CURRENT ELECTRICITY

1.Ans: the force due to electric field=qE

Force due to magnetic field=qvBsin ϴ=0

i.e. magnetic field does not exert any force .but the particle experience a force due to electric field and gains velocity. So the particle will move in the direction of the electric field along a straight line .Answer: (1)

2.In mechanics momentum p= mv =mdr/dt

Similarly LI = Ldq/dt is analogous to momentum.

Answer is (1).

3. Ans: upward. Applying Fleming's left hand thumb rule, if forefinger is set in the direction of field direction(south), middle finger along direction of proton(eastward), thumb points in the downward direction towards which proton is deflected.

Answer: (2)

4.Answer F=Bqv and B=F/qv=MLT^{-2}/CLT^{-1}

$[B]=MT^{-1}c^{-1}$ answer :(1)

5. Ans: since the charged particle enters perpendicular to magnetic field, it describes circular path. Since velocity and force are mutually perpendicular, no change in the velocity. Hence both momentum and kinetic energy remains constant. Answer:(2)

6.r=mv/Bq
therefore r α m/q
rαm

7.if I_2 is the current through voltmeter branch,and R=resistance of the voltmeter,
Then V = I_2R 120 = $(IR_1/R+R_1)R$
120 = (2X75/75+R)R OR 120 =150R/75+R
or 75+R =150R/120
On solving we get R=300 ohm . Answer : (3).

8. we know that in parallel combination, maximum current flows along the least resistance .so $I_1/I_2=R_2/R_1 = l_2/A_2 \times A_1/l_1 = l_2/l_1 \times A_1/A_2 = 3/4 \times 2^2/3^2$ =3/4x4/9= 1/3.Therefore answer is (2)

9.we know that ,magnetic field at the centre of a circular coil is B = Kn/r .if the coil is rewound to have 'n' turns, radius decreases by 'n' times .B is proportional to n/r
B'/B=n/r / r/n $=n^2$
B' $=n^2$ B .answer is (2)

10.The initial force is given by $F=kI_1I_2/d$ .when current in one of them is doubled and distance becomes 3d, the force becomes $F'=k2I_1I_2/3d$ .F'/F= 2/3 but nature of the force is also reversed. Hence the answer is F' = -2/3F .Ans : (1)

11. shunt resistance required is given by $S=I_gG/I-I_g$ .here,I_g =1A, G=0.81 ohm and I=10A
Substituting we get
S =1x0.81/10-1=0.81/9 = 0.09ohm

Answer is (3)

12. When length of a wire is decreased 4 times, area of cross-section increases by 4 times. therefore R_2/R_1 = $l_2/A_2XA_1/l_1$ =$l_1/4/4lA_1X$ = 1/16

Answer:(3)

13. When two cells are parallel. The effective potential difference of the combination is given by (when they send the current in the same direction)

V = $E_1r_2+E_2r_1/r_1+r_2$

=18x1+12x2/2+1

=18+24/3=42/3=14V

Hence answer is (4)

14.current in a circuit is inversely proportional to the resistance. Let 'R' is the initial resistance.If another resistance of 3Ω is connected in series to R, effective resistance is R+3. Then current becomes 2A $I_2/I_1=R_1/R_2$

2/5=R/R+3 2R+6=5R 3R=6 R=2ohm Answer is (3).

15. If resistance RΩ is cut into 20 pieces, then resistance of each part becomes R/20. If half of the pieces i.e.10 pieces are joined in series.R_s=10(R/20) = R/2 . other 10 pieces are joined in parallel. Since R_P =R/n =(R/20)/10=R/200

If R/2 and R/200 are connected in series again, the effective resistance is R_S = (R/2)+(R/200) =100R+R/200=101R/200.answer is (3)

16.If length of the 2Ω wire is doubled, the new resistance is R_2 = n^2R_1 = 2^2x2 = 4X2 =8 Ω. If 8Ω

is bent in the form of a circle, resistance of each quarter part is 2 Ω.
Because 1/4 the circumference is considered, longer arc of 6 Ω and 2 Ω are parallel. Then effective resistance is R_P
$=R_1R_2/R_1+R_2=6x2/6+2=12/8=3/2=1.5$ohm.
Hence answer is (4).

