EXERCISE-I

Faraday's and Lenz's Law

1. The magnetic field in a coil of 100 turns and 40 *square cm* area is increased from 1 *Tesla* to 6 *Tesla* in 2 *second.* The magnetic field is perpendicular to the coil. The e.m.f. generated in it is

(A) 10^4 *V* (B) 1.2 *V*

(C) 1.0 *V* (D) 10^{-2} *V*

2. The dimensions of magnetic flux are

(A) $MLT^{-2}A^{-2}$ (B) $ML^2T^{-2}A^{-2}$

(C) $ML^2T^{-1}A^{-2}$ (D) $ML^2T^{-2}A^{-1}$

3. Lenz's law gives

(A) The magnitude of the induced e.m.f.

(B) The direction of the induced current

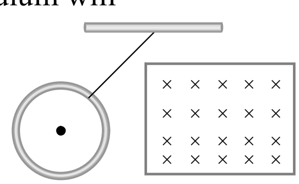
(C) Both the magnitude and direction of the induced current

(D) The magnitude of the induced current

4. The north pole of a bar magnet is moved swiftly downward towards a closed coil and then second time it is raised upwards slowly. The magnitude and direction of the induced currents in the two cases will be of

	First case	***Second case***
(A)	Low value clockwise	Higher value anticlockwise
(B)	Low value clockwise	Equal value anticlockwise
(C)	Higher value clockwise	Low value clockwise
(D)	Higher value anticlockwise	Low value clockwise

5. A metallic ring connected to a rod oscillates freely like a pendulum. If now a magnetic field is applied in horizontal direction so that the pendulum now swings through the field, the pendulum will



(A) Keep oscillating with the old time period

(B) Keep oscillating with a smaller time period

(C) Keep oscillating with a larger time period

(D) Come to rest very soon

6. A circular coil of 500 turns of wire has an enclosed area of $0.1 m^2$ per turn. It is kept perpendicular to a magnetic field of induction 0.2 *T* and rotated by 180° about a diameter perpendicular to the field in 0.1 *sec*. How much charge will pass when the coil is connected to a galvanometer with a combined resistance of 50 *ohms*

(A) 0.2 *C* (B) 0.4 *C*

(C) 2 *C* (D) 4 *C*

7. A coil of 100 *turns* and area 5 *square centimetre* is placed in a magnetic field B = 0.2 *T*. The normal to the plane of the coil makes an angle of 60° with the direction of the magnetic field. The magnetic flux linked with the coil is

(A) $5\times10^{-3} Wb$ (B) $5\times10^{-5} Wb$

(C) 10^{-2} *Wb* (D) 10^{-4} *Wb*

8. In a circuit with a coil of resistance 2 *ohms*, the magnetic flux changes from 2.0 *Wb* to 10.0 *Wb* in 0.2 second. The charge that flows in the coil during this time is

(A) 5.0 *coulomb* (B) 4.0 *coulomb*

(C) 1.0 *coulomb* (D) 0.8 *coulomb*

9. The direction of induced current is such that it opposes the very cause that has produced it. This is the law of

(A) Lenz (B) Faraday

(C) Kirchhoff (D) Fleming

10. To induce an e.m.f. in a coil, the linking magnetic flux

(A) Must decrease

(B) Can either increase or decrease

(C) Must remain constant

(D) Must increase

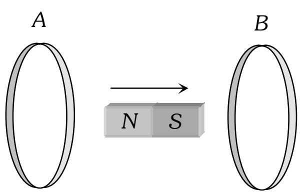
11. A coil has an area of 0.05 m^2 and it has 800 turns. It is placed perpendicularly in a magnetic field of strength $4 \times 10^{-5} \, Wb/m^2$, it is rotated through 90^o in 0.1 *sec*. The average e.m.f. induced in the coil is

(A) 0.056 *V* (B) 0.046 *V*
(C) 0.026 *V* (D) 0.016 *V*

12. A moving conductor coil in a magnetic field produces an induced e.m.f. This is in accordance with

(A) Amperes law (B) Coulomb law
(C) Lenz's law (D) Faraday's law

13. In the diagram shown if a bar magnet is moved along the common axis of two single turn coils *A* and *B* in the direction of arrow



