PHYSICS

Section A

1. (a)

As we know the relation for escape velocity of satellites can be expressed as shown below

$$v_e = \sqrt{\frac{2GM}{R}}$$

$$\therefore v_e = \sqrt{\frac{2G4\times\pi R^3\rho}{\frac{3}{R}}} \Rightarrow v_e \propto R$$

2. (c)

$$\frac{\frac{80-60}{t'}}{\frac{90-80}{t}} = \frac{\left(\frac{80+60}{2}-20\right)}{\left(\frac{90+80}{2}-2\right)}$$

$$\Rightarrow \frac{20}{t'}\times\frac{t}{10} = \frac{50}{65} \Rightarrow t = 2t\times\frac{65}{50} = \frac{13}{5}t$$

3. (d)

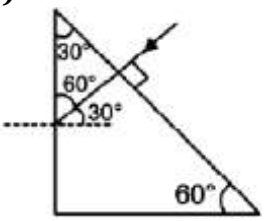
$$B \propto r\left(0 \le r \le R\right)$$

$$B \propto \frac{1}{r}\left(r \ge R\right)$$

4. (a)

Polar dielectric molecules have a permanent dipole moment, In the absence of an electric field, these dipoles align at random due to thermal agitation. As a result, the total dipole moment is equal to zero. When an electric field is applied, these randomly aligned dipoles try to align in the direction of the electric field. As a result there is a net dipole moment in the direction of the electric field.

5. (b)



$$\frac{\sin e}{\sin 30^0} = \sqrt{3}$$

$$\Rightarrow \sin e = \frac{\sqrt{3}}{2}$$

$$e = 60^0$$

6. (d)

Energy density, $U = \frac{1}{2}\epsilon_0 E^2$

Total energy stored, U = u x (Ad) = $\frac{1}{2}\epsilon_0 E^2 Ad$

7. (a)

Conserving energy,

K + U = mgs $\Rightarrow$ 3U + U = mgs

$$\therefore K = \frac{3mgS}{4}$$

$$\Rightarrow \frac{1}{2}mv^2 = \frac{3}{4}mgs \Rightarrow v = \sqrt{\frac{3gs}{2}}$$

8. (b)

$F_0 + B = Mg$

$\Rightarrow F_0 + \left(\frac{d}{2}\right)\left(\frac{M}{d}\right)g = Mg \Rightarrow F_D = \frac{Mg}{2}$

9. (d)

I_N = Current in N-type semiconductor

$= \left(\mu_e N_e + \mu_h N_h\right) eAE$

I_P = Current in P-type semiconductor

$= \left(\mu_e N_e + \mu_h N_h\right) eAE$

Now $N_e = N_h$ and $n_e = n_h$

Also, $\mu_e > \mu_h$ and $N_e >> n_e, N_h >> n_e$

Were,

N_e = electron concentration in N-type

N_h = Hole concentration P-type

&$N_e = N_h$

n_h = hole concentration in N-type

n_e = Electron concentration P- type

$\therefore I_N - I_P = \left[\left(\mu_e - \mu_h\right)N_e + \left(\mu_h - \mu_e\right)n_e\right]eAE$

$= \left(\mu_e - \mu_h\right)\left(N_e - n_e\right)eAE$

Since, $\mu_e > \mu_h$ and $N_e > n_e$

From this we can conclude that, $I_N > I_P$

10. (a)

$B = \frac{\mu_0 i}{2\pi r}$

$F = evB = ev \times \frac{\mu_0 i}{2\pi r}$

$= \frac{\left(1.6 \times 10^{-19}\right) \times 10^5 \times 4\pi \times 10^{-7} \times 5}{2\pi \times 0.2} N$

$= 1.6 \times 2 \times \frac{5}{2} \times 10^{-20} N$

$\Rightarrow F = 8 \times 10^{-20} N$

11. (d)

$K_{max} = \frac{hc}{\lambda}$

$\Rightarrow \lambda_d = \frac{h}{p} = h\sqrt{\frac{\lambda}{2mhc}} = \sqrt{\frac{\lambda h}{2mc}}$

$\therefore \lambda = \left(\frac{2mc}{h}\right)\lambda_d^2$

12. (c)

$\frac{Q_1}{4\pi \in_0 R_1} = \frac{Q_2}{4\pi \in_0 R_2} = V$

$\therefore \frac{Q_1}{Q_2} = \frac{R_1}{R_2}$

$\therefore \frac{\sigma_1}{\sigma_2} = \frac{Q_1 / 4\pi R_1^2}{Q_2 / 4\pi R_2^2} = \frac{Q_1}{Q_2} \times \left(\frac{R_2}{R_1}\right)^2 = \left(\frac{R_1}{R_2}\right)\left(\frac{R_2}{R_1}\right)^2$

$\Rightarrow \frac{\sigma_1}{\sigma_2} = \frac{R_2}{R_1}$

13. (a)

Supply voltage, $V = \sqrt{(V_L - V_C)^2 + V_R^2}$

$\Rightarrow V = \sqrt{(40-10)^2 + 40V} = 50Volt$

Volt Thus, peak values of supply voltage = $50\sqrt{2}$ Volt

$\therefore Z = \frac{50\sqrt{2}}{10\sqrt{2}} = 5\Omega$

14. (c)

$(\vec{E} \times \vec{B})$ gives the direction of propagation

$\vec{E} = -j + k, \vec{B} = -j - k,$

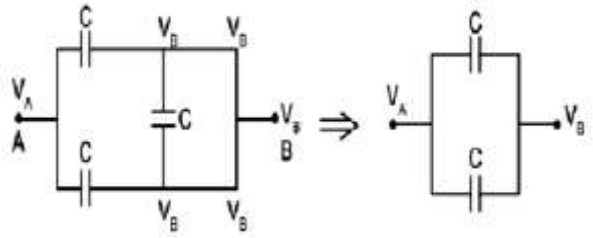
$$\vec{E} \times \vec{B} = \begin{vmatrix} \hat{i} & j & k \\ 0 & -1 & 1 \\ 0 & -1 & -1 \end{vmatrix} = 2\hat{i}$$

Also $\vec{E}.\vec{B} = (-j + k)(-j - k) = 0$

15. (d)

Both (A) and (B) are correct,
For Ge P-N junction, potential barrier is 0.3 volt.

