Answers

1) Ans (b)

Here both electric and magnetic fields parallel to each other. A charged particle moving parallel to magnetic field will not experience force due to magnetic field. it experience force due to electric field. If it is positive charge it moves in the direction of the field and if it is negative charge it move opposite to direction of field, so it moves in a straight line .

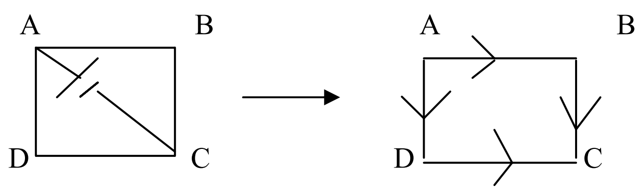
2) Ans (d)

Let m is the mass, e is the charge of electron .F be the force and v is the velocity,V be the accelerating potential. Kinetic energy can be written as,

$\frac{1}{2}mv^2$ =Ve ; v= $\sqrt{\frac{2eV}{m}}$; F=Bev; F=Be $\sqrt{\frac{2eV}{m}}$

F α V; $\frac{F_2}{F_1} = \sqrt{\frac{V_2}{V_1}} = \sqrt{\frac{2V}{V}} = \sqrt{2}$; $F_2 = \sqrt{2}\ F_1$

3) Ans (a)



ABCD is a square of side ‘a’ .Battery is connected along diagonal AC. The direction of current in opposite parallel sides is shown in the figure. Applying right hand rule for all side we get net field at the center is zero.

4) Ans(b)
Moving charge produces magnetic field, and by changing magnetic field electric field can be created. Electric and magnetic fields are not independent. Together they called electromagnetic field
5) Ans (a)
In a moving coil galvanometer current is given by I=kθ where k=c/Ban, I α θ
6) Ans (a) The ratio magnetic force to electric for charged particles moving is given by $\frac{F_m}{F_e} = \frac{v^2}{c^2}$ where velocity of charged particles and ‘c’ is velocity of light in vacuum. Here two positrons beams moving in same direction ,v<<c so $F_m << F_e$. There is force of repulsion as charge of same nature.

7) Ans (d)

$I_{g=} N(I/\theta)$; $I_g = 25X(4X10^{-4}) = 10^{-2}$

$$R = \frac{V}{I_g} - G;\quad R = \frac{25}{10^{-2}} - 50 = 2450\Omega \text{ in series}$$

8) Ans (d)

I_g is the current required for full deflection and $I=nI_g$; $I/I_g = n$

$$s = \frac{G}{\frac{I}{I_g} - 1} = \frac{G}{n-1}$$

9) Ans(a)

Let I_g be the current in the galvanometer and I be the main current ,S is the shunt resistance is connected to the galvanometer of resistance 'G'. We can write

$I_g = \frac{IS}{G+S}$; $\frac{I_g}{I} = \frac{S}{G+S}$; here deflection reduces to 1 division from 100div,when a shunt of 1 ohm is connected. $\frac{I_g}{I} = \frac{1}{100}$; $\frac{1}{100} = \frac{1}{G+1}$

$$G+1=100 \quad G=99\Omega$$

10) Ans(c)

$R = \frac{V}{I_g} - G$; $I_g=V/G$; when V becomes nV resistance to be connected in series is

$$R = \frac{nV}{V/G} - G = (n-1)G$$

11) Ans(d)

The wire B experiences a force of attraction from both the wires, as all carries current in same direction. From force expression we can write

$F_{BA} = \frac{\mu_0 I_1 I_2}{2\pi d} = \frac{\mu_0 X 1 X 2}{2\pi d} = \frac{\mu_0}{\pi d}$ and $F_{BC} = \frac{\mu_0 X 2 X 3}{2\pi d} = \frac{3\mu_0}{\pi d}$

$F_{BC} > F_{BA}$, resultant force is directed towards C

12) Ans(c)

Current sensitivity I_g=150/10=15mA ; voltage sensitivity v=150/2=75mV

G is resistance of galvanometer $G=v/I_g$ = 75mV/15mA =5Ω

$$R = \frac{V}{I_g} - G = \frac{150}{15X10^{-3}} - 5 = 1000\,\Omega$$

13) Ans(c)

Here PQ is in the direction of magnetic field, it won't experience any force. QR is perpendicular to the field and experiences a force BIL

14) Ans(d)

Both are neutral .They are not accelerated by the field.

