## PART-I PHYSICS

**1. (d)** Given: Mass of rocket $(m) = 5000\text{Kg}$

Exhaust speed $(v) = 800 \text{ m/s}$

Acceleration of rocket $(a) = 20 \text{ m/s}^2$

Gravitational acceleration $(g) = 10 \text{ m/s}^2$

We know that upward force

$F = m(g + a) = 5000(10 + 20)$

$= 5000 \times 30 = 150000$ N.

We also know that amount of gas ejected

$$\left(\frac{dm}{dt}\right) = \frac{F}{v} = \frac{150000}{800} = 187.5 \text{ kg/s}$$

**2. (c)** The power dissipated in the circuit.

$$P = \frac{V^2}{R_{eq}}$$
$$v = 10 \text{ volt}$$
$$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{5} = \frac{5+R}{5R}$$
$$R_{eq} = \left(\frac{5R}{5+R}\right)$$
$$P = 30 \text{ W}$$

Substituting the values in equation (i)

$$30 = \frac{(10)^2}{\left(\frac{5R}{5+R}\right)}$$
$$\frac{15R}{5+R} = 10 \Rightarrow 15R = 50 + 10R$$
$$5R = 50 \Rightarrow R = 10\Omega$$

**3. (c)** $E = \frac{1}{2}mv^2$ or $mv = \sqrt{2mE}$

so $\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mE}}$

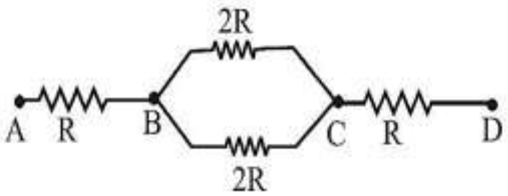
**4. (c)** As $\frac{1}{2} m_A v_A^2 = \frac{1}{2} m_B v_B^2$

$$\frac{v_A}{v_B} = \sqrt{\frac{m_B}{m_A}}$$

$$\frac{P_B}{P_A} = \frac{m_B v_B}{m_A v_A}$$

$$= \frac{m_B}{m_A}\sqrt{\frac{m_A}{m_B}} = \sqrt{\frac{m_B}{m_A}} = \frac{1}{\sqrt{3}}$$

**5. (d)**
**6. (d)** Photoelectric effect does not support the wave nature of light.
**7. (c)** The equivalent electrical circuit of the arrangement is shown in figure.




Temperature difference between the end points A and D $= 200 - 20 = 180°C$

As the resistances for the three parts are equal, the temperature difference must be distribuited equally in the three parts $(= 180 / 3 = 60°C)$

$\therefore$ Temperature of B $= 200°C - 60° = 140°C$.

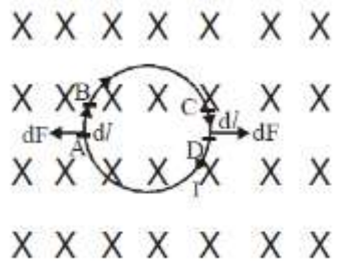
**8. (c)** Number of possible spectral lines emitted when an electron jumps back to ground state from $n^{th}$ orbit $= \frac{n(n-1)}{2}$

Here, $\frac{n(n-1)}{2} = 6 \Rightarrow n = 4$

Wavelength $\lambda$ from transition from $n = 1$ to $n = 4$ is given by,

$$\frac{1}{\lambda} = R\left(\frac{1}{1} - \frac{1}{4^2}\right) \Rightarrow \lambda = \frac{16}{15R} = 975Å$$

**9. (c)** The magnetic field is perpendicular to the plane of the paper. Let us consider two diametrically opposite elements. By Fleming's Left -hand rule on element AB the direction of force will be Leftwards and the magnitude will be $dF = Idl\, B\sin 90° = Id/B$




On element CD, the direction of force will be towards right on the plane of the papper and the magnitude will be $dF = Id/B$.

**10. (b)** Apparent depth $= d/\mu_1 + d/\mu_2$
**11. (c)** By law of conservation of momentum, $Mu = MV + mv$

Also $e = \frac{|v_1 - v_2|}{|u_1 - u_2|} \Rightarrow Mu = Mv - MV$

From (i) and (ii), $2Mu = (M + m)v$

$$\Rightarrow v=\frac{2uM}{M+m} \Rightarrow v=\frac{2u}{1+\frac{m}{M}}$$

**12. (c)** Consider the potential at D be ' V '.

Potential drop across $C_1$ is $(V-V_1)$ and $C_2$

i

$(V_2-V)$

$\therefore q_1=C_1(V-V_1), q_2=C_2(V_2-V)$

As $q_1=q_2$ [capacitors are in series]

$\therefore C_1(V-V_1)=C_2(V_2-V)$

$$V=\frac{C_1V_1+C_2V_2}{C_1+C_2}$$

**13. (b)** Given: work function $\phi$ of metal $=2.28eV$

Wavelength of light $\lambda=500\text{ nm}=500\times10^{-9}\text{ m}$

$$KE_{max}=\frac{hc}{\lambda}-\phi$$

$$KE_{max}=\frac{6.6\times10^{-34}\times3\times10^{8}}{5\times10^{-7}}-2.82$$

$$KE_{max}=2.48-2.28=0.2eV$$

$$\lambda_{min}=\frac{h}{p}=\frac{h}{\sqrt{2\,m(KE)_{max}}}$$

$$=\frac{\frac{20}{3}\times10^{-34}}{\sqrt{2\times9\times10^{-31}\times0.2\times1.6\times10^{-19}}}$$

$$\lambda_{min}=\frac{25}{9}\times10^{-9}$$

$=2.80\times10^{-9}\text{ nm} \therefore \lambda\geq2.8\times10^{-9}\text{ m}$

**14. (b)** Kerosene oil rises up in wick of a lantern because of capillary action. If the surface tension of oil is zero, then it will not rise, so oil rises up in a wick of a lantern due to surface tension.

**15. (a)** $e=\frac{LdI}{dt}=\frac{40\times10^{-3}(11-1)}{4\times10^{-3}}=100\text{ V}$

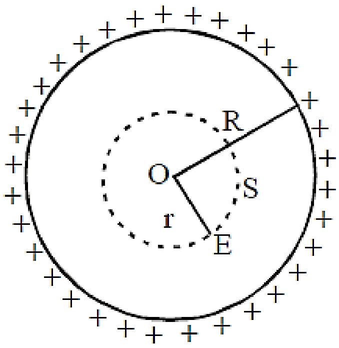
**16. (d)** Impedence of a capacitor is $X_C=1/\omega C$

$X_C=\frac{1}{2\pi fC}=\frac{1}{2\pi\times50\times2\times10^{-6}}=\frac{5000}{\pi}$.

**17. (a)** The final boolean expression is,

$X=\overline{(\bar{A}\cdot\bar{B})}=\bar{\bar{A}}+\bar{\bar{B}}=A+B\Rightarrow$ OR gate

**18. (a)** Charge resides on the outer surface of a conducting hollow sphere of radius R. We consider a spherical surface of radius $r<R$. By Gauss theorem




$$\int_S \vec{E}\cdot\vec{ds} = \frac{1}{\varepsilon_0}\times \text{ charge enclosed or}$$

$$E \times 4\pi r^2 = \frac{1}{\varepsilon_0}\times 0 \Rightarrow E = 0$$

i.e electric field inside a hollow sphere is zero.

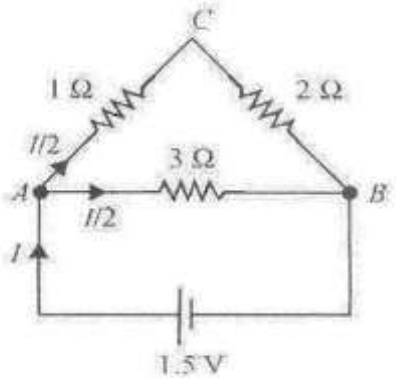
**19. (d)** Let R be the radius of the bigger drop, then Volume of bigger drop $= 2 \times$ volume of small drop

$$\frac{4}{3}\pi R^3 = 2\times\frac{4}{3}\pi r^3 \Rightarrow R = 2^{1/3}r$$

Surface energy of bigger drop,

$$E = 4\pi R^2 T = 4\times 2^{2/3}\pi r^2 T = 2^{8/3}\pi r^2 T$$

**20. (b)** Equivalent resistance between A and B = series combination of $1\Omega$ and $2\Omega$ in parallel with $3\Omega$ resistor..




$\frac{1}{R} = \frac{1}{3} + \frac{1}{3} = \frac{2}{3}$ or $R = 1.5\Omega$.

$\therefore$ Current in the circuit is $I = V/R = 1.5/1.5 = 1$ A.

Since the resistance in arm ACB = resistance in arm AB $= 3\Omega$, the current divides equally in the two arms. Hence the current through the $3\Omega$ resistor $= I/2 = 0.5$ A.