16. (c)



Two capacitors are in parallel combination,
Hence equivalent capacitance $C_{eq} = C_1 + C_2 = C + C = 2C$

17. (b)

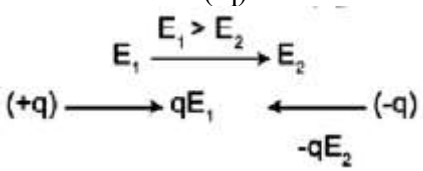
The displacement current is given by

$I_d = \frac{CdV}{dt} = C\frac{d}{dt}(V_0 \sin \omega t)$

$I_d = CV_0\omega \cos \omega t = V_0(\omega C)\cos \omega t$

18. (c)

As the electric field will lose its strength in the rightward direction. So, the force on (+q) will be more than the force on (-q).



$|\overrightarrow{F_1}| > |\overrightarrow{F_2}|$

19. (b)

Potential gradient $= \frac{1.5}{36}$

$\therefore \frac{25}{I_2} = \frac{1.5}{36}$

$\Rightarrow I_2 = \frac{36 \times 2.5}{1.5} = 60cm$

20. (d)

The number of protons delivered per second is given by

$$\frac{n}{t}=\frac{IA\lambda}{hc}=\frac{P\lambda}{hc}\Rightarrow\frac{n}{t}=\frac{3.3\times10^{-3}\times600\times10^{-9}}{3\times10^{8}\times6.6\times10^{-34}}$$

$$\frac{n}{t}=10^{16}$$

21. (c)

$$S_n=0+\frac{1}{2}a(2n-1)$$

$$S_{n+1}=0+\frac{1}{2}a(2(n+1)-1)$$

$$=\frac{1}{2}a(2n+1)$$

$$\frac{S_n}{S_{n+1}}=\frac{(2n-1)}{(2n+1)}$$

22.(b)

Least count = $\frac{1}{100}$ = 0.01 mm

Diameter of the wire = GSR x LC

= 52 x 0.01mm

= 0.52 mm

d = 0.052 cm

23.(d)

$${}_{Z}X^{A}\rightarrow{}_{Z-1}B(\beta^{+}decay)$$

$${}_{Z-1}B\rightarrow{}_{Z-2}C(\alpha-decay)$$

$${}_{Z-3}C\rightarrow{}_{Z-2}D(\beta^{-}decay)$$

24.(d)

All of the above

25.(c)

Potential energy of a particle executing SHM is given by $U=\frac{1}{2}m\omega^{2}x^{2}$.

So, if the frequency of oscillation is n, then frequency of its potential energy will be 2n,

26.(c)

$$A=\frac{A_0}{2^{t/T_{1/2}}}\Rightarrow\frac{A}{A_0}=2^{-t/T_{1/2}}=2^{\frac{150}{100}}=2^{-3/2}=\frac{1}{2\sqrt{2}}$$

27. (d)

A $\rightarrow$ Q

B $\rightarrow$ P

C $\rightarrow$ S

D $\rightarrow$ R

28.(c)

Energy= F.S $=F\frac{S}{T^{2}}T^{2}=\left[FAT^{2}\right]$

29.(c)

Energy imparted to the turbine per unit time= mgh

= 15 x 10 x 60 = 9000]/s.

10%loss = 900J/s

Power to the turbine = (9000 - 900) = 8100 J/s

P = 8.1 kW

30. (a)

If the wires are connected in parallel then

$R_{eq}=R/4=0.25$

$\Rightarrow R = 1\Omega$

So, after they are connected in series

$R_{eq} = 4R = 4\Omega$

31. (b)

$j = neV_d = \sigma E$

$\sigma = j / E \Rightarrow \rho = E / j$

(A) $\rightarrow$ (R)

(B) $\rightarrow$ (S)

(C) $\rightarrow$ (P)

(D) $\rightarrow$ (Q)

32.(a)

Final total binding energy

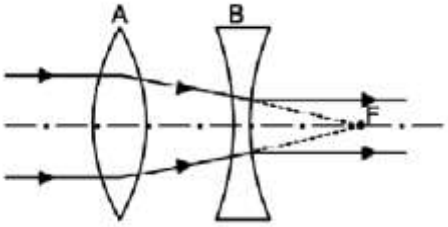
= 2 x 8.5 x 120 MeV = 2040 MeV

Initial total binding energy

= 240 x 7.6 MeV = 1824 MeV

Gain = (2040 - 1824) MeV = 216 MeV

33.(c)



Point F is the second focal length of A and first focal length of B.

d = 20-5 cm = 15cm

34.(a)

$k = \dfrac{10}{5\times10^{-2}}$ N/m = 200 N/m

$\therefore T = 2\pi\sqrt{\dfrac{m}{K}} = 2\pi\sqrt{\dfrac{2}{200}}s = \dfrac{\pi}{5}s$

T = 0.62S s

35. (b)

$[E] = ML^2T^{-2}$

$[G] = \dfrac{[Fr^2]}{[m_1m_2]} = \left[\dfrac{MLT^{-2}L^2}{M^2}\right] = M^{-1}L^3T^{-2}$

$\therefore \left[\dfrac{E}{G}\right] = \dfrac{ML^2T^{-2}}{M^{-1}L^3T^{-2}} = \left[M^2L^{-1}T^0\right]$

Section B

36.(a)

If each drop has a charge 'q' and radius 'r'.

