^2 having 30 turns is making 1800 rev/min in a magnetic field of 1 T. The peak value of the induced emf is: **[1]**

a) 2.26 V
b) 226 V
c) 0.6 V
d) 0.4 V

61. Two inductors of inductance L each are connected in series with opposite magnetic fluxes. What is the resultant inductance? **[1]**

a) L
b) Zero
c) 2 L
d) 3 L

62. 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. Mutual inductance of the arrangement is **[1]**

a) $\frac{\mu_0 \pi r_1^2}{2r_2^3}$
b) $\frac{\mu_0 \pi r_1^3}{2r_2^2}$
c) $\frac{\mu_0 \pi r_1}{3r_2}$
d) $\frac{\mu_0 \pi r_1^2}{2r_2}$

63. The magnetic flux linked with the coil varies with time as $\phi = 3t^2 + 4t + 9$. The magnitude of the induced emf at t = 2 s is **[1]**

a) 3V

b) 4V

c) 9V

d) 16V

64. If two coils of inductances L_1 and L_2 are linked such that their mutual inductance is M, then the maximum value of M is **[1]**

a) $L_1 - L_2$

b) $L_1 + L_2$

c) $L_1 \times L_2$

d) $\sqrt{L_1 L_2}$

65. A uniformly wound long solenoid of inductance L and resistance R is broken into two equal parts in the ratio $\frac{\eta}{1}$, which are then joined in parallel. This combination is then joined to a cell of emf ε. The time constant of the circuit is **[1]**

a) $\frac{2L}{R}$

b) $\frac{L}{R}$

c) $\frac{L}{2R}$

d) $\frac{L}{R^2}$

66. Two inductors each of inductance L are joined in parallel. What is their equivalent inductance? **[1]**

a) 2 L

b) zero

c) L

d) $\frac{L}{2}$

67. A dynamo works on the principle of: **[1]**

a) Induced magnetism

b) Faraday's effect

c) Electromagnetic induction

d) Induced current

68. The magnetic flux linked with a coil is given by an equation $\phi = 5t^2 + 2t + 3$. The induced e.m.f. in the coil at the third second will be **[1]**

a) 32 units

b) 40 units

c) 54 units

d) 65 units

69. The average emf induced in which current changes from 0 to 2 A in 0.05 sec is 8 V. The self-inductance of the coil is: **[1]**

a) 0.4 H

b) 0.2 H

c) 0.1 H

d) 0.8 H

70. An emf of 100 mV is induced in a coil when current in another near by coil becomes 10 A from 0 in 0.1 s. The coefficient of mutual induction between the two coils will be: **[1]**

a) 100 mH

b) 1 mH

c) 1000 mH

d) 10 mH

71. Inductance plays the role of **[1]**

a) inertia

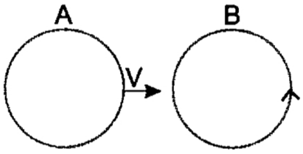
b) friction

c) force

d) source of emf

72. There are two coils A and B as shown in the 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 **[1]**

moves. We can infer that



a) there is a constant current in the counterclockwise direction in A.

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

c) there is a varying current in A.

d) there is no current in A.

73. A coil of area 100 cm^2 is kept at an angle of 30^o with a magnetic field of 10^{-1} T. The magnetic field is reduced to zero in 10^{-4} s. The induced emf in the coal is **[1]**

a) 50. 0 V

b) $50\sqrt{3}$ V

c) 5.0 V

d) $5\sqrt{3}$ V

74. Suppose the number of turns in a coil be tripled, the value of magnetic flux linked with it **[1]**

a) is doubled

b) becomes $\frac{1}{3}$

c) remains unchanged

d) is tripled

75. If an inductor having inductance L is joined to another identical inductor with its one end joined, the resultant inductance would become **[1]**

a) zero

b) 2 L

c) $\frac{L}{2}$

d) $\frac{L}{4}$