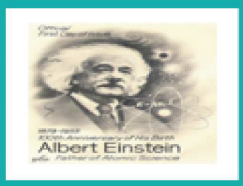
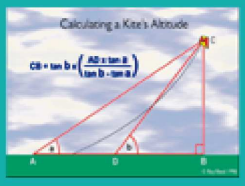
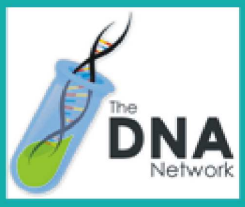
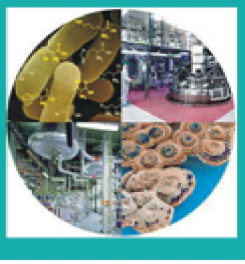










IIT-JAM - CHEMISTRY

MOCK TEST PAPER(According to new pattern)

- Attempt ALL the 60 questions.
- SECTION-A Consists of 30 questions. These questions are Multiple Choice Questions (MCQs),First 20 questions carries one marks for each and remaining 10 questions carries two marks for each.
- Section-B Consists of 10 questions. These questions are Multiple Select Questions (MSQs), each question carries two marks.
- Section-C Consists of 20 Numerical Answer Type (NAT) questions each question carries two marks. For each NAT type question, the answer is a signed real number.
- In Section A, for all 1 mark questions,1/3 marks will be deducted for each wrong answer and for all 2 marks questions,2/3 marks will be deducted for each wrong answer.There is no negative marking in Section B and Section C.

- *Total marks : 100*
- *Duration of test : 3 Hours*

For IIT-JAM, JNU, GATE, NET, NIMCET and Other Entrance Exams
Plot No.-8, Radha Nikunj-B Yojna, Near Iskcon Mandir, Muhana Mandi Road, Jaipur.302020
Web Site www.vpmclasses.com E-mail-vpmclasses@yahoo.com

SECTION-A (Q. 1-30)

MULTIPLE CHOICE QUESTIONs (MCQs)

1. The correct order of electron affinity among the following is :

(A) F > Cl > Br

(B) Cl > F > Br

(C) Br > Cl > F

(D) F > Br > Cl

2. In which of the following group of species, the hybrid state of carbon is same ?

(A) CH_4, C_2H_2, charcoal

(B) ethene, graphite, CO_2

(C) CO_2, propane, diamond

(D) CH_4, diamond, cyclohexane

3. A unit cell consists of a cube in which there are anions (B) at each corner and one at the centre of the unit cell and cations (A) at the centre of each face. What is the simplest formula for this compound ?

(A) AB

(B) AB_2

(C) A_3B_2

(D) A_2B_3

4. The nature of $B(OH)_3$ boric acid is

(A) Triacidic Base

(B) Tribasic acid

(C) Monoacidic Base

(D) Mono basic acid

5. XeF_6 on reaction with quartz gives :

(A) XeO_4

(B) XeO_3

(C) XeF_4

(D) $XeOF_4$

6. How many diastereomers are shown by the following molecule ?

$CH_3CH = CHCH = CHC_2H_5$

(A) 1

(B) 2

(C) 3

(D) 4

7. The order of stability of following carbocations is ,

(i) Tropylium cation

(ii) Allyl carbocation

(iii) Benzyl carbocation

(iv) Triphenylmethyl carbocation

(A) i > ii > iii > iv

(B) i > iv > iii > ii

(C) iv > iii > ii > i

(D) ii > iii > iv > i

8. The order of aromaticity of the following heterocycles

(i) Thiophene,

(ii) Pyrrole,

(iii) Furan

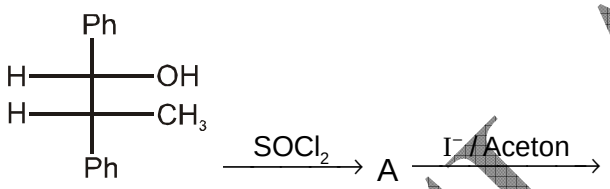
(A) ii > iii > i

(B) ii > i > iii

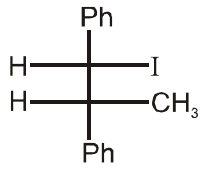
(C) i > ii > iii

(D) iii > ii > i

9. The end product formed in the following reaction is



(A)



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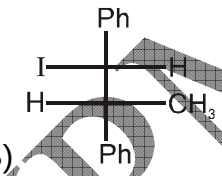
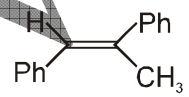
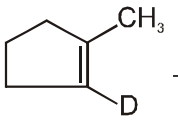


(C)

(D)



10. 