Then from conservation of charge, charge on the big drop is nq = 27 q (n = 27)

from conservation of volume $\dfrac{4}{3}\pi r^3 n = \dfrac{4}{3}\pi R^3$

$R = n^{1/3}r$

Now potential of the small drop $V = \dfrac{q}{4\pi \in_0 r} = 220V$

Potential of the big drop.

$V = \dfrac{nq}{4\pi \in_0 R} = \dfrac{nq}{4\pi \in_0 n^{1/3}r} = n^{2/3}\dfrac{q}{4\pi \in_0 r}$

37. (a)

Velocity of the particle $v = \frac{2\pi R}{T}$

When projected at angle θ

H = maximum height $= \frac{v^2 \sin^2\theta}{2g} = 4R$

$= \frac{4\pi^2 R^2}{T^2}\frac{\sin^2\theta}{2g} = 4R$

$\sin^2\theta = \frac{2gRT^2}{\pi^2 R^2}$

$\sin^2\theta = \frac{2gRT^2}{\pi^2 R^2}$

$\sin^2\theta = \frac{2gT^2}{\pi^2 R^2}$

$\sin\theta = \left(\frac{2gT^2}{\pi^2 R}\right)^{1/2}$

$\theta = \sin^{-1}\left(\frac{2gT^2}{\pi^2 R}\right)^{1/2}$

38.(b)

If 90° arc is removed, remaining part is 270° and mass of the remaining part is 3/4 M and moment of inertia is

$\frac{3}{4}MR^2 = KMR^2$

$K = \frac{3}{4}$

39.(b)

(i) If it is an equilateral triangle of side 'a' no. of triangular loops formed $\frac{12a}{3a} = 4$

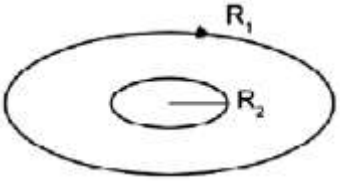
and magnetic moment $4.\frac{\sqrt{3}a^2}{4}l = \sqrt{3}la^2$

(ii) Side of the square if it is a.

No. of square formed $\frac{12a}{4a} = 3$

Magnetic moment of the square loop is $3a^2l$.

40. (a)



Magnetic field due to Ri at the center.

$B = \frac{\mu_0 i}{2R_1}$

Flux linked with R_2

$\phi = BA_2 = \frac{\mu_0 i}{2R_1} \times \pi R_2^2 = Mi$

$$M = \frac{\mu_0 \pi R_2^2}{2R_1}$$

41. (a)

As the particle is projected with a velocity less than escape velocity, it will go to a maximum heigftt and come back.

From censervati&n of energy

$$\frac{mgRh}{R+h} = \frac{1}{2}m\left(kV_e\right)^2$$

$$\frac{2gRh}{R+h} = k^2\left(2gR\right)$$

$$\frac{h}{R+h} = k^2$$

$$\frac{R+h}{h} = \frac{1}{k^2}$$

$$\frac{R}{h} + 1 = \frac{1}{k^2}$$

$$\frac{R}{h} = \frac{1}{k^2 - 1}$$

$$h = \frac{Rk^2}{1-k^2}$$

42.(b)

V_p =220V V_3 =11V P = 44 W

As it is an ideal transformer

$V_p i_p = V_s i_s$ =44W

220 x i_p =44

$i_p = \frac{44}{220} = \frac{1}{5} = 0.2A$

43.(c)

The logic operation

$$Y = AB + \overline{BC}$$

$$= AB + \overline{B} + \overline{C}$$

Now input

A B C Y

0 0 1 1

1 0 1 1

0 1 0 1

1 1 0 1

44.(b)

Velocity while hitting the ground

$$v = \sqrt{2 \times 10 \times 10} = 10\sqrt{2}$$

As it goes to the same height it will return with sane speed.

So change in velocity v-(-v) = 2v

Change in momentum or impulse

= 2mv

$$= 2 \times 0.15 \times 10\sqrt{2} = 3\sqrt{2} = 4.2 \text{kgm/s}$$

45.(a)

Velocity of the car at t = 4 sec is

V_x = at = 4 x 5 = 20 m/s

So horizontal velocity = 20 m/s (remain constant)

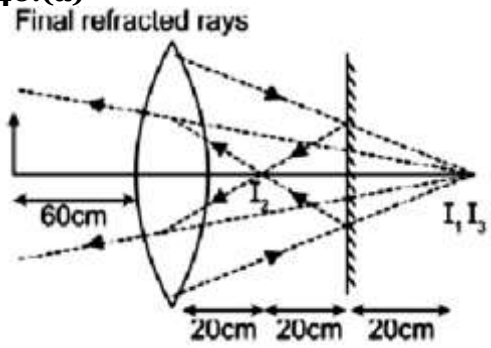
Vertical velocity at t = 6 sec

i.e. after 2 sec of free fall

V_y = gt = 20 m/s

So net velocity = $\sqrt{20^2+20^2} = 20\sqrt{2}$ m/s
and once it starts falling acceleration is only 'g'
i.e., 10 m/s^2

46.(a)



Position of the image formed by lens.

$$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$$

$$\frac{1}{v}+\frac{1}{60}=\frac{1}{30}$$

$$\frac{1}{v}=\frac{1}{30}-\frac{1}{60}=\frac{1}{60}$$

v=60cm

So, position of the image is (60 - 40) = 20 cm behind the plane mirror, it acts as a virtual object So final image is a real image 20 cm from the plane mirror.

This real image will act as an object for the lens and final image is

$$\frac{1}{v}+\frac{1}{20}=\frac{1}{30}$$

$$\frac{1}{v}=\frac{-1}{60}$$

v = -60cm from lens
i.e., 20 cm behind the plane mirror.