17.we know that the magnetic moment of a current loop is M= IA.Equivalent current due to revolution of electron is I=e/T =e/2kr/v =exv/2kr.but $A=kr^2$.
Therefore M = $(exv/2kr)xkr^2= 1.6x10^{-19}x5x10^{-11}x2x10^6/2=8x10^{-24}Am^{-2}$.answer is (3)

18. the current in the circuit containing capacitor is given $I=V/_{XC}$ given $V_0=200x2^{1/2}$ v.
$X_C=1/100x10x10^{-6}=1000$ ohm.
$I_0=200x\sqrt{2}_{/1000}=200\sqrt{2}$mA.
But ammeter reads rms value of current.
therefore $I_{RMS}=200x\sqrt{2}/\sqrt{2}$ = 0.02A=20mA. Hence answer is (2)

19. Resistance of the coil =R=10Ω and phase angle $=45^0$ But phase angle is given by
tan $45^0 = X_L /R$ OR X_L =R= 10Ω
i.e. 2πfL=10 or 2X3.14X100 X f =10 or f =10/628
= 0.01599 = 16mH. Answer :(3)

20.the power in an ac circuit is P = V_{rms} I_{rms} $\cos 60^{0.}$
V_O =100 V and I_o $=100X10^{-3}$A so
$P=(100x100x10^{-3}/2)x1/2$
$=50x50x10^{-3}$ =2.5W .answer is (3)

21. the power dissipated in a resistor is $P=V^2/R$ since resistance of the wire is assumed to be constant $P_2/P_1 = V_2^2 / V_1^2$

$P_2 = 500(15X15/100) = 1125W$

22.heat required to melt 'm' kg of ice = Q=mL

L=latent heat of fusion

Heat produced in the resistor H=VIt.

mL=VIt

$m = VIt/L = 210x1x3600/3.6x10^5$

=2.1 kg .Answer : (2)

23.resistance of a wire is given by R=kl/A $R=kl/r^2$

$R_2 /R_1 = r_1^2/r_2^2$ $R_2 = 5x9^2/3^=5$ X 81/9 = 45Ω

If such six wires each of 45Ω is connected in parallel, R_P =45/6 = 7.5Ω

24. given rating of the bulb is 90W-30V . using

$R=v^2/P$ =30X30/90 =10Ω

Also current needed by the bulb to glow with maximum intensity is calculated by I=P/V=90/30=3A.If the bulb is connected with another resistance of XΩ ,then current in the circuit is equal to I=E/R+X or 3=120/10+X or 10+X=40 therefore X=30Ω..answer is (3)

25.when a wire is stretched n times resistance new resistance= n^2 x initial resistance.after stretching resistance of the wire is R = 2^2 x 3 = 4 x3 =12Ω

If it connected to from a triangle two arms of the triangle are in series and third side is in parallel with it. Therefore 8Ω parallel to 4Ω. R_P =8x4/8+4 = 32/12 = 8/3 Answer :(2)

26. the force experienced by an electron in the electric field is F=eE

But E=F/e ,V being the P.d.across the wire = EMF of the cell equating ,we get

F=ev/l

$3.2X10^{-19}$ =$1.6X10^{-19}$XV/4 solving this we get V= emf of the battery =8V . The answer is (4)

27.we know that low wattage bulb will have high resistance.(since R=v^2/P) Heat produced is H=I^2Rt i.e. hence 25W bulb glows more brightly when they are in series. the answer is (1)

28. shunt resistance is calculated by S=I_gG/I-I_g
herG=R and I_g =I. S=IR/4I-I =R/3.
therefore the answer is (1)

29.since particles have same charge and accelerated through same p.d. their kinetic energies are equal. We have
therefore v=BqR/m mv^2/R=Bqv
KE=1/2(mv^2)=1/2 m[$B^2q^2R^2/m^2$] =1/2[$B^2q^2R^2$/m]Since kinetic energies
are equal $R_1^2/R_2^2=m_1/m_2$ or $m_1/m_2=[R_1/R_2]^2$
answer is (4)

30.using Flemings left hand thumb rule , electron experiences a force in upward direction.
hence answer is (1)

31. we know that shunt resistance is given by
S=I_gG/I-I_g Given I_g=0.02I

therefore S = 0.02IG/I-0.02I
=0.02G/0/98=G/49
hence answer is (2).