15) Ans(d)

Here weight is balanced by the magnetic force which is acting upwards.

BIL=mg; $B(1.5X2) = 200X10^{-3}X9.9$

By solving B=0.66T

16) Ans(b)

When currents in same direction magnetic field in between the wires is in opposite directions. Let B_1 is field midway between the wires, r is distance between the wires and I_1 and I_2 be the currents.

$$B_1=\frac{\mu_0 I_1}{2\pi(r/2)}-\frac{\mu_0 I_2}{2\pi(r/2)}$$

$$20X10^{-6} = \frac{\mu_0}{\pi r}(I_1 - I_2) \text{ ....(i)}$$

When currents are in opposite directions magnetic field in between the wires is in same direction and add up.B_2 is the field in midway between them.

$$B_2= \frac{\mu_0 I_1}{2\pi(r/2)}+\frac{\mu_0 I_2}{2\pi(r/2)}$$

$$50X10^{-6}=\frac{\mu_0}{\pi r}(I_1 + I_2) \text{ ....(ii)}$$

Dividing i by ii

$$\frac{2}{5}=\frac{I_1 - I_2}{I_1 + I_2}; \quad 2(I_1+I_2) = 5(I_1-I_2)$$

By solving $\frac{I_1}{I_2}=\frac{7}{3}$

17) Ans(c)

Electrons are moving from south to north and earths vertical component is downwards. By left hand rule electrons deflected right i.e. totards east.

18) Ans(c)

$I_g=(10/100)I$; $\frac{I_g}{I}=\frac{1}{10}$; $\frac{I_g}{I}=\frac{S}{G+S}$; $\frac{1}{10}=\frac{S}{G+S}$

By solving , $S=\frac{G}{9}$

19) Ans(d)

Resistance of an ideal ammeter is zero.

20) Ans(c)

Resistance of an ideal voltmeter is infinite.

21) Ans(a)

Let 'i' be the current for unit deflection. Initial current is 50i , when shunt is applied current in galvanometer is 20i and current flows in shunt is 30i. AS we have seen in example discussed already we can write , $\frac{I_g}{I}=\frac{S}{G+S}$

$\frac{20i}{50i}=\frac{12}{12+G}$; By solving G=18Ω

22) Ans(b)

Force, F=$\frac{\mu_0 2I_1I_2}{4\pi r}$ i.e. F$\alpha\frac{1}{r}$, r is smaller for arm ab than for arm cd. The force on arm ab be F_1 will be repulsive and on arm cd is F_2 will be attractive. Since $F_1 > F_2$, loop will move away from the wire.

23) Ans(b)

Force between two long parallel current carrying conductors is inversely proportional to the distance between them (previous example) F against $\frac{1}{d}$ is straight line

24) Ans(a)

V is the initial range,G is the resistance of galvanometer and R_1 be resistance in series $V=I_g(G+R_1)$….(1) in order to increase the range to 3V, R_2 be the series resistance.

$3V= I_g(G+R_2)$…..(2)

(1/2) gives $\frac{3}{1}=\frac{G+R_2}{G+R_1}$;$3G+3R_1 =G+R_2$; $R_2=2G+3R_1$

$R_2>>2G$; $R_2 \approx 3R_1$

Resistance R_1 already there so additional resistance to be connected is $3R_1 - R_1=2R_1$ $=2X50X10^3=10^5\Omega$

25) Ans(c)

$(12V)_{DC}= (12V\ rms)_{AC}$; $V_0=\sqrt{2}\ V_{rms}$; $V_0=12\sqrt{2}$

26) Ans(a)

Energy stored in an inductor E=$\frac{1}{2}LI^2$; L= $\frac{2E}{I^2}=\frac{ML^2T^{-2}}{A^2}=ML^2T^{-2}A^{-2}$

27) Ans(a)

e= -L$\frac{di}{dt}$; 8= -$\frac{L(-2-2)}{.05}$; L=$\frac{.05X8}{4}$;L= 0.1H

28) Ans(c)

Average value over half cycle in AC $V_m=\frac{2V_0}{\pi}$; $V_{rms}=\frac{V_0}{\sqrt{2}}$; $\frac{V_{rms}}{V_m}=\frac{\pi}{2\sqrt{2}}$

29) Ans (d)

Quality factor 'Q' is given by all equations.