47.(c)

$$\vec{F}=q\left(\vec{V}\times\vec{B}\right)$$

$$\vec{F}.\vec{B}=0$$

$$\vec{V}\times\vec{B}=\hat{i}\left[4B_0-6B\right]+j\left[6B-2B_0\right]+k\left[2B-4B\right]$$

$$=\hat{i}\left[4B_0-6B\right]+j\left(6B-2B_0\right)-k\left(2B\right)$$

$4B_0-6B=4$ …(1)

$6B-2B_0 = -20$ ...(2)

$-2B = 12$ …(3)

Solving (1), (2) and (3) we get

$B = -6$ and $B_0 = -8$

48. (d)

$$\omega_0=\frac{1}{\sqrt{LC}}=\frac{1}{\sqrt{5\times80\times10^{-6}}}$$

$$=\frac{1}{\sqrt{4\times10^{-4}}}=\frac{10^2}{2}=50$$

Half power frequency band width is $\frac{R}{L}$

$$=\frac{40}{5}=8$$

Half power frequencies
50 - 4 = 4-6 Hz and 50 + 4 = 54 Hz

49.(c)

$\frac{i_2}{i_3}=\frac{r_3}{r_2}$ and $i_2+i_3=i_1$

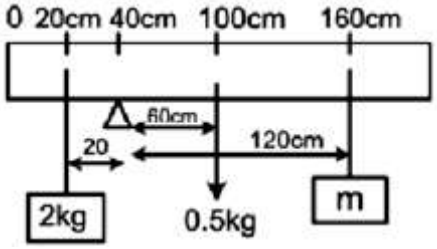
$\frac{i_2}{i_3}+1=\frac{r_3+r_2}{r_2}$

$\frac{i_2+i_3}{i_3}=\frac{r_2+r_3}{r_2}$

$\frac{i_1}{i_3}=\frac{r_2+r_3}{r_2}$

$\frac{i_1}{i_3}=\frac{r_2}{r_2+r_3}$

50.(a)



From principle of moments
2x20 = 0.5x60 + mx120
2 = 1.5 +6m
0.5 = 6m

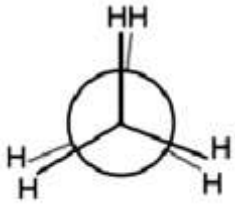
$m=\frac{1}{12}kg$

CHEMISTRY

Section A

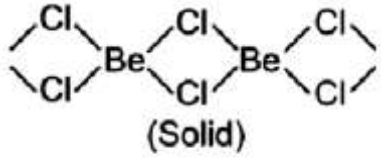
51. (a)

Eclipsed conformer is highly unstable Dihedral angle is zero

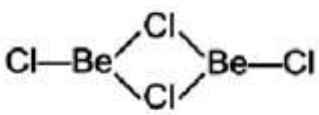


52.(b)

Beryllium chloride has chain structure in solid state. Vapour phase forms chlorobridged dimer.



(Solid)



(Vapour)

53.(d)

1° amines react with Hingsberg's reagent to give a solid, which dissolve in alkali.

54.(c)

$\lambda_M^{CH_3COOH} = \lambda_{CH_3COO}^M + \lambda_{Na^+}^M + \lambda_{H^+}^M + \lambda_{Cl^-}^M - \lambda_{Na^+}^M - \lambda_{Cl}^M$
$= \lambda_{CH_3COONa}^M + \lambda_{HCl}^M - \lambda_{NaCl}^M$
$= 91 + 426.16 - 126.45$
$= 390.71S\ cm^2\ mole^{-1}$

55. (a)
Number of tetrahedral voids = 2N
Number of octahedral voids = N
N = effective atoms for Hexagonal effective atoms = 6
Tetrahedral voids = 2x6=12
Octahedral voids = 6

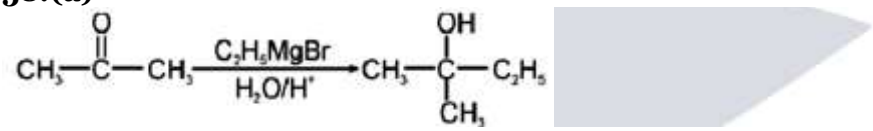
56. (b)
Tritium isotope of hydrogen is radioactive and emits low energy β - particles.

57. (d)

Element	%	At.weight	$\frac{\%}{\text{At.weight}}$	simplest ratio
C	78	12	6.5	1
H	22	1	22	= 3

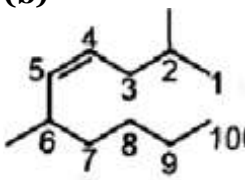
Empirical formula of this compound is CH_3

58. (a)



59. (a)
$P \propto \frac{1}{V}$
at constant temperature PV = K
Greater the temperature greater the magnitude of PV

60. (b)



61. (b)
PCl_5 - Trigonal bipyramidal [5 bond pairs)
SF_6 - Octahedral (6 bond pairs)
BrF_5 - Square pyramidal (5 bond pairs + 1 lone pair)
BF_3 - Trigonal planar (3 bond pairs

62. (c)
Temperature about 2200 K. This temperature is attained at the bottom near tuyers.

63. (c)
For one mole of an ideal gas $C_p - C_v = R$.

64. (b)
Down the group acidic strength increases as bond length increases and bond strength decreases due to which ease of release of H^4 increases. Acidic strength increases.

65. (d)
Colloidal sol shows Tyndall effect Starch is a colloid

66. (a)
The number of Body centred unit cells in all 14 types of Bravais lattice unit cells is 3,

67. (c)
More electropositive element displaces less electropositive metal.

68. (c)
It is an exothermic reaction

For exothermic reaction, energy of reactants is greater than energy of products. By inspection option 3 is correct.