32. induced emf =-rate of change of magnetic flux
e=-d/dt(BA)=BxdA/dt
=-3.14x0.02x(2x0.04)x(-10^{-3})
=5x10^{-6} =5μV. Hence answer is (3)

33.since current is devided equally into two parts and flows in opposite direction, each part produces equal and opposite magnetic field at the centre of the loop.hence resultant magnetic magnetic field is zero. Therefore the answer is (1)

34.magnetic moment of a coil = iA
=i(πr^2)
Given that 2πr = L or r = L/2π M =iL^2/4π
Answer :(1)

35. on inserting the iron rod into the coil, the inductive reactive(X_L) increases. Hence impedence of the circuit also increases.which results in decrease of current .hence intensity of the bulb decreases. Correct answer is(1).

36.if a wire is stretched by n%, resistance increases by 2n%.therefore, if length is increased by 10%, resistance increases by 20%. New resistance is R = 10Ω + 20% of 10Ω =10+2=12Ω.therefore answer is (3)

37.P/Q =400/X Q/P= 441/X

solving these two $X=\sqrt{400x441}=20X21=420\Omega$.

38.because one of the cells is reversed , it nullifies
emf of one cell.
Total emf =1.5+1.5 =3V
Total internal resistance of four cells = $4X1/4=1\Omega$
Therefore current in the circuit is I = 3/1+1=3/2=1.5 A
Therefore answer is (4)

39.we have to find the main current =current
through 4 ohm=I
We know that branch current $I_1 = IxR_2/R_1+R_2$
0.8 = Ix6/6+3 or 0.8=2I/3=1.2A
hence p.d. across 4Ω =IR
=1.2 X 4 = 4.8 V

40. the heat dissipated in a reisistor is
$Q = I^2R$
$80 = 2^2 X R X10$
8 = 4R .$R=2\Omega$ Answer is (2)

41.500 ohms in parallel with 500 ohm.
So Rp=R1R2/R1+R2Rp=250 Ohm.
This is series with remaining part of the rheostat.
Their eff.res=500+250 ohm
Current in the ckt I=E/R I=15/750A
Branches are equal-I1=I2=1/2[15/750]
AMMETER READING =15/1500=0.01A
Answer (c)

42.each branch contain same reisstancei.e (p+q)
Current devides equally I1=I2=1A
P.d.across p= 1Xp =P volts

P.d.across Q =1XQ=Q volts
Then p.d.=V_{A-} V_B =P-Q

43. Resistance of the bulb=V^2/p=1.5x1.5/4.5=0.5Ohm
Rp=1x0.5/1+0.5=1/3=0.333ohm
Current requied for its glow=I=P/v=4.5/1.5=3A
Similarly current ! ohm branch=I=V/R=1.5A.Wkt
I=E/Rp+r
(3+1.5)=E/1.333+2.67   4.5=E/3 E=13.5V

44.emf=amout of workdone to transfer 1 coulomb of charge
charge transferred Q=It=2x6x360coulombs
To transfer Q , workdone=1000J
t0 transfer workdone=emf=1000/2x6x360=2.03j
therefore E=2.03

45.The voltage across the cell
=terminal p.d
=E-Ir
=E-(E/R+r)r
=2-[2x0.1/3.9+0.1]
=2-[0.2/4]
=2-0.05=1.95V. Answer :(3)

46.E=i(R+r)
E=0.5x(r+2)=0.25x(r+5)
Therefore r=1
and E=1.5V. Answer: (3)

47.Hint:R_2/R_1 =(l_2/l_1)x(A_1/A_2) if radius decreases by 1/3.
Area of cross-section by 1/9. Therefore length

increases 9 times.Answer: (3) 81:1

8. $P=I^2 R=(E/R+R)^2$
$150=E^2 x6/(6+r)^2$
$196=E^2x4/(4+r)^2$ solving ,we get
r=1 Ω

49.current flowing through the voltmeter
$=I=V/R=200/20x10^3$
$=10X10^{-3}$
same current flows through R
then $R=30/10X10^{-3}=3k\Omega$

50.$I_1=v/R_1$ $1= V/R_1$ $R_1=v$
$I_2=V/R_2$ $3=V/R_2$ $R_2=V/3$
$I_3=V/R_3$ $6=V/R_3$ $R_3= v/6$
$R_s=V+V/3+V/6=9/6V$
$I=V/R_s=V/(9/6)V=2/3V$

51.resistance is least when they are connected in parallel. When al the six of them are in parallel, effictive resistance will be
$R_p= R/6=0.6/6=0.1\Omega$

52. It is known that current is independent of area of
cross-section.therefore is (4)

53. WKT $R_s=nR$ $R_P=R/n$
X=nR   Y=R/n
$XY=R^2$ .therefore $R=\sqrt{XY}$

54.Since all the bulbs should get 200V, they are in

parallel. Resistance of each bulb
$=R=V^2/p=200x200/100=400\ \Omega$

There fore $I=E/R_p$

$5=200/(400/n)$

$5=200n/400$.solving we get n=10.

