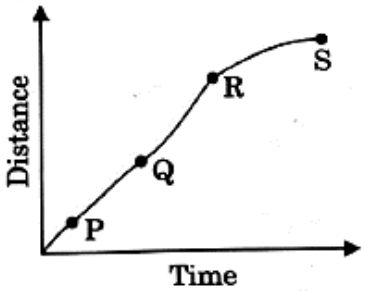
## Physics

**1. (c)**

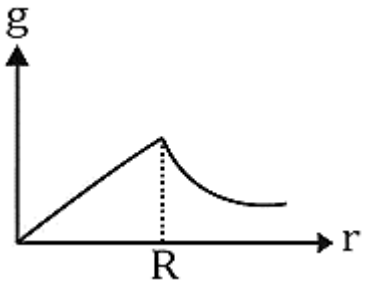



$V_max = \frac{dx}{dt}$ = maximum slope

From the figure, at point R the slope is maximum, hence at this point velocity is maximum.

∴ Maximum instantaneous velocity of the particle is around the point ' $R$ '.

**2. (b)**




For an isothermal process,

$$B = \frac{1}{P}c$$

Graph will be rectangular hyperbola

**3. (a)**

$T_1 = 65.5°C,\ T_2 = 62.5°C$
Room temperature $(T_0) = 22.5°C$
Ist Case:-
Using Newton's law cooling

$$\frac{T_1 - T_2}{t} = -k\left[\frac{T_1 - T_2}{t} - T_0\right]$$

$$\frac{65.5 - 62.5}{1} = -k\left[\frac{65.5 - 62.5}{2} - 22.5\right]$$

$$3 = -k[64 - 22.5]$$

$3 = -k[41.5]$------- (1)

II nd-Case: -

$T_1 = 46.5°C,\ T_2 = 40.5°C$

$$\frac{46.5 - 40.5}{t} = -k\left[\frac{46.5 + 40.5}{2} - 22.5\right]$$

$$\frac{6}{t} = -k[43.5 - 22.5]$$

$$\frac{6}{t} = -k[21] - \cdots - - - - -(2)$$

Eq. (1) dividing by Eq. (2)

$$\frac{3}{\frac{6}{t}} = \frac{-k[41.5]}{-k[21]}$$

$$\frac{t}{2} = \frac{41.5}{21}$$

After solving

$t = 4$ min.

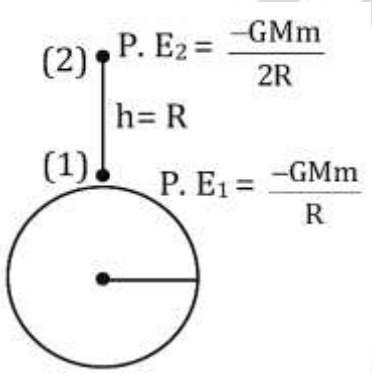
**4. (a)** Magnetic flux $(\varphi) = BA$

Permeability $(\mu) = B/H$

$$\Phi = B.A \times \mu_0 \frac{1}{d} A \Rightarrow \frac{0}{\mu} = \frac{IA}{d}$$

$\Rightarrow IL \Rightarrow [M^0\ L^1\ A^1\ T^0]$

**5. (a)**




P.E. of the earth surface (P.E 1) $= -\frac{GMm}{R}$

P.E. of h height on the surface of earth

$$\text{P.E, } 2 = \frac{-GNM}{R + R} \Rightarrow -\frac{GMm}{2R}$$

$$\therefore W = U_f - V_i \Rightarrow \text{ P.E. 2 P.E. 1} \Rightarrow \left(-\frac{GMm}{2R}\right) - \left(-\frac{GMm}{R}\right)$$

After solving

$$W = -\frac{MgR}{2}$$

**6. (a)** First overtone frequency for closed

Organ pipe $f = 3\ V/4\ L_1$

Frequency for open pipe $f = \frac{2u}{2L_2}$

$\Rightarrow \frac{L_1}{L_2} = \frac{3}{4}$

**7. (c)** $R = \frac{V}{I}$

$V = (100 \pm 5)V,\ I = (10 \pm 0.2)A.$

$R = \frac{100}{10} = 10$

$\frac{\Delta R}{R} = \pm\left(\frac{\Delta V}{V} + \frac{\Delta I}{I}\right)$

$\left(\frac{\Delta R}{R} \times 100\right) = \pm\left(\frac{\Delta V}{V} \times 100\right) + \left(\frac{\Delta I}{I} \times 100\right)$

$= \pm\left[\frac{5}{100} \times 100 + \frac{0.2}{10} \times 100\right]$

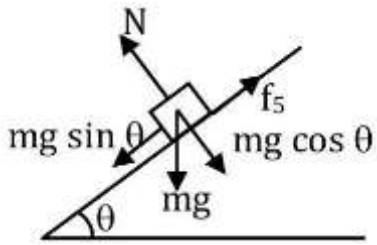
$R = \pm 7\%$

**8. (b)** $N = mg\cos\theta$

$Mg\sin\theta = f_s$

$M \times 10 \times \sin 30 = 10$

$\therefore m = 2\ kg$




**9. (c)** Kinetic energy, $k = \frac{P^2}{2M}$

$\therefore P^2 = 2mK$

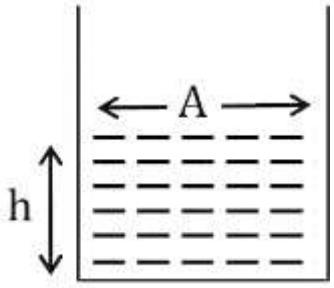
$P = \sqrt{2mK}$

$\frac{P_1}{P_2} = \sqrt{\frac{2m_1K}{2m_2K}}$

$= \sqrt{\frac{m_1}{m_2}}$

$\therefore P_1 : P_2 = \sqrt{m_1} : \sqrt{m_2}$

**10. (d)** The pressure depends on acceleration, height of the liquid and the density of liquid. Pressure does not depend on the area of the liquid surface.




Force $(F) = (h.A)\rho.g$

$F = hA\rho g$

Pressure $(P) = \frac{F}{A}$

$P = h\rho g$

**11. (b)** Given: -

$T_1 = 500k$

$Q_1 = 300$ calories

$Q_3 = 150$ calories

$T_2 = ?$

$$\frac{Q_2}{Q_1} = \frac{T_2}{T_1}$$

$$T_2 = \frac{Q_2 \times T_1}{Q_1}$$

$$T_2 = \frac{150 \times 500}{300}$$

$T_2 = 250$ K

**12. (c)** $PV = nRT$

Hence $P \propto V$

Temperature is constant there is no change in Kinetic energy of molecules.

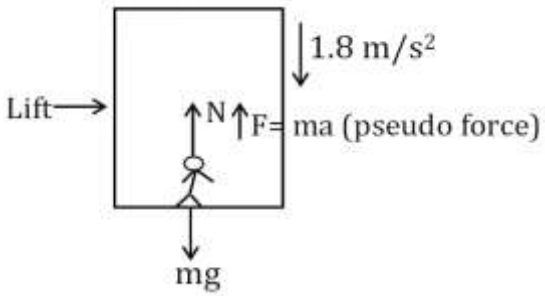
**13. (b)** Lift -

Now -

$N + F = mg$

[Where F is a Pseudo force]

$N = mg - F$
$= mg - ma$
$= m(g - a)$
$= 60(9.8 - 1.8)$
$= 60 \times 8$
$N = 480\ N$




**14. (b)** Using perpendicular axis theorem: -

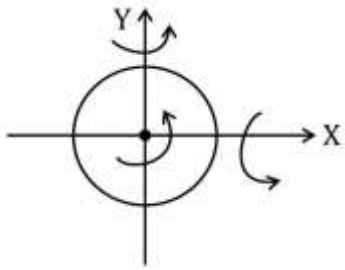
$I_z = I_x + I_y$…….. (1)

Given: -

$I_x = 20\ kg\ m^2$
$I_y = 25\ kg\ m^2$

Substitute values in Eq$^n$ (1)

$I_2 = 20 + 25$
$I_2 = 45\ kg\ m^2$




**15. (b)**

$$\text{Stress} = F/A \quad \frac{\text{Stress A}}{\text{Stress B}} = \frac{\frac{F}{A_A}}{\frac{F}{A_B}} = \frac{A_B}{A_A}$$

Given: -

Area of cross section of wire ' A ' is double that of ' B '

$\therefore AA_A = 2AB$

$$\frac{\text{Stress A}}{\text{Stress B}} = \frac{A_B}{2A_B} = \frac{1}{2}$$

$\therefore$ Stress B = twice on stress ' A '

**16. (a)** Magnitude of electric field is 2 N/C.

Distance $r = 30$ cm $\Rightarrow 30 \times 10^{-2}$ m

Apply formula of E.F.

$$E = \frac{Kq}{r^2}$$
$$2 = \frac{9 \times 10^9 \times q}{(30 \times 10^{-2})^2}$$
$$q = \frac{2 \times (30 \times 10^{-2})^2}{9 \times 10^9}$$
$$q = \frac{2 \times (900 \times 10^{-4})}{9 \times 10^9}$$

After solving

$Q = 2 \times 10^{-11} C$

**17. (b)** Given: -

$m = 1$ kg
$q = 2C$

Potential $(V) = 1$ V

Electrostatic Potential Energy = K.E.

$q \times V = 1/2MVV^2$
$2 \times 1 = 1/2 \times 1 \times V^2$
$V = 2$ m/s

**18. (d)** Case Ist: -

Force $(f) = \frac{kq_1q_2}{r^2}$ ..... (1)

$$F = \frac{1}{4\pi \in_0} \frac{q_1q_2}{r^2}$$

Case 2 nd: - New distance after dielectric slab is inserted between 2 changes,

$$d_{new} = \left[\frac{r}{2} + \frac{r}{2}\sqrt{4}\right]$$

$$\Rightarrow \frac{r}{2} + r \Rightarrow \frac{3r}{2}$$

Thus,

New force $[F^1] = \frac{1}{4\pi\epsilon_0} \frac{q_1q_2}{\left(\frac{3r}{2}\right)^2}$ ..... (2)

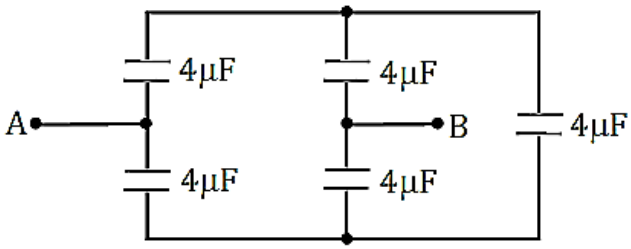
Equation (ii) dividing by equation (i)

$$\frac{F^1}{F} = \frac{\frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{\left(\frac{9r^2}{4}\right)}}{\frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}}$$

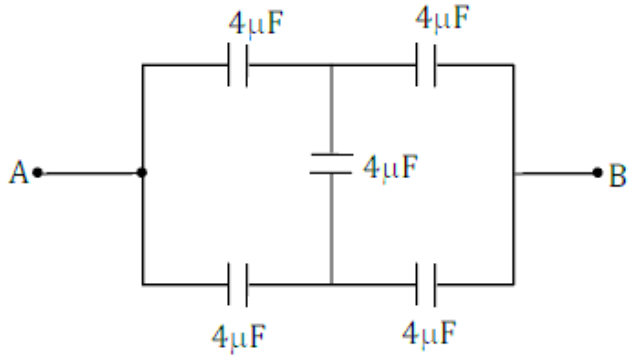
After solving,

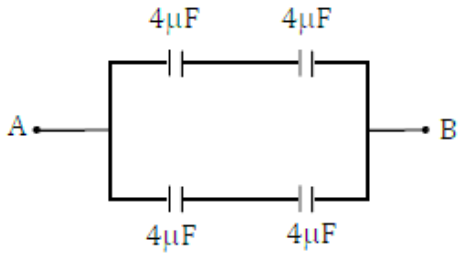
$$F' = \frac{4F}{9}$$

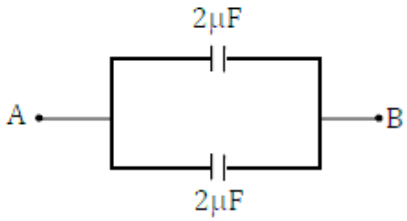
**19. (a)**

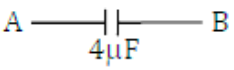



From balanced wheat stone bridge,



**20. (d)** An equipotential surface is one in which all the points are at the same electric potential so, the work done to move a charge on an equipotential surface is zero.

According to the formula

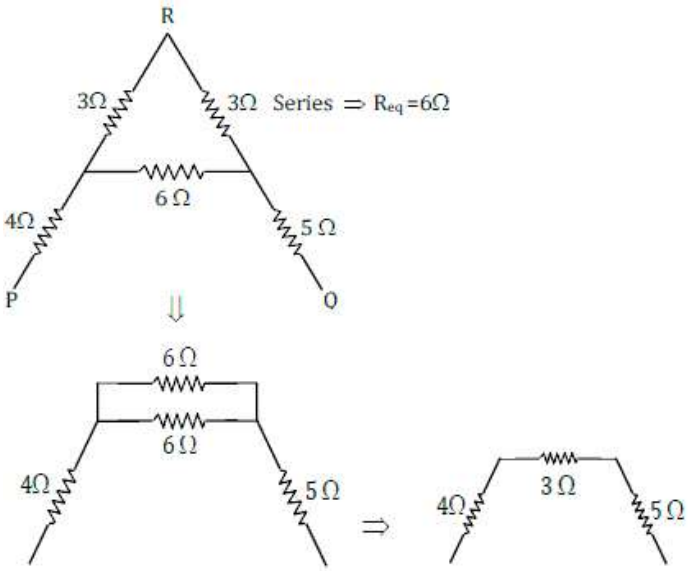
$dw = q.dv$

**21. (c)**

**22. (d)** Ohm's law is applicable only to conductors.

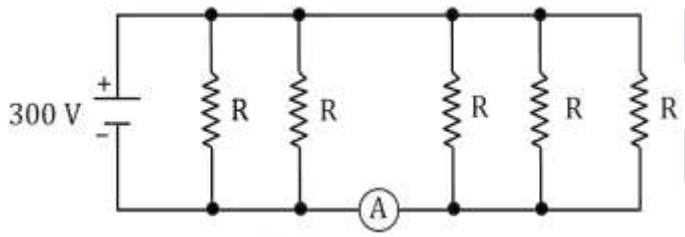
**23. (b)** If the last bond on the carbon resistor is absent, there is no tolerance band, it is 20%.

**24. (c)**




Req. $= 4 + 3 + 5 = 12\Omega$

**25. (b)**




Using formula

$V = IR$
$I = V/R$

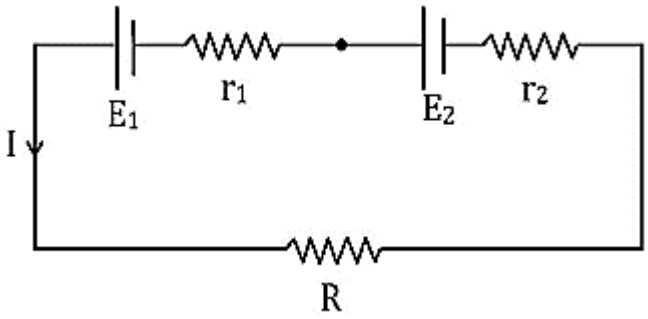
All resistances are in parallel.

$\therefore\ I = \dfrac{V}{R/5} = \dfrac{300 \times 5}{R}$

Given: - $R \Rightarrow 1500$

Current through $(A) = \frac{3}{5}$ A.