(A) Current is induced only in *A* & not in *B*
(B) Induced currents in *A* & *B* are in the same direction
(C) Current is induced only in *B* and not in *A*
(D) Induced currents in *A* & *B* are in opposite directions

14. Magnetic flux ϕ (in *weber*) linked with a closed circuit of resistance 10 *ohm* varies with time *t* (in seconds) as $\varphi = 5t^2 - 4t + 1$

The induced electromotive force in the circuit at *t* = 0.2 *sec*. is

(A) 0.4 *volts* (B) – 0.4 *volts*
(C) – 2.0 *volts* (D) 2.0 *volts*

15. The formula for induced e.m.f. in a coil due to change in magnetic flux through the coil is (here *A* = area of the coil, *B* = magnetic field)

(A) $e = -A.\frac{dB}{dt}$ (B) $e = -B.\frac{dA}{dt}$
(C) $e = -\frac{d}{dt}(A.B)$ (D) $e = -\frac{d}{dt}(A \times B)$

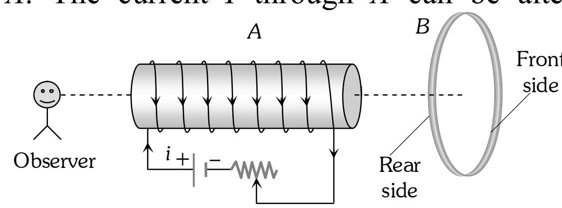
16. Lenz's law is expressed by the following formula (here *e* = induced e.m.f., ϕ = magnetic flux in one turn and *N* = number of turns)

(A) $e = -\varphi \frac{dN}{dt}$ (B) $e = -N\frac{d\varphi}{dt}$
(C) $e = -\frac{d}{dt}\left(\frac{\varphi}{N}\right)$ (D) $e = N\frac{d\varphi}{dt}$

17. A magnet is dropped down an infinitely long vertical copper tube

(A) The magnet moves with continuously increasing velocity and ultimately acquires a constant terminal velocity
(B) The magnet moves with continuously decreasing velocity and ultimately comes to rest
(C) The magnet moves with continuously increasing velocity but constant acceleration
(D) The magnet moves with continuously increasing velocity and acceleration

18. An aluminium ring *B* faces an electromagnet *A*. The current *I* through *A* can be altered



(A) Whether *I* increases or decreases, *B* will not experience any force
(B) If *I* decrease, *A* will repel *B*
(C) If *I* increases, *A* will attract *B*
(D) If *I* increases, *A* will repel *B*

19. The magnetic flux linked with a coil at any instant '*t*' is given by $\phi = 5t^3 - 100t + 300$, the e.m.f. induced in the coil at *t* = 2 *second* is

(A) – 40 *V* (B) 40 *V*
(C) 140 *V* (D) 300 *V*

20. A coil has 1,000 turns and 500 cm^2 as its area. The plane of the coil is placed at right angles to a magnetic induction field of $2 \times 10^{-5} \, Wb/m^2$. The coil is rotated through 180^o in 0.2 *seconds*. The average e.m.f. induced in the coil, in *milli-volts*, is

(A) 5 (B) 10
(C) 15 (D) 20

Motional EMI

21. A long horizontal metallic rod with length along the east-west direction is falling under gravity. The potential difference between its two ends will

(A) Be zero (B) Be constant
(C) Increase with time (D) Decrease with time

22. A two metre wire is moving with a velocity of 1 m/*sec* perpendicular to a magnetic field of 0.5 *weber*/m^2. The e.m.f. induced in it will be

(A) 0.5 *volt* (B) 0.1 *volt*
(C) 1 *volt* (D) 2 *volt*

23. A metal rod moves at a constant velocity in a direction perpendicular to its length. A constant uniform magnetic field exists in space in a direction perpendicular to the rod as well as its velocity. Select the correct statement(s) from the following

(A) The entire rod is at the same electric potential
(B) There is an electric field in the rod
(C) The electric potential is highest at the centre of the rod and decreases towards its ends
(D) The electric potential is lowest at the centre of the rod and increases towards its ends