55.Internal resistance of the battery can be calculated as follows $I=E/R+r$

$1=4/2+r$ OR $2+r=4$

$r=2\ \Omega$

when terminals are connected directly R=0
$I=E/r=4/2=2A$

56.Effective resistance of the network=20/7 Ω
Therefore main current $I=E/R=2[20/7]=7/10A$
Current through each branch=1/10A. since four branch currents pass through ammeter, reading=4/10A

57.Pot.gradient

$V/L=IR/L=[I/L]x[\rho L/A]$

Therefore $V/L=I\rho/A$

58.given $R_p=R_1R_2/R_1+R_2$ $R_p=1.2\ \Omega$ and one the resistanc =2 Ω

$1.2=2R/2+R$

$2.4+1.2R=2R$

$2.4=2R-1.2R$

$2.4=0.8R$ solving we get $R=3\ \Omega$

59.$Bev=mv^2/r$

$B=mv/er$ but $v=2\pi r/T$

$B=[m/er]x[2\pi r/T]$

$B = m \times 2\pi / eT$
$= (9.1 \times 10^{-31} \times 2 \times 3.14)/(1.6 \times 10^{-19} \times 1 \times 10^{-6})$
$= 3.6 \times 10^{-5} T$

60.Magnetic field due to a straight conductor is
$B = \mu_0 I / 2\pi d$
$B = 4\pi \times 10^{-7} \times 90 / 2\pi X 1.5$
$B = 1.2 \times 10^{-5} T$

61.Force acting on acurrent carrying conductor due to magnetic field=BIL
Weight of the wire =w=mg
To support F=W
BIL=mg B=mg/IL
$B = 3 \times 10^{-4} \times 9.8 / 5 \times 1$
$B = 0.6 X 10^{-3} T$

62. $e = d\phi/dt$
$|d\phi| = e x dt$
= V X T
=J/C XT   I=Q/T |Q|=|It| = AT
=FxS XT/AT
$= MLT^{-2} LXT / AxT$
$= ML^2 T^{-2} A^{-1}$

63 .P.d.across voltmeter=5V
Res. of the voltmeter=$20 X 10^3 \Omega$.
Current through voltmeter=V/R=5/($20 X 10^{-3}$)
Same current flows through resistance R. potential difference across resistor=110-5=105V
R=V/I=105/5/($20 X 10^{-3}$)=420 Ω

64.at resonance ,inductive reactance =capacitative reactive .hence Z=R.so voltage is always in phase with current.

65.the rms value of Ac= the current which produces same heat as the dc current .therefore 20√2 amperes of dc current produces same heat as produced by 20A 0f ac

66.on heating a conducting wire its resistance increases. since R is proportional to length, to keep the balance again, the balancing point shifts toward right.

67. since radius of the circle is proportional to mass. Radius of proton path is greater than that of electron.hence timeperiod of proton is more than that of electron

68.Hint : at each end face of the coil,magnetic poles are created .depending on the direction of the current since opposite poles are created in the two loops facing eaching other, they attract and spring contracts

69. electrostatic force

$F_e=(1/4\pi\epsilon_0)e^2/r^2$

Magnetic force

$F_m= \mu_0/\pi[e^2v^2/r]$

Deviding one by the other,

$F_m/F_e= \mu_0 \epsilon_0 v^2=v^2/c^2$

(since $\mu_0 \epsilon_0=1/c^2$)

70.Hint. Magnetic field intensity is stronger near the poles. Hence shcnge in the magnetic flux is higher .more emf may be induced

71.since $X_L=2\pi fL$,X_L increases.
$X_C=1/2\pi fC$, X_c decreases.
Hence $Z=\sqrt{R^2+[X_L-X_c]^2}$ increases

72.using Fleming's left hand thumb rule.
fore finger-towards east
Middle finger –towards south
Then Thumb is set –vertically downwards
(2)

73. wkt B=mv/er since momentum (mv) for both proton and electron is same , r is also same.
Hence answer is (3)

74.qvB=qE
$2x10^3x1.5=E=3X10^3N/C$

75.
$qvB=mv^2/r$
$v=qBr/m=wr=2\pi fr$
or $f=qB/2\pi r$

76.
V=igG
$nV=i_g (G+R)$
or 1/n=G/G+R
or G+R=nG
0r R=(n-1)G

77.
$r=mv/qB$
$A=\pi r^2$
$=\pi(mv)^2/q^2B^2$
$=\pi.2mE/q^2B^2$
therefore area is proportional to energy