69.(d)

Dimethylammonium acetate is a weak acid & weak base type of salt

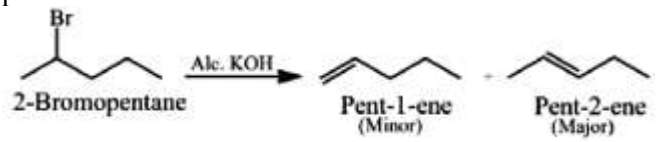
$$pH = 7 + \frac{1}{2}pK_a - \frac{1}{2}pK_b$$

$$= 7 + \frac{1}{2} \times 4.77 - \frac{1}{2} \times 3.27$$

$= 7.75$

70.(b)

During dehydrohalogenation most stable alkene Is formed by Saytzeff rule. According to Saytzeff s rule an alkene with more number of hyperconjugated hydrogens Is the major product.



71. (b)

Teflon is formed by addition polymerisation of Tetrafluoro ethylene

$$n CF_2 = CF_2 \xrightarrow[\text{Under pres}]{\text{Peroxide}} (-CF_2 - CF_2)_n$$

72.(b)

Deficiency of vitamin B_{12} causes Megaloblastic Anaemia/Pernicious anaemia

73.(b)

$$\pi = iCRT$$

$$P_1 = 1 \times \frac{10}{180} \times R \times T \text{ (For Glucose)}$$

$$P_2 = 1 \times \frac{10}{60} \times R \times T \text{ (For Urea)}$$

$$P_3 = 1 \times \frac{10}{342} \times R \times T \text{ (For Sucrosa)}$$

74.(b)

$$\lambda = \frac{c}{v}$$

$$\lambda = \frac{3 \times 10^8}{1368 \times 10^3} = 219.298m = 219.3m$$

75.(c)

Noble gases have very high melting and boiling points due to weak london dispersion forces.

76.(c)

Aspirin and Paracetamol are non-narcotic where as Morphine and Heroin are narcotic analgesics,

77.(d)

Only metal stable in liquid state at room temperature is Hg. It has non volatile impurity. Therefore, it is purified by distillation,

78.(c)

Atomic size F < Cl < Br <I

From R-F to R-I bond length increases where as bond enthalpy decreases.

79.(a)

$C_4H_{10}O$ shows metamerism.

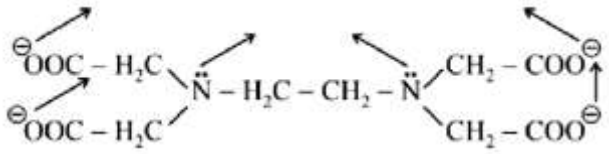
With the formula $C_4H_{10}O$ the possible ethers are-

(1) diethyl ether

(2) methyl n-propyl ether

(3) iso propyl methyl ether

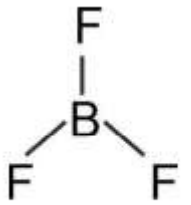
80. (b)



81. (d)

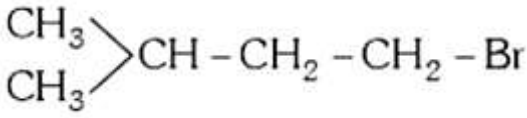
Zr and Hf have same size due to lanthanoid contraction.

82.(d)



sp^2 and 6

83. (d)



84. (c)

Most of the Lanthanoids are in trivalent state are coloured due to unpaired electrons in f-subshell, La^{+3}, Lu^{+3} are colourless.

85.(a)

Due to high polarising power of Be^{+2} ion, all berylium halides are predominantly covalent. They are soluble in organic solvents.

Section- B

86. (d)

Applying Raoult's law.

$$P_{total} = P_A^0 X_A + P_B^0 X_B$$

$$X_A = \frac{3}{5}, X_B = \frac{2}{5}$$

$$P_{total} = 280 \times \left(\frac{3}{5}\right) + 420 \times \left(\frac{2}{5}\right)$$

=336mm of Hg

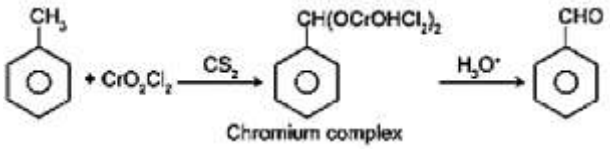
87.(d)

For an isothermal process, $\Delta T = 0$

$\Delta U = 0$

For an irreversible expansion, $\Delta S_{total} \neq 0$

88. (b)



89. (d)

Given:

V = 1L

T = 273K

Let us find the Partial pressure of O_2.

No. of moles = 4/32 =0.125 moles

P_1= nRT/v =0.125x0.082 x 273/1 =2.80 atm

Now let us find the partial pressure of H_2.

P_2 = nRT/v =1 x 0.082 x 273/1 =22.386 atm

Total pressure of the mixture =2.30 + 22.38=25.13 atm

90. (a)

Fe^{+2}....[Ar]$3d^{e-}$..... 24 electrons

Mn^{+2}….[Ar]$3d^{5}$..... 23 electron

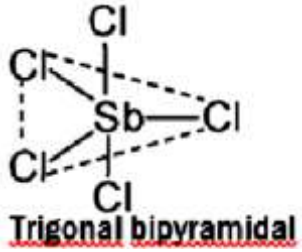
91. (d)

This is a decarboxylation reaction

$$CH_3CH_2COONa + NaOH \xrightarrow[\Delta]{CaO} CH_3 - CH_3 + Na_2CO_3$$

92.(d)

dipole moment (μ) = 0



Trigonal bipyramidal

93.(b)

$$\ln K = \ln A - \frac{Ea}{R}\left(\frac{1}{T}\right)$$

In $\ln k$ v/s $\frac{1}{T}$ graph

Slope = $-\frac{Ea}{R}$

$$-5\times10^{3} = \frac{-Ea}{8.314}$$

=41500 J mol^{-1} or 41.5 kJ mol^{-1}

94.(d)

(a) $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g) \rightarrow$ [iv] Tropospheric pollution