24. A conducting wire is dropped along east-west direction, then

(A) No emf is induced
(B) No induced current flows
(C) Induced current flows from west to east
(D) Induced current flows from east to west

25. The magnetic induction in the region between the pole faces of an electromagnet is 0.7 *weber*/m^2. The induced e.m.f. in a straight conductor 10 *cm* long, perpendicular to B and moving perpendicular both to magnetic induction and its own length with a velocity 2 *m/sec* is

(A) 0.08 V (B) 0.14 V
(C) 0.35 V (D) 0.07 V

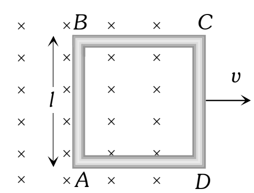
26. A straight conductor of length 0.4 m is moved with a speed of 7 *m/s* perpendicular to the magnetic field of intensity of 0.9 Wb/m^2. The induced e.m.f. across the conductor will be

(A) 7.25 V (B) 3.75 V
(C) 1.25 V (D) 2.52 V

27. A coil of N turns and mean cross-sectional area A is rotating with uniform angular velocity ω about an axis at right angle to uniform magnetic field B. The induced e.m.f. E in the coil will be

(A) $NBA \sin\omega t$ (B) $NB\ \omega \sin\omega t$
(C) $NB/A \sin\omega t$ (D) $NBA\ \omega \sin\omega t$

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 at the loop exists everywhere with half the loop outside the field, as shown in figure. The induced e.m.f. is



(A) Zero
(B) RvB
(C) VBl/R
(D) VBl

29. A wheel with ten metallic spokes each 0.50 m long is rotated with a speed of 120 *rev/min* in a plane normal to the earth's magnetic field at the place. If the magnitude of the field is 0.4 Gauss, the induced e.m.f. between the axle and the rim of the wheel is equal to

(A) $1.256\times10^{-3}\ V$ (B) $6.28\times10^{-4}\ V$
(C) $1.256\times10^{-4}\ V$ (D) $6.28\times10^{-5}\ V$

30. 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 0.3 T. The potential difference between the ends of the rod is

(A) 30 V (B) 40 V
(C) 60 V (D) 600 V

Static EMI

31. A closely wound coil of 100 turns and area of cross-section $1\,cm^2$ has a coefficient of self-induction 1 *mH*. The magnetic induction in the centre of the core of the coil when a current of 2*A* flows in it, will be

(A) $0.022\,Wbm^{-2}$ (B) $0.4\,Wb\,m^{-2}$

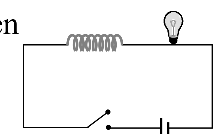
(C) $0.8\,Wb\,m^{-2}$ (D) $1\,Wb\,m^{-2}$

32. Two circuits have coefficient of mutual induction of 0.09 *henry*. Average e.m.f. induced in the secondary by a change of current from 0 to 20 *ampere* in 0.006 *second* in the primary will be

(A) 120 *V* (B) 80 *V*

(C) 200 *V* (D) 300 *V*

33. In the following circuit, the bulb will become suddenly bright if



(A) Contact is made or broken

(B) Contact is made

(C) Contact is broken

(D) Won't become bright at all

34. Two pure inductors each of self inductance *L* are connected in parallel but are well separated from each other. The total inductance is

(A) $2L$ (B) L

(C) $\frac{L}{2}$ (D) $\frac{L}{4}$

35. A coil and a bulb are connected in series with a dc source, a soft iron core is then inserted in the coil. Then

(A) Intensity of the bulb remains the same

(B) Intensity of the bulb decreases

(C) Intensity of the bulb increases

(D) The bulb ceases to glow

36. Self-induction of a solenoid is

(A) Directly proportional to current flowing through the coil

(B) Directly proportional to its length

(C) Directly proportional to area of cross-section

(D) Inversely proportional to area of cross-section

37. 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 core

(D) None of the above

38. The self-inductance of a coil is 5 *henry*, a current of 1 *amp* change to 2 *amp* within 5 *second* through the coil. The value of induced e.m.f. will be