30) Ans(d)

Motional emf e= BLv ; it is not depend on the thickness of the conductor.

31) Ans(d)

Here electron is moving from left to right. It is equivalent to current is flowing from right to left. As the electron passes flux increases first and decreases, the induced emf opposes the increase in flux first and opposes the decrease in flux as electron passes. From Lenz's law the induced current is anticlockwise first and clockwise as electron passes.current as electron passes by. The direction of current changes.

32) Ans(d)

V=$\sqrt{V_R^{\ 2}+(V_L-V_C)^2}$; $V_L=V_C$; $V=V_R$ = 100volt

Z =$\sqrt{R^2+(X_L-X_C)^2}$; $X_L=X_C$; Z=R =50Ω

I=V/Z ; I=100/50= 2A

33) Ans(d)

Induced emf appear only when magnetic flux changes, it is either increase or decrease.

34) Ans (a)

When the plane of the coil is parallel to the field change in flux is maximum, hence current induced also maximum.

35) Ans(c)

Back emf is opposite to the applied emf. Let I be the current and E is emf applied, e is the back emf and R is the resistance .

$I=\frac{E-e}{R}$; 1.5= $\frac{220-e}{20}$

By solving e = 190v.

36) Ans(c)

P = $\frac{E_0}{\sqrt{2}}\frac{I_0}{\sqrt{2}}\cos\phi$ = $\frac{100}{\sqrt{2}} X \frac{100X10^{-3}}{\sqrt{2}}\cos(\frac{\pi}{3})$; $\frac{10}{2} X \frac{1}{2} = 2.5watt$

37) Ans(d)

In a pure capacitor current leads the voltage by 90^0. Cosφ = cos π/2 =0, average power consumed is zero.

38) Ans(a)

At resonance in series LCR circuit , Z=R ; power factor cosφ = $\frac{R}{Z}$ =1

39) Ans(a)

e = - $\frac{d\phi}{dt} = -\frac{d}{dt}(5t^3-100t+300)$ =-($15t^2$-100); at t=2 s

e = -($15X2^2$ – 100)=-(60 – 100) = 40v

40) Ans (b)

F= 50 Hz ; T=1/f; T= 1/50

Time taken by AC to reach its maximum from zero is T/4 seconds i.e. $\frac{1}{50X4} = 5X10^{-3}s$

41) Ans (c)

As the magnet falls the induced current set up in the ring develops the magnetic field which opposes the field of the magnet. The movement of the magnet towards the ring is opposed, so that acceleration of the magnet less than ‘g’ i.e acceleration due to gravity.

42) Ans (c)

Resonant frequency , f= $\frac{1}{2\pi\sqrt{LC}}$; $\sqrt{LC} = \frac{1}{2\pi f} = \frac{1}{T^{-1}} = T$ i.e. dimension of time

43) Ans (d)

X_L= 2πfL = 2πX50X $\frac{200X10^{-3}}{\pi}$ =20Ω

X_C = $\frac{1}{2\pi fC} = \frac{1}{2\pi X\,50X\,\frac{10^{-3}}{\pi}}$ = 10Ω

tanφ= $\frac{X_L - X_C}{R} = \frac{20-10}{10}$ =1

φ= $\frac{\pi}{4}rad$

44) Ans(b)

I=I_0sinωt , here I= I_0/2; 1/2 = sinωt ; ωt= $\sin^{-1}(1/2)$; ωt= π/6 rad

$2\pi ft = \frac{\pi}{6}$; t= $\frac{1}{6X2X50} = \frac{1}{12X50}$ = 1.67X10^{-3} s

45) Ans (d)

Here two coils are identical and carrying the current in same direction. The facing faces of the coils are of opposite poles. If they move apart the flux associated with them decreases, current induces in them try to increase the flux. In order to increase the flux current in them increases.