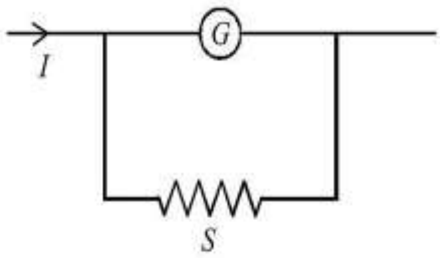
**21. (d)**

**22. (a)** $\tan(90^\circ - \theta) = \frac{\text{stress}}{\text{strain}}$

**23. (c)** $U = -K\frac{ze^2}{r}; T\cdot E = -\frac{k}{2}\frac{ze^2}{r}\ K.E = \frac{k}{2}\frac{ze^2}{r}$. Here r decreases

**24. (c)** When resistance is connected to A.C source, then current & voltage are in same phase.

**25. (a)** Galvanometer is converted into ammeter, by connected a shunt, in parallel with it.




$$\frac{GS}{G+S}=\frac{V_G}{I}=\frac{25\times10^{-3}}{25}$$

$$\frac{GS}{G+S}=0.001\Omega$$

Here $S \ll G$ so $S = 0.001\Omega$

**26.** **(b)** For path difference $\lambda$, phase

difference $= 2\pi\left(Q=\frac{2\pi}{\lambda}x=\frac{2\pi}{\lambda}\cdot\lambda=2\pi\right)$

$\Rightarrow I = I_0 + I_0 + 2I_0\cos 2\pi$

$\Rightarrow I = 4I_0\ (\because \cos 2\pi = 1)$

For $x=\frac{\lambda}{4}$, phase difference $=\frac{\pi}{2}$

$\therefore I' = I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2}\cos\frac{\pi}{2}$

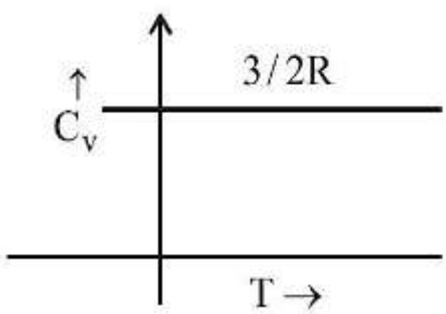
If $I_1 = I_2 = I_0$ then $I' = 2I_0 = 2\cdot\frac{I}{4}=\frac{I}{2}$

**27.** **(a)** Static friction is a self- adjusting force in magnitude and direction.

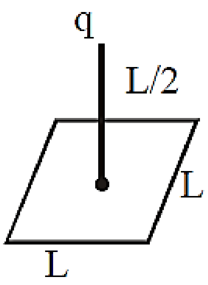
**28.** **(a)** Cosmic rays are coming from outer space, having high energy charged particles, like a-particle, proton etc. β-rays are stream of high energy electrons, coming from the nucleus of radioactive atoms.

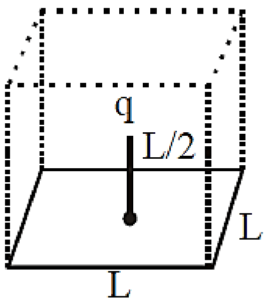
**29.** **(c)** For a monatomic gas $C_V=\frac{3}{2}R$

So correct graph is




**30.** **(c)**




The given square of side L may be considered as one of the faces of a cube with edge L. Then given charge q will be considered to be placed at the centre of the cube. Then according to Gauss's theorem, the magnitude of the electric flux through the faces (six) of the cube is given by

$$\phi = q/\varepsilon_0$$

Hence, electric flux through one face of the cube for the given square will be

$$\phi' = \frac{1}{6}\phi = \frac{q}{6\varepsilon_0}$$

**31. (d)** When work is done upon a system by a conservative force then its potential energy increases.

**32. (c)** $C_s = \frac{C_1C_2}{C_1+C_2} = 3$

$$C_p = C_1 + C_2 = 16 \therefore C_1C_2 = 48$$
$$C_1 - C_2 = \sqrt{(C_1 + C_2)^2 - 4C_1C_2}$$
$$= \sqrt{16^2 - 4 \times 48} = \sqrt{64} = 8$$
$$C_1 + C_2 = 16\mu F$$
$$C_1 - C_2 = 8\mu F$$
$$\Rightarrow 2C_1 = 24\mu F \Rightarrow C_1 = 12\mu F$$
$$\therefore C_2 = \frac{48}{12} = 4\mu F$$

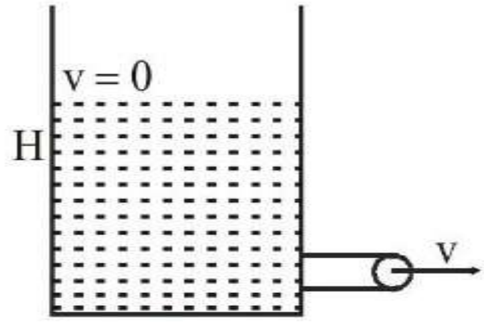
**33. (d)** In LCR series circuit, resonance frequency $f_0$ is given by

$$L\omega = \frac{1}{C\omega} \Rightarrow \omega^2 = \frac{1}{LC} \quad \therefore \quad \omega = \sqrt{\frac{1}{LC}} = 2\pi f_0$$
$$\therefore \; f_0 = \frac{1}{2\pi\sqrt{LC}} \quad \text{or} \quad f_0 \alpha \frac{1}{\sqrt{C}}$$

When the capacitance of the circuit is made 4 times, its resonant frequency become $f_0' \therefore \frac{f_0'}{f_0} = \frac{\sqrt{C}}{\sqrt{4C}}$ or $f_0' = \frac{f_0}{2}$

**34. (b)** On polarisation by reflection, the reflected and refracted waves are at 90° to each other.

**35. (a)** v = velocity of efflux through an orifice = $\sqrt{2gH}$




It is independent of the size of orifice.

**36.** **(c)** The acceleration of both the blocks $= \frac{15}{3x} = \frac{5}{x}$

$\therefore$ Force on B $= \frac{5}{x} \times 2x = 10\ \text{N}$

**37.** **(b)** Potential gradient along wire

$= \dfrac{\text{potential difference along wire}}{\text{length of wire}}$

or, $0.1 \times 10^{-3} = \frac{I \times 40}{1000}$ V/cm

or, Current in wire, $I = \frac{1}{400}$ A

or, $\frac{2}{40+R} = \frac{1}{400}$ or $R = 800 - 40 = 760\Omega$

**38.** **(b)** $i = \frac{A+\delta_m}{2} = \frac{60+30}{2} = 45^\circ$

**39.** **(b)** I $\rightarrow$ ON

II $\rightarrow$ OFF

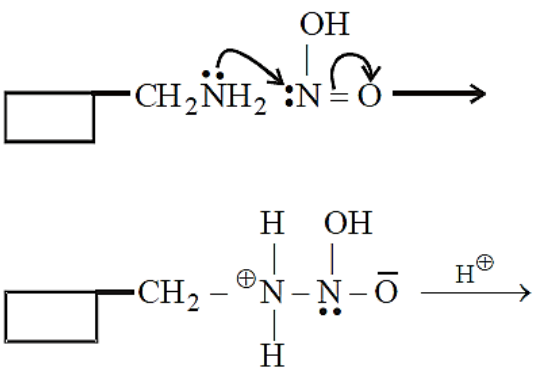
In II$^{nd}$ state it is used as a amplifier it is active region.

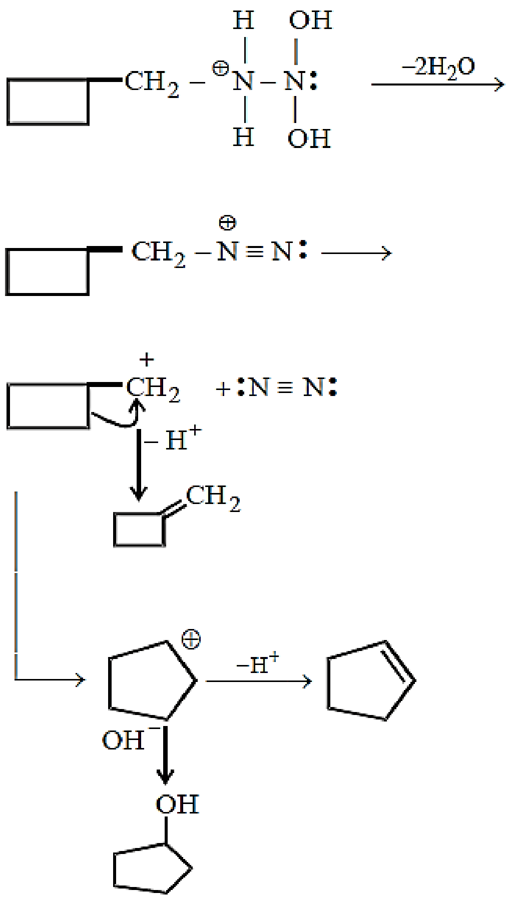
**40.** **(c)** $\tau = MB\sin\theta = \vec{M} \times \vec{B}$

## PART-II CHEMISTRY

**41.** **(b)** It is stoichiometric defect and it is observed when equal number of cations and anions are missing from the lattice site.