$\xrightarrow[NaBH_4]{Hg(OCOCH_3)/H_2O}$ A + B **isomers**

A & B isomers are :

(A) Identical

(B) Meso

(C) Diastereomers

(D) Pair of Enantiomers

11. What are the component values (in terms of h/2π) of the orbital angular momentum along the z-direction for a 2p electron ?

(A) $+\frac{1}{2}, -\frac{1}{2}$

(B) $+\frac{3}{2}, +\frac{1}{2}, -\frac{1}{2}, -\frac{3}{2}$

(C) +2, +1, 0, –1, –2

(D) +1, 0, –1

12. The correct order of first ionization potential is

(A) He > F > O > N > Mg

(B) N > F > He > O > Mg

(C) He > F > N > O > Mg

(D) F > He > N > Mg > O

13. Which of the following species have the same bond order ?

(I) CO

(II) CN^-

(III) O^+_2

(IV) NO^+

(A) I, II, III

(B) I, II, IV

(C) I, III, IV

(D) II, III, IV

14. Match List-I (compound) with List-II (shape) and select the correct answer :

	List-I (Compound)		**List-II (Shape)**
(a)	XeF_5^+	(1)	Tetrahedral
(b)	SiF_5^-	(2)	Square planar
(c)	AsF_4^+	(3)	Trigonal bipyramidal
(d)	ICl_4^-	(4)	Square pyramidal
		(5)	Octahedral

	a	**b**	**c**	**d**
(A)	1	2	5	3
(B)	4	3	1	2
(C)	1	3	5	2
(D)	4	2	1	3

15. HNO_3 on treatment with P_2O_5 products.

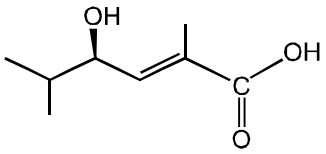
(A) N_2O_5

(B) NO_2

(C) HNO_2

(D) N_2O_4

16. For the compound



The stereochemical notations are

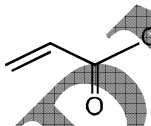
(A) 2Z, 4R

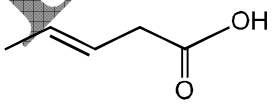
(B) 2Z, 4S

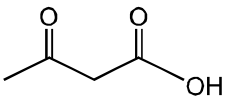
(C) 2E, 4R

(D) 2E, 4S

17. The correct order of decarboxylation of the three acids is

(I) 

(II) 

(III) 

(A) III > II > I

(B) III = II > I

(C) III > II = I

(D) III = II = I

18. (R)-Ph – $CHBrCH_3$ $\xrightarrow[EtOH]{aqeous}$ Ph – $CH(OH)CH_3$

Which statement is the most likely to be correct concerning the given S_N1 reaction.

(A) The reaction proceeds with partial racemization.

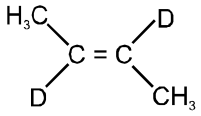
(B) The stereochemistry of the Halide is not inverted.

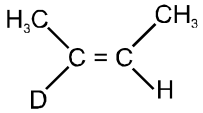
(C) The carbonium ion Ph – CH_2 – CH_2^+ is involved.

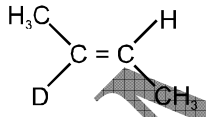
(D) The carbonium ion is attacked in each side to same degree.

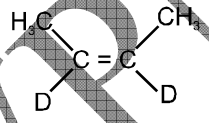
19. $CH_3 – C \equiv C – CH_3$ $\xrightarrow[(ii)\ CH_3COOD]{(i)\ BH_3,\ THF}$ **[X]**

The major product [X] is

(A) 

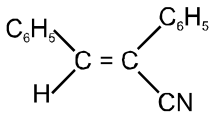
(B) 

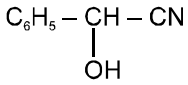
(C) 

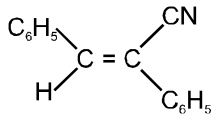
(D) 

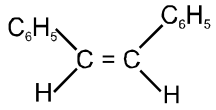
20. $C_6H_5CHO + C_6H_5 – CH_2CN \xrightarrow{\ominus OH}$ **[X]**

The major product [X] is

(A) 

(B) 

(C) 

(D) 

21. The wave number of the limiting line in Lyman series of hydrogen in 109678 cm^{-1}. The wave number of the limiting line in Balmer series of He^{+} would be (in cm^{-1}).