46) Ans(c)

V=V_0sinωt =10 sin(314t) =10sin ($\left(\frac{314}{600}\right)$= 10sin$\left(\frac{100\pi}{600}\right)$=10sin$\left(\frac{\pi}{6}\right)$= 10sin$30^0$

V=10X0.5= 5volt

47) Ans(d)

Train is moving towards north with constant velocity. The axle of the train is a conductor moving in a constant magnetic field. It is moving in a horizontal plane and cuts the earth's vertical component and emf induced is due to motion of the conductor in a uniform field perpendicular to motion. Hence emf induced is e= BLv

V=180X$\frac{5}{18} = 50ms^{-1}$; e=BLv =0.2X10^{-4}X1.5X50 = 1.5X10^{-3}V =1.5 mV

48) Ans(a)

Transformer is a device which can increase or decrease the AC voltage. It doesn't work with DC. Here Dc source is connected to primary, output voltage is zero .

49) Ans (b)

Here E_p=230v,I_s=2A,$\frac{n_p}{n_s} = \frac{1}{25}$,$I_p$= ?

As $\frac{I_p}{I_s} = \frac{n_s}{n_p}$; I_p=$\frac{n_s}{n_p} I_s$; 25X2= 50 A

50) Ans(d)

Here current is flowing in long straight wire. If current is not changing ,then there is no induced current in the loop, so option (a) is wrong. If $\frac{di}{dt}$ > 0,i.e current is increasing with time flux linked with loop is also increasing. Current induced in the loop flow in such a way that it opposes the increasing flux(Lenz's law). Current has to flow in the loop should be anticlockwise.

51) Ans (c)

Let 'Q' be the maximum charge and 'q' be the charge when energy is equally shared

$\frac{1}{2}\left(\frac{Q^2}{2C}\right) = \frac{1}{2}\left(\frac{q^2}{C}\right)$; $\frac{Q^2}{2} = q^2$; q = $\frac{Q}{\sqrt{2}}$

52) Ans(b)

RC has the dimension of time, 'V' has the dimension of emf, which has the same as the dimension of L$\left(\frac{di}{dt}\right)$; $\frac{L}{RCV} = \frac{L}{TL\left(\frac{di}{dt}\right)} = \frac{1}{di} = \frac{1}{current}$

53) Ans(b)

Two straight conductors carrying current in same direction there is a force of attraction between them. Two similar kind of charges moving in same direction the electrostatic force of repulsion is very much greater than magnetic force. A and B attract . X and Y repel.

54) Ans(a)

Here particle is moving perpendicular to the field. Force does not work on the charged particle, so kinetic energy will not change.

55) Ans(d)

Both fields parallel to each other. Magnetic field does not exert force ,electric field exerts force in opposite direction of the motion. Velocity electron decreases.

56) Ans (a)

When a charged particle moving normal to the field it describe uniform circular motion . Let R be the radius of the circle, v is the velocity and B is the magnitude of the field and q is the charge on the particle. Here magnetic force provides the centripetal force.

$\frac{mv^2}{R} = Bqv$; R=$\frac{mv}{Bq}$; here v and B is same for proton and alpha particle.

$$\frac{R_p}{R\alpha} = \left(\frac{m_p}{m\alpha}\right)\left(\frac{q_\alpha}{q_p}\right) = \frac{1}{4} X \frac{2}{1} = \frac{1}{2} = 1:2$$

57) Ans(b)

K.E. $E_k = \frac{p^2}{2m} = \frac{m^2v^2}{2m}$; mv=$\sqrt{2mE_k}$ and R=$\frac{mv}{Bq}$; R=$\frac{\sqrt{2mE_k}}{qB}$

K.E. same , R α $\sqrt{m}$; q and B is same for proton and electron. Mass of proton is very large compared to electron. $R_p > R_e$. Trajectory of proton is less curved.

58) Ans(d)

F=Bqvsinθ ; θ=90^0; F=Bqv ; here B and v are same. Fα q. Li^{++} has maximum force.

59) Ans(c)

V = I_g (G+R) = $10X10^{-3}$(1+R); R= 999Ω.