**26. (c)**




According to Ohm's law

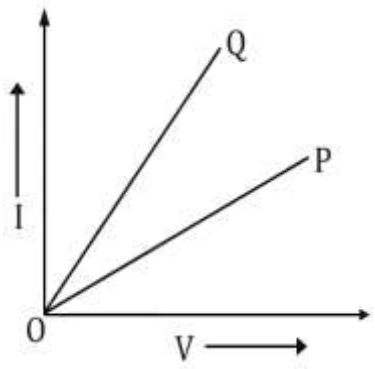
$$V = IR$$
$$E + E = 2I(r_1 + r_2 + R)$$
$$I = \frac{2E}{R + r_1 + r_2}$$

Terminal potential difference across the cells of Internal resistance $r_1 = 0$

$$V = E - Ir_1$$
$$0 = E_1 - Ir$$

$$\frac{2E}{R + r_1 + r_2} = \frac{E}{r_1}$$
$$2r_1 = R + r_1 + r_2$$
$$R = r_1 - r_2$$

**27. (b)**




Slope of this graph is reciprocal of resistance

Q (slope) > P (slope)

$\frac{1}{R_Q} > \frac{1}{R_P}$ ∴ $R_P > R_Q$

**28. (b)** Biot-Savart law: -

$$dB = \frac{\mu_0}{4\pi}\frac{Idl\sin\theta}{r^2}$$

Vector form: -

Now we know,

$\hat{r} = \frac{\vec{r}}{r}$, Using this

$\overrightarrow{dB} = \frac{\mu_0}{4\pi}\frac{Idl\sin\theta}{r^2} \times \hat{r}$

$\overrightarrow{dB} = \frac{\mu_0}{4\pi}\frac{I(\vec{dl} \times \vec{r})}{r^3}$

**29. (b)** Radius of circular path,

$R = \frac{mV}{qB}$

Thus,

$r_1B_1 = r_2B_2$

$r.B = r^1 \cdot \frac{B}{2}$

$r^1 = 2r$

**30. (b)** Radius of circular path

$r = \frac{mV}{qB}$

For acceleration energy

$ev = 1/2mv^2$

$v^2 = \frac{2eV}{m}$

$v = \sqrt{\frac{2eV}{m}}$

$r \propto \sqrt{V}$

$V \propto r^2$

So,

$\frac{V_2}{V_1} = \left(\frac{r_2}{r_1}\right)^2$

After solving

$V_2 = 4\ V_1$

**31. (c)** Frequency, $v = 10MHz \Rightarrow 10^7$ Hz

Magnetic field: -

$B = \frac{2\pi mv}{q}$

$\therefore B = \frac{2 \times \frac{22}{7} \times 1.6 \times 10^{-27} \times 10^7}{1.6 \times 10^{-19}} \Rightarrow \frac{10.4876}{1.6}$

After solving

$B = 0.656$ T

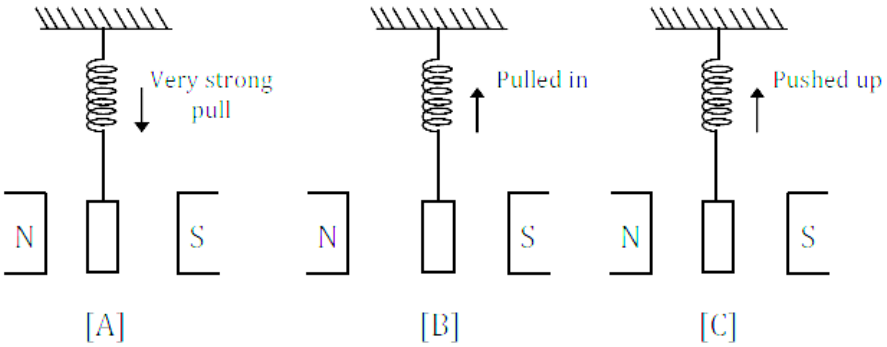
Now energy: -

$$E_{max} = \frac{B^2q^2R^2}{2M}$$
$$= \frac{(0.656)^2 \times (1.67 \times 10^{-27})^2 \times (60 \times 10^{-2})^2}{2 \times 1.67 \times 10^{-27}}$$

After solving,

$= 7\text{MeV}$

**32. (b)**




(a) These are strongly attracted in an external magnetic field [In ferromagnetic substance]
(b) These are feebly attracted in an external magnetic field (in Paramagnetic substance).
(c) These are repelled in an external magnetic field. (In diamagnetic Substance)

So,
A magnet will attract $N_1$ strongly, $N_2$ weakly and repel $N_3$ weakly.

**33. (d)** A magnetic field extends infinitely. The strength of the earth's magnetic field is not constant. It varies from one place to other place on the surface of earth.

**34. (b)** Length (l) $= 25$ m

Speed (V) $= 3600\text{KM/ hour}$

$$= 3600 \times \frac{5}{18}$$

$$= 200 \times 5$$

$V = 1000$ m/s

Magnetic field $B = 4 \times 10^{-4}$ T

$\theta = 30°$

Vertical component of earth (Bv)

$Bv = B \cdot \sin\theta$

$E = (Bv) \times l \times V \Rightarrow B.\text{Sin}\,\theta \times 1 \times V$

$= 4 \times 10^{-4} \times 1/2 \times 25 \times 1000$

After solving,

$E = 5$ Volt

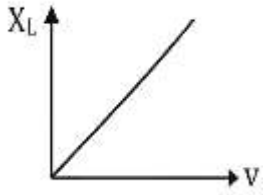
**35. (a)** We know that

Inductive reactance

$X_L = \omega_L$

Frequency $= v$

$X_L = 2\pi v_L$
$X_L = 2\pi L \times v$




This equation can be compared to the equation of straight line

$Y = m \times C$

**36. (b)** $e = \frac{d\varphi}{dt}$
$\varphi = 3t^2 + 4t + 9$

So,

$e = 6t + 4$
$t = 2sec$
$e = 6 \times 2 + 4$
$e = 16v$

**37. (a)** Power (P) $= 100w$

$V = 220$

We know that

$P = VI$

$I = P/V \Rightarrow \frac{100}{220}$

$I = \frac{5}{11}$Amp

**38. (a)** Formula used power dissipated in an LCR circuit

$P = V_{rms.}$ Irms $\cos\phi$

**39. (b)** $i_{rms} = \frac{V_0}{\sqrt{2}}$

rms value of voltage & frequency

**40. (b)** No. of primary winding $= 1$

No. of secondary winding $= 25$

Used formula

$$\frac{N_P}{N_S} = \frac{I_S}{I_P}$$

So,

$$IP = Is \times \frac{N_S}{N_P}$$

Substitute values

$$I_P = 2 \times \frac{25}{1}$$
$$I_P = 50\ A$$

**41. (b)** Wavelength $(\lambda) = 5 \times 10^{-7}$

Force $(F) = 6.62 \times 10^{-5}$ N

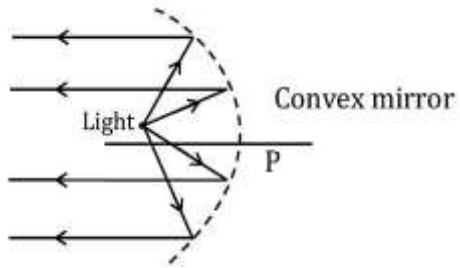
$h = 6.62 \times 10^{-34}$ J.S

Used formula

$$P = \frac{n}{t} \cdot \frac{hc}{\lambda}$$
$$Fc = \frac{n}{t} \cdot \frac{hc}{\lambda}$$

$$\frac{n}{t} = \frac{F\lambda}{h}$$
$$= \frac{6.62 \times 10^{-5} \times 5 \times 10^{-7}}{6.62 \times 10^{-34}}$$
$$= 5 \times 10^{22}\ V$$

**42. (c)**




When the object is placed at the focus the image is formed at infinity & highly emerged

**43. (a)** Apply mirror formula $u = -20$ cm
$F = 10$ cm

$$\boxed{\frac{1}{f}=\frac{1}{v}+\frac{1}{u}}$$

**44. (a)** Using mirror formula

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

Given: -
Object initial distance (u) $= -25$ cm
Image distance (v) $= +75$ cm
Substitute values

$$\frac{1}{f}=\frac{1}{75}-\frac{1}{-25}$$
$$\frac{1}{f}=\frac{1}{75}+\frac{1}{25}\Rightarrow\frac{1}{f}=\frac{1+3}{75}\Rightarrow\frac{1}{f}=\frac{4}{75}$$

After solving

$f = +18.75$ cm and convex lens

**45. (a)** Fringe width $\Rightarrow \beta=\frac{\lambda D}{d}$

Angular width $\theta \Rightarrow \frac{\beta}{D}$

$$\therefore\ \theta=\frac{\lambda D}{dD}$$
$$\theta=\frac{\lambda}{d}$$

$d = a$ (given)

Angular width $\theta=\frac{\lambda}{a}$

**46. (d)** When a blue light is used instead of yellow, decreases & hence, diffraction bands become narrower.

**47. (c)** $\lambda_1 = 780$ nm

$\lambda_2 = 520$ nm

We know that,

The distance from the central maxima to $n^{th}$ bright band

$$y_n=\frac{n\lambda D}{d}\ \frac{n\lambda_1 D}{d}=\left(n+1\frac{\lambda_2 D}{d}\right)$$

$$n_1\lambda_1=(n+1)\lambda_2$$

$$\frac{n+1}{n}=\frac{\lambda_1}{\lambda_2}\Rightarrow\frac{780}{520}$$

$$\frac{n+1}{n} = \frac{78}{52}$$

$$52n + 52 = 78n$$

$$26n = 52$$

$$n = 2$$

**48. (a)**

$$\lambda_1 = 6500A^\circ$$
$$\gamma_1 = \frac{4\lambda_1 D}{d}$$
$$\lambda_2 = 5200A^\circ$$

$$\gamma_2 = \frac{4\lambda_2 D}{d}$$
$$\gamma_1 - \gamma_2 = \frac{4D}{d}(\lambda_1 - \lambda_2)$$
$$= \frac{4 \times 1.2}{2 \times 16^{-3}}(6500 - 5200)$$
$$= \frac{4 \times 1.2 \times 1300 \times 10^{-10}}{2 \times 10^{-3}}$$

After solving

$$= 0.312 \text{ mm}$$

**49. (b)** By Einstein's photoelectric equation

K.E. of photoelectron is

$$1/2mv^2 = h\nu$$

K.E. of emitted photoelectrons depends on frequency of incident radiations.

**50. (b)** De-Broglie wavelength

$$\lambda = \frac{h}{mv} \; [\because P = mv]$$

De-Broglie wavelength of a proton: -

$$\text{Mass} = m_1$$
$$\lambda_1 = \frac{h}{\sqrt{2m_1 k}} \; [\therefore P = \sqrt{2mk}]$$
$$[k = qv]$$
$$\lambda_1 = \frac{h}{\sqrt{2m_1 kv}} \qquad (1)$$

For an α-particle

$$\text{Mass} = m_2$$
$$\text{Charge} = q_0$$

$$\lambda_2 = \frac{h}{\sqrt{2m_2 q_0 v}}$$

For α - particle

$${}^4_2He \Rightarrow q_0 = 2q$$
$$M_2 = 4\ m_1$$

$$\lambda_2 = \frac{h}{\sqrt{2\times 4m_1 \times 2q \times V}} \quad \ldots\ldots(2)$$

Eq$^n$(i)&(ii)

$$\frac{\lambda_1}{\lambda_2} = \frac{h}{\sqrt{2m_1 qv}} = \frac{\sqrt{2 \times m_1 \times 4 \times 2qv}}{h}$$

After solving,

$$\frac{\lambda_1}{\lambda_2} = 2\sqrt{2}$$

**51. (c)** Energy: -

$$E_n = \frac{-13.62}{n^2}$$

For hydrogen atom

$$Z = 1; n = 2$$
$$E_n = \frac{-13.6 \times 1^2}{2^2}$$
$$= \frac{-13.6}{4}$$
$$= -3.4eV$$

**52. (d)** Time period (T) $= \frac{2\pi r}{v}$

$$= r \times \frac{n^2}{Z}$$

So,

$$T \times \frac{n^3}{z^2}$$

First excited state, $n = 2$

$$\frac{T_2}{T_1} = \left(\frac{n_2}{n_1}\right)^3 = \left(\frac{2}{1}\right)^3$$
$$T_2 = 8\ T$$

**53. (b)** $M = 1\ g \Rightarrow 10^{-3}$ kg

Using Einstein's equation: -

$E = mc^2$

$= 10^{-3} \times (3 \times 10^8)^2$

$= 10^{-3} \times 9 \times 10^{16}$

$E = 9 \times 10^{13}$

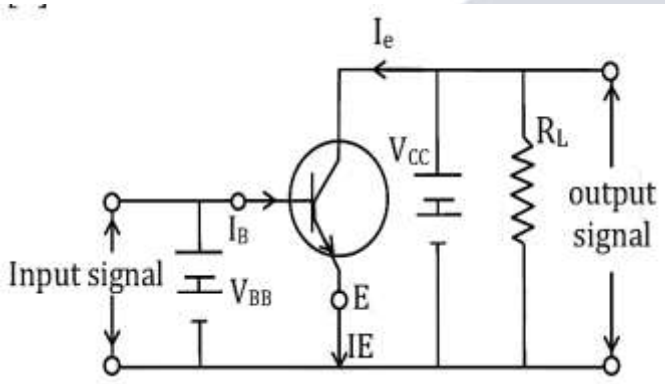
**54. (d)** Un-decayed

$$\frac{N}{N_0} = \frac{1}{2x}$$

$$X = \frac{50}{12.5} = 4$$

$$N = \frac{N_0}{16} = \frac{64}{16} = 4mg$$

**55. (a)**




The input ac signal to be amplified is applied across forward biased emitter - base junction.

**56. (a)**

$A = 1, \ B = 0$
$\bar{A} + B = \bar{1} + 0 = 0 + 0 = 0$
$\bar{A} + B = B$

**57. (b)**

$n_1 = 3 \times 10^{16} \ m^{-3}$
$n_n = 4.5 \times 10^{22} \ m^{-3}$
$n_1^2 = n_n n_e$
$n_e = \frac{n_1^2}{n_n}$
$= \frac{(3 \times 10^{16})^2}{4.5 \times 10^{22}}$
$n_e = \frac{9 \times 10^{32}}{4.5 \times 10^{22}}$

$n_e = 2 \times 10^{10}$

**58. (b)**

$$I_C = \frac{V_{CE}}{R_C}$$

Given; -

$V_{CE} = 2\ V$
$R_C = 4\ K$

Substituting values

$$I_C = \frac{2}{4 \times 10^3} = 0.5 \times 10^{-3}\ A$$

$IC = 0.5\ mA$
$\beta = \frac{I_C}{I_B} \Rightarrow I_B = \frac{I_C}{\beta}$
$= \frac{0.5 \times 10^{-3}}{50} = 10^{-5}\ A$
$I_B = 10\mu A$

**59. (c)**

Range $= \sqrt{2Rh}$
$= \sqrt{2 \times 6400 \times 10^3 \times 500}$
$= 80 \times 10^3$
$= 80\ cm$

**60. (c)**

$$\frac{-GMm}{(R+R)} + \frac{1}{2}mv^2 = 0$$
$$\frac{1}{2}mv^2 = \frac{-GMm}{2R}$$
$$V' = \sqrt{\frac{GM}{R}} \Rightarrow \sqrt{gR}$$
$$V_E = \sqrt{2gR}$$
$$\frac{V^E}{V'} = \sqrt{\frac{2gR}{gR}}$$
$$V' = V_E \times \frac{1}{\sqrt{2}}$$

## Chemistry

**61. (b)** Given : Amount of Mg $= 1.0$ g

Amount of $O_2 = 0.25$ g

Balanced chemical reaction

$2Mg + O_2 \longrightarrow 2MgO$

Moles of Mg $= \frac{\text{given mass}}{\text{atomicmass}} = \frac{1\ g}{24\ g/mol}$ { atomic weight of mg $= 24$ ; atomic weightg $O = 16$

$= 0.0416$ moles

Moles of $O_2 = \frac{0.28\ g}{32\ g/mol} = 0.00875$ moles

In this chemical reaction, $O_2$ acts as limiting reagent.