**42.** **(d)**






**43.** **(a)** The reaction given is an exothermic reaction thus according to Le chatalier's principle lowering of temperature, addition of $F_2$ and $Cl_2$ favour the forward direction and hence the production of $ClF_3$.

**44.** **(d)** For the reaction :-

$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$

Given $K_c = 1.8 \times 10^{-6}$ at 184°C

$R = 0.00831\ kJ/mol.K$

$K_p = K_c(RT)^{\Delta n_g}$

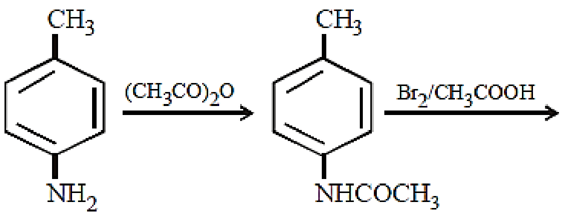
$\Delta n_g = 3 - 2 = 1$

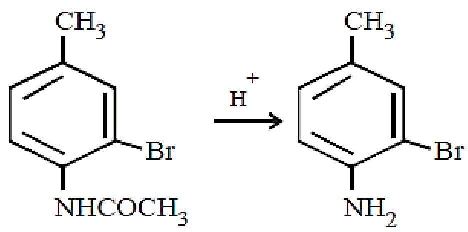
$K_p = 1.8 \times 10^{-6} \times 0.00831 \times 457$

$= 6.836 \times 10^{-6}$

Hence it is clear that $K_p > K_c$

**45.** **(b)**





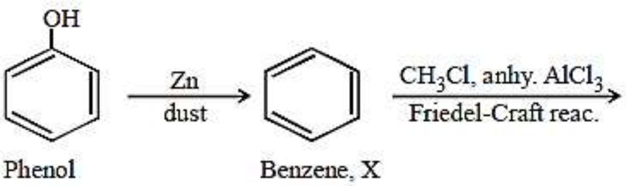
($-NHCOCH_3$ is more electron-releasing than $-CH_3$)

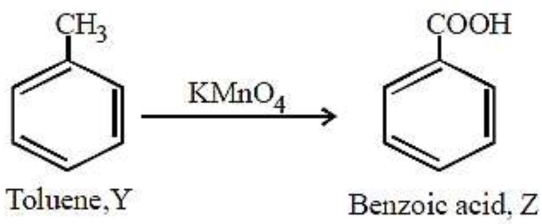
**46. (b)** No. of M atoms $= \frac{1}{4} \times 4 + 1 = 1 + 1 = 2$

No. of X atoms $= \frac{1}{2} \times 6 + \frac{1}{8} \times 8 = 3 + 1 = 4$

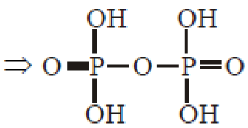
So, formula $= M_2X_4 = MX_2$

**47. (c)**

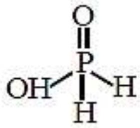




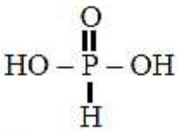
**48. (b)**

(a) $H_4P_2O_7$ 

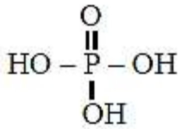
Pyrophosphoric acid

(b) $H_3PO_2$ $\Rightarrow$ 

Hypophosphorous acid

(c) $H_3PO_3$ $\Rightarrow$ 

Phosphorous acid

(d) $H_3PO_4$ $\Rightarrow$ 

orthophosphoric acid

**49. (d)** The given structure has three double bonds whose each carbon atom is differently substituted hence number of geometrical isomers will be $2^n = 2^3 = 8$, where n is the number of double bonds whose each carbon atom is differently substituted.

**50. (a)** Following generalization can be easily derived for various types of lattice arrangements in cubic cells between the edge length (a) of the cell and r the radius of the sphere.

For simple cubic : $a = 2r$ or $r = \frac{a}{2}$

For body centred cubic :

$a = \frac{4}{\sqrt{3}} r$ or $r = \frac{\sqrt{3}}{4} a$

For face centred cubic :

$a = 2\sqrt{2} r$ or $r = \frac{1}{2\sqrt{2}} a$

Thus the ratio of radii of spheres for these will be

simple : bcc : fcc

$= \frac{a}{2} : \frac{\sqrt{3}}{4} a : \frac{1}{2\sqrt{2}} a$ i.e.

option (a) is correct answer.

**51. (d)** $\log k = \log A - \frac{E_a}{2.303RT}$

Also given $\log k = 6.0 - (2000)\frac{1}{T}$

On comparing equations, (1) and (2)

$\log A = 6.0 \Rightarrow A = 10^6\ s^{-1}$

and $\frac{E_a}{2.303R} = 2000$;

$\Rightarrow E_a = 2000 \times 2.303 \times 8.314$

$= 38.29 \text{ kJ mol}^{-1}$

**52. (c)**

(a)

$$CH_3CH_2CH_2OH \xrightarrow[\text{or } K_2Cr_2O_7/H+]{\text{alk. } KMnO_4} CH_3CH_2CHO$$

$$\longrightarrow CH_3CH_2COOH \xrightarrow{\text{Fehling sol}} \text{No reaction}$$

(b)

$$CH_3CHOHCH_3 \xrightarrow[\text{or } K_2Cr_2O_7/H+]{\text{alk. } KMnO_4} CH_3COCH_3$$

$$\longrightarrow CH_3COOH \xrightarrow{\text{Feh sol.}} \text{No reaction}$$

(c) $CH_3CH_2CH_2OH \xrightarrow{Cu} CH_3CH_2CHO$

$$\xrightarrow[\text{solution}]{\text{Fehling}} \underset{\text{(red)}}{Cu_2O \downarrow}$$

$$CH_3CHOHCH_3 \xrightarrow{Cu} CH_3COCH_3$$

$$\xrightarrow[\text{solution}]{\text{Fehling}} \text{No reaction}$$

(d) $CH_3CH_2CH_2OH$ or

$$CH_3CHOHCH_3 \xrightarrow{\text{Conc. } H_2SO_4} CH_3CH=CH_2$$

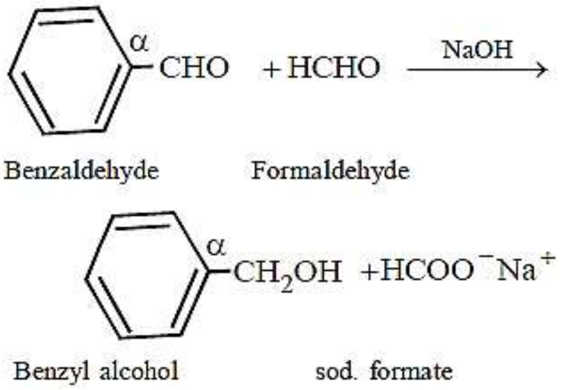
**53. (b)**

$Cu^{2+}[Ar]3\,d^9, Ti^{4+}[Ar]3\,d^0$
$Co^{2+}[Ar]3\,d^7, Fe^{2+}[Ar]3\,d^6$

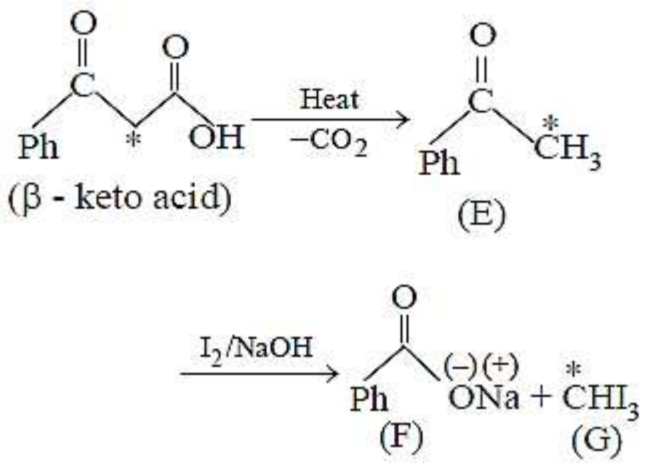
**54. (b)** For first order reaction,

$$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{6.93}$$
$$k = \frac{2.303}{t}\log\frac{100}{100-99}$$
$$\frac{0.693}{6.93} = \frac{2.303}{t}\log\frac{100}{1}$$
$$\frac{0.693}{6.93} = \frac{2.303 \times 2}{t}$$
$$t = 46.06 \text{ min}$$