60) Ans(c)

We know R=$\frac{V}{I_g} - G = \frac{10}{I_g} - 100$ ………(i)

To double the range 1000Ω is connected in series with R

1000+R =$\frac{20}{I_g} - 100$ …………(ii)

Subtract the equation (i) from (ii) we get ,1000=$\frac{10}{I_g}$; $I_g = 10^{-2}$ A

Introduce the value of I_g in (i) we get R=900Ω

61) Ans (c)

Moving charge produces both electric and magnetic fields.

62) Ans(a)

Converting an ammeter into another ammeter is same as converting galvanometer into an ammeter. Let R_A is the resistance of an ammeter and 'S' is the shunt resistance connected to it.i_1 φis the initial range and i_2 be the final range ,then

$i_1 = i_2\left(\frac{S}{S+R_A}\right)$; $100X10^{-3} = \frac{750X10^{-3}S}{S+13}$; S=2Ω

63) Ans(d)

F= Bqvsinθ. The force is zero if θ= 0^0 and 180^0 . When θ=90^0, force is maximum. Here the force is non zero means angle is other than zero and 180 degree.

64) Ans(a)

V=5cosωt = 5sin(ωt +π/2), I=2sinωt ; here phase angle φ= π/2

P=$E_{rms}I_{rms}$cosφ ; cos(π/2)=0 ; p=0 watt

65) Ans (c)

When two parallel straight conductors carrying current in same direction field in between them is in opposite direction. Here current is same and point midway between them , field is equal and opposite, so net field is zero.

66)Ans(d)

Peak value , e=nBAω , ω=2πf ; e=300X 4X10^{-2} X25X10X10^{-4} X2πX50 =30π volt

67) Ans(c)

Shaking of picture is due to change in flux, which effects the motion of electrons

68) Ans (a)

Here there is no power loss. Input power= output power.

69)Ans (c)

Transformer core is laminated to reduce the energy loss due to eddy currents.

70) Ans(b)

Ac meters reads rms value. Here rms current is 10A. peak value = $\sqrt{2}$ rms value

Peak value =$\sqrt{2}$ 10 A

71) Ans(d)

Cosφ=$\frac{R}{Z} = \frac{R}{\sqrt{R^2+(\sqrt{3}R)^2}} = \frac{R}{4R^2} = \frac{R}{2R} = \frac{1}{2}$; φ= 60^0 ; i.e. $\frac{\pi}{3}$

72)Ans (a)

Transformer changes Ac voltage value.

73) Ans(d)

Self inductance characteristic property of a coil of circuit to oppose the change in magnetic flux.It is equivalent to inertia.

74)Ans (a)

Here the ring is cut. Circuit is not complete, there is induced emf but no induced current. The movement of magnet is not opposed. Acceleration of magnet is equal to ‘g’

75)Ans (c)

As coil A is move towards B flex linked with is increasing. Current induced in B must oppose this increase in flux, so current induced must be anticlockwise.

76)Ans(d)

When the current in the electromagnetic increases flux linked with aluminium ring increases,the current in the ring develop the magnetic field to decrease the flux. So there is repulsion when current increases in A.

77)Ans(b)

When magnet move towards coil there is force of repulsion due to increase in flux. When magnet moves away from the coil threre force of attraction which try to retain the flux. Galvanometer shows deflection left and right , but with amplitude decreases because of damping.

78) Ans(d)

As the charged particle passes flux increase and decreases, current induces changes its direction.

79)Ans(b)

$e = m\frac{di_1}{dt}$ (in magnitude)

$e = mI_0[\frac{d}{dt}(\sin \omega t)] = mI_0\omega\cos\omega t$

$e_{max} = mI_0\omega = .005 X 10 X 100\pi = 5\pi$

80) Ans(b)

Resonant frequency $f = \frac{1}{2\pi\sqrt{LC}}$, when C becomes four times and L not changed, f becomes f/2

81)Ans (d)

When the speed of the magnet doubles induced emf and current increases. But total change in flux remains same. Total charged induced is not depend on time, as there is no change in flux charge remains same.