1 mole $O_2$ react with 2 mole Mg

0.0875 Mole $O_2$ react with $= 2 \times 0.00875$ moles of mg $= 0.0175$ moleMg

Number of moles of Mg left after reaction with oxygen

$= 0.0416 - 0.0175$
$= 0.0241$moles

Weight of Mg left in excess = moles × atomic weight

$= 0.0241 \times 24$

$= 0.578 \approx 0.58\ g$

**62. (c)** Penetration power of the electron describes how much it is closer to the nucleus.

Penetration power of an electron follows:

$1\ S > 2\ S > 2P > 3\ S > 3P > 4\ S > 3\ d > 4P > 5\ S > 4\ d > 5P > 6\ S$

Sub shell penetration power follows:

$S > P > D > F$

So, 4 S orbital is closer to the nucleus among the other 4f, 5 d, 7p orbital.

**63. (a)** Correct order of radius:

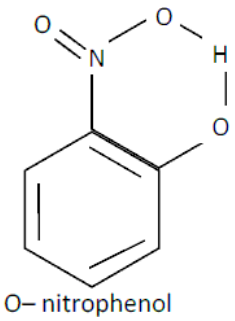
$H^- > H > H^+$

Size of an atom is directly proportional to atomic radius if size increases, atomic radius also increases.

Addition of an extra electron in an atom increases the size of the atom as compare to neutral atom and removal of an electron (cation) makes the atom size shorter than the parent atom

**64. (b)** Intramolecular hydrogen bonding:

When H - atom of one molecule form bond with an atom of the electronegative element. Intramolecular H-bonding presents in O - nitrophenol.




O– nitrophenol

Intramolecular hydrogen -bonding

**65. (c)** According to VSEPR theory, we can use the steric number to determine the hybridization of an atom.

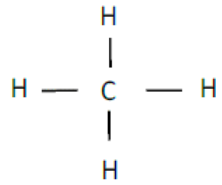
SN = number of lone pairs + number of atom directly attached to the central atom.

For $CO_2$: $\ddot{O} = C = \ddot{O}$ :

$SN = 0 + 2 = 2 = S\,P$ hybridization

That means one S and one P hybrid orbital participate in hybridization.

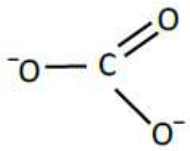
For $CH_4$:



$SN = 0 + 4 = SP^3$ hybridization

Here, one S and three P hybrid orbitals participate in hybridization.

For $CO_3^{2-}$ :



$SN = 0 + 3 = SP^2$ hybridization

In $CO_3^{\,2-}$ ions

That means one S and two P hybrid orbitals participate in hybridization.

**66. (b)** Compressibility factors of an ideal gas to describe the deviation of a real gas behavior from ideal gas, compressibility factor represented by Z.

$$Z = \frac{PV}{nRT}$$

For ideal gas, value of Z is always unity $= 1$

**67. (d)** For the reaction:

$NH_4Cl_g \square\ NH_{3(g)} + HCl_{(8)}$

$\Delta n_g$ = Number of moles of gaseous product - Number of moles of reactant

$\Delta ng_g = 2 - 0$

$\Delta n_g = 2$

**68. (c)** Lewis concept: According to Lewis acid base theory bases are lone pair donor and acids are lone pair acceptor.

$BF_3$ molecule is electro deficient.

Electronic configuration of boron $= 1\,S^2, 2\,S^2, 2P^1$

Exited state electronic configuration of boron $= 1\,S^2, 2\,S^2, 2P_x^1, 2P_y^1, P_z$

After bond formation with the fluorine atom, boron having one vacant P -orbitals which makes the molecule electron deficient. $BF_3$ very energetically react with water and ammonia that has available lone pair.

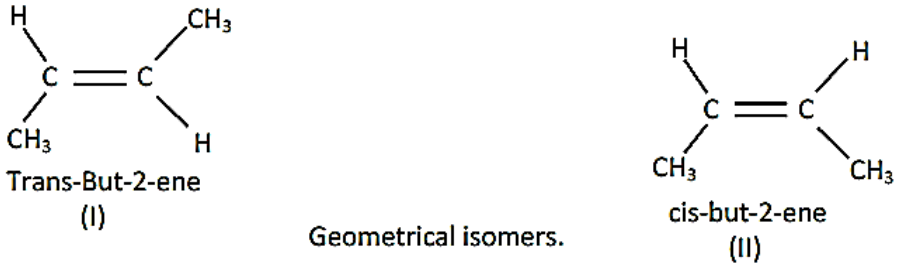
**69. (b)**

**70. (c)** $H_2O_2$ is act as both oxidizing and reducing agent oxygen of $H_2O_2$ ( -1 oxidation state) is reduced to $H_2O$ ( -2 oxidation state) act as oxidizing agent. When oxygen of $H_2O_2$ ( -1 oxidation state) is oxidized to (0) oxidation state act as reducing agent.

**71. (a)** Plaster of Paris ( $CaSO_4.1/2H_2O$ ) is heated above 393 K , its half water molecule last to crystallization and anhydrous calcium sulphate is left which is called as dead burnt plaster ($CaSO_4$).

**72. (a)** Geometrical isomerism (cis-trans isomerism): -

This isomerism occurs where restricted rotation is found in a molecule. Usually involve the carbon -carbon double bond containing compound.



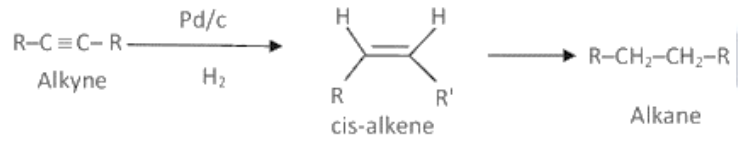

In one case, the $CH_3$ groups are on opposite sides of the double bond and in the other case they are on the same side.

**73. (c)** When organic compound reacts with sodium (Na) metal, its nitrogen converted in sodium cyanide.

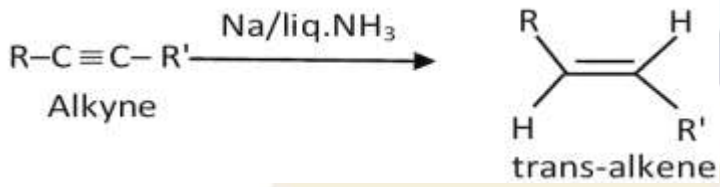
Chemical reaction:

$$\underset{\text{Carbon}}{C} + \underset{\text{Nitrogen}}{N} + \underset{\text{Sodium}}{Na} \rightarrow \underset{\text{Sodium yananide}}{NaCN}$$

**74. (b)** Hydrogenation of an alkyne with $Pd/C$ gives cis alkane.




⇒ Reduction of alkynes using sodium metal and liquid ammonia $NH_3$ gives trans alkane




⇒ Lithium aluminiumhydride ($LiAlH_4$) does not reduce alkynes, reduce only if an alcohol group is nearby.

**75. (a)** Hardness in water:

Calcium and magnesium carbonates or bicarbonates dissolved in the water are the two most common mineral that make water "hard". Water which does not give lather with soap is hard water.

**76. (d)** Transition metal oxides show electrical properties like metals. $CrO_2$ (chromium oxides) is a good conductor of electricity. It is ferromagnetic at room temperature. The Curie temperature is $118°C$ and the material readily is demagnetized with little energy input. The electrical conductivity of this black compound is quite high.

**77. (b)** Colligative properties of solutions are properties that depend upon the concentration of solute molecules or ions but not the identity of the solute.

Concentrations of all the solutions are same given one. So, colligative property (elevation in boiling point) depends only on number of ions or molecules. Boiling point increases as number of ions increases in the aqueous solutions.

1 M NaOH give number of ions $= 2$

$1\text{M}Na_2SO_4$ give number of ions $= 3$

$1\text{M}NHNO_4$ give number of ions $= 2$

$1\text{M}KNO_3$ give number of ions $= 2$

So, $1\text{M}Na_2SO_4$ have maximum boiling point among the all.

**78. (b)**

$$\text{For: } \overset{+7}{MnO_4^-} \xrightarrow[\text{reduced}]{[H]} \overset{+4}{MnO_2}$$

Change is oxidation state $= 7 - 4 = +3$

The amount of electric charge carried by one mole of electrons ( $6.02 \times 10^{23}$ electrons) is called the Faraday (F) and is equal to 96,500 coulombs.

1 mole e-required1F electric charge

3 mole $e^-$required 3 F electric charge

To reduce $MnO_4^-$into $MnO_2$ we require 3 mole of electron charge.

**79. (b)** For the reaction

$2SO_2 + O_2 \rightleftharpoons 2SO_3$

Rate of reaction

$$-\frac{1}{2}\frac{d[SO_2]}{dt} = \frac{-d[O_2]}{dt} = \frac{1}{2}\frac{d[SO_3]}{dt}$$

Rate of disappearance of $O_2 = 2 \times 10^{-4}$ mol $L^{-1}$ $S^{-1}$

Then,

$$\frac{-d[O_2]}{dt} = \frac{1}{2}\frac{d[SO_3]}{dt}$$

$$2 \times 10^{-4} = \frac{1}{2}\frac{d[SO_3]}{dt}$$

$$\frac{d[SO_3]}{dt} = 4 \times 10^{-4} \text{ mol } L^{-1}sec^{-1}$$

Rate of appearance of $SO_3 = 4 \times 10^{-4}$ mol $L^{-1}sec^{-1}$

**80. (d)** Different electrolytes have different coagulation values. Smaller the coagulation value of the electrolyte larger is its coagulating or precipitating power.

$$\text{Coagulating power} \propto \frac{1}{\text{Coagulation value or flocculation value}}$$

According to Hardy-schulze law, greater the charge on anion greater the coagulating power

| Electrolyte | Anion | Charge |
|---|---|---|
| $Na_2$ S | $S^{2-}$ | 2 |
| $Na_3PO_4$ | $PO_4{}^{3-}$ | 3 |
| $Na_2SO_4$ | $SO_4{}^{2-}$ | 2 |
| NaCl | $Cl^-$ | 1 |

So, NaCl has lowest anionic charge and maximum coagulating power.

**81. (a)** Electrolytic refining:

It is a process of refining a metal (mainly copper and Zinc) by the process of electrolysis.

During electrolysis impure metal is used as anode with a thin strip of pure metal at the cathode. In this setup, an electrolyte (metal salt aqueous solution) depending on the metal is after use(d)

The pure metal is obtained at the cathode when the electric current of a sufficient voltage is applied by dissolving metal to the anode. It is about 99.95% pure which makes it good product.

**82. (c)** Dry ice: Dry ice is common name for solid carbon dioxide ($CO_2$). It gets this name because it does not melt into a liquid when heated; Instead, it changes directly into a gas (a process known as sublimation).

**83. (a)** Amphoteric oxides can react with both acids and bases to form salt and water as the main products.

Element that form amphoteric oxides have some metals and some of the non-metal's characteristics.

Amphoterism based on oxide's oxidation state.

Both $Cr_2O_3$ and $V_2O_5$ are amphoteric in nature because of their high oxidation state.

$V_2O_5$ reacts with alkalies as well as acids to give $VO_4^{3-}$ and $VO_4^{+}$respectively.

$Cr_2O_3$ (chromium (III) oxide) insoluble in water but dissolves in acid to produce hydrated chromium ions, $[Cr(H_2O)_6]^{+3}$ which react with base to give slat of $[Cr(OH)_6]^{3-}$

It dissolved in concentrated alkali to yield cromite ions $[CrO_2]^-$.

**84. (a)** First write the name of cationic part and then anionic part. After that ligands name in alphabetical order and then name of metal atom.

For ambidentate ligand here we use -N - before the name of metal ion, because of the nitrogen of $-NO_2$ ligand is directly attached to the cobalt metal.

After the name of metal ion with its oxidation state in roman number and then anionic ligand name

$[CO(NH_3)_4Cl(NO_2)]Cl$

$x + (0)4 + (-1) + (-1) = +1$

$x = +3$

IUPAC name of this complete is tetraamminechloridonitrito -N-cobalt (III) chloride.

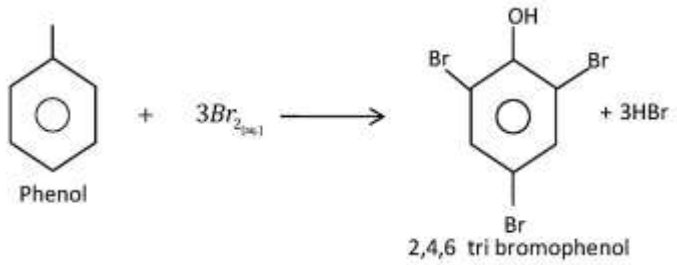
**85. (a)** Polarity results from the uneven partial charge distribution between various atoms in a compound More the electro negativity difference between two atoms more will be the polarity of that compound In alkyl halide, the carbon-hydrogen bond is polar because all the halogen is more electronegative than carbon. Due to high

electronegativity of halogens they pull electrons of carbon towards them so, on carbon a small positive charge ( $\delta +$ ) and on halogen partial negative charge ( $\delta -$ ) developed

As the Alkyl halides have polar bond they are not soluble in water not form H -bond also.

**86. (a)** Bromine water test (Saturation test):-

The bromine water test used to identify the alkene or alkane functional groups. phenols undergo substitution reaction in the presence of bromine water to give a brominated product. During the process, bromine water is decolorized and gives white precipitate.



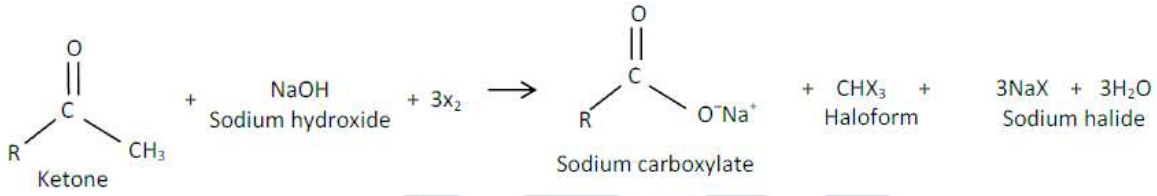

Ethanol ($C_2H_5OH$) is a saturated compound; it does not react with a bromine water solution.

**87. (a)** Haloform reaction:

Haloform reaction is a chemical reaction where haloform (R-X) are produced by the complete halogenations of acetone ($CH_3 - CO - CH_3$). Acetophenone ($PHCOCH_3$), or acetaldehyde ($HCOCH_3$) in the presence of a base.

The aldehyde or ketone must have a methyl group ( α-hydrogen) next to the carbonyl.

Haloform reaction:

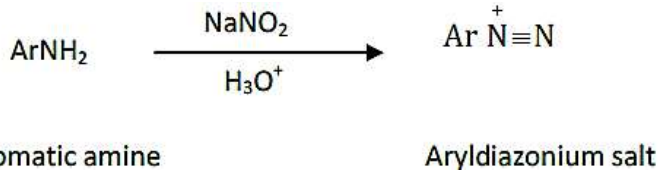



**88. (b)**

$R - \overset{+}{N} \equiv N$

Diazonium salts are usually prepared by the reaction (diazotization) of primary amines with nitrous acid; their most striking property is their stability.

The aliphatic diazonium salts exist only as transient intermediates quickly decomposes into a nitrogen molecular and a carbonium ion; Aromatic diazonium salts are stable enough to be isolated but react readily either by loss of nitrogen or by formation of azo compounds



$C_6H_5\ N_2^+X^-$is more stable in comparison to $C_6H_5\ N_2^+X^-$because of resonance stabilized due to direct bond with nitrogen.

**89. (d)** DNA is made up of nucleotides. A nucleotide has two compounds: a backbone, made from the sugar deoxyribose, phosphate groups, and nitrogenous bases, known as cytosine, thymine, adenine, and guanine.