**55. (a)** Benzaldyde and formaldehyde, both do not have α-hydrogen atom, so both will undergo Cannizzaro reaction; here formaldehyde will always be oxidised to formate while the other aldehyde ($C_6H_5CHO$ or any other aldehyde not having $\alpha - H$, viz- $Me_3CCHO$ ) will always be reduced to corresponding alcohol (crossed Cannizzaro reaction)




**56. (c)**



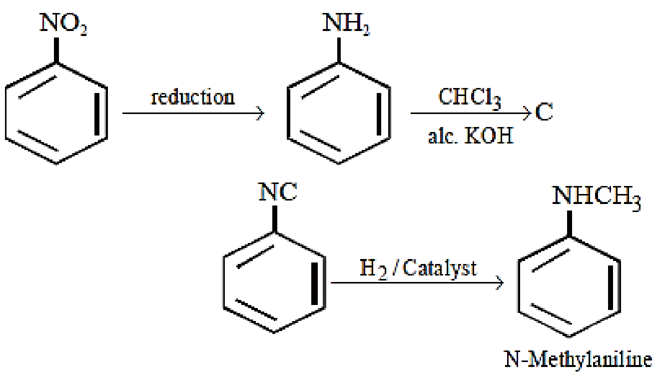

**57. (a)** $\Delta S$ for the reaction $\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightleftharpoons XY_3$

$\Delta S = 50 - (30 + 60) = -40$ J

For equilibrium $\Delta G = 0 = \Delta H - T\Delta S$

$$T = \frac{\Delta H}{\Delta S} = \frac{-30000}{-40} = 750 \text{ K}$$

**58. (d)**




**59. (a)** When pH $= 14 [H^+] = 10^{-14}$ and $[OH^-] = 1M$

$$K_{sp} = [Cu^{2+}][OH^-]^2 = 10^{-19}$$

$$\therefore\ [Cu^{2+}] = \frac{10^{-19}}{[OH^-]^2} = 10^{-19}$$

The half -cell reaction

$Cu^{2+} + 2e^- \longrightarrow Cu$

$$E = E^\circ - \frac{0.059}{2}\log\frac{1}{[Cu^{2+}]}$$

$$= 0.34 - \frac{0.059}{2}\log\frac{1}{10^{-19}} = -0.22\ V$$

**60. (b)**

$$C_4H_8 \xleftarrow[(-H_2O)]{Conc.H_2SO_4} C_4H_{10}O \xrightarrow{Oxi}$$

$C_4H_8O(R-COCH_3)$

Thus $C_4H_8O$ should be $CH_3CH_2COCH_3$,

hence $C_4H_{10}O$ should be $CH_3CH_2CHOHCH_3$

**61. (a)** $W_{max} = -n.FE;$

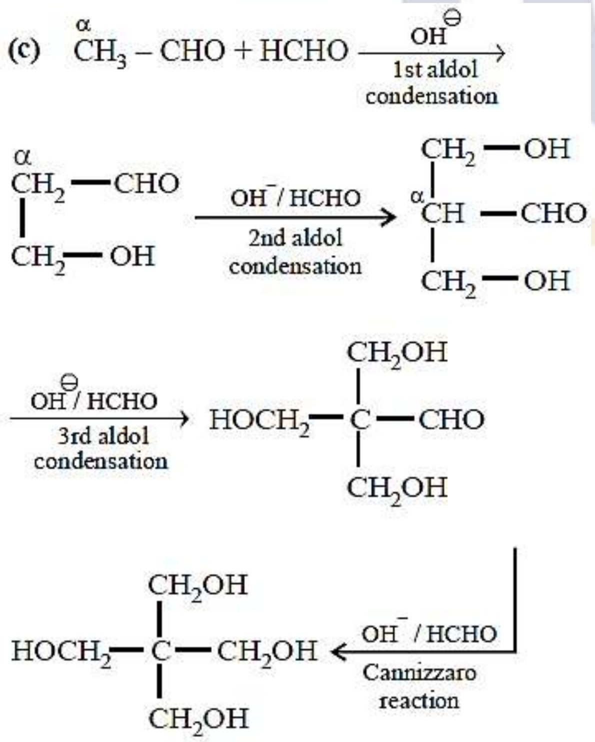
$W_{max} = -2 \times 96500 \times 0.65 = -1.25 \times 10^5$ J

$0.5\ gHH_2 = 0.25$ mole.

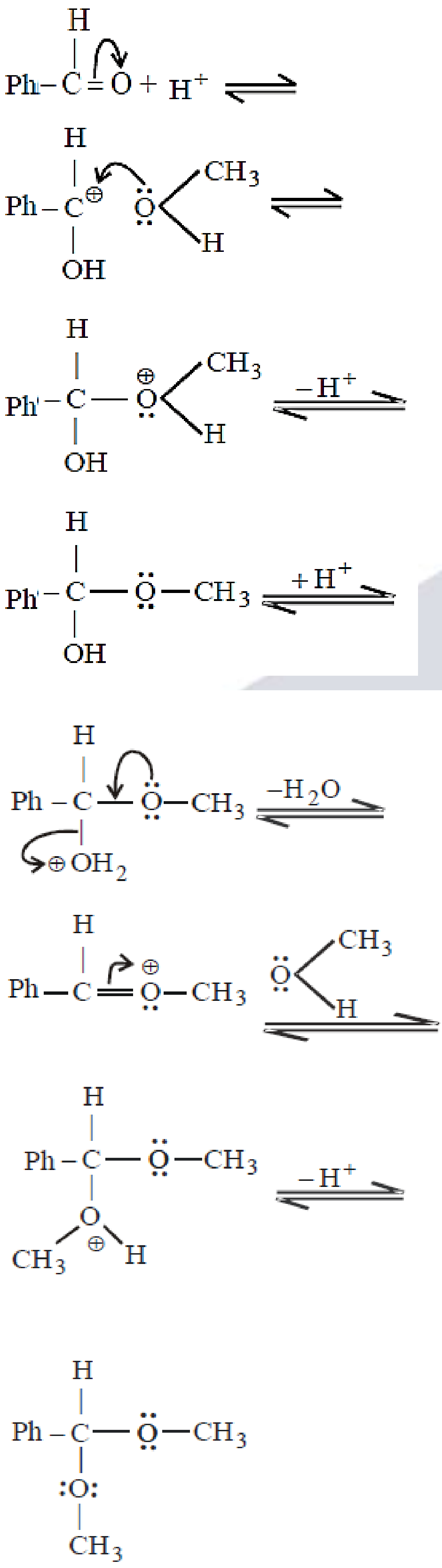
Hence,

$W_{max} = 1.25 \times 10^5 \times 0.25 = -3.12 \times 10^4$ J

**62.**



**63. (b)**



**64. (a)** In α-form distance between nearest neighbour atom is $\frac{\sqrt{3}a_1}{2}$.

In γ form distance between nearest neighbour atom is $\frac{a_2}{\sqrt{2}}$.

$\therefore\ \frac{\sqrt{3}a_1}{2} = \frac{a_2}{\sqrt{2}}$ (given)

or $\frac{a_2}{a_1} = \sqrt{\frac{3}{2}}$

$$\frac{\rho_1}{\rho_2} = \frac{z_1}{z_2}\left(\frac{a_2}{a_1}\right)^3 = \frac{1}{2}\left(\sqrt{\frac{3}{2}}\right)^3 = 0.918$$

**65. (c)**

**66. (a)** Solubility of the compound in conc. $H_2SO_4$ indicates that it can be an alkene, alcohol or an ether. The inability to discharge bromine colour indicates absence of an alkene. Hence the compound is an alcohol which should be primary because it is readily (within 2 seconds) oxidised by $CrO_3$ in sulphuric acid.