(A) 10 *volt* (B) 0.10 *volt*

(C) 1.0 *volt* (D) 100 *volt*

39. The unit of inductance is

(A) *Volt/ampere* (B) *Joule/ampere*

(C) *Volt-sec/ampere* (D) *Volt-ampere/sec*

40. The current flowing in a coil of self-inductance 0.4 *mH* is increased by 250 *mA* in 0.1 *sec*. The e.m.f. induced will be

(A) + 1 *V* (B) – 1 *V*

(C) + 1 *mV* (D) – 1 *mV*

41. A 100 *mH* coil carries a current of 1 *ampere*. Energy stored in its magnetic field is

(A) 0.5 *J* (B) 1 *J*

(C) 0.05 *J* (D) 0.1 *J*

42. The mutual inductance of an induction coil is $5H$. In the primary coil, the current reduces from $5A$ to zero in $10^{-3}\,s$. What is the induced emf in the secondary coil

(A) $2500V$ (B) $25000V$

(C) $2510V$ (D) Zero

43. The self-inductance of a straight conductor is

(A) Zero (B) Very large

(C) Infinity (D) Very small

44. What is the coefficient of mutual inductance when the magnetic flux changes by $2\times10^{-2}\,Wb$ and change in current is $0.01A$

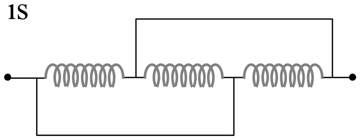
(A) 2 *henry* (B) 3 *henry*

(C) $\frac{1}{2}$ *henry* (D) Zero

45. The current in a coil changes from 4 *ampere* to zero in 0.1 *s*. If the average e.m.f. induced is 100 *volt*, what is the self-inductance of the coil

(A) 2.5 H (B) 25 H
(C) 400 H (D) 40 H

46. Pure inductance of 3.0 H is connected as shown below. The equivalent inductance of the circuit is



(A) 1 H (B) 2 H
(C) 3 H (D) 9 H

47. A varying current at the rate of 3 A/s in a coil generates an e.m.f. of 8 mV in a nearby coil. The mutual inductance of the two coils is

(A) 2.66 mH (B) 2.66×10^{-3} mH
(C) 2.66 H (D) 0.266 H

48. If a current of 10 A flows in one second through a coil, and the induced e.m.f. is 10 V, then the self-inductance of the coil is

(A) $\frac{2}{5}H$ (B) $\frac{4}{5}H$
(C) $\frac{5}{4}H$ (D) 1 H

49. The inductance of a closed-packed coil of 400 turns is 8 mH. A current of 5 mA is passed through it. The magnetic flux through each turn of the coil is

(A) $\frac{1}{4\pi}\mu_0 Wb$ (B) $\frac{1}{2\pi}\mu_0 Wb$
(C) $\frac{1}{3\pi}\mu_0 Wb$ (D) $0.4\,\mu_0 Wb$

50. When the current through a solenoid increases at a constant rate, the induced current

(A) Is constant and is in the direction of the inducing current
(B) Is a constant and is opposite to the direction of the inducing current
(C) Increases with time and is in the direction of the inducing current
(D) Increases with time and opposite to the direction of the inducing current

51. An L-R circuit has a cell of e.m.f. E, which is switched on at time $t = 0$. The current in the circuit after a long time will be

(A) Zero (B) $\frac{E}{R}$
(C) $\frac{E}{L}$ (D) $\frac{E}{\sqrt{L^2 + R^2}}$

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

(A) The currents in the two coils
(B) The rates at which currents are changing in the two coils
(C) Relative position and orientation of the two coils
(D) The materials of the wires of the coils

53. When the current change from + 2A to – 2A in 0.05 *second*, an e.m.f. of 8 V is induced in a coil. The coefficient of self-induction of the coil is

(A) 0.1 H (B) 0.2 H
(C) 0.4 H (D) 0.8 H

54. A coil resistance 20Ω and inductance 5H is connected with a 100V battery. Energy stored in the coil will be

(A) 41.5 J (B) 62.50 J
(C) 125 J (D) 250 J

55. Why the current does not rise immediately in a circuit containing inductance

(A) Because of induced emf
(B) Because of high voltage drop
(C) Because of low power consumption
(D) Because of Joule heating