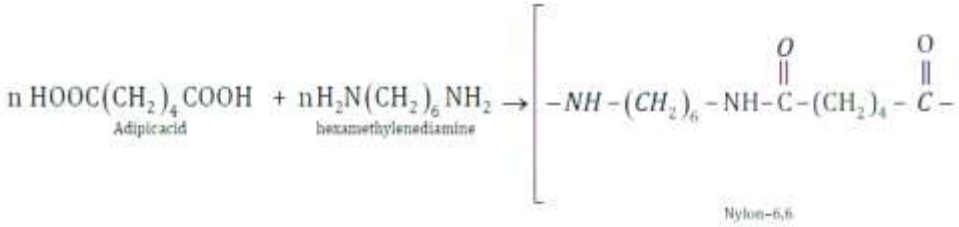
Adenine and Uracil are the main basic building block of RNA

**90. (b)** Polyamide polymers are the poly condensation product of a diacid chloride and a diamine.

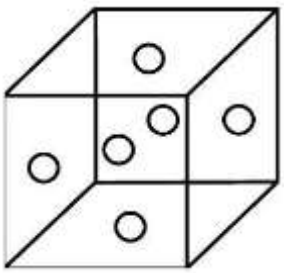
Nylon-6, 6 is a member of polyamide group.

The structural unit of polyamide is joined together by an amide

$\left[ NH-\underset{\underset{O}{\|}}{C}- \right]$ groups.




**91. (c)** In FCC arrangement, there are eight atoms at corners of the unit cell, and one atom centered and six in each of the faces. The atoms in the face are shared with the adjacent unit cell. So, in FCC unit cell is shared equally six-unit cell.



Atoms present on the six faces of the face centered unit cell.

**92. (a)** Given

Concentration $= 0.01$ m

$\wedge m = k/c$
$k =$ specific conductance
$\wedge m =$ molar conductance
$\wedge_m = \frac{K \times 100}{m}$
$C =$ concentration (mol/L)

Ratio of $\frac{\text{molarcondutance}}{\text{specific conductance}} = \frac{\wedge_m}{k} = \frac{1000}{m} = \frac{1000}{0.01}$

$\frac{\Lambda_m}{k} = 10^{+5}\ cm^3\ mol^{-1}$

**93. (c)** Isotonic solution

Two solutions having the same osmotic pressure across a semipermeable membrane is referred to as an isotonic solution It has the same osmolarity (solute concentration) as another solution.

**94. (d)** Given that

Temperature coefficient $= 2$

$T_1 = 30°C$
$T_2 = 90°C$

Rate of the reaction $(R) = (\text{ Temperaturecoefficient })^{\frac{\Delta T}{10}}$

$= (2)^{\frac{90-30}{10}}$

$= (2)^6$

$R = 64$

So, the rate of reaction is increased by 64 times.

**95. (c)** Gold sol is example of multi molecular colloid In multi molecular colloid many particles (atoms or small molecules) of the dispersed phase aggregate together to form species having the size of a colloidal particle (1-1000 nm).

**96. (c)** Major impurities in bauxite are iron oxides [hematite ($Fe_2O_3$) & goethite] , silicon dioxide, the clay mineral kaolinite as well as small amount of anatase ($TiO_2$)

**97. (d)** Thermal decomposition of ammonium dichromate:

$$\underset{\text{ammonium dichromate}}{(NH_4)_2Cr_2O_7} \xrightarrow{\Delta} \underset{\text{Nitrogen gas}}{N_2} + 4H_2O + \underset{\text{Chromium(III) oxides}}{Cr_2O_3}$$

Treatment of aqueous solution of $NH_4Cl$ and $NaNO_2$

$$NH_4Cl + NaNO_2 \rightarrow NaCl + N_2\uparrow + 2H_2O$$

Thermal decomposition of sodium azide:

$$2NaN_3 \xrightarrow{\Delta} 3N_2\uparrow + 2Na_{(s)}$$

From the above decomposition of sodium azide gives maximum and very pure $N_2$ gas.

**98. (b)** The lanthanides consist of the elements in the f-block of period six, in the periodic table. Lanthanide's most common and stable oxidation state is +3 . It is obtain by removing three outer most electrons from 6 S orbital and one electron from 4 f orbital. Removal of one more electron from 4 f sub-shell is difficult because of high energy difference.

**99. (b)** The electronic configuration of X after removal of three electrons is $X^{+3}$ : $[Ar]3d^5$.

So, before removal of electrons. This compound contain $X = 18 + 5 + 3 = 26e^-$.

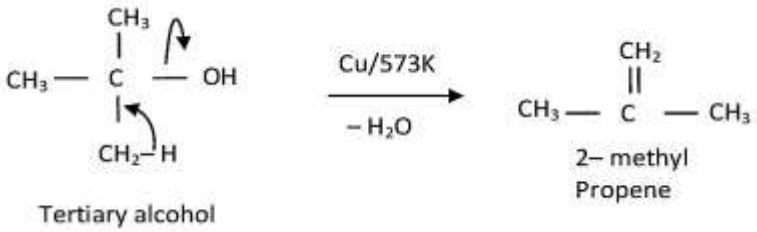
Atomic number of X is 26.

**100.** **(a)**

$$n=\underset{\text{n-propylchloride}}{(H_3C-H_2C-H_2C-H_2C-Cl)} \xrightarrow[\text{dry ether}]{Na} \underset{\text{n-hexane}}{CH_3-CH_2-CH_2-CH_3}$$

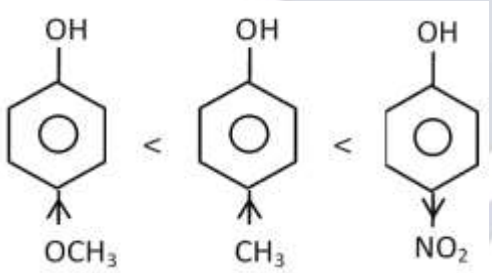
n-propyl chloride reacts with sodium metal in presence of dry ether to give n-hexane, this reaction is known as wurtz reaction.

**101.** **(c)** When the tertiary butyl alcohol vapors pass through heated copper, 2-methyl propene is formed with removal of one water molecule.



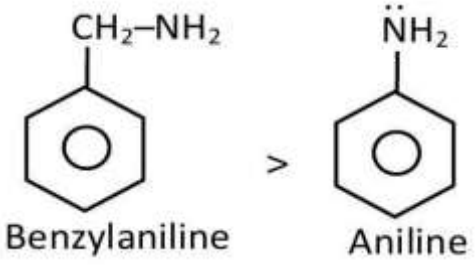

According to saytzeff rule more substituted alkene will be more stable.

**102.** **(c)**




P-nitro phenol is more acidic due to -I effect of -nitro group which make the benzene ring $e^-$deficient, so the $H^+$ion removed easily. On the other hand p-methoxyphenol is less acidic due to high mesomeric effect of the $-OCH_3$ groups in comparison to the weak hyper conjugation effect of the $-CH_3$ group.

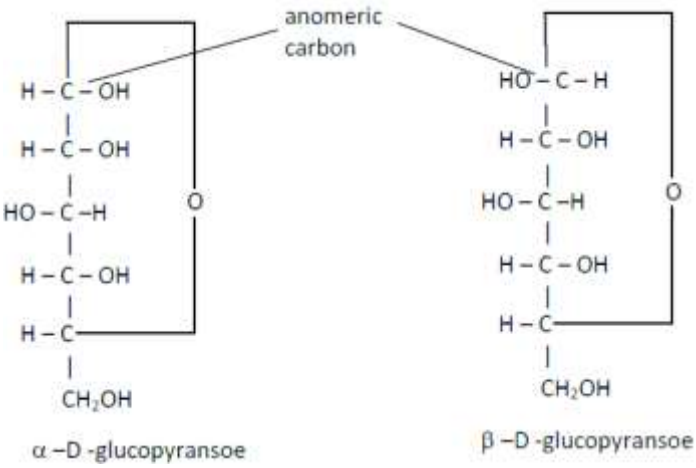
**103.** **(d)** Benzyl aniline is more basic than aniline




Basic character of a compound depends on availability of lone pair of electrons.

In aniline, lone pair of nitrogen atom delocalized to take part in resonance and not available to donate but in case of benzyl aniline nitrogen attached to the methyl group not to the benzene ring and do not take part in resonance so, available to donate.

**104.** **(d)** D -glucopyranose: Anomers




**105.** **(c)** Branched chain polymers are those polymers in which the monomers are joined to form long chain with side chains or branches of different lengths.

These branched chain polymers are irregularly packed and therefore, they have low density, low boiling point and low melting point.

So, the branched chain polymer is low density polymer.

**106.** **(c)** Given

Edge length of a cube (a) $= 300\text{pm}$.

Body $= \sqrt{3} \cdot \text{a}$.

Diagonal $= \sqrt{3} \times 300$

$= 1.732 \times 300$
$= 519.6\text{pm}$

Body diagonal would be 519.6 pm.

**107.** **(a)** To conduct electricity compound must have free electrons or ions. In solid state NaCl compound has fixed composition of ions. So these ions do not move from its place to conduct electricity. But in molten state (moist) ions are free to move to conduct electricity. So, in molten state they are good conductor of electricity.

**108.** **(d)** Nernt's equation

For a cell reaction:

$$E^{\circ}_{Cell} = \frac{2.303RT}{nF}\log k$$

F (faraday) $= 96500$
R = gas constant ($8.314\ \text{J mol}^{-1}\text{k}^{-1}$)
T = Temperature (k)
n = charge

$$E^{\circ}_{Cell} = \frac{2.303 \times 8.314 \times 298}{2 \times 96500}\log k$$

$$E^{\circ}_{Cell} = \frac{0.059}{2}\log k$$

given

$E^{\circ}_{Cell} = 0.3\ \text{V}$

$0.3 = 0.0295\log k$ or

$0.3 = 0.03\log k$

$k =$ antilog 10

$k = 10^{10}$

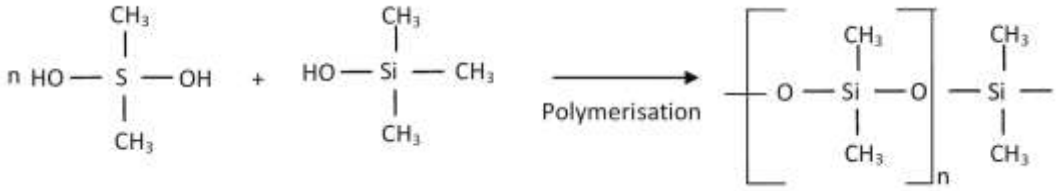
Equilibrium constant of the reaction is $10^{10}$

**109.** **(c)** A pseudo final order reaction can be defined as a second order reaction that is made to behave like a first order reaction.

This reaction occurs when one reacting material is present in great excess.

In pseudo first order reaction rate is depends on the concentration of reaction present in excess.

**110.** **(a)**




During polymerization of organosilicons $(CH_3)_3SiCl$ block the end terminal to control the chain length of organo silicon polymers

**111.** **(b)** $PbO_2 + \text{Con(c) } HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O + O_2$

When lead oxide reacts with concentrated nitric acids, removal of $O_2$ occurs due to the reduction of $PbO_2$.

**112.** **(c)** In alkaline medium $KMnO_4$ act as oxidizing agent. When alkaline $KMnO_4$ is treated with

KI, Iodide ion oxidized to iodate ion

$$2MnO_4^- + \underset{\text{(iodideion)}}{I^-} + H_2O \rightarrow 2MnO_4 + 2\bar{O}H + \underset{\text{(iodate ion)}}{IO_3^-}$$

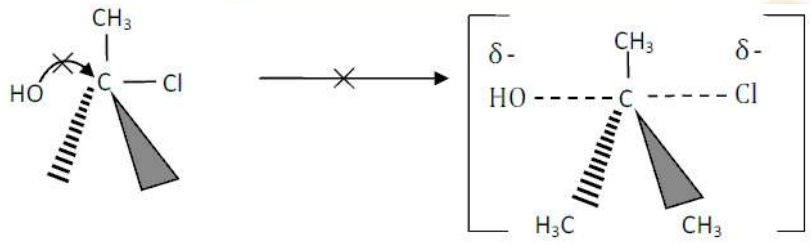
**113.** **(a)** Linkage isomerism:

When two complexes differing only in the mode of attachment of an ambidentate ligand to the metal atom.

$[Fe(NO_2)_3Cl_3]$ and $[Fe(O-NPO)_3Cl_3$ are pair of linkage isomers, in which ligand is joined to iron atom through nitrogen or oxygen, with the formulas $NO_2^-$(nitro) and ( $ONO^-$) (nitrito), respectively.

**114.** **(d)** Tertiary alkyl halides do not react by an $SN^2$ mechanism because the substance blocks the approach of the nucleophile.

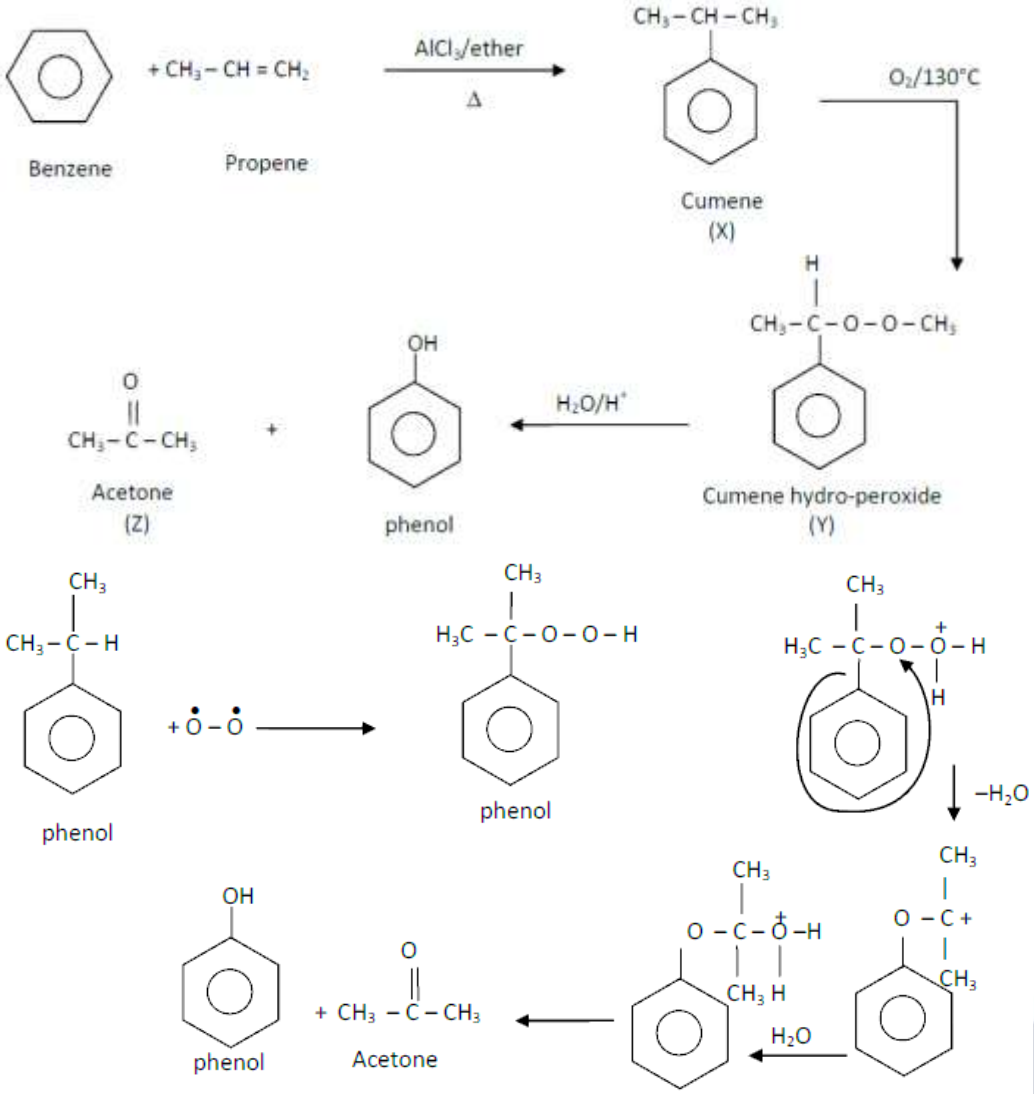
The trigonal bipyramidal transition state cannot form because it is too statically crowded