**67. (b)** $E = h\nu = \frac{ch}{\lambda}$; and $\nu = \frac{c}{\lambda}$

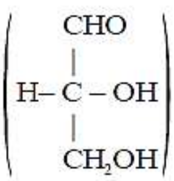
$$8 \times 10^{15} = \frac{3.0 \times 10^8}{\lambda}$$

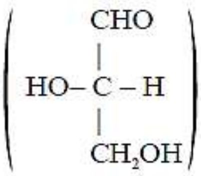
$$\therefore \lambda = \frac{3.0 \times 10^8}{8 \times 10^{15}} = 0.37 \times 10^{-7}$$

$$= 37.5 \times 10^{-9}\ \text{m} = 4 \times 10^1\ \text{nm}$$

**68. (b)**

**69. (c)** Positive sign is for optical rotation (dextro rotatory) and D - is for configuration. It is derived from

D (+) glyceraldehyde 

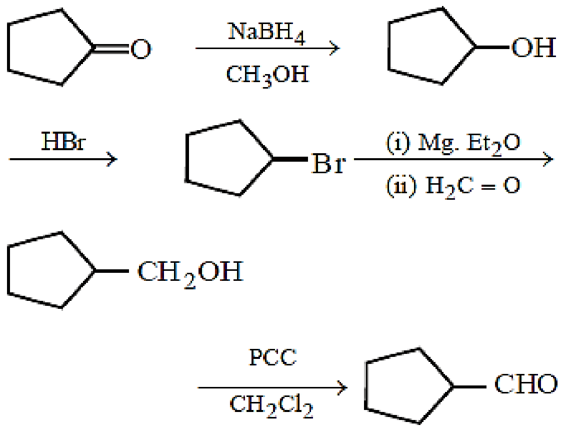
L (–)glyceraldehyde is 

**70. (b)** $\Delta H = \Delta U + \Delta nRT$ for

$$N_2 + 3H_2 \longrightarrow 2NH_3$$
$$\Delta n_g = 2 - 4 = -2$$

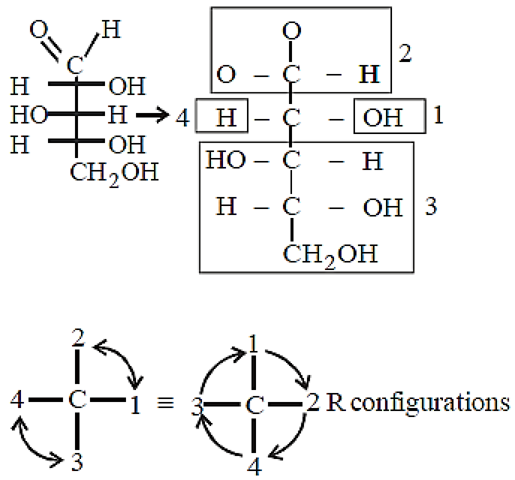
$\therefore \Delta H = \Delta U - 2RT$ or $\Delta U = \Delta H + 2RT\ \therefore \Delta U > \Delta H$

**71. (a)**



**72. (b)** Most of the $Ln^{3+}$ compounds except $La^{3+}$ and $Lu^{3+}$ are coloured due to the presence of f-electrons.

**73. (c)**



Arrange the groups in order of priority by following the text.

**74. (b)** Saponification (alkaline hydrolysis) of oils and fats gives glycerol and sodium salt of fatty acids, which is sodium palmitate in the present question

**75. (a)** For non -spontaneous reaction

$\Delta G = +ve$
$\Delta G = \Delta H - T\Delta S$ and
$\Delta S = 121 JK^{-1}$

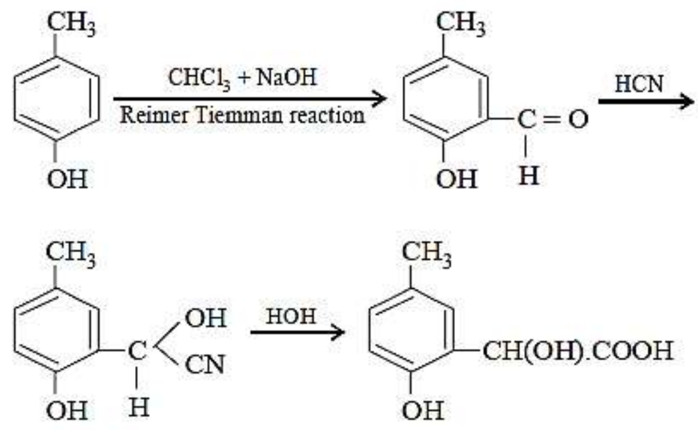
For $\Delta G = +$ ve

$\Delta H$ has to be positive. Hence the reaction is endothermic.

The minimum value of $\Delta H$ can be obtained by putting $\Delta G = 0$

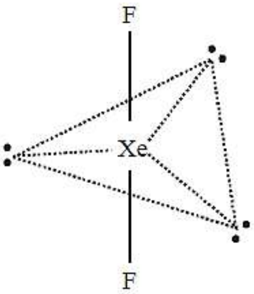
$$\Delta H = T\Delta S = 298 \times 121 \text{ J}$$
$$= 36.06 \text{ kJ}$$

**76. (c)**

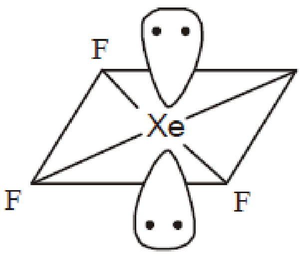


Cyanohydrin

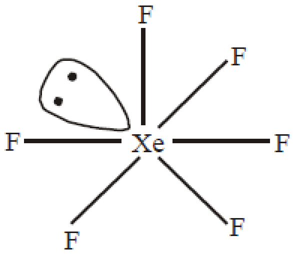
**77. (c)**

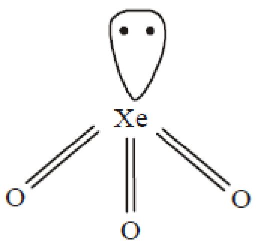
$XeF_2$ : 

$3\ell p$

$XeF_4$ : 

$2\ell p$

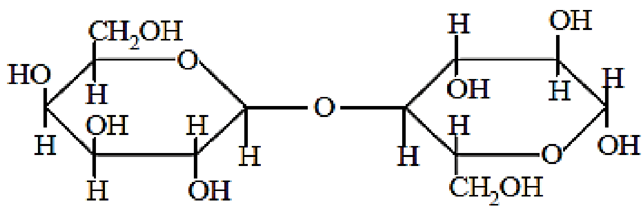
$XeF_6$ : 

$XeO_3$ : 

$1\ell p$

Hence $XeF_2$ has maximum no. of lone pairs of electrons.

**78. (c)**



(Lactose)

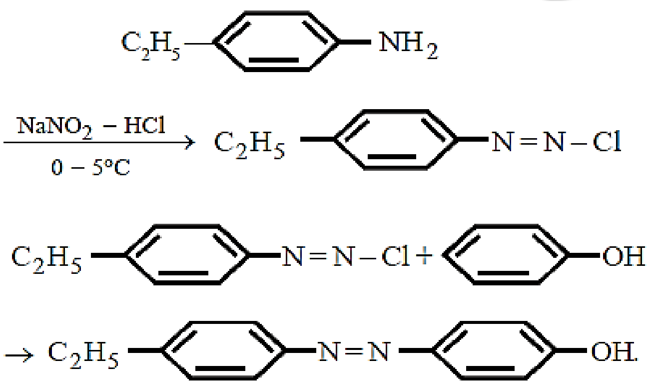
All reducing sugar shows mutarotation.

**79. (a)** On the basis of structure of guanine and complementary bases present in them, we can say that if the sequence of bases in one strand of DNA is I, then the sequence in the second strand should be II

A:T:G:C:T:T:G:A I

T: A: C: G: A: A: C: T II

**80. (b)**



## PART-III MATHEMATICS

**81. (d)** $\frac{3\pi}{2} < 5 < \frac{5\pi}{2}$

$\Rightarrow \sin^{-1}(\sin 5) = 5 - 2\pi$

Given $\sin^{-1}(\sin 5) > x^2 - 4x$

$\Rightarrow x^2 - 4x + 4 < 9 - 2\pi$

$\Rightarrow (x-2)^2 < 9 - 2\pi$

$\Rightarrow -\sqrt{9-2\pi} < x - 2 < \sqrt{9-2\pi}$

$\Rightarrow 2 - \sqrt{9-2\pi} < x < 2 + \sqrt{9-2\pi}$

**82. (c)** Using Lagrange's Mean Value Theorem Let $f(x)$ be a function defined on $[a, b]$

then, $f'(c) = \frac{f(b)-f(a)}{b-a}$

$c \in [a, b]$

$\therefore$ Given $f(x) = \log_e x \ \therefore f(x) = \frac{1}{x}$

$\therefore$ equation (i) become

$$\frac{1}{c}=\frac{f(3)-f(1)}{3-1}$$

$$\Rightarrow \frac{1}{c}=\frac{\log_e 3-\log_e 1}{2}=\frac{\log_e 3}{2} \Rightarrow c=\frac{2}{\log_e 3}$$

$$\Rightarrow c=2\log_3 e$$

**83. (c)** p : we control population, q : we prosper $\therefore$ we have $p \Rightarrow q$

Its negation is $\sim (p \Rightarrow q)$ i.e. $p \wedge \sim q$

i.e., we control population but we do not prosper.

**84. (b)** Consider the equation

$$z\bar{z}+(2-3i)z+(2+3i)\bar{z}+4=0$$

Let $z=x+iy$ and $\bar{z}=x-iy, z\bar{z}=x^2+y^2$

Put value of $z, \bar{z}$ and $z\bar{z}$ in equation (1), we get

$(x^2+y^2)+(2-3i)(x+iy)+(2+3i)(x-iy)$

$+4=0$

$\Rightarrow 4x+6y+4+x^2+y^2=0$

Now, we make it perfect square

$\Rightarrow x^2+y^2+4x+6y+4+4+9=4+9$

$\Rightarrow (x+2)^2+(y+3)^2=9$

This represents a circle of radius 3 .