(b) $HOCl(g) + hv \rightarrow OH^{*} + Cl^{*} \rightarrow$ (iii) Ozone depletion

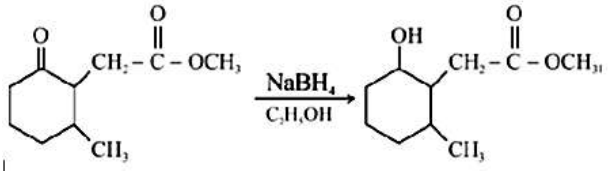
(c) $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2 \rightarrow$ (i) Acid rain

(d) $NO_2(g) + hv \rightarrow NO(g) + O(g) \rightarrow$ (ii) Smog

95.(a)

96. (a)

97.(a)



98. (c)

$H_2Q < H_2S < H_2Se < H_2Te$ from going down the group bond length increase so bond strength decreases therefore acidic nature of these will increase but pKa will decrease,

99.(d)

$$\Lambda^{o}_{CH_3COOH} = \Lambda^{o}_{CH_3COO^-} + \Lambda^{o}_{H^+}$$

$$\Lambda^{o}_{CH_3COOH} = 350 + 50 = 400 Scm^2\ mol^{-1}$$

$$\Lambda_{CH_3COOH} = 20 Scm^2\ mol^{-1} \text{ Given}$$

$$a = \frac{\Lambda_{CH_3COOH}}{\Lambda^{o}_{CH_3COOH}} = \frac{20}{400} = 5\times10^{-2}$$

$$K_a = c\alpha^2 = 0.007 \times (5\times10^{-2})^2 = 1.75\times10^{-5}\ mol\ L^{-1}$$

100. (c)

BIOLOGY

101. (b)
Cells with active cell division - Meristematic tissue
Tissue having all cells similar in structure and function- Simple tissue
Tissue having different types of cells - Vascular tissues
Dead cells with highly thickened walls and narrow lumen - Sclereids

102. (b)
Mature sieve tube elements do not have nucleus but have cytoplasm. (Anucleated living cells).

103. (c)
Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo. Here genes are inserted into a person's cells and tissues to treat a disease. Amplification is used to increase the expression of desired gene

104. (c)
Addition of chilled ethanol precipitates the genomic DNA during the isolation of DNA or genetic material,

105. (c)
Protoplast fusion - Pomato Plant tissue culture - Totipotency Meristem culture - Virus free plants Micropropagation – Somaclones

106. (b)
Metacentric chromosome has a median centromere, due to which it has two almost equal arms. It attains V shape in anaphase

107. (a)
Founder effect and bottleneck effect are two types of genetic drift. In a small isolated population change in gene frequency occurs by chance, it is called genetic drift. Sometimes the change in allele frequency is so different in the new sample of population that they become a different species. The original drifted population becomes founders and the effect is called founder effect

108. (b)
The correct sequence of steps in PCR is Denaturation, Annealing and Extension.

109. (b)
Species facing competition might evolve mechanisms that promote co-existence rather than exclusion. One such mechanism is 'resource partitioning'. Mac Arthur showed that five closely related species of warblers living on the same tree were able to avoid competition and co-exist due to behavioural differences in their foraging activities.

110. (b)
A typical embryo sac is 8-nucleated and 7-celled. It is polygonum type.

111. (a)
The site of perception of light in plants during photoperiodism is leaf

112. (c)
Chara is an alga with monoecious condition. It has male sex organ antheridium and female sex organ oogonium at the same node. Cycas circinalis, Carica papaya and Marchantia polymorpha are dioecious.

113. (d)
Cristae - Infoldings in mitochondria (inner membrane)
Thylakoids - Flattened membranous sacs in stroma of plastids
Centromere - Primary constriction in chromosome
Cisternae - Disc shaped sacs in Golgi apparatus

114. (b)
Cohesion - Mutual attraction among water Adhesion - Attraction towards polar surfaces Surface tension – More attraction in liquid phase Guttation - Water loss in liquid phase

115. (c)
Lenticels - Exchange of gases Cork cambium - Phellogen Secondary cortex - Phelloderm Cork - Suberin deposition

116. (b)
Xenogamy is transfer of pollen grains from anthers of one plant to stigma of a different plant which, during pollination, brings genetically different types of pollen grains to stigma.

117. (d)
Purification of isolated protein is not an application of PCR (Polymerase Chain Reaction).
118. (d)
Punnet square: It is a diagram which shows the production of gametes by parents, formation of zygotes, the F_1 and F_2 plants
119. (d)
Carrageen is produced by Red algae.
120. (b)
In Amensalism one species is harmed (-) whereas the other is unaffected (0).
121. (d)
During meiosis centromere division is seen in Anaphase II.
122. (d)
2,a - replication of DNA; b - Transcription; c- Translation; d - Protein
123. (d)
Gamma rays induce mutations,
124. (a)
Gross primary productivity minus respiration losses [R], is the net primary productivity (NPP).GPP-R=NPP.
125. (d)
The ability of plants to form morphologically different structures by following different pathways in response to environment or phases of life is called Plasticity.
126. (d)
The synthetic auxin 2, 4 - D is used to destroy weeds in a monocot field.
127. (c)
The pyramid of biomass in sea is generally inverted because the biomass of fishes far exceeds that of phytoplankton,
128. (a)
Gemmae are formed in some liverworts like Marchantia.
129. (c)
The first stable product of $_{CO2}$ fixation in Sorghum (C_4 plant) is Oxaloacetic acid.
130. (b)
Ectocarpus [Brown alga) has mannitol as reserve food material,
131. (c)
DNA strands on a gel stained with ethidium bromide when viewed under UV radiation appear as bright orange bands.
132. (d)
Diadelphous stamens are seen in pea (Fabaceae).
133. (c)
Amino acids and Glucose are primary metabolites but not secondary metabolites as they have some known functions
134. (d)
The amount of nutrients, such as carbon, nitrogen, phosphorus and calcium present in the soil at any given time is called standing state.
135. (a)
Genera like Selaginella and Salvinia (Pteridophytes) form two types of spores microspores and megaspores and they are described as heterosporous,
136. (b)
Since the gene is inserted at Pstl of ampR region ofpBR322, the ampR gene is inactivated which is called as insertional inactivation, Hence the genetically modified E.coli strain will not be able to confer ampicillin resistance
137. (a)
In dicot families like Solanaceae, Rosaceae and Leguminosae the viability of pollen grains remain months together after their release
138. (c)
Transcription is terminated when Rho factor binds to RNA polymerase in bacteria
139. (c)
Fusion of protoplasms between two motile or non-motile gametes is called as plasmogamy
140. (c)