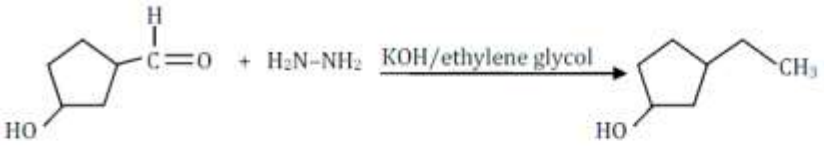

A tertiary alkyl halide

Sterically hindered trigonal
Bipyromidal transition State
an $SN^2$ reaction does not occur

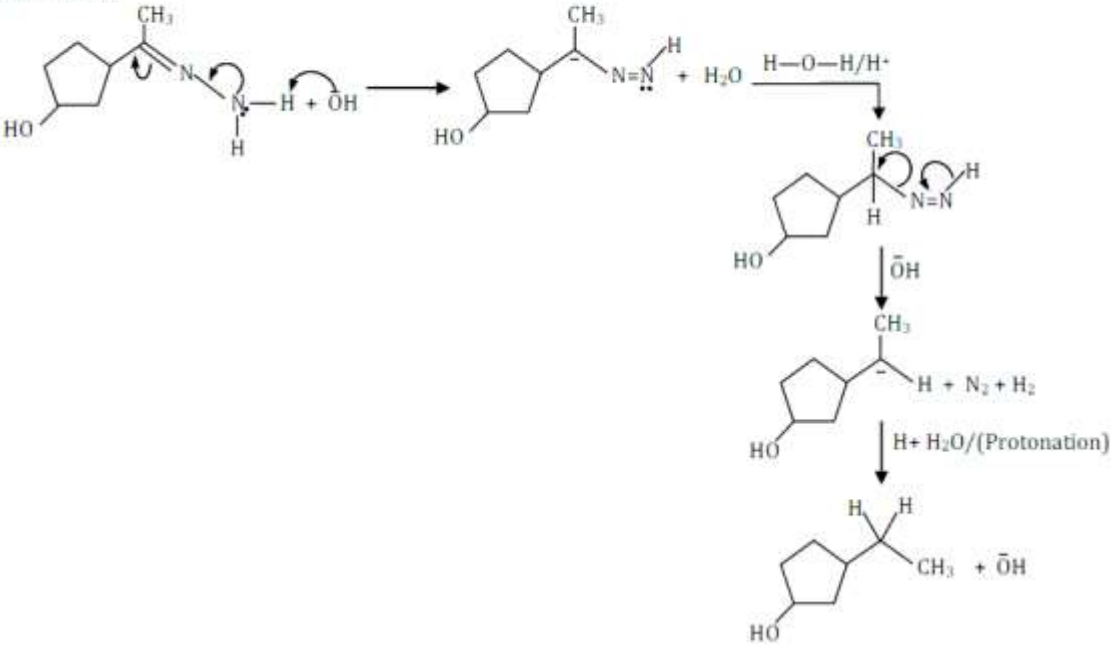
**115.** **(a)**



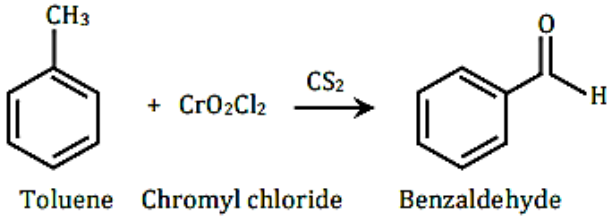

**116.** **(b)** Ketones can be converted to a hydrazine derivative by reaction with hydrazine. These "Hydrazones" can be further converted to the corresponding alkane by reaction with base and heat.



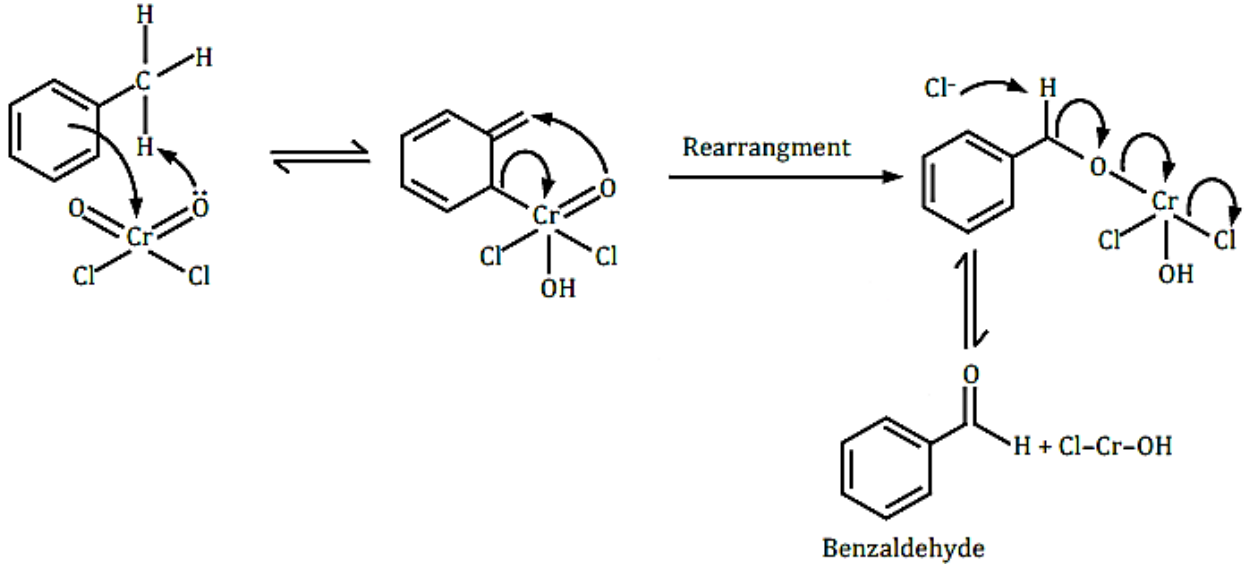

**Mechanism:**



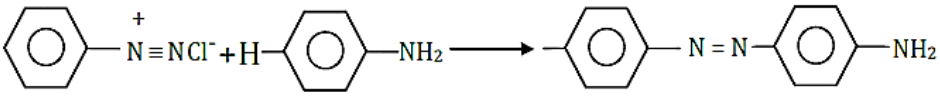

**117.** **(b)** Toluene can be oxidized to Benzaldely using Etard reaction. The reaction begins with toluene with chromyl chloride, forming an Etard complex. Reducing condition provided by saturated aqueous Sodium sulphide prevents further oxidation of the Etard Complex into a carboxylic acid




Mechanism:

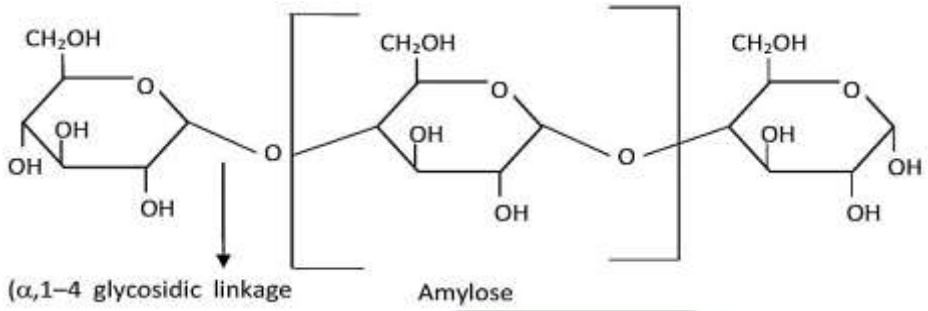


**118.** **(b)** Some liquid phenyl amine (aniline) is added to a cold solution of benzene diazonium chloride, and the mixture is shaken vigorously. A yellow solid is produced




Benzene diazonium Chloride — Anline — P– Aminoazo benzene (aniline yellow azodye)

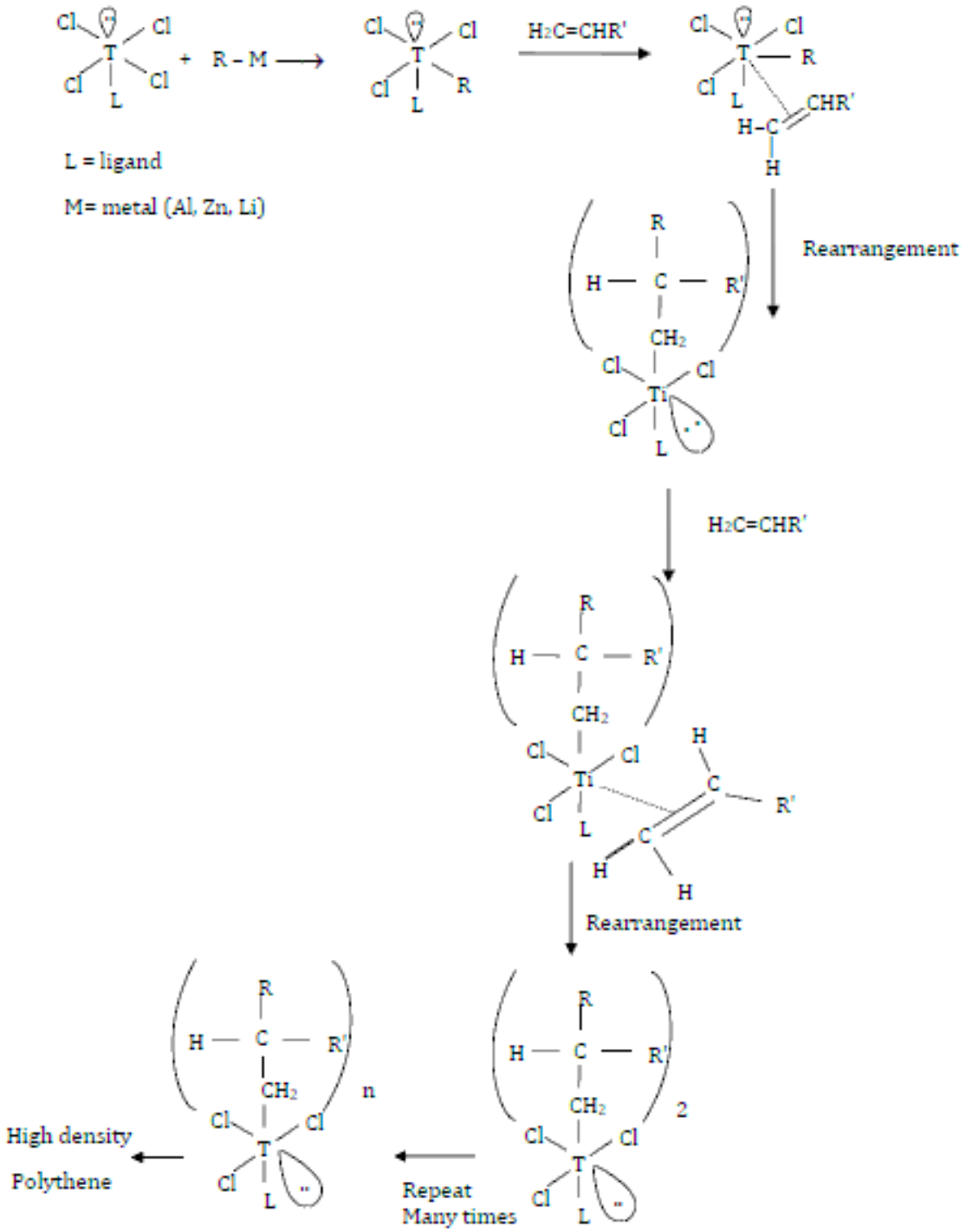
**119.** **(d)** Amylase is a polysaccharide made of $\alpha$-D-glucose bonded to each other by a (1,4) glycoside bond




(α,1–4 glycosidic linkage — Amylose

Amylase is linear polymer of glucose, arrange in three dimensional helical structures.

**120.** **(c)** Ziegler -Natta catalyst is used for the production of high -density polyethylene. One of the common example is mixture of titanium tetrachloride ( $TiCl_4$ ) and trimethyl aluminum $(Al(C_2H_5)_3)$




## Mathematics

**121. (c)**

$\Rightarrow |x + 5| \geq 10$
$\Rightarrow x + 5 \leq -10$ or $x + 5 \geq 10$
$\Rightarrow x \leq -15$ or $x \geq 5$
$\Rightarrow x \in (-\infty, -15] \cup [5, \infty)$

**122. (b)**

Let total no. of handshake $= {}^{n}C_2$

We know $\Rightarrow {}^{n}C_2 = 45$

$\Rightarrow \frac{n!}{2!\,(n-2)!} = 45$

$\Rightarrow \frac{n(n-1)}{2} = 45$

$\Rightarrow n^2 - n - 90 = 0$

$\Rightarrow n = 10, -9$ (not possible)

Total no. of persons in room is 10.

**123.** **(a)** Let $T_{r+1}$ is constant term

$\Rightarrow T_{r+1}$

$= {}^{16}C_r (x^2)^{16-r} \left(\frac{1}{x^2}\right)^r$

$= {}^{16}C_r x^{32-4r}$

For constant term $32 - 4r = 0$

$\Rightarrow 4r = 32$

$\Rightarrow r = 8$

$\Rightarrow T_{8+1} = {}^{16}C_8$

**124.** **(b)**

$P(1) = 2^{2\times1} - 1 = 4 - 1 = 3$

$P(2) = 2^{2\times2} - 1 = 16 - 1 = 15$

We can say 3 is only prime number which is divisible by 3 and 15.