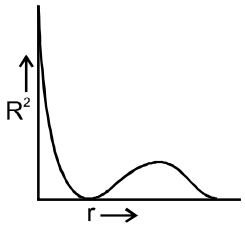
(A) 107879 cm^{-1}

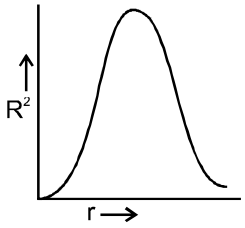
(B) 1096.78 cm^{-1}

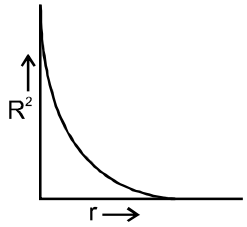
(C) 109678 cm^{-1}

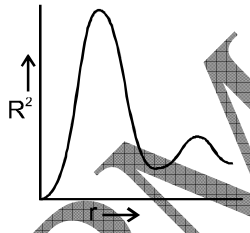
(D) 119658 cm^{-1}

22. Which of the following probability distribution curves represents 2s orbital for H-atom.

(A) 

(B) 

(C) 

(D) 

23. A gas causes heating effect when allowed to expand at room temperature, it shows heating effect because

(A) A gas has high critical temperature.

(B) A gas has inversion temperature much below room temperature.

(C) A gas has high Inter molecular forces above room temperature.

(D) A gas has inversion temperature above room temperature.

24. An ideal gas initially at 710 torr and 30ºC occupies 2600 ml. The final temperature if the conditions are changed to a pressure of 1.20 atm and a volume of 3.20 L is :

(A) 306ºC

(B) 206ºC

(C) 312ºC

(D) 226ºC

25. An ideal gas occupying a volume of 2 dm^3 at a presence of 5 bar undergoes isothermal and irreversible expansion against external pressure of 1 bar. The final volume of the system and the work involved in the process is :