56. Two circular coils have their centres at the same point. The mutual inductance between them will be maximum when their axes

(A) Are parallel to each other
(B) Are at 60° to each other
(C) Are at 45° to each other
(D) Are perpendicular to each other

57. The current in a coil decreases from 1 A to 0.2 A. In 10*sec.* Calculate the coefficient of self-inductance. If induced emf is 0.4 *volt*.
(A) 5 H (B) 3 H
(C) 4 H (D) 2 H

58. The current through choke coil increases form zero to 6A in 0.3 *seconds* and an induced e.m.f. of 30 V is produced. The inductance of the coil of choke is
(A) 5 H (B) 2.5 H
(C) 1.5 H (D) 2 H

59. The resistance and inductance of series circuit are 5Ω and 20H respectively. At the instant of closing the switch, the current is increasing at the rate 4A-s. The supply voltage is
(A) 20 V (B) 80 V
(C) 120 V (D) 100 V

60. A coil of $N = 100$ turns carries a current $I = 5$ A and creates a magnetic flux $\varphi = 10^{-5}\,Tm^{-2}$ per turn. The value of its inductance L will be
(A) 0.05 mH (B) 0.10 mH
(C) 0.15 mH (D) 0.20 mH

Application of EMI (Motor, Dynamo, Transformer...)

61. In an induction coil with resistance, the induced emf will be maximum when
(A) The switch is put on due to high resistance
(B) The switch is put off due to high resistance
(C) The switch is put on due to low resistance
(D) The switch is put off due to low resistance

62. An electric motor operating on a 60 V dc supply draws a current of 10 A. If the efficiency of the motor is 50%, the resistance of its winding is
(A) 3Ω (B) 6Ω
(C) 15Ω (D) 30Ω

63. A device which converts electrical energy into mechanical energy is
(A) Dynamo (B) generator
(C) Electric motor (D) Induction coil

64. An electric motor operates on a 50 *volt* supply and a current of 12A. If the efficiency of the motor is 30%, what is the resistance of the winding of the motor
(A) 6Ω (B) 4Ω
(C) 2.9Ω (D) 3.1Ω

65. A motor having an armature of resistance 2Ω is designed to operate at 220 V mains. At full speed, it develops a back e.m.f. of 210V. When the motor is running at full speed, the current in the armature is
(A) 5A (B) 105A
(C) 110A (D) 215A

66. Fan is based on
(A) Electric Motor (B) Electric dynamo
(C) Both (D) None of these

67. A transformer is employed to
(A) Obtain a suitable dc voltage
(B) Convert dc into ac
(C) Obtain a suitable ac voltage
(D) Convert ac into dc

68. What is increased in step-down transformer
(A) Voltage (B) Current
(C) Power (D) Current density

69. The core of a transformer is laminated so that
(A) Ratio of voltage in the primary and secondary may be increased
(B) Rusting of the core may be stopped
(C) Energy losses due to eddy currents may be reduced
(D) Change in flux is increased

70. In transformer, core is made of soft iron to reduce
(A) Hysteresis losses
(B) Eddy current losses
(C) Force opposing electric current
(D) None of the above

71. The coils of a step down transformer have 500 and 5000 turns. In the primary coil an ac of 4 *ampere* at 2200 *volts* is sent. The value of the current and potential difference in the secondary coil will be
(A) 20 A, 220 V (B) 0.4 A, 22000 V
(C) 40 A, 220 V (D) 40 A, 22000 V

72. A power transformer is used to step up an alternating e.m.f. of 220 *V* to 11 *kV* to transmit 4.4 *kW* of power. If the primary coil has 1000 turns, what is the current rating of the secondary ? Assume 100% efficiency for the transformer

(A) 4 *A* (B) 0.4 *A*
(C) 0.04 *A* (D) 0.2 *A*

73. A step up transformer connected to a 220 *V AC* line is to supply 22 *kV* for a neon sign in secondary circuit. In primary circuit a fuse wire is connected which is to blow when the current in the secondary circuit exceeds 10 *mA*. The turn ratio of the transformer is