**85. (b)** Let $f(x)=\sin x-kx-c$ where k and c are constants

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

$\therefore$ f decreases if $\cos x \le k$

Thus, $f(x)=\sin x-kx-c$ decrease always when

$k \ge 1$.

**86. (b)** Given, equation is

$\frac{1}{r}=\frac{1}{8}+\frac{3}{8}\cos\theta$ or $\frac{8}{r}=1+3\cos\theta$

which is the form of $\frac{l}{r}=1+e\cos\theta$

$\because\ e=3>0,$

$\therefore$ Given equation is a hyperbola.

**87. (c)** The differential equation of the motion is $\frac{dv}{dt}=30-3v$

$\Rightarrow \frac{dv}{30-3v}=dt.$

Integrating we get

$$-\frac{1}{3}\log(30-3v)=t+C$$

$$\Rightarrow \log(30-3v)=-3(t+c)$$

$$\Rightarrow 30-3v=e^{-3t-3c}=Ae^{-3t}, A=e^{-3c}$$

$$\Rightarrow 3v=30-Ae^{-3t}$$

For maximum velocity $\frac{dv}{dt}=0$

$\Rightarrow 30-3v=0$ from (i)

$$\therefore v=\frac{30}{3}=10\ \text{cm/s}$$

which is the maximum velocity

However from (ii) $\frac{dv}{dt}=3Ae^{-3t}$

Clearly $\frac{dv}{dt}=0$ if $t\to\infty$

$\therefore$ The maximum velocity will be achieved after infinite time in other words, the maximum velocity will hever be reached.

**88. (b)** Given curve is $y^2=4x+5$

on differentiating, we get

$$2y\frac{dy}{dx}=4\Rightarrow\frac{dy}{dx}=\frac{2}{y}$$

Given line is $2x-y+5=0$

$$\Rightarrow y=2x+5$$

slope of line is 2 . Therefore,

$$\frac{2}{y}=2\Rightarrow y=1$$

put $y=1$ in the equation of curve, we get

$$1=4x+5$$

$$x=-1$$

Hence, point of contact is $(-1,1)$

**89. (c)** Let $I=\int_0^{\pi/2}\frac{\sqrt{\sin x}}{\sqrt{\sin x}+\sqrt{\cos x}}dx$

Then, I =

$$\int_0^{\pi/2} \frac{\sqrt{\sin(\pi/2 - x)}}{\sqrt{\sin(\pi/2 - x)} + \sqrt{\cos(\pi/2 - x)}} dx$$

Adding (i) and (ii), we get

2I

$$\int_0^{\pi/2} \frac{\sqrt{\sin x}}{\sqrt{\cos x} + \sqrt{\sin x}} dx + \int_0^{\pi/2} \frac{\sqrt{\cos x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx$$
$$\int_0^{\pi/2} \frac{\sqrt{\sin x} + \sqrt{\cos x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx = \int_0^{\pi/2} 1.\, dx = [x]_0^{\pi/2} = \frac{\pi}{2} - 0$$
$$\Rightarrow\ I = \frac{\pi}{4} \Rightarrow \int_0^{\pi/2} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx = \frac{\pi}{4}$$

**90. (c)** We have

$-1 \le \cos 3x \le 1 \Rightarrow -1 \le -\cos 3x \le 1$

Add '2' on both side

$1 \le 2 - \cos 3x \le 3$

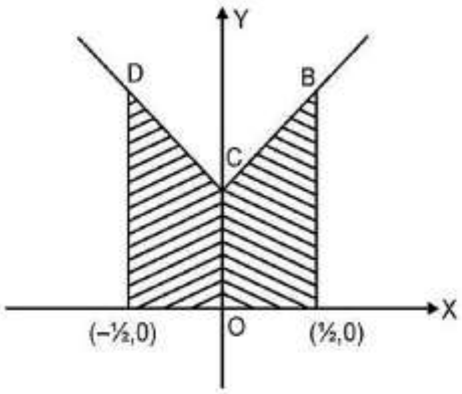
$\Rightarrow 1 \ge \frac{1}{2-\cos 3x} \ge \frac{1}{3}$.

**91. (c)** The given lines are,

$y - 1 = x, x \ge 0;\ y - 1 = -x, x < 0$

$y = 0;\ x = -\frac{1}{2}, x < 0;\ x = \frac{1}{2}, x \ge 0$

so that the area bounded is as shown in the figure.




Required area $= 2\int_0^{1/2} (1 + x)dx$

$$= 2\left(x + \frac{x^2}{2}\right)_0^{1/2} = 2\left(\frac{1}{2} + \frac{1}{8}\right) = \frac{5}{4}$$

**92. (a)** Given $\begin{vmatrix} x+\alpha & \beta & \gamma \\ \gamma & x+\beta & \alpha \\ \alpha & \beta & x+\gamma \end{vmatrix} = 0$

Operate $C_1 \to C_1 + C_2 + C_3$

$$\begin{vmatrix} x+\alpha+\beta+\gamma & \beta & \gamma \\ x+\alpha+\beta+\gamma & x+\beta & \alpha \\ x+\alpha+\beta+\gamma & \beta & x+\gamma \end{vmatrix} = 0$$

$$= (x+\alpha+\beta+\gamma)\begin{vmatrix} 1 & \beta & \gamma \\ 1 & x+\beta & \alpha \\ 1 & \beta & x+\gamma \end{vmatrix} = 0$$

$$\Rightarrow x+\alpha+\beta+\gamma = 0 \Rightarrow x = -(\alpha+\beta+\gamma)$$

Again if $\begin{vmatrix} 1 & \beta & \gamma \\ 1 & x+\beta & \alpha \\ 1 & \beta & \gamma \end{vmatrix} = 0 \Rightarrow \begin{vmatrix} 1 & \beta & \gamma \\ 0 & x & \alpha-\gamma \\ 0 & 0 & x \end{vmatrix} = 0$

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

$\therefore$ Solutions of the equation are $x = 0, -(\alpha+\beta+\gamma)$

**93. (c)** $\frac{dy}{dx} + \frac{y}{x\log x} = \frac{\sin 2x}{\log x}$

I.F. $= e^{\int \frac{dx}{x\log x}}$

$\therefore$ I.F. $= e^{\int \frac{1}{t}dt} = e^{\log t} = t = \log|x|$

solution is given by

$$y\,(\text{I.F.}) = \int Q.(\text{I.F.})\,dx + C$$

$$y\log|x| = \int \frac{\sin 2x}{\log|x|}(\log|x|)dx + C$$

$$= -\frac{\cos 2x}{2} + C$$

**94. (d)** Consider $\lim_{x\to\infty}\left[\frac{x^2}{3x-2} - \frac{x}{3}\right]$

$$= \lim_{x\to\infty}\left[\frac{3x^2 - x(3x-2)}{3(3x-2)}\right]$$

$$= \lim_{x\to\infty}\frac{2x}{3(3x-2)} = \lim_{x\to\infty}\frac{2x}{3x\left[3-\frac{2}{x}\right]}$$

$$= \lim_{x\to\infty}\frac{2}{3}\frac{1}{\left(3-\frac{2}{x}\right)} = \frac{2}{3}\times\frac{1}{3-0} = \frac{2}{9}$$

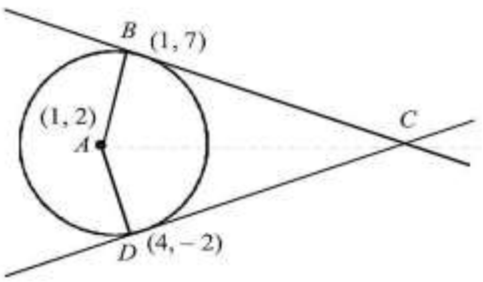
**95. (c)** $((\vec{a}\times b)\times(\vec{c}\times d))\cdot(\vec{a}\times d) = 0$

$([\vec{a}\vec{c}\vec{d}]\vec{b} - [\vec{b}\vec{c}\vec{d}]\vec{a})\cdot(\vec{a}\times\vec{d}) = 0$

$[\vec{a}\vec{c}\vec{d}][\vec{b}\vec{a}\vec{d}] = 0$

Either $\vec{c}$ or $\vec{b}$ must lie in the plane of $\vec{a}$ and $\vec{d}$.