(A) 10 dm^3, 1000 J

(B) 10 dm^3, –1000 J

(C) 8 dm^3, –800 J

(D) 10 dm^3, –800 J

26. Which of the following statements are correct about the following complex $[CrCl_2(OH)_2(NH_3)_2]^-$.

(A) It shows geometrical isomerism

(B) It does not show optical isomerism

(C) It shows ionization isomerism

(D) It shows hydrate isomerism

27. Which of the following compound on reaction with NaOH and Na_2O_2 gives yellow colour?

(A) $Cr(OH)_3$

(B) $Zn(OH)_2$

(C) $Al(OH)_3$

(D) None of these

28. What volume of 5.00 N H_2SO_4 is required to neutralize a solution containing 2.50 g NaOH ?

(A) 16.4 ml

(B) 10.2 ml

(C) 13.5 ml

(D) 12.5 ml

29. In the trigonal bipyramidal crystal field the d-orbital with the Highest energy is

(A) dxy

(B) $dx^2 - y^2$

(C) dyz

(D) dz^2

30. What mass of N_2H_4 can be oxidized to N_2 by 24.0 g K_2CrO_4, which is reduced to $Cr(OH)_4^-$?

(A) 4.28 g

(B) 2.15 g

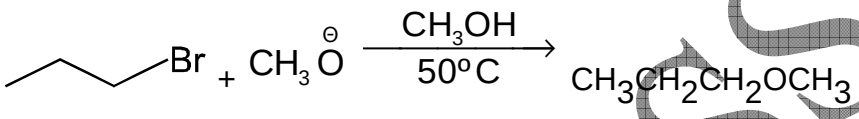
(C) 2.97 g

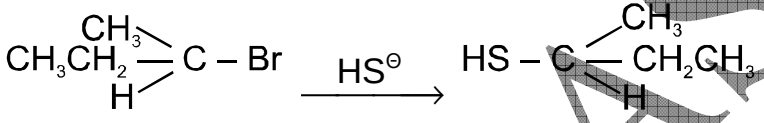
(D) 3.25 g

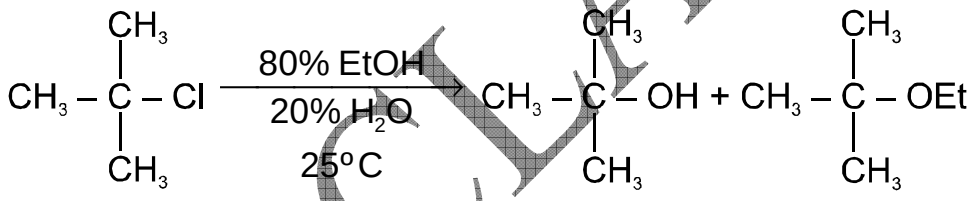
SECTION-B (Q. 31-40)

MULTIPLE SELECT QUESTIONs (MSQs)

31. Which of the following reaction occur by SN^2 mechanism.

(A) 

(B) 

(C) 

(D) $C_6H_5 - CH_2 - CH_2 - Br \xrightarrow{KOH} C_6H_5CH_2CH_2OH$

32. Which of the following metals contain (Al) Aluminium as a metal?

(A) Bauxite

(B) Cryolite

(C) Corundum

(D) Kaolin

33. In phase equilibria :

(A) Sulphur system consist of six stable curve and four metastable curve.

(B) Sulphur system consist of 3 triple point.

(C) At the triple and eutectic point the degree of freedom is zero.

(D) In water system triple point exist at 4.5 mm of Hg pressure.

34. $^{234}_{90}Th$ disintegrates to give $^{206}_{82}Pb$ for this disintegration.

(A) The mass of α-particle emitted is four.

(B) The mass of β-particle emitted is zero.

(C) The no. of α-particle emitted is 7.

(D) The no. of β-particle emitted is 6.

35. An Aliphatic Ketone M.W. 86, when converted into its oxime which is then reduced, gives an amine that can be resolved. What is this Ketone?

(A) $CH_3CH_2COCH_2CH_3$

(B) $CH_3COCH_2CH_2CH_3$

(C) $CH_3COCH(CH_3)_2$

(D) $(CH_3)_3CC(O)H$

36. In NMR spectroscopy :

(A) In P_4S_3 molecule ^{31}P-NMR give quadrate doublet signal.

(B) In HPF_2 molecule ^{19}F-NMR give quadrate signal.

(C) In HPF_2 molecule ^{19}F-NMR give doublet signal.

(D) In P_4S_3 molecule ^{32}S-NMR give quintet signal.

37. Oxyacids of bromine :

(A) HOBr

(B) $HBrO_2$

(C) $HBrO_3$

(D) $HBrO_4$

38. The vapour pressure of ethanol and methanol are 44.5 mm and 88.7 mmHg respectively. An ideal solution is formed at the same temperature by mixing 60 gm of ethanol with 40 gm of methanol. So :

(A) The total vapour pressure of solution is 66.13 mm of Hg.

(B) mol fraction of ethyl alcohol is .4893.

(C) mol fraction of methyl alcohol is .5107.

(D) mol fraction of methyl alcohol in vapour is 0.6563.

39. Which of the following pair is buffer :

(A) Potassium acid phthalate + Di potassium phthalate

(B) Borax + NaOH

(C) Boric Acid + Borax

(D) Na_2HPO_4 + NaH_2PO_4

40. Acetylene is formed by the following reactions

(A) $6CH_4 + O_2 \xrightarrow{\text{high temp.}}$

(B) $BrCH_2CH_2Br \xrightarrow{NaNH_2}$

(C) $CHI_3 + 6Ag + CHI_3 \xrightarrow{\Delta}$

(D) $\begin{matrix} CCu \\ \| \\ CCu \end{matrix} + 2HCl \longrightarrow$

PART C (41 - 60)

41. The amount of ^{14}C isotope in a piece of wood is found to be one-sixth of its amount present in a fresh piece of wood. Calculate the age of wood. (Half life of ^{14}C = 5577 years).

42. The heats of hydrogenation of cycloheptene and 1,3,5-cycloheptatriene are 110 kJ/mol (26.3 kcal/mol) and 305 kJ/mol (73.0 kcal/mol), respectively. In both cases cycloheptane is the product. What is the resonance energy of 1,3,5-cycloheptatriene?