So the value of $K = 3$

**125.** **(a)** Let line which is parallel to given line is -

$\Rightarrow 3x - 4y + \lambda = 0$ ……. .(1)

This line is passing through $(-2,3)$

$\Rightarrow 3(-2) - 4(3) + \lambda = 0$

$\Rightarrow \lambda = 18$ {put in equation (1)}

$\Rightarrow$ Equation of line $= 3x - 4y + 18 = 0$

**126.** **(b)** $\Rightarrow \left(\frac{1-i}{1+i}\right)^{96}$

$\Rightarrow \left[\frac{(1-i)(1-i)}{(1+i)(1-i)}\right]^{96}$

$\Rightarrow \left[\frac{-2i}{2}\right]^{96}$

$\Rightarrow [-i]^{96} = 1 + 0i = a + ib$

$\Rightarrow$ On comparing both sides

$\Rightarrow (a, b) = (1,0)$

**127.** $(\mathbf{a}, \mathbf{d})$

Distance b/w the foci of hyperbola

$\Rightarrow 2ae = 16 \{e = \sqrt{2} \text{ given }\}$
$\Rightarrow a = 4\sqrt{2}$
$\Rightarrow e^2 = 1 + \frac{b^2}{a^2}$
$\Rightarrow b^2 = a^2(e^2 - 1)$
$\Rightarrow b^2 = 32(2 - 1) = 32$
$\Rightarrow b = 4\sqrt{2}$

Equation of hyperbola is $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

$\Rightarrow \frac{x^2}{32} - \frac{y^2}{32} = 1$

$\Rightarrow x^2 - y^2 = 32$

$\Rightarrow$ Equation of conjugate hyperbola is $x^2 - y^2 = -32$

Because eccentricity of (c)H. is $\sqrt{2}$

**128.** **(d)** No two are together $= 5! \times {}^6C_3 \times 3!$ (gap method)

$= 120 \times 20 \times 6$

**129.** **(d)**

$2b = a + c$ …….. (1)

$y^2 = xz$ …… (2)

$= x^{b-a} \cdot y^{c-a} \cdot z^{a-b}$

$= x^{a-b} \cdot x^{\frac{c-a}{2}} \cdot z^{\frac{c-a}{2}} \cdot z^{a-b}$

$= x^{\frac{a-2b+c}{2}} \cdot z^{\frac{a-2b+c}{2}}$

$= x^0 . z^0 = 1$

**130.** **(d)**

LHL $\lim_{x \to 0^-} \frac{-x}{x} = -1$

RHL $\lim_{x \to 0^+} \frac{x}{x} = 1$

$\Rightarrow$ LHL $\neq$ RHL

$\Rightarrow$ limit does not exist

**131.** **(b)** $f(x) = x - \frac{1}{x}$

On differentiating

$$f'(x) = 1 + \frac{1}{x^2}$$

$$f'(-1) = 1 + \frac{1}{1} = 2$$

**132.** **(a)**

p: 72 is divisible by 2

q: 72 is divisible by 3

$\sqcup$ p: 72 is not divisible by 2

$\sqcup$ q: 72 is not divisible by 3

$\Rightarrow \sqcup (p \wedge q) = \sqcup p \vee \sqcup q$

$\Rightarrow$ 72 is not divisible by 2 or 72 is not divisible by 3

**133.** **(c)**

$P(A) = 0.5$

$P(B) = 0.3$

$P(A \cap B) = 0$

$\Rightarrow P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$= 0.5 + 0.3 - 0 = 0.8$

$\Rightarrow P(A \cup B)' = 1 - P(A \cup B)$

$= 1 - 0.8 = 0.2$

**134.** **(c)** No. of ways of getting total more than 7

$\{(6,6), (6,5), (5,6), (6,4), (4,6), (6,3), (3,6), (6,2), (2,6), (5,5), (5,4), (4,5), (5,3), (3,5), (4,4)\} = 15$

Probability of getting total more then 7 is $= \frac{15}{36} = \frac{5}{12}$

**135.** **(a)**

$P(A) = \frac{3}{5}$

$P(B) = \frac{1}{5}$

$P(A \cap B) = 0$

$\Rightarrow P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$= \frac{3}{5} + \frac{1}{5} + 0$

$= \frac{4}{5} = 0.8$

**136. (c)**

$f(x) = |x| + x$

$g(x) = |x| - x$

$f[g(x)] = f[|x| - x]$

$= ||x| - x| + |x| - x \; [\because x < 0]$
$= |-2x| + (-2x)$
$= -2x - 2x$
$= -4x$

**137. (c)** Total no. of functions from $A \to A$ is $= 6^6$

Total no. of bijective functions $= 6\,!$

No. of not bijective functions $= 6^6 - 6\,!$

**138. (a)**

$\Rightarrow f(-1) + f(2) + f(4)$
$\Rightarrow 3(-1) + (2)^2 + 2 \times 4$
$\Rightarrow -3 + 4 + 8 = 9$

**139. (b)**

$\Rightarrow \sin^{-1} x + \cos^{-1} y = \frac{2\pi}{5}$

$\Rightarrow \frac{\pi}{2} - \cos^{-1} x + \frac{\pi}{2} - \sin^{-1} y = \frac{2\pi}{5}$

$\Rightarrow \cos^{-1} x + \sin^{-1} y = \pi - \frac{2\pi}{5} = \frac{3\pi}{5}$

**140. (b)**

$\tan\left(\frac{1}{2}\cos^{-1}\frac{2}{\sqrt{5}}\right)$

Let $\theta = \frac{1}{2}\cos^{-1}\frac{2}{\sqrt{5}} \;\; \because \left[\theta \in \left(0, \frac{\pi}{2}\right)\right]$

$\Rightarrow \cos 2\theta = \frac{2}{\sqrt{5}} \Rightarrow \frac{1 - \tan^2\theta}{1 + \tan^2\theta} = \frac{2}{\sqrt{5}}$

$\Rightarrow \sqrt{5} - \sqrt{5}\tan^2\theta = 2 + 2\tan^2\theta$

$\Rightarrow \frac{\sqrt{5} - 2}{\sqrt{5} + 2} = \tan^2\theta$

$\Rightarrow \tan^2\theta = (\sqrt{5} - 2)^2$

$\Rightarrow \tan\theta = \pm(\sqrt{5}-2) \ \because \theta \in \left(0, \frac{\pi}{2}\right)$

$\therefore \tan\theta = \sqrt{5}-2$

**141. (d)**

$A = 2\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$

$A^2 = 2^2\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$

$= 2^2\begin{bmatrix} 2 & -2 \\ -2 & 2 \end{bmatrix} = 2^2 A$

$A^3 = (A)A^2$

$= 2^3\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} = 2^4 A$

Now check from option by putting $n = 2\&3$

**142. (d)**

$\begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ 4 \end{bmatrix}$

$\Rightarrow x + y = 2 \ldots\ldots (1)$

$-x + y = 4 \ldots\ldots (2)$

On solving equation (i) & (ii) We get

$x = -1$

$y = 3$

**143. (d)**

$AA' = \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}\begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$

$= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$

**144. (d)**

$C_1 \to C_1 - C_2$

$= \begin{vmatrix} 4 & (5^x - 5^{-x})^2 & 1 \\ 4 & (6^x - 6^{-x})^2 & 1 \\ 4 & (7^x - 7^{-x})^2 & 1 \end{vmatrix}$

$= 4\begin{vmatrix} 1 & (5^x - 5^{-x})^2 & 1 \\ 1 & (6^x - 6^{-x})^2 & 1 \\ 1 & (7^x - 7^{-x})^2 & 1 \end{vmatrix} = 4 \times 0 = 0$

**145. (b)**

**146. (c)**

$$2k = \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$$

$$\Rightarrow \begin{vmatrix} x_1 & y_1 & 4 \\ x_2 & y_2 & 4 \\ x_3 & y_3 & 4 \end{vmatrix} = 16 \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}^2 = 16 \times 4k^2 = 64k^2$$

**147.** **(b)** $|5\ A| = 5^3|\ A| = 125|\ A|$

**148.** **(b)**

L.H.L

$$\lim_{x\to 0^-} \frac{\sqrt{1+kx} - \sqrt{1-kx}}{x} \times \frac{\sqrt{1+kx} + \sqrt{1-kx}}{\sqrt{1+kx} + \sqrt{1-kx}}$$

$$\lim_{x\to 0^-} \frac{2kx}{x(\sqrt{1+kx} + \sqrt{1-kx})} = \frac{2k}{2} = k$$

RHL

$$\lim_{x\to 0^+} \frac{2x+1}{x-1} = -1$$

$\Rightarrow$ L.H.L = R.H.L

$\Rightarrow k = -1$

**149.** **(b)**

$$\cos y = x\cos(a+y)$$

$$\Rightarrow x = \frac{\cos y}{\cos(a+y)}$$

$$\Rightarrow 1 = \frac{[-\cos(a+y)\sin y + \cos y \sin(a+y)]\frac{dy}{dx}}{\cos^2(a+y)}$$

$$\Rightarrow \frac{dy}{dx} = \frac{\cos^2(a+y)}{\sin a}$$

**150.** **(a)**

$f(x) = |\cos x - \sin x|$

At $x = \frac{\pi}{6}$

$f(x) = \cos x - \sin x$

$f'(x) = -\sin x - \cos x$

$$f'\left(\frac{\pi}{6}\right) = \frac{-1}{2} - \frac{\sqrt{3}}{2} = \frac{-1}{2}(1+\sqrt{3})$$

**151.** **(d)**

$\Rightarrow y = \sqrt{x+y}$

$\Rightarrow y^2 - y - x = 0$

$\Rightarrow 2y\frac{dy}{dx} - \frac{dy}{dx} - 1 = 0$

$\Rightarrow \frac{dy}{dx} = \frac{1}{2y-1}$

**152. (b)**

$\Rightarrow \lim_{x\to 1} \frac{\log_e x}{x-1}\left(\frac{0}{0}\right)$

Using L-Hospital Rule

$\Rightarrow \lim_{x\to 1} \frac{\frac{1}{x}}{1} = 1$
$\Rightarrow LHL = RHL = f(1)$
$\Rightarrow 1 = k$

**153. (a)**

$\Delta x = \frac{3}{100} \times x$

$= .03x$

$\Rightarrow \Delta v = \frac{dv}{dx} \times \Delta x$

$\Delta v = 3x^2 \times .03x$

$= .09x^3$

**154. (c)** $y = \frac{1}{x^x}$

$\frac{dy}{dx} = -x^{-x}(1 + \log_e^x) = 0$

$= x = 1/e$ (point of maxima)

$y_{max} = (e)^{1/e}$

**155. (b)**

$f(x) = x^x$

$f'(x) = x^x(1 + \log x) = 0$

$\Rightarrow x = 1/e$ (stationary point)

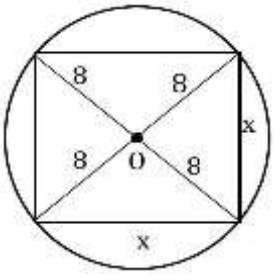
**156. (c)**

$(x+1)^2 + (y-3)^2 = 64$
$\Rightarrow x^2 + x^2 = (16)^2$
$\Rightarrow 2x^2 = 16.16$
$\Rightarrow x^2 = 8.16$
$\Rightarrow x = 8\sqrt{2}$

Given rectangle is a square

$\Rightarrow$ Area of square is $= 8\sqrt{2} \times 8\sqrt{2}$

$= 128$ sq. units




**157. (c)**

$$\Rightarrow \int \frac{1}{1+e^x}dx$$

$$\Rightarrow \int \frac{e^{-x}}{1+e^{-x}}dx$$

$\because$ Let $1+e^{-x}=t$

$-e^{-x}dx = dt$

$$\Rightarrow -\int \frac{dt}{t}$$

$$\Rightarrow -\ell nt + c$$

$$\Rightarrow +\ell n\left|\frac{1}{1+e^{-x}}\right| + c$$

$$\Rightarrow \ell n\left(\frac{e^x}{1+e^x}\right) + c$$

**158. (c)**

$$\int \frac{1}{\sqrt{3-6x-9x^2}}dx$$

$$\Rightarrow \int \frac{1}{\sqrt{4-(3x+1)^2}}$$

$$\Rightarrow \frac{1}{3}\sin^{-1}\left(\frac{3x+1}{2}\right) + c$$

**159. (a)**

$$\int e^{\sin x}\left(\frac{\sin x+1}{\sec x}\right)dx$$

Let $\sin x = t$

$\cos x dx = dt$

$$\Rightarrow \int e^t(t+1)dt$$

$$\Rightarrow te^t + c$$

$$\Rightarrow (\sin x)e^{\sin x} + c$$

**160. (a)**

**161. (b)**

$\Rightarrow \int_0^1 \frac{dx}{e^x + e^{-x}}$

$\Rightarrow \int_0^1 \frac{e^x dx}{1 + e^{2x}}$

Let $e^x = t \Rightarrow e^x dx = dt$

$\Rightarrow \int_1^e \frac{dt}{1 + t^2}$

$\Rightarrow \tan^{-1} t|_1^e$

$\Rightarrow \tan^{-1} e - \frac{\pi}{4}$

**162. (a)**

$\Rightarrow \int_0^{1/2} \frac{dx}{(1 + x^2)\sqrt{1 - x^2}}$

$\Rightarrow$ Let $x = \frac{1}{t} \Rightarrow dx = \frac{-1}{t^2} dt$

$\Rightarrow -\int_\infty^2 \frac{1/t^2 dt}{\frac{(1 + t^2)\sqrt{t^2 - 1}}{t^3}}$

$\Rightarrow \int_2^\infty \frac{tdt}{(1 + t^2)\sqrt{t^2 - 1}}$

Let $t^2 - 1 = z^2 \Rightarrow t^2 = z^2 + 1$ $2tdt = 2zdz$

$\Rightarrow \int_{\sqrt{3}}^\infty \frac{zdz}{(z^2 + 2)z}$

$\Rightarrow \int_{\sqrt{3}}^\infty \frac{dz}{2 + z^2}$

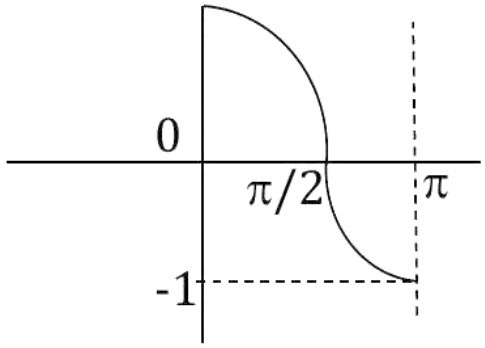
$\Rightarrow \frac{1}{\sqrt{2}} \tan^{-1}\left(\frac{z}{\sqrt{2}}\right)\Big|_{\sqrt{3}}^\infty =$

$\Rightarrow \frac{1}{\sqrt{2}}\left(\frac{\pi}{2} - \tan^{-1}\frac{\sqrt{3}}{\sqrt{2}}\right)$

$\Rightarrow \frac{1}{\sqrt{2}} \cot^{-1}\frac{\sqrt{3}}{\sqrt{2}}$

$\Rightarrow \frac{\sqrt{2}}{2} \tan^{-1}\sqrt{\frac{2}{3}} \Rightarrow \frac{1}{\sqrt{2}} \tan^{-1}\sqrt{\frac{2}{3}}$

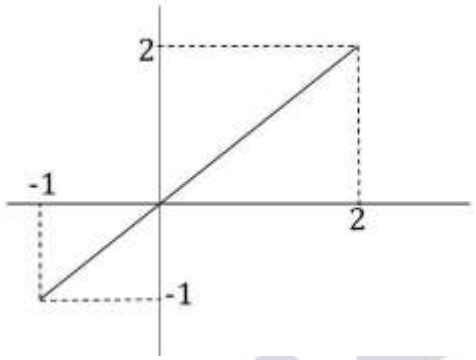
**163. (c)**




$\Rightarrow A = \int_0^{\pi/2} \cos x dx + \left| \int_{\pi/2}^{\pi} \cos x dx \right| \Rightarrow A = \sin x|_0^{\pi/2} + |\sin x|_{\pi/2}^{\pi}|$

$\Rightarrow A = 1 + |-1| = 2$ sq. units

**164. (b)**




$\Rightarrow A = \left|\frac{1}{2}(-1)(-1)\right| + \frac{1}{2} \times 2 \times 2$

$\Rightarrow A = \frac{1}{2} + 2$

$\Rightarrow A = \frac{5}{2}$

**165. (b)**

$\Rightarrow \frac{d^2y}{dx^2} = \left|1 + \left(\frac{dy}{dx}\right)^2\right|^{1/3}$

$\Rightarrow \left(\frac{d^2y}{dx^2}\right)^3 = 1 + \left(\frac{dy}{dx}\right)^2$

$\Rightarrow$ Order $= 2$

degree $= 3$

**166. (a)**

$\Rightarrow x\frac{dy}{dx} - y = 3$

$\Rightarrow \frac{dy}{dx} - \frac{y}{x} = \frac{3}{x}$ (Linear equation)

$\text{I.F} = e^{-\int \frac{1}{x}dx} = e^{-fnx} = \frac{1}{x}$

$\Rightarrow y \times \text{I. F} = \int \frac{3}{x} \times \text{I. F} dx$

$\Rightarrow \frac{y}{x} = \int \frac{3}{x^2} dx$

$\Rightarrow \frac{y}{x} = \frac{-3}{x} + c$

$\Rightarrow y = -3 + xc$ (straight line)

**167. (c)**

$\Rightarrow \frac{dy}{dx} + y = \frac{1+y}{x}$

$\Rightarrow \frac{dy}{dx} + y - \frac{y}{x} = \frac{1}{x}$

$\Rightarrow \frac{dy}{dx} + y\left(1 - \frac{1}{x}\right) = \frac{1}{x}$

$\text{I.F} = e^{\int \left(1-\frac{1}{x}\right)dx} = e^{x - \ln x} = e^x \cdot \frac{1}{x}$