(A) 50 (B) 100
(C) 150 (D) 200

74. In a transformer the primary has 500 *turns* and secondary has 50 *turns*. 100 *volts* are applied to the primary coil, the voltage developed in the secondary will be

(A) 1 *V* (B) 10 *V*
(C) 1000 *V* (D) 10000 *V*

75. A transformer is used to

(A) Change the alternating potential
(B) Change the alternating current
(C) To prevent the power loss in alternating current flow
(D) To increase the power of current source

76. A step-up transformer operates on a 230 *V* line and supplies a load of 2 *ampere*. The ratio of the primary and secondary windings is 1 : 25. The current in the primary is

(A) 15 *A* (B) 50 *A*
(C) 25 *A* (D) 12.5 *A*

77. The number of turns in the primary coil of a transformer is 200 and the number of turns in the secondary coil is 10. If 240 *volt AC* is applied to the primary, the output from the secondary will be

(A) 48 *V* (B) 24 *V*
(C) 12 *V* (D) 6 *V*

78. The primary winding of transformer has 500 turns whereas its secondary has 5000 turns. The primary is connected to an ac supply of 20 *V*, 50 *Hz*. The secondary will have an output of

(A) 200 *V*, 50 *Hz* (B) 2 *V*, 50 *Hz*
(C) 200 *V*, 500 *Hz* (D) 2 *V*, 5 *Hz*

79. A step-up transformer has transformation ratio of 3 : 2. What is the voltage in secondary if voltage in primary is 30 *V*

(A) 45 *V* (B) 15 *V*
(C) 90 *V* (D) 300 *V*

80. In a transformer, the number of turns in primary coil and secondary coil are 5 and 4 respectively. If 240 *V* is applied on the primary coil, then the ratio of current in primary and secondary coil is

(A) 4 : 5 (B) 5 : 4
(C) 5 : 9 (D) 9 : 5

81. An ideal transformer has 500 and 5000 turn in primary and secondary windings respectively. If the primary voltage is connected to a 6V battery then the secondary voltage is

(A) 0 (B) 60 *V*
(C) 0.6 *V* (D) 6.0 *V*

82. In a primary coil 5A current is flowing on 220 volts. In the secondary coil 2200*V* voltage produces. Then ratio of number of turns in secondary coil and primary coil will be

(A) 1 : 10 (B) 10 : 1
(C) 1 : 1 (D) 11 : 1

83. A step up transformer has transformation ration 5 : 3. What is voltage in secondary if voltage in primary is 60 *V*

(A) 20 *V* (B) 60 *V*
(C) 100 *V* (D) 180 *V*

84. In a step up transformer, 220 *V* is converted into 200 *V*. The number of turns in primary coil is 600. What is the number of turns in the secondary coil

(A) 60 (B) 600
(C) 6000 (D) 100

85. The output voltage of a transformer connected to 220 *volt* line is 1100 *volt* at 1 *amp* current. Its efficiency is 100%. The current coming from the line is

(A) 20 A (B) 10 A
(C) 11 A (D) 22 A

86. Quantity that remains unchanged in a transformer is

(A) Voltage (B) Current
(C) Frequency (D) None of the above

87. In a region of uniform magnetic induction $B = 10^{-2}$ *tesla*, a circular coil of radius 30 *cm* and resistance π^2 *ohm* is rotated about an axis which is perpendicular to the direction of B and which forms a diameter of the coil. If the coil rotates at 200 *rpm* the amplitude of the alternating current induced in the coil is

(A) $4\pi^2$ *mA* (B) 30 *mA*
(C) 6 *mA* (D) 200 *mA*

88. In a transformer, the number of turns in primary and secondary are 500 and 2000 respectively. If current in primary is 48 A, the current in the secondary is

(A) 12 A (B) 24 A
(C) 48 A (D) 144 A

89. In an inductor of inductance L = 100 *mH*, a current of $I = 10A$ is flowing. The energy stored in the inductor is

(A) 5 J (B) 10 J
(C) 100 J (D) 1000 J

90. The turn ratio of a transformers is given as 2 : 3. If the current through the primary coil is 3 A, thus calculate the current through load resistance

(A) 1 A (B) 4.5 A
(C) 2 A (D) 1. 5 A