43. The EMF of the concentration cell with transference, viz., Pt; H_2 (1 atm), HCl ($a_{\pm}$ = 0.009048) : HCl ($a_{\pm}$ = 0.01751), H_2(1 atm); Pt, is 0.02802 V at 25ºC. The EMF of the corresponding cell without transference is 0.01696 V. Calculate the liquid junction potential, E_t and the transference number of the H^+ ion.

44. At 100ºC, the specific volumes of water and steam are, respectively, 1 c.c. and 1673 c.c. Calculate the change in vapour pressure of the system by 1ºC change in temperature. The molar heat of vaporisation of water in this range may be taken as 9.70 kcal.

45. N_2O_4 is 25% dissociated at 37ºC and one atmospheric pressure. Calculate the percentage dissociation at 0.1 atmosphere and 37ºC.

46. N_2O_4 is 25% dissociated at 37ºC and one atmospheric pressure. What is the minimum pH of a solution 0.10 M in Mg^{2+} from which $Mg(OH)_2$ will not precipitate? K_{sp} $Mg(OH)_2 = 1.2 \times 10^{-11}$ M^3.

47. n-butane is produced by the monobromination of ethane followed by the wurta reaction. Calculate the volume of ethane at STP required to produce 55gm n-butane If the bromination takes place with 90% yield and the wurtz reaction with 85% yield.

48. Calculate the wave number for the shortest wavelength transition in the Balmer series of atomic hydrogen.

49. Electromagnetic radiation of wave length 242 mm is just sufficient to ionize the sodium atom. Calculate the ionization energy of sodium in KJ mol^{-1}.

50. The composition of a sample of wustite is $Fe_{0.93}O_{1.00}$. What % of Iron is present in the form of Fe (III).

51. A metal complex having composition $Cr(NH_3)_4$ Cl_2Br has been isolated in two forms A and B. The form A react with $AgNo_3$ to give a white precipitate readily soluble in dilute aqueous ammonia, whereas B gives a pale yellow precipitate soluble in concentrated ammonia. What is their magnetic moment of compound A & B.

52. An acid type indicator, HIn differs in colour from its conjugate base (In). The human eye is sensitive to colour differences only when the ratio $[In^-]/[HIn]$ is greater than 10 or smaller than 0.1. What should be the minimum change in the pH of the solution to observe a complete colour change ($Ka = 1.0 \times 10^{-5}$)

53. For a first order reaction the energy of activation is 210 kJ mol^{-1}, and the frequency factor is 2×10^{12} s^{-1}. What is the half life of the reaction at 700 k.

54. 36.4 gm of 1,1,2,2- tetrachloropropane was heated with zinc dust and the product was bubbled through ammoniacal $AgNO_3$. What is the weight of the ppt.

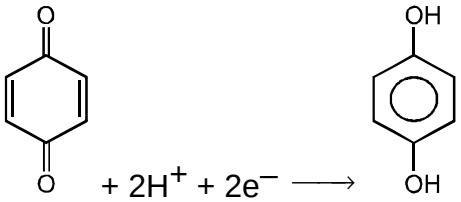
55. Calculate the number of radial nodes in 4F.

56. 0.66 g of H_3PO_2 will require x ml of 0.1 M NaOH for complete neutralization. Find out the value of x.

57. What is the number of dipeptides that can be prepared from alanine and phenylalanine?

58. Calculate the ionic strength of a solution that contains 0.1 mol/kg NaCl and 0.05 mol/kg Na_2SO_4.

59. Calculate the half cell potential for the quinhydrone electrode



set up at pH = 4 will be (quinhydrone = 1 : 1 molecular compound of quinone (Q) and hydroquinone (QH_2), E^o = 0.699 V).

60. The equilibrium pressure of $NH_4CN(s) \rightleftharpoons NH_3(g) + HCN(g)$ is 0.298 atm. Calculate K_p. If $NH_4CN(s)$ is allowed to decompose in presence of NH_3 at 0.25 atm, calculate partial pressure of HCN at equilibrium.

ANSWER KEY

HINTS & SOLUTIONS

1. (B) ∵ In a group electron affinity is decreased when we go up to down.

∗ But electron affinity of F is less than that of Cl due to its extremely small size.

So order is Cl > F > Br.

2. (D) The hybrid state of C in CH_4, diamond and cyclohexane is sp^3.