**168. (c)**

$\Rightarrow |\vec{a} \times \vec{b}|^2 + |\vec{a} \cdot \vec{b}|^2 = 144$

$\Rightarrow |\vec{a}2^2|\vec{b}|^2 = 144$

$\Rightarrow |\vec{b}|^2 = \frac{144}{16} = 9$

$\Rightarrow |\vec{b}| = 3$

**169. (b)** Given -

$|\vec{a}| = 1$

$|\vec{b}| = 1$

$\vec{a}.\vec{b} = 0$

$\Rightarrow (3\vec{a} + 2\vec{b}) \cdot (5\vec{a} - 6\vec{b})$

$\Rightarrow 15 - 18(\vec{a} \cdot \vec{b}) + 10(\vec{a} \cdot \vec{b}) - 12$

$\Rightarrow 15 - 12 = 3$

**170. (b)** $\because$ Vector one coplanar

$\therefore \Delta = 0$

$\Rightarrow \begin{vmatrix} a & 1 & 1 \\ 1 & b & 1 \\ 1 & 1 & c \end{vmatrix} = 0$

$\Rightarrow a(bc-1)-(c-1)+(1-b)=0$

$\Rightarrow abc-(a+b+c)=-2$

**171. (a)**

$\Rightarrow \vec{a}\cdot\vec{b}=0$
$\Rightarrow \mu+\lambda=2 \quad \ldots\ldots(1)$
$\Rightarrow |\vec{a}|=|\vec{b}|$
$\Rightarrow \sqrt{1+\lambda^2+4}=\sqrt{\mu^2+1+1}$
$\Rightarrow \lambda^2+3=\mu^2 \quad \ldots\ldots(2)$

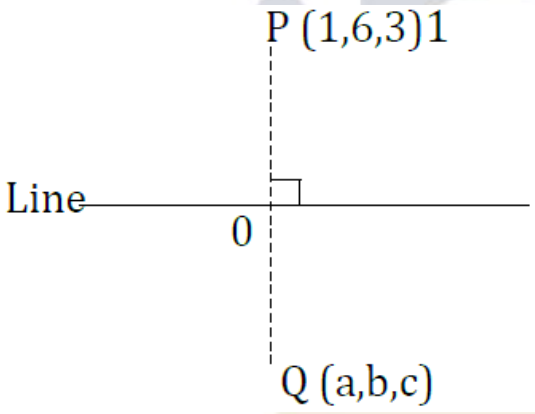
Put equation (1) in equation (2)

$\Rightarrow \lambda^2+3=(2-\lambda)^2$
$\Rightarrow 3=4-4\lambda$
$\Rightarrow \lambda=\frac{1}{4}$
$\mu=2-\frac{1}{4}=\frac{7}{4}\{\text{ usingeq(1) }\}$

**172. (a)**

$\overrightarrow{PQ}$ (d)r is $=((a-1),(b-6),(c-3))$

$\frac{x}{1}=\frac{y-1}{2}=\frac{z-2}{3}=t$




$x=t, y=2t+1, z=3t+2\ldots..(1)$

$\vec{0}\equiv\langle t,2t+1,3t+2\rangle$

$\because \overrightarrow{OP}\perp^r$ dr of line

$\Rightarrow (1-t)\cdot 1+2(6-2t-1)+3(3-3t-2)=0$

$\Rightarrow 1-t+10-4t+3-9t=0$

$\Rightarrow 14t=14\Rightarrow t=1$

$\vec{0}=\langle 1,3,5\rangle$

$\vec{Q} = \langle 2-1, 6-6, 10-3 \rangle$

$= \langle 1,0,7 \rangle$

**173. (c)**

$\frac{x}{3} = \frac{y}{2} = \frac{z}{-6}$

$\frac{x}{-4} = \frac{y}{24} = \frac{z}{6}$

$\Rightarrow \cos\theta = \frac{-12+48-36}{\sqrt{9+4+36}\sqrt{16+24^2+36}}$

$\Rightarrow \cos\theta = 0$

$\Rightarrow \theta = \frac{\pi}{2}$

**174. (d)** Point $(4,2,k)$ of line will be on plane. So point will satisfy the plane.

$\Rightarrow 2(4) - 4(2) + k = 7$

$\Rightarrow k = 7$

**175. (d)**

$\Rightarrow y(x+z) = 0$

$\Rightarrow y = 0$ or $x + z = 0$

$p_1 : y = 0 \Rightarrow \vec{n}_1 = \hat{j}$

$p_2 : x + z = 0 \Rightarrow \vec{n}_2 = \hat{i} + \hat{k}$

$\Rightarrow \vec{n}_1 \cdot \vec{n}_2 = \hat{j}(\hat{i} + \hat{k}) = 0$

$\Rightarrow \vec{n}_1 . \perp r\vec{n}_2$

$\Rightarrow$ a pair of perpendicular planes.

**176. (a)**

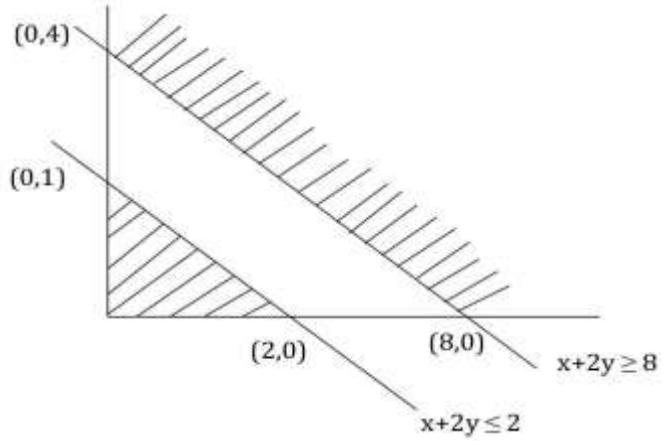
$Z = 3x + 9y$

| | |
|---|---|
| $Z(0,10)$ | $= 90$ |
| $Z(5,5)$ | $= 60$ |
| $Z(0,20)$ | $= 180$ |
| $Z(15,15)$ | $= 180$ |
| $Z\min = 60$ at | $(5,5)$ |

**177. (d)** $L_1 = x + 2y \leq 2$

$L2 = x + 2y \geq 8$

Has no feasible solution




**178. (b)**

$M(x) = \sum p_i x_i$

$= 0 \times \frac{25}{36} + 1 \times \frac{5}{18} + 2 \times \frac{1}{36} = \frac{6}{18} = \frac{1}{3}$

$M(x^2) = \sum p_i x_i^2$

$= 0^2 \times \frac{25}{36} + 1^2 \times \frac{5}{18} + 2^2 \times \frac{1}{36} = \frac{7}{18}$

Variance $(x) = M(x^2) - [M(x)]^2$

$= \frac{7}{18} - \frac{2}{18} = \frac{5}{18}$

$\sigma = \sqrt{Var(x)}$

$\sigma = \sqrt{\frac{5}{18}}$

$\sigma = \frac{1}{3}\sqrt{\frac{5}{2}}$

**179. (a)** In bag → 1,2,3, ... ... ... ... ... .....17 ← tickets

Even no → 2,4,6,8,10,14,16 ← 8 even numbers

Probability at getting even no. at first time $= \frac{8}{17}$

Probability of getting even no. at second time $= \frac{7}{16}$

⇒ Probability that both the ticket may show

Even numbers $= \frac{8}{17} \times \frac{7}{16} = \frac{7}{34}$

**180. (a)** Total batteries $= 10$

Dead batteries $= 4$

Probability of battery to be dead $= \frac{4}{10}$

Probability that all 3 batteries are dead

$$= \frac{4}{10} \times \frac{{}^{3}C_1}{{}^{9}C_1} \times \frac{{}^{2}C_1}{{}^{8}C_1}$$

$$= \frac{4}{10} \times \frac{3}{9} \times \frac{2}{8} = \frac{1}{30}$$

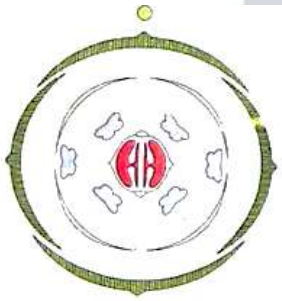
## Biology

**181.** **(b)** Taxonomic hierarchy is the process of arranging various organisms into successive levels of the biological classification either in a decreasing or an increasing order from kingdom to species and vice versa." Each of this level of the hierarchy is called the taxonomic category or rank. There are seven main taxonomic ranks: kingdom, phylum or division, class, order, family, genus, species. In ascending order the correct sequence is species - genus - family order - class - phylum - kingdom.

**182.** **(d)**

| Column I | Column II |
|---|---|
| Apendocytes | Aves |
| Hemidactylus | Osteichthyes |
| Carcharodon | Chondrichthyes |
| Pteropus | Mammalia |

**183.** **(c)**



$\oplus ♂ K_{2+2} C_4 A_{2+4} G_{(2)}$

Brassicaceae or Cruciferae is a medium-sized and economically important family of flowering plants, commonly known as mustards, the crucifers or the cabbage family. In Brassicaceae, the flowers are actinomorphic (radial symmetry), bisexual (possess both male and female flowers), sepals 4 and they are dimerous (arranged in two whorls), petals 4 and they are arranged in a single whorl, stamens 6 and they are tetradynamous (two lateral stamens are smaller and four median stamens are larger), carpels are 2 (bicarpellary) syncarpous, ovary superior.

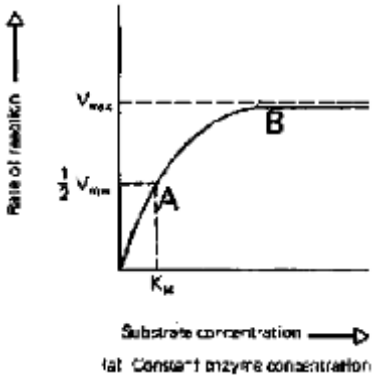
**184.** **(c)** When xylem and phloem are situated on the same radii of vascular bundles, the arrangement is called as conjoint and the vascular bundle is called as conjoint vascular bundles. Such vascular bundles are common in stem and leaves of dicots and monocots.

**185.** **(b)** Parenchyma present between xylem and phloem in the vascular bundles of roots is called conjunctive tissue. In anatomy of dicot root, parenchyma present between xylem and phloem is called conjunctive tissue. It is concerned in the formation of vascular cambium and storage of food and water

**186.** **(c)** The endoplasmic reticulum is a type of organelle in the cells of eukaryotic organisms that forms an interconnected network of flattened, membrane-enclosed sacs or tubes known as cisternae. The endoplasm is the

inner core of the cytoplasm and the membranes of the ER are continuous with the outer membrane of the nuclear envelope. There are two types of endoplasmic reticulum, rough and smooth. The outer (cytosolic) face of the rough endoplasmic reticulum is studded with ribosomes that are the sites of protein synthesis, whereas active smooth endoplasmic reticulum lacks ribosomes and functions in lipid metabolism and biosynthesis, carbohydrate metabolism, etc.

**187. (b)**




The substrate - enzyme activity is represented by Michelis Menton equation which represents Velocity of reaction on Y axis and substrate concentration on X axis, with the increase in substrate concentration, the velocity of the enzymatic reaction at first. The reaction ultimately reaches a maximum velocity (Vmax) which is not exceeded by any further rise in concentration of the substrate molecules and after saturation of these molecules, there are no free enzyme molecules to bind with the additional substrate molecules.

**188. (d)** In $C_4$ cycle, carbon dioxide fixation in mesophyll cells by PEP Carboxylase and synthesis of sugars in bundle sheath cells by RuBISCO. For example, in maize plants $CO_2$ fixation occurs in both mesophyll and bundle sheath cells.

**189. (c)** The pyruvate which is formed by glycolysis enters into mitochondrial matrix undergoes oxidative decarboxylation by a catalyst called pyruvate dehydrogenase. During this process, two molecules of NADH are produced from the metabolism of two molecules of pyruvic acid. This reaction can be shown by the following equation:

$$\text{Pyruvic acid} + \text{CoA} + \text{NAD}^+ \xrightarrow[\text{Pyruvate dehydrogenase}]{\text{M2+}} \text{Acetyl CoA} + \text{Co2} + \text{NADH} + \text{H}^+$$

Enzyme pyruvate dehydrogenase brings about decarboxylation of pyruvic acid to form two molecules of Acetyl CoA which is further utilized in the Krebs cycle. So X is a pyruvate dehydrogenase and Y Acetyl CoA.

**190. (b)** The normal temperature favors the binding of hemoglobin with oxygen. The high temperature is responsible for the dissociation of the oxygen from haemoglobin. In the alveoli, where there is high $pO_2$, low $pCO_2$, lesser $H^+$concentration and lower temperature, the factors are all favourable for the formation of oxyhaemoglobin.

**191. (d)** Gastric juice-protein digestion partially.

Saliva-carbohydrate digestion partially.

Bile juice has no enzymes.

Pancreatic juice has enzymes for digesting proteins, carbohydrates and fats. The pancreatic enzymes include amylase that digests the remaining complex carbohydrates into monosaccharides; trypsin, chymotrypsin and elastase all digest proteins; lipase digests triglycerides into fatty acids and monoglycerides. Hence, without pancreas starch protein and fat digestion cannot take place.

**192. (b)** Simple squamous epithelia are found in capillaries, alveoli, glomeruli etc. This epithelium is associated with filtration and diffusion. The type of epithelium found in the inner lining of PCT is known as the cuboidal epithelium. They consist of a monolayer of epithelial cells which appear square shaped in cross section with large, round, centrally located nuclei. Glandular epithelium forms the covering of all major glands. It is also present in

the intestinal lining. Ciliated epithelia are found in the airways, the uterus and Fallopian tubes, the efferent ducts of the testes, and the ventricular system of the brain.

**193.** **(d)** Erythroblastosis fetalis also called hemolytic disease of the newborn, type of anaemia in which the red blood cells (erythrocytes) of a fetus are destroyed in a maternal immune reaction resulting from a blood group incompatibility between the fetus and its mother. This happens during second pregnancy when the mother's immune system is already sensitized to $Rh^+$antigens present on the blood cells of the foetus during the first pregnancy i.e. incompatible blood group of mother and foetus. When mother is Rh negative while the father is Rh positive. Since the antigen producing gene is dominant, therefore expressed in the progeny and so the foetus is $Rh^+$. Since the mother is $Rh^-$the antigen present on the child's RBC can cause antibody reaction a condition called erythroblastosis fetalis.

**194.** **(b)** Algae, bryophytes, and pteridophytes have independent gametophytes. Gymnosperms and angiosperms have dependent gametophytes. In gymnosperms the male and the female gametophytes do not have an independent free-living existence and remain within the sporangia retained on the sporophytes.

For example; cedrus

**195.** **(c)** Hormones of fright, fight and flight is called adrenaline or epinephrine it is secreted by the adrenal cortex. Helps the organism to offend, defend or run away from a threatening situation.

Adrenaline is a hormone produced by the adrenal glands during high stress or exciting situations.

This powerful hormone is part of the human body's acute stress response system, also called the fight or flight response. It works by stimulating the heart rate, contracting blood vessels, and dilating air passages, all of which work to increase blood flow to the muscles and oxygen to the lungs.

Additionally, it is used as a medical treatment for some potentially life-threatening conditions including anaphylactic shock.

**196.** **(b)** Vegetative propagation is a form of asexual reproduction of a plant. Here, only one plant is involved and the offspring is the result of one parent. The new plant is genetically identical to the parent. The plant that cannot be propagated by vegetative means is sugarcane internode as buds are absent.

**197.** **(c)** In over 60% of angiosperms, pollen grains are shed at this 2 -celled stage tube cell or vegetative cell, generative cell. In the remaining species, the generative cell divides mitotically to give rise to the two male gametes before pollen grains are shed tube cell or vegetative cell two male gamete 3-celled stage. The pollen grain is protected by two layers, the outer exine and the inner intine. The exine is made of chemical substance sporopollenin, while the intine contains in parts cellulose and hemicellulose. It is continuous with the germ pore, while exine is discontinuous with the germ pore.

**198.** **(b)**

| Column I | | Column II |
|---|---|---|
| 1) | DNA replication | DNA polymerase |
| 2) | Translation | Amino acyl synthetase |
| 3) | Transcription | RNA polymerase |
| 4) | Reverse transcription | Reverse transcriptase |

**199.** **(a)** A pollen grain with pollen tube carrying male gametes represents mature male gametophyte. Generative cell divides, forming two male gametes and hence at 3 celled stages the pollen grain contains two male gametes and one vegetative cell.