DNA fingerprinting involves identifying differences in some specific regions in DNA sequence called as repetitive DNA, because in these sequences, a small stretch of DNA is repeated many times.

141. (d)

Inter fascicular cambium is formed from medullary ray cells which is a part of vascular cambium in dicot stems.

142. (c)

In ETC of respiration, oxidation of one molecule of NADH + H^4 gives rise 3 ATP and FADhh produces 2 ATP.

143. (a)

In Cyclic photophosphorylation only PSI is involved but not PS II,

144. (b)

Nitrococcus - Conversion of ammonia to nitrite
Rhizobium - Conversion of atmospheric nitrogen to ammonia
Thiobacillus- Denitrification
Nitrobacter- Conversion of Nitrite to Nitrate

145. (c)

RNA polymerase III is involved in transcribing tRNA, 5srRNA and snRNA.

146. (d)

The integral form of the exponential growth equation as $N_t = N_0e^{rt}$
Where,
N_t = Population density after time t
No = Population density at time zero
r = intrinsic rate of natural increase
e = the base of natural logarithms (2.71828

147. (d)

A single stranded DNA or RNA, tagged with a radioactive molecule (probe) is allowed to hybridise to its complementary DNA in a clone of cells followed by detection using autoradiography, The clone having the mutated gene will hence not appear on the photographic film, because the probe will not have complementarity with the mutated gene

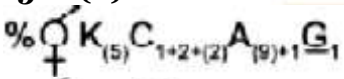
148. (b)

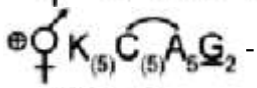
Protein - Peptide bonds
Unsaturated fatty acid - C = C double bonds
Nucleic acid - Phosphodiester bonds
Polysaccharide - Glycosidic bonds

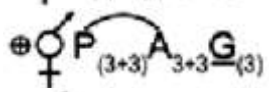
149. (d)

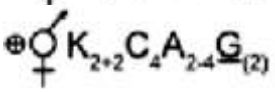
S phase - DNA replication
G_2 phase - Proteins are synthesized
Quiescent stage - Inactive phase
G_1 phase - Interval between mitosis and initiation of DNA replication

150. (b)

 - Fabaceae

 - Solanaceae

 - Liliaceae

 - Brassicaceae

ZOOLOGY
SECTION - A

151. (a)

One of the glycoproteins in the zona pellucida, called ZP3, acts as a sperm receptor.

152. (d)

During Diakinesis of meiotic Prophase I, the distinctive feature of this stage, terminalisation of chiasmata

is seen.

153. (c)

Endomembrane system includes Endoplasmic Reticulum, Golgi complex, Lysosomes and Vacuoles

154. (d)

Palindromic Nucleotide sequence is specific recognition sequence identified by endonucleases to cut the DNA strands at the specific positions.

155. (b)

High pO_2, low pCO_2, lesser H^4 concentration and lower temperature are all favourable factors for the formation of oxyhaemoglobin at the alveoli.

156. (d)

Physalia - Portuguese man-of-war
Limulus (King crab). - Living fossil
Ancylostoma - (Hookworm)
Pinctada - Pearl oyster

157. (d)

The thickness of the ozone in a column of air from the ground to the top of the atmosphere is measured in terms of Dobson units (DU),

158. (d)

House fly belongs to family Muscidae.

159. (d)

Venereal disease can spread through transfusion of blood from infected person, infected mother to foetus, etc. Kissing can also transmit a few STIs like CMV (cytomegalovirus), HSV (herpes simplex virus) and syphilis.
Note: Kissing also can transmit a few STIs like CMV, herpes and syphilis.

160. (c)

DNA dependent RNA polymerase of prokaryotes has the ability to initiate, elongate and terminate the process of transcription

161. (c)

Vaults - Entry of sperms through cervix is blocked
IUDs - Phagocytosis of sperms within the uterus
Vasectomy - Removal of vas deferens
Tubectomy - Removal of fallopian tube

162. (b)

Aspergillus niger- Citric acid
Acetobacter aceti - Acetic acid
Clostridium butylicum - Butyric acid
Lactobacillus - Lactic acid

163. (a)

Ricin is toxin but not drug,

164. (b)

In the alveolar air, the partial pressures of oxygen (pO2) is 104 mmHg and that of carbon dioxide (pCO2) is 40 mmHg.

165. (c)

Sphincter of Oddi guards the opening of hepatopancreatic duct into duodenum

166. (a)

siRNA (smaller interference RN A] is involved in preventing the translation of mRNA to form protein. It is associated with pest resistance in plants by RNA interference.

167. (c)

Succus entericus is also called intestinal juice, The secretions of the brush border cells of the mucosa along with the secretions of the goblet cells constitute the intestinal juice.

168. (a)

Persons with 'AB' group can accept blood from persons with AB as well as the other groups of Blood because they do not have anti A and anti B antibodies in their blood plasma.

169. (b)

A ring of 6-8 blind tubules called hepatic or gastric caeca is present at the junction of foregut and midgut, which secrete digestive juice.