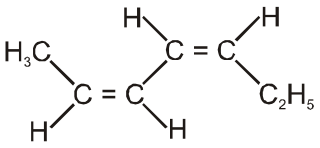
3. (C) No. of anions (B) present in the unit cell = $\frac{1}{8} \times 8 + 1 \times 1 = 1 + 1 = 2$

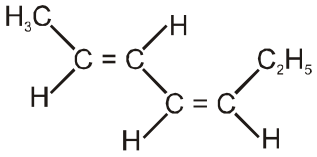
No. of cations (A) present in the unit cell = $6 \times \frac{1}{2} = 3$

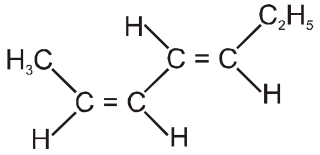
∴ Formula of the compound = A_3B_2

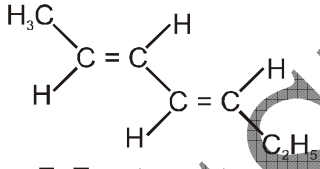
4. (D) $B(OH)_3$ is Mono basic acid.

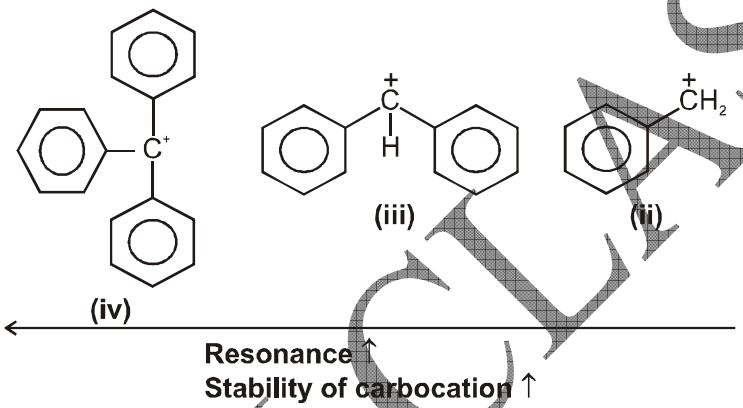
5. (D) $2XeF_6 + SiO_2 \rightarrow 2XeOF_4 + SiF_4$.

6. (D) (A) 
Z, Z or cis-, cis

(B) 
E, Z or trans, cis

(C) 
Z, E or cis, trans

(D) 
E, E or trans, trans

7. (B) 

In iv & i, (i) is more stable due to aromaticity.

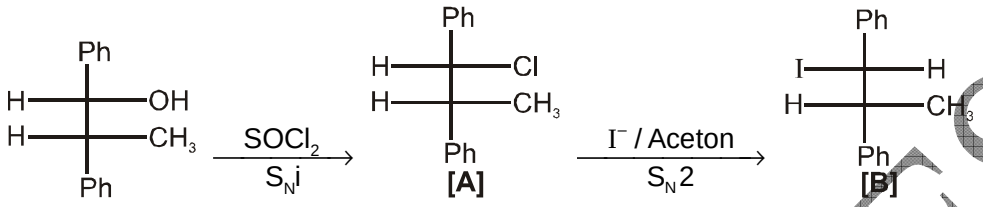
Aromatic

So order of carbocation stability i > iv > iii > ii.

8. (C) The aromatic character in these p-excessive heterocycles depends on the availability of lone pair of electrons on the heteroatom for cyclic delocalization which, in turn, depends on the electronegativity of heteroatom. The more electronegative heteroatom will have stronger attraction for the lone pair of electrons and will make it less available for cyclic delocalization. The aromaticity order in these heterocycles depends on the electronegativity of the heteroatom : O

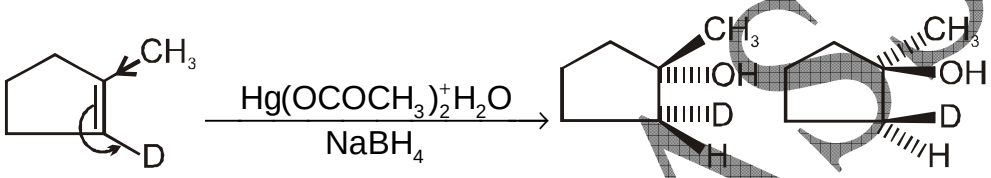
> N > S and therefore, the aromaticity follows the order as : thiophene > pyrrole > furan.