78. $V^2=V_R{}^2+(V_L-V_C)^2$
$V^2=40^2+(60-30)^2$
$V^2=40^2+(30)^2$
$V^2=50^2$
$V=50V$

79.we know that $f=1/2\pi\sqrt{LC}$
When C is doubled,L should be halved so that resonant frequency remains unchanged

80 .The radius of curvature of acharged particle moving in the magnetic field is given by
$r=mv/qB=\sqrt{2mK}/qB$
$r'=\sqrt{2mK'}/qB$
$r'/r=\sqrt{K'/K}=\sqrt{k/2/k}=1/\sqrt{2}$
therefore $r'=1/\sqrt{2}r$

81.deflection becomes half if current reduced by half .that means resistance of the shunt must be equal to resistance of the galvanometer so that the current divides equally.

82,. Radius of curvature r of the path of the charged particle is given by $r=mv/qB$

Where m is the mass,v be its velocity.when q and B are fixed,then r is proportional to mv(momentum of the particle)

83.Principle: a cells delivers maximum current when external resistance = internal resistance . (Maximumpower transfer theorem)

84.low wattage bulb has high resistance.
Powers are in the ratio 1:4 therefore R2/R1=1/4Then p.d.are in the ratio $V_1/V_2=4$
But $V_1+V_2=440$.On solving we get
p.d.across25Vbulb=352V
p.d.across 100Vbulb=88V
Since p.d across 25W bulb is more than tolerance. It will fuse

85. on completing half revolution, the f0rce vector and velocity are mutually perpenducular.hence work done by the magnetic field is zero. Hence there is no increase in the kinetic energy

86.Equation for the self inductance of a coil is
$L=\mu_0 N^2 A/L$
Therefore if number of turns is doubled, L increases four times

87.Given $I_0=50\sqrt{2}$
Therefore $I_{rms}= I_0/\sqrt{2}$
Or $I_{rms}= 50A$
Also $2\pi f=400\pi$
$f=200Hz$

88.We know that V=IR

$V=(neAv_d)x\rho xL/A$

Therefore if V is doubled, drift velocity also gets doubled.

89.slope of VI graph gives resistance which is proportional to temparature.there slope tanΘ proportional to T_1

tan(90-Θ) proportional to T_2

T_2-T_1=cotΘ –tanΘ

=cosΘ/sinΘ –sinΘ/cosΘ

$=\cos\Theta^2-\sin\Theta^2/\sin\Theta \cos\Theta$

=proportional to cot Θ

90.when electron approaches the loop, the downward flux linked with the coil increases.so anticlockwise current is induced in the loop.when electron recedes away from the loop, downward flux decreases.so clockwise current is induced in the loop.

91. we angular frequency ω=2πf

=2π x[1/2π√LC]

=1/ √LC

subsituting the value of L and C we get

$\omega = 1x10^4$

92.HINT

$I=q/t=e/T=fe=1.6x10^{-19}x5x10^{-10}$

$=8x10^{-4}$=8mA

93Ans: we know that

$I_1/I_2=\tan\Theta_1/\tan\Theta_2$

$2/I_2 = \tan 30^0/\tan 60^0$
$2/I_2 = 1/3$
therefore I_2=6A

94.Ans: impedance $Z=\sqrt{R^2+X^2}=\sqrt{3^2+4^2} = 5\Omega$
Power factor $\cos \phi$ = 3/5 =0.6

95.we know that $\tan\phi = X_L/R$
$\tan 45^0 = X_L/R$
Therefore $X_L = R$

96.The coils are connected in series. Hence irrespective of the magnetic fluxes, the inductances are added in series combination. Hence resultant inductance is L+L=2L

97. The induced charge is given by
$q=NBA/R=50x0.2x(100x10^{-4})/2=0.5c$

98. If $V_L=V_C$ then it is a case of resonance. Then $V_L$and V_C are out of phase Hence voltage across the resistance =source voltage=100V

99.resistivity of a material depends on the temparature and independent of other physical conditions.

100.When a resistance wire cut in two pieces new resistance will be half the initial resisitance.when these two ate joined in parallel,R_p=R/4
$Q_2/Q_1=R_1/R_2$ =R/(R/4)=4 therefore heat produced increases 4times

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