**200.** **(c)**

Chasmogamous flowers are the flowers which have exposed anthers and stigma and thus, both self-pollination and cross pollination can occur. Chasmogamous flowers may also depend on external agencies for cross pollination.

Geitonogamous flowers are the flowers in which pollen are transferred from the anther to the stigma of other flower on the same plant. These flowers also need external agencies for pollination.

Cleistogamy is the phenomenon, where flowers never open and in such flowers, only self-pollination occurs within the bud (unopened flower). Bisexual flowers which do not open at all are called cleistogamous. In such flowers, anthers and stigma lie close to each other. When the anthers dehisce in the flower buds, pollen grains come in contact with the stigma and pollination occurs. Cleistogamous flowers are not dependent on external agencies for pollination. Hence, seed setting is not dependent on pollinators. Hence, assured seed set is possible even in the absence of pollinators when the flower is Cleistogamous.

Xenogamous flowers are the flowers in which pollen are transferred from the anther to the stigma of a different flower on different plant. Xenogamous flowers are cross pollinated and depend on external agencies for pollination.

**201.** **(a)** The process of Differentiation of immature no motile spermatids to motile sperms are called spermiogenesis.

Oogenesis is growth process, in which the primary egg cell (or ovum) becomes a mature ovum.

Sporogenesis is the production of spores.

Spermatogenesis is the process by which haploid spermatozoa develop from germ cells in the seminiferous tubules of the testis.

**202.** **(c)** A Functional mammary gland is characteristic of all female mammals. The mammary glands are paired structures (breasts) that contain glandular tissue and variable amount of fat. The glandular tissue of each breast is divided into 15-20 mammary lobes containing cluster of cells called alveoli. The cells of alveoli open into mammary tubules. The tubules of each lobe join to form a mammary duct which joins to form a wider mammary ampulla. Mammary ampulla is connected to lactiferous duct through which milk is sucked out.

**203.** **(b)**

**204.** **(a)** Tubectomy is a major surgical procedure in which the fallopian tubes are cut open and clipped or tied up to block the passage of the egg into the uterus.

Barrier methods are used only when you have sexual intercourse. Barrier methods include the condom, diaphragm and cervical cap.

The lactational amenorrhea method is a natural method of family planning for women who breastfeed their infants.

Pill is the same as taking other tablets. It is the chemical methods.

**205.** **(b)** Reproductive health in society can be improved by better awareness about sex related matters, increased number of medically assisted deliveries and better post-natal care leading to decreased maternal and infant mortality rates, increased number couples with small families, better detection and cure of STDs and overall increased medical facilities for all sex-related problems, etc. all indicate improved reproductive health of the society.

**206.** **(c)** Human blood group inheritance is governed by three alleles namely $I^A$, $I^B$ and i. When both recessive and dominant traits are expressed in a heterozygous genotype; it is codominance. Alleles $I^A$ and $I^B$ show codominance as ' $I^AI^B$ genotype produce AB blood group that exhibits characters of both IA and IB alleles. Allele 'i' is recessive to both 'IA' and 'IB'; $I^A$i and $I^B$i phenotypes exhibit A and B blood groups respectively.

Presence of more than two alleles for a gene is called Multiple alleles. These are present on the same locus of homologous chromosomes. Eg: ABO blood group.

**207.** **(a)** The correct sequence of amino acids is CAU-Histidine, CCU-Proline, AAA-Lysine and CUG-Leucine.

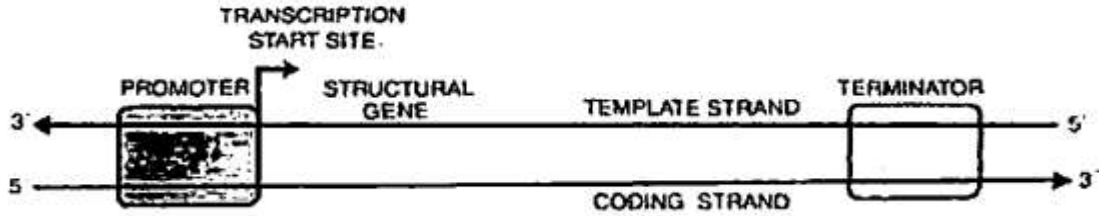
**208.** **(c)**

**209.** **(a)** If both male and female have normal vision. Father and mother have normal vision, the probability of daughter becoming colour blindness is 0%, because in both parents no presence of genes for colour blindness.

**210.** **(d)** The correct sequence of amino acids is AUG-Methionine, CUA - Leucine, GUG- Valine, CGU Arginine and GCC- Alanine

**211.** **(a, d)**Sickle cell anemia is a form of point mutation, where a single nitrogen base (CTC) of the codon for Leucine is changed to (CAC) for Histidine. Sickle-cell disease is caused by a single point mutation (a mis-sense mutation) in the beta-hemoglobin gene that converts a GAG codon into GUG, which encodes the amino acid valine rather than glutamic acid.

**212. (c)**




There is the promoter region which is the start site of transcription. There is a structural gene. There are two strands. The 5'-3' is the coding strand and the 3 '-5' is the template strand. The transcription unit has a promoter on the 5′ end (up steam) of the coding strand and terminator on the 3′ end.

**213. (d)** There are 3 STOP codons in the genetic code - UAG, UAA, and UGA. These codons signal the end of the polypeptide chain during translation.

An anticodon is the three-base sequence, paired with a specific amino acid that a tRNA molecule brings to the corresponding codon of the mRNA during translation.

The universal genetic code comprises of a degenerate set of 61 sense codons that can be translated into polypeptides containing the natural 20 amino acids.

UTR's are untranslated regions present before start codon and after stop codon on mRNA.

**214. (b)**

5′ – G G A T C C – 3′
3′ – C C T A G G – 5′

The palindrome in DNA is a sequence of base pairs that reads same on the two strands when orientations of reading are kept the same.

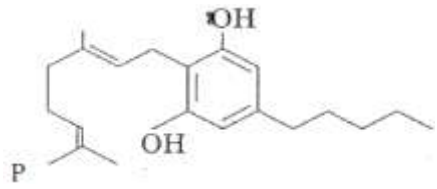
**215. (b)** Friedrich Meischer was a Swiss physician and was the first to isolate nucleic acid or DNA as a distinct molecule. He named it 'nuclein' that is DNA associated with proteins and isolated it from the cell nuclei.

**216. (c)** The repressor of the operon is synthesized (all-the-time-constitutively) from the i gene. The repressor protein binds to the operator region of the operon and prevents RNA polymerase from transcribing the operon. In the presence of an inducer, such as lactose or allolactose, the repressor is inactivated by interaction with the inducer. This allows RNA polymerase access to the promoter and transcription proceeds. Thus, the lac operon gets switched on.

**217. (a)** The first experimental support to Oparin-Haldane's theory of origin of life came from Urey and Miller's experiment. They conducted experiment on evolution to prove the biochemical origin of life.

In 1953, Miller built an apparatus of glass tubes and flasks in laboratory. He created an atmosphere containing hydrogen, ammonia, methane and water vapour in one big flask and allowed condensed liquid to accumulate in another small flask. The ratio of methane, ammonia and hydrogen in the large flask was 2: 1: 2. Energy was supplied to the apparatus by heating the liquid as well as by electric sparks from tungsten's electrodes in the gaseous flask. The conditions of apparatus resembled the atmosphere present on the early earth.

**218. (c)**




The Skeletal structure is of cannabinoid molecule. It is obtained from Cannabis sativa.

**219.** **(a)** In a stable population, for a gene with two alleles, 'A' (dominant) and 'a' (recessive), if the frequency of 'A' is p and the frequency of 'a' is q, then the frequencies of the three possible genotypes (AA, Aa and aa) can be expressed by the Hardy-Weinberg equation:

$p^2 + 2pq + q^2 = 1$.

Where $p^2$ = Frequency of AA (homozygous dominant) individuals

$q^2$ = Frequency of aa (homozygous recessive) individuals

$2pq$ = Frequency of Aa (heterozygous) individuals.

So, $p = 0.6$ and $q = 0.4$ (given)

$\therefore$ 2 pq (frequency of heterozygote) $= 2 \times 0.6 \times 0.4 = 0.48 \times 100 = 48\%$

**220.** **(a)** Interferons are used in treatment of cancer. Rest all are causes of cancer.

A number of viruses are suspected of causing cancer in animals, including humans, and are frequently referred to as oncogenic viruses.

Proto-oncogene is normal gene which, when altered by mutation, becomes an oncogene that can contribute to cancer.

Damage from UV exposure is cumulative and increases your skin cancer risk over time.

**221.** **(b)** After a retrovirus enters a host cell, reverse transcriptase converts the retroviral RNA genome into double-stranded DNA. This viral DNA then migrates to the nucleus and becomes integrated into the host genome. Viral genes are transcribed and translated

**222.** **(a)** In malignant tumors, the cells divide rapidly and move to distant parts of the body and cause new tumors is called metastasis.

The alternation of generations between sexual and asexual reproduction is called metagenesis.

Teratogenesis is a prenatal toxicity characterized by structural or functional defects in the developing embryo or fetus. Mitosis a type of cell division that results in two daughter cells each having the same number and kind of chromosomes as the parent nucleus, typical of ordinary tissue growth.

**223.** **(c)** When breeding is done between animals of the same breed for 4-6 generations, it is called inbreeding. Inbreeding is necessary if we want to develop a pure line of any animal. It exposes harmful recessive genes that are eliminated by selection. It also helps in accumulation of superior genes and elimination of less desirable genes.

**224.** **(a)** The entire collection having all the diverse alleles for all genes in a given crop is called germplasm collection. It is an example of ex-situ conservation of biodiversity. Ex-situ conservation is done by preserving the components of biological diversity outside their natural habitats. It is done by conserving genetic resources, as well as wild and cultivated or species.

**225.** **(b)** After the primary treatment of sewage water, primary effluent is passed into large aeration tanks, where it is constantly agitated mechanically, and air is pumped into it. This allows vigorous growth of useful aerobic microbes into flocs (masses of bacteria associated with fungal filaments to form mesh like structures). While growing, these microbes consume the major part of the organic matter in the effluent. It reduces the Biochemical Oxygen Demand of the effluent. The effluent is then passed into a settling tank, where the bacterial flocs are allowed to sediment. This sediment is called activated sludge.

**226.** **(c)** Lactobacilli belong to the lactic acid bacteria; they produce lactic acid and derive energy from the fermentation of lactose, glucose and other sugars to lactate.

Citric acid is the most important organic acid produced mainly by submerged fermentation using Aspergillus Niger. Acetic acid is a group of Gram-negative bacteria which oxidize sugars or ethanol and produce acetic acid during fermentation. The acetic acid bacteria consist of family Acetobacteraceae.

Clostridium butyricum is a strictly anaerobic endospore-forming Gram-positive butyric acid-producing.

**227.** **(b)** Micro-injection is a method used to inject a recombinant DNA into the nucleus of an animal cell. This is the only way to introduce alien DNA into host cells.

Biolistic or gene gun method is used for bombarding gold or tungsten coated with DNA into a plant cell.

E. coli using the heat shock method is a basic technique of molecular biology. It consists of inserting a foreign plasmid or ligation product into bacteria.

When the disarmed pathogen infects the cell, it transfers the recombinant DNA into host.

**228.** **(c)** The restriction enzymes are isolated from the bacterial sources and are named according to the name of the bacterial species. REN is isolated from the haemophilus influenza, E. coli and bacillus amyloliquefaciens. But no REN is extracted from Agrobacterium tumefaciens.

**229.** **(c)** Silencing of gene could achieve through the use of short interfering RNA and antisense RNA because antisense RNA is a single stranded oligonucleotide complementary to a protein coding mRNA. It forms a ds structure with the mRNA Thus, blocking the process of translation RNA interference technique silences the targeted mRNA molecule using ds RNA.

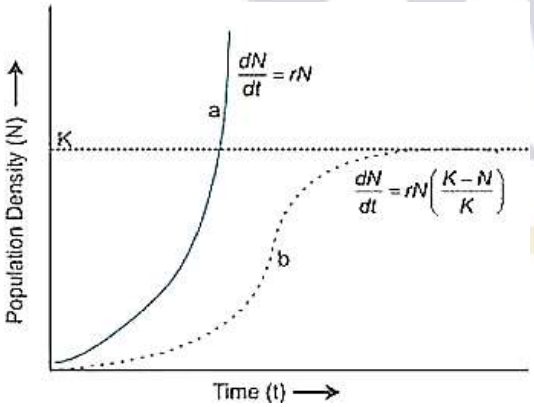
**230.** **(d)** The technique of DNA Fingerprinting was initially developed by Alec Jeffreys. It includes: -

- Hybridization using labelled VNTR probe,
- Digestion of DNA by restriction endonucleases,
- Separation of DNA fragments by electrophoresis,
- Transferring (blotting) of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon,
- Isolation of DNA,
- Detection of hybridised DNA fragments by autoradiography.

**231.** **(b)** RNA interference involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to prevent translation of the mRNA (silencing).

**232.** **(c)** There are some parasites found in birds. They are called brood parasites. Parasitic birds lay their eggs in the nests of other birds for incubation, hatching and rearing of young ones. For example, cuckoo is a parasite that lays its eggs in crow's nest. The eggs of the cuckoo (brood parasite) resemble the eggs of the crow (host) in size and colour and the crow (host bird) is not able to detect the foreign eggs.

**233.** **(b)**

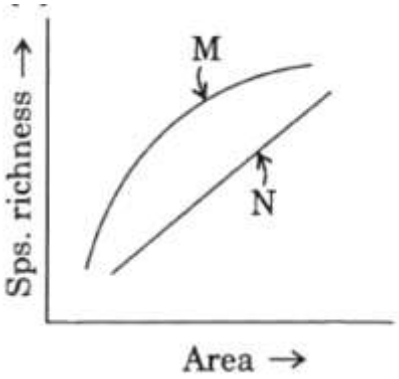



Logistic growth curve is the population growth curve represented by the equation, $dN/dt = rN[K - N/K]$,where r - intrinsic rate of natural increase, K - carrying capacity.

**234.** **(a)** Net primary productivity, or NPP, is gross primary productivity minus the rate of energy loss to metabolism and maintenance.

**235.** **(d)** Pollution is the introduction of contaminants into the natural environment that causes adverse change. It is not a functional unit of the ecosystem.

**236.** **(a)**




The species-area relationship describes the relationship between the area of a habitat and the number of species found within that area is: " $M \rightarrow S = CA^Z$, $N \rightarrow \log S = \log C + Z\log A''$.

**237.** **(b)** A Biodiversity Hotspot is an area containing large number of species, abundance of endemic species and larger number of exotic species. Habitat destruction is the process by which a natural habitat becomes incapable of supporting its native species is not a major feature of biodiversity hotspots.

**238.** **(c)** DDT is a crystalline compound which is used as an insecticide. DDT on runoff from the fields reaches the water bodies and gets accumulated in the bodies of fishes. When fishes are eaten by birds, it gets accumulated in the body of birds and hence, in this way it enters the food chain. High concentration of DDT leads to decline in their population.

**239.** **(b)** Snow blindness is the condition of loss of vision due to overexposure of UV ligh0074. When the layer of ozone gets depleted a large amount of UV radiation start reaching to the earth's atmosphere and increased dose of UV radiation causes diseases.

**240.** **(a)** Human hepatitis B virus vaccine was prepared using antigen produced by recombinant technology in yeast (Saccharomyces cerevisiae).

Snake antivenom is a medication made up of antibodies used to treat snake bites by venomous snakes.

Colostrum contains large numbers of antibodies called (IgA) that help protect the mucous membranes in the throat, lungs, and intestines of the infant.

Neutrophils are a type of white blood cell i.e. leucocyte (PMNL) that helps heal damaged tissues and resolve infections.