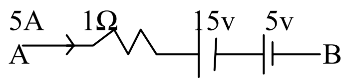
82)Ans (a)

Here the side BC is outside the field. Side AB and DC in the direction of motion ,there is no induced emf in them. It is the side AD moving perpendicular to the field. By motional emf formula $e = \frac{d\phi}{dt} = BL\frac{dx}{dt} = 5 X 10^{-2}$ T X 0.3m X $0.2 ms^{-1} = 3 X10^{-3}$v

$I = e/R = \frac{3X10^{-3}}{5} = 0.6mA$; Point A is at higher potential, current go from B to C through 5 ohm resistor.

83)Ans (a)

When current is increasing the induced emf in inductor is opposite to applied emf. The equivalent circuit can be written as

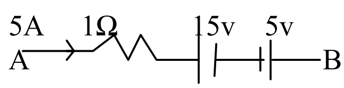


Induced emf=L $\frac{di}{dt}$ =5 X 1/1 =5v

Let V_A be the potential at A V_B be the potential at B.
We can write $V_A - (5 X1) - 15 - 5 = V_B$
$V_A - V_B = 25$ V

84)Ans (b)

When current is decreasing the induced emf in the inductor is in the direction of applied emf. The equivalent circuit is



Induced emf=L $\frac{di}{dt}$ =5 X 1/1 =5v

$V_A - (5 X1) - 15 + 5 = V_B$
$V_A - V_B = 15$ V

85)Ans (d)

In choke, if it is pure inductance power factor is zero. There is no wastage of power.

86)Ans(d)

Input power = 220X 0.5 =110 W. out power = 100 W

$\eta = \frac{P_0}{P_i} = \frac{100}{110} \approx 91\%$

87)Ans (c)

e= BLv = 0.9 X 0.4 X 7=2.52v

88)Ans (d)

$\text{Cos}\varphi = \frac{R}{Z}; \frac{\cos\phi_1}{\cos\phi_2} = \frac{Z_2}{Z_1}; \frac{0.5}{0.25} = 2$; $Z_2 = 2Z_1$

Percentage change $= \frac{2Z_1 - Z_1}{Z_1} X100 = 100\%$

89)Ans(c)

$$\tan\varphi = \frac{X_L}{R} \text{ ; } \tan 45^0 = \frac{X_L}{R} \text{ ;} X_L = R$$

90)Ans (a)

Mutual inductance is maximum in position (i), in this position flux linkage is maximum.

91)Ans(b)

Initially the magnet approaches the coil , magnetic flux gradually increases an induced emf (opposite direction) gradually rises. Once the magnet enters the coil flux does not change and emf falls. As the magnet comes out from other side of the coil magnet flux decreases and emf induced try to retain the flux. Emf is forward . When magnet moves far away flux reduces to zero and emf falls to zero again.

92)Ans(b)

Working of transformer is based on mutual induction.

93)Ans(b)

Current flowing in adjacent turns of the spring is in same direction ,hence there is force of attraction between the turns and spring compress.

94)Ans(c)

Induced emf is not depend on resistivity

95)Ans(c)

When a conductor falls vertically downwards with its ends pointing north-south direction it is parallel to both B_H and B_V , hence it will not any magnetic field lines and there is no induced emf.

96)Ans (d)

In step up transformer number of turns and voltage in secondary is more than in primary.

97)Ans(a)

Field is above the conductor is towards north. Apply right hand rule.

98)Ans(a)

Both statements are correct.

99)Ans(c)

In transformer flux linkage should be high and hysteresis loss should be low

100) Ans(a)

Lenz's is based on conservation of energy.

101) Ans(b)

Electromagnets are not permanent magnet. ,they should be demagnetized easily.

102) Ans (c)

103) Ans (b)

When current is started , change of current is 0 to I. On suddenly rotating through 180^0 , change in current is from I to –I or net change in current is 2I. so deflection is doubled.

104) Ans(d)

Kinetic energy doesn't change, because speed of the particle is constant. But velocity continuously changes in direction . Momentum is not constant.

105) Ans (a)

Voltage across all elements is same. In L voltage leads current by 90^0 and in C it lags by 90^0. In LC combination it is out of phase.