**96. (b)**




Here, centre is A(1,2), and Tangent at B (1,7) is

$x.1 + y.7 - 1(x+1) - 2(y+7) - 20 = 0$

or $y = 7$

Tangent at $D(4,-2)$ is

$3x - 4y - 20 = 0$

Solving (1) and (2), we get C is (16,7)

Area ABCD $= 2$ (Area of $\triangle$ ABC )

$= 2 \times \frac{1}{2} AB \times BC$

$AB \times BC = 5 \times 15 = 75$ units

**97.** **(c)** Integrating by parts.

$\int f(x)g''(x)dx - \int f''(x)g(x)dx$
$= f(x)g'(x) - \int f'(x)g'(x)dx$
$-f'(x)g(x) + \int f'(x)g'(x)dx$

$= f(x)g'(x) - f'(x)g(x)$

Hence, $\int_0^1 f(x)g''(x)dx - \int_0^1 f''(x)g(x)dx$

$= f(1)g'(1) - f'(1)g(1) - f(0)g'(0) + f'(0)g(0)$

$= f(1)g'(1) - f'(1)g(1)$

**98.** **(d)** $z = \frac{7-i}{3-4i} \times \frac{3+4i}{3+4i}$

$= \frac{21+25i+4}{16+9} = \frac{25(1+i)}{25} = (1+i)$

$z^{14} = (1+i)^{14} = [(1+i)^2]^7 = (2i)^7$

$= 2^7 i^7 = -2^7 i$

**99.** **(c)** $f(x) = 2\sin x + \sin 2x$

$f'(x) = 2\cos x + 2\cos 2x = 2(\cos x + \cos 2x)$

$\therefore f'(x) = 0 \Rightarrow 2\cos^2 x + \cos x - 1 = 0$

$\cos x = \frac{-1 \pm 3}{4} = -1, \frac{1}{2} \quad \therefore x = \pi, \frac{\pi}{3}$

Now, $f(0) = 0, f\left(\frac{3\pi}{2}\right) = -2$

$f(\pi) = 0, f\left(\frac{\pi}{3}\right) = 2\frac{\sqrt{3}}{2} + \frac{\sqrt{3}}{2} = \frac{3\sqrt{3}}{2}$

∴ difference between greatest value and least value

$= \frac{3\sqrt{3}}{2} + 2$

**100.** **(d)** A and B will agree in a certain statement if both speak truth or both tell a lie. We define following events

$E_1$ = A and B both speak truth $\Rightarrow P(E_1) = xy$

$E_2$ = A and B both tell a lie

$\Rightarrow P(E_2) = (1 - x)(1 - y)$

E = A and B agree in a certain statement

Clearly, $P(E/E_1) = 1$ and $P(E/E_2) = 1$

The required probability is $P(E_1/E)$.

Using Baye's theorem

$P(E_1/E)$

$= \frac{P(E_1)P(E/E_1)}{P(E_1)P(E/E_1) + P(E_2)P(E/E_2)}$

$= \frac{xy \cdot 1}{xy \cdot 1 + (1 - x)(1 - y) \cdot 1} = \frac{xy}{1 - x - y + 2xy}$

**101.** **(a)**

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$
$$\Rightarrow \frac{3}{4} = 1 - P(\bar{A}) + P(B) - \frac{1}{4}$$
$$\Rightarrow 1 = 1 - \frac{2}{3} + P(B) \Rightarrow P(B) = \frac{2}{3};$$

Now, $P(\bar{A} \cap B) = P(B) - P(A \cap B) = \frac{2}{3} -$

$\frac{1}{4} = \frac{5}{12}$.

**102.** **(a)** Let the line be $\frac{x}{a} = \frac{y}{b} = \frac{z}{c}$

If line (i) intersects with the line $\frac{x-1}{2} = \frac{y+3}{4} = \frac{z-5}{3}$, then

$$\begin{vmatrix} a & b & c \\ 2 & 4 & 3 \\ 4 & -3 & 14 \end{vmatrix} = 0$$

$\Rightarrow 9a - 7b - 10c = 0$

from (i) and (ii), we have

$$\frac{a}{1} = \frac{b}{-3} = \frac{c}{5}$$

$\therefore$ The line is $\frac{x}{1} = \frac{y}{-3} = \frac{z}{5}$

**103. (a)**

Given: $u_n = \int_0^{\pi/4} \tan^n \theta d\theta$

$$= \int_0^{\pi/4} \tan^2 \theta \tan^{n-2} \theta d\theta$$

$$= \int_0^{\pi/4} (\sec^2 \theta - 1)\tan^{n-2} \theta d\theta$$

$$= \int_0^{\pi/4} \sec^2 \theta \tan^{n-2} \theta d\theta$$

$$- \int_0^{\pi/4} \tan^{n-2} \theta d\theta$$

$$= \int_0^{\pi/4} \sec^2 \theta \tan^{n-2} \theta d\theta - u_{n-2}$$

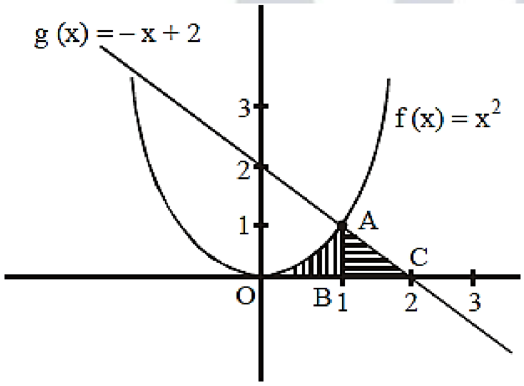
$$\Rightarrow u_n + u_{n-2} = \int_0^{\pi/4} \sec^2 \theta \tan^{n-2} \theta d\theta$$

$$= \frac{\tan^{n-1} \theta}{n-1}\Bigg|_0^{\pi/4} = \frac{1}{n-1}$$

**104. (a)** Total number of words that can be formed $= 10^5$. Number of words in which no letter is repeated ${}^{10}P_5$.

So, number of words in which at least one letter is repeated $= 10^5 \; {}^{10}P_5 = 69760$.

**105. (d)** Required area = Area of OAB + Area of ABC




Now, Area of OAB $= \int_0^1 f(x)dx + \int_1^2 g(x)dx$

$$= \int_0^1 x^2 dx + \int_1^2 (-x + 2)dx$$

$$= \frac{x^3}{3}\Big|_0^1 + \left[\frac{-x^2}{2} + 2x\right]_1^2$$
$$= \frac{1}{3} + \left[\left(\frac{-4}{2} + 4\right) - \left(\frac{-1}{2} + 2\right)\right]$$
$$= \frac{1}{3} + \left[(-2+4) - \left(\frac{3}{2}\right)\right]$$
$$= \frac{1}{3} + \frac{1}{2} = \frac{5}{6} \text{ sq unit}$$

**106.** **(a)** The line $\frac{x}{p} + \frac{y}{q} = 1$ will be a normal to the parabola $y^2 = 4ax$ if, for some value of m, it is identical with $y = mx - 2am - am^3$ i.e. $mx - y = (2am + am^3)$

Comparing coefficients, we get

$$\frac{m}{1/p} = \frac{-1}{1/q} = \frac{2am + am^3}{1} \Rightarrow mp = -q, \ \therefore$$
$$m = -\frac{q}{p} \text{ and } mp = m(2a + am^2)$$
$$p = 2a + am^2 = 2a + a\left(\frac{-q}{p}\right)^2$$
$$p = 2a + \frac{aq}{p^2}$$
$$p^3 = 2ap^2 + aq^2,$$

Which is the required condition.

**107.** **(b)** $P(E) = P(2 \text{ or } 3 \text{ or } 5 \text{ or } 7)$

$= 0.23 + 0.12 + 0.20 + 0.07 = 0.62$

$P(F) = P(1 \text{ or } 2 \text{ or } 3)$

$= 0.15 + 0.23 + 0.12 = 0.50$

$P(E \cap F) = P(2 \text{ or } 3)$

$= 0.23 + 0.12 = 0.35$

$\therefore P(EUF) = P(E) + P(F) - P(E \cap F)$
$= 0.62 + 0.50 - 0.35 = 0.77$

**108.** **(c)** $\tan^{-1}\frac{1}{2} + \tan^{-1}\frac{1}{3} + \tan^{-1}\frac{7}{8}$

$$= \left[\frac{\frac{1}{2} + \frac{1}{3} + \frac{7}{8} - \frac{1}{2} \times \frac{1}{3} \times \frac{7}{8}}{1 - \frac{1}{2} \times \frac{1}{3} - \frac{1}{3} \times \frac{7}{8} - \frac{7}{8} \times \frac{1}{2}}\right]$$

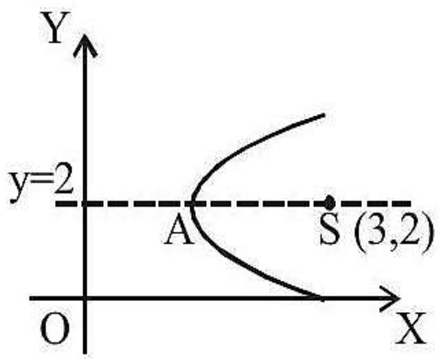
$$\left[\because \tan^{-1} x + \tan^{-1} y + \tan^{-1} z = \tan^{-1}\left(\frac{x + y + z - xyz}{1 - xy - yz - zx}\right)\right]$$

$$= \tan^{-1}\left[\frac{\frac{41}{24} - \frac{7}{48}}{1 - \frac{1}{6} - \frac{7}{24} - \frac{7}{16}}\right]$$

$$= \tan^{-1}\left[\frac{\frac{75}{48}}{1-\frac{43}{48}}\right] = \tan^{-1}\left(\frac{75}{48-43}\right)$$

$$= \tan^{-1}\left[\frac{75}{5}\right] = \tan^{-1} 15$$

**109.** **(b)** Vertex of the parabola is a point which lies on the axis of the parabola, which is a line $\perp$ to the directrix through the focus, i.e., $y = 2$ and equidistant from the focus and directrix $x = 0$, so that the vertex is $\left(\frac{3}{2}, 2\right)$.