170. (d)

Communication among the cells is performed by intercalated discs in cardiac muscle. Intercalated discs are absent in smooth muscle.

171. (b)

In Aves [e,g,, Neophron), endoskeleton is fully ossified [bony] and the long bones are hollow with air cavities (pneumatic),

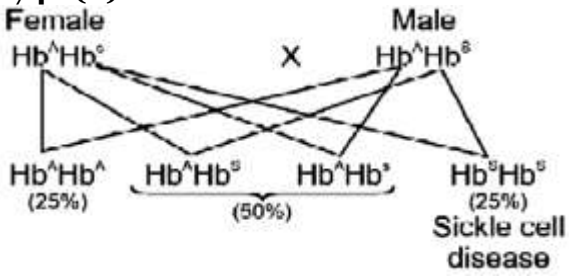
172. (d)

Thymine - 30%, Guanine - 20%, Cytosine - 20% (Chargaffs nitrogen base pairing rule which states that amount of Adenine is equal to Thymine and Guanine is equal to Cytosine

173. (b)

The enzyme thrombin converts inactive fibrinogens in the plasma into fibrins.

174. (d)



175. (c)

LNG 20 is a hormone-releasing intrauterine device. It releases 20 micrograms of levonorgestrel (synthetic progestogen) per day. Progestasert is also a hormone releasing IUD, Cu T, Cu 7 and Multiload375 are copper-releasing IUDs.

176. (b)

Centrioles duplicate in S phase of cell cycle.

177. (d)

Myasthenia gravis is an autoimmune disorder affecting neuromuscular junction leading to fatigue, weakening and paralysis of skeletal muscle.

178. (d)

Recombinant DNA technology, Polymerase Chain Reaction (PCR) and Enzyme Linked Immunosorbent Assay (EL1SA) are some of the techniques that serve the purpose of early diagnosis.

179. (a)

Metagenesis is exhibited by cnidarians (not helminths). Comb plates of ctenophores help in locomotion (not digestion).

180. (a)

The Juxtaglomerular cells of kidney produce a peptide hormone called erythropoietin which stimulates erythropoiesis (formation of RBC

181. (d)

C peptide present in proinsulin is removed during its maturation. The insulin produced by rDNA technology has only A peptide and B peptide.

182. (d)

Metamerism -Annelida Canal system - Porifera Comb plates - Ctenophora Cnidoblasts - Coelenterata

183. (c)

Improving resistance to disease in crop is not an objective of Biofortification of crops.

184. (d)

During PCR process, if high temperature is not maintained, the initial step of the process known as denaturation of DNA is not done.

185. (b)

During mitotic cell cycle if the chromosome number in G1 phase is 8, it remains same till Metaphase. Hence, even after S phase same chromosome number 8 is maintained in the cell of fruit fly.

ZOOLOGY
SECTION - B

186. (b)

A person goes to high altitude and experiences altitude sickness with symptoms like breathing difficulty and heart palpitations
because in the low atmospheric pressure of high altitudes, the body does not get enough oxygen.

187. (a)

AUG codes for only methionine but not tryptophan. (A given codon codes for only one amino acid but not more than one amino acids.). AAG and AAA are the two codons for the amino acid Lysine.

188. (b)

Anterior end consists of the mouth and the prostomium, a lobe which serves as a covering for the mouth and as a wedge to force open cracks in the soil into which the earthworm may crawl. The prostomium is sensory in function, The first body segment is called the peristomium (buccal segment) which contains the mouth.

189. (b)

In MOET a cow is administered hormones, with FSH-like activity, to induce follicular maturation and super ovulation,

190. (c)

Tight junctions help to stop substances from leaking across a tissue. Gap junctions facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells, for rapid transfer of ions, small molecules and sometimes big molecules.

191. (c)

Relaxin is produced first by the corpus luteum of the ovary and later by the placenta. It helps in parturition as it increases the flexibility of the pubic symphysis and helps dilate the uterine cervix.

192. (b)

During muscle contraction, the cross bridges pull the thin filaments towards the centre of A band. The Z line attached to the actins are also pulled inwards thereby causing a shortening of the sarcomere. The I bands get reduced, whereas the 'A' bands retain the length. Myosin head acts as ATPase.

193. (b)

Adenosine deaminase (ADA) is crucial for the immune system to function, Its deficiency causes severe combined immunodeficiency.

194. (b)

Adaptive Radiation	Darwin Finches
Convergent evolution	Wings of Butterfly and Bird
Divergent evolution	Bone of forelimbs in Man and Whale
Evolution by anthropogenic action excessive	Selection of resistant varieties due to use of herbicides and pesticides

195. (a)

Release of Prolactin is not an important component of initiation of parturition in humans, Towards the end of pregnancy, the increasing ratio of estrogen to progesterone promotes uterine contractions, Progesterone no longer inhibits them, High levels of estrogens increase the number oxytocin receptors and gap junctions in the myometrium, Prostaglandins induce the softening of uterine cervix and enhance uterine contractile strength,

196. (d)

Lecithin is a phospholipid, Glycerol is trihydroxy propane. Unsaturated fatty acids have double bonds in R group at one or more regions,

197. (d)

Allen's Rule	Polar seal
Physiological adaptation	Kangaroo rat
Behavioural adaptation	Desert Lizard
Biochemical adaptation	Marine Fish at depth

198. (c)

Filariasis	Washeteria bancroftian
Amoebiasis	Entamoeba histolytic
Pneumonia	Hemophilus influenzae
Ringworm	Trichophyton

199. (c)

Histones are basic proteins. Hence, they are alkaline or basic because of abundance of basic amino acids Lysine and Arginine.

200. (a)

Scapula	Triangular flat bone
Cranium	Fibrous joints
Sternum	Flat bone
Vertebral Column	Cartilaginous joints