**110.** **(b)** Let

$$A = \begin{bmatrix} -1 & 2 & 5 \\ 2 & -4 & a-4 \\ 1 & -2 & a+1 \end{bmatrix} \sim \begin{bmatrix} -1 & 2 & 5 \\ 0 & 0 & a+6 \\ 0 & 0 & a+6 \end{bmatrix}$$

$$[R_2 \to R_2 + 2R_1, R_3 \to R_3 + R_1]$$

Clearly rank of A is 1 if $a = -6$

Also, for $a = 1, |A| = \begin{vmatrix} -1 & 2 & 5 \\ 2 & -4 & -3 \\ 1 & -2 & 2 \end{vmatrix} = 0$

and $\begin{vmatrix} 2 & 5 \\ -4 & -3 \end{vmatrix} = -6 + 20 = 14 \neq 0$

$\therefore$ rank of A is 2 if $a = 1$

**111.** **(b)** $f(x) = 4\cos^3 x - \cos x - 2\cos x = \cos 3x$

[Expansion of determinant]

$$\therefore \int_0^{\pi/2} f(x)dx = \left[\frac{\sin 3x}{3}\right]_0^{\pi/2} = -\frac{1}{3}$$

**112.** **(a)** Equation of the line through $(1, -2, 3)$ parallel to the line $\frac{x}{2} = \frac{y}{3} = \frac{z-1}{-6}$ is

$\frac{x-1}{2} = \frac{y+2}{3} = \frac{z-3}{-6} = r$ (say)

Then any point on (1) is $(2r + 1, 3r - 2, -6r + 3)$

If this point lies on the plane $x - y + z = 5$ then

$(2r+1)-(3r-2)+(-6r+3)=5 \Rightarrow r=\frac{1}{7}$

Hence the point is $\left(\frac{9}{7},-\frac{11}{7},\frac{15}{7}\right)$

Distance between $(1,-2,3)$ and $\left(\frac{9}{7},-\frac{11}{7},\frac{15}{7}\right)$

$=\sqrt{\left(\frac{4}{49}+\frac{9}{49}+\frac{36}{49}\right)}=\sqrt{\left(\frac{49}{49}\right)}=1$

**113.** **(b)** The given equation of the curve is $y^2=4ax$

Differentiating both sides of (1) with respect to x, we get

$2y\frac{dy}{dx}=4a; \Rightarrow \frac{dy}{dx}=\frac{4a}{2y}=\frac{2a}{y}$

If $\psi$ be the angle which the tangent to the curve at $(x,y)$ makes with the positive direction of x-axis then $\tan\psi=\frac{dy}{dx}$ or $\tan\psi=\frac{2a}{y}$ ….(3), [using(2)]

At $x=a$, then from (1), $y^2=4a\cdot a=4a^2 \Rightarrow y=\pm 2a$.

Hence, we get two points $(a,2a)$ and $(a,-2a)$ on the curve.

At$(a,2a)x=a, y=2a$ and let $\psi=\psi_1$.

$\therefore$ from (3), $\tan\psi_1=\frac{2a}{2a}=1=\tan 45°$;

$\Rightarrow \psi_1=45°$

At$(a,-2a), x=a, y=-2a$ and let $\psi=\psi_2$.

$\therefore$ from (3), $\tan\psi_2=\frac{2a}{-2a}=-1=\tan 135°$;

or $\psi_2=135°$

Hence the required angle between tangents

to (1) at $(a,2a)$ and $(a,-2a)=\psi_2-\psi_1=135°\ 45°=90°$.

This shows that the tangent lines to (1) at (a, 2a) and (a, $-2a$ ) are perpendicular to each other.

**114.** **(a)** Eccentrcity of $\frac{x^2}{25}-\frac{y^2}{25\sin^2\alpha}=1$ is

$\sqrt{1+\sin^2\alpha}$

Eccentricity of $\frac{x^2}{5\sin^2\alpha}+\frac{y^2}{5}=1$ is

$\sqrt{1-\sin^2\alpha}$

Given, $\sqrt{1+\sin^2\alpha}=\sqrt{5}\sqrt{1-\sin^2\alpha}$

$\Rightarrow \sin^2 \alpha = \frac{2}{3}$

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

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

| $p$ | $q$ | $p \wedge q$ | $(p \wedge q) pp$ |
|---|---|---|---|
| $T$ | $T$ | $T$ | $T$ |
| $T$ | $F$ | $F$ | $T$ |
| $F$ | $T$ | $F$ | $T$ |
| $F$ | $F$ | $F$ | $T$ |

$\therefore (p \wedge q) \Rightarrow p$ is a tautology.

**116.** **(c)** We have, $f(x) = \lim_{n\to\infty} \frac{(2\sin x)^{2n}}{3^n - (2\cos x)^{2n}}$

$= \lim\limits_{n\to\infty} \frac{(2\sin x)^{2n}}{(\sqrt{3})^{2n} - (2\cos x)^{2n}}$

f(x) is discontinuous when

$(\sqrt{3})^{2n} - (2\cos x)^{2n} = 0$

i.e. $\cos x = \pm\frac{\sqrt{3}}{2} \Rightarrow x = n\pi \pm \frac{\pi}{6}$

**117.** **(d)** $V = 5x - \frac{x^2}{6} \Rightarrow \frac{dV}{dt} = 5\frac{dx}{dt}\frac{x}{3} \cdot \frac{dx}{dt}$

$\Rightarrow \frac{dx}{dt} = \frac{\frac{dV}{dt}}{\left(5 - \frac{x}{3}\right)}$

$\Rightarrow \left(\frac{dx}{dt}\right)_{x=2} = \frac{5}{5 - \frac{2}{3}} = \frac{15}{13}$ cm/sec

**118.** **(b)** Since vectors are coplanar

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

$\Rightarrow \begin{vmatrix} a & 1 & 1 \\ 1-a & b-1 & 0 \\ 0 & 1-b & c-1 \end{vmatrix} = 0$ [ Using $R_2 - R_1$

$R_3 - R_2]$

$\Rightarrow a(b-1)(c-1)-(1-a)\{(c-1)-(1-b)\}=0$

$\Rightarrow a(1-b)(1-c)+(1-a)(1-c)+(1-a)(1-b)$

$=$

$\Rightarrow (a-1+1)(1-b)(1-c)+(1-a)(1-c)$

$+(1-a)(1-b)=0$

$\Rightarrow (1-b)(1-c)+(1-a)(1-c)+(1-a)(1-b)$

$=(1-a)(1-b)(1-c)$

$$\Rightarrow \frac{1}{1-a}+\frac{1}{1-b}+\frac{1}{1-c}=1$$

**119.** **(c)** If $A=\begin{bmatrix}3 & -2 & 4\\ 1 & 2 & -1\\ 0 & 1 & 1\end{bmatrix}$

and $A^{-1}=\frac{1}{k}\mathrm{adj}(A)$

Also, we know $A^{-1}=\frac{\mathrm{adj}(A)}{|A|}$

∴ By comparing (i) and (ii)

$|A|=k$

$$\Rightarrow |A|=\begin{vmatrix}3 & -2 & 4\\ 1 & 2 & -1\\ 0 & 1 & 1\end{vmatrix}$$

$=3(2+1)+2(1+0)+4(1-0)$

$=9+2+4=15$

**120.** **(d)** Radius of circle

$=\sqrt{4+9-9\sin^2\alpha-13\cos^2\alpha}=2|\sin\alpha|$

If T be $(h,k)$ then as in Q. 44

$$\tan\alpha=\frac{2|\sin\alpha|}{\sqrt{h^2+k^2+4h-6k+9\sin^2\alpha+13\cos^2\alpha}}$$

$\Rightarrow h^2+k^2+4h-6k+9\sin^2\alpha$

$+13\cos^2\alpha=4\cos^2\alpha$

$\Rightarrow h^2+k^2+4h-6k+9=0$

∴ Locus of T is $x^2+y^2+4x-6y+9=0$

## PART-IV ENGLISH

**121.** **(c)**

**122.** **(d)**

**123.** **(a)**

**124.** **(c)**

**125.** **(b)** The best pronunciation of the word 'sorbet' is sore-bay.