9. (B)



10.(D) **Oximercuration Demercuration :** [(i) $Hg(OCOCH_3)_2/H_2O$; (ii) $NaBH_4$]

It's give anti addition of H_2O on alkene acc. to marckonicoff rule. So the reaction is



or **Pair of Enantiomer**

11.(D) The component values of orbital angular momentum in z-direction = m_ℓ ×

m_ℓ for 2p = +1, 0, –1

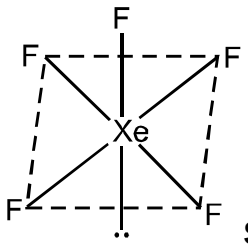
12.(C) He F N O Mg

$1s^2 > 2p^5 > 2p^3 > 2p^4 > 3s^2$

13.(B) CO (10 valence electrons) : B.O. = 3; CN^- (10) : B.O. = 3, O^+_2 (11) : B.O. = 2.5;

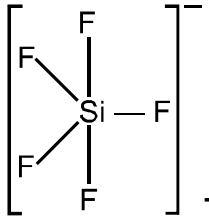
NO^+ (10) : B.O. = 3

14.(B) XeF_5^- — sp^3d^2 Hybridization



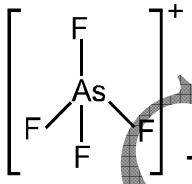
Square Pyramidal

SiF_5^- — sp^3d Hybridization



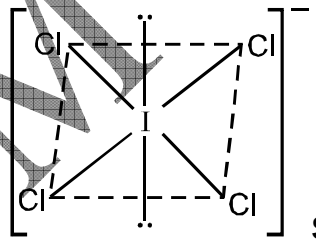
Trigonal bipyramidal

AsF_4^+ — sp^3 Hybridization



Tetrahedral

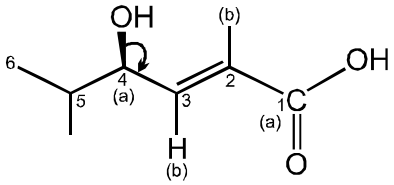
ICl_4^- — sp^3d^2 Hybridization



Square planar

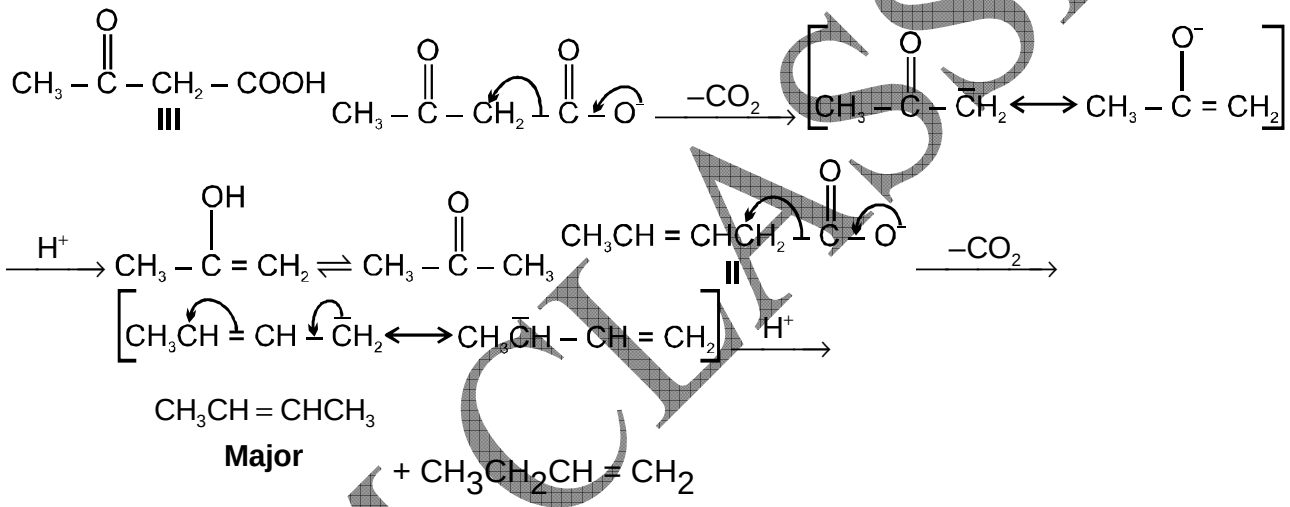
15.(A) $2P_2O_5 + 4HNO_3 \rightarrow 2N_2O_5 + 4HPO_3$

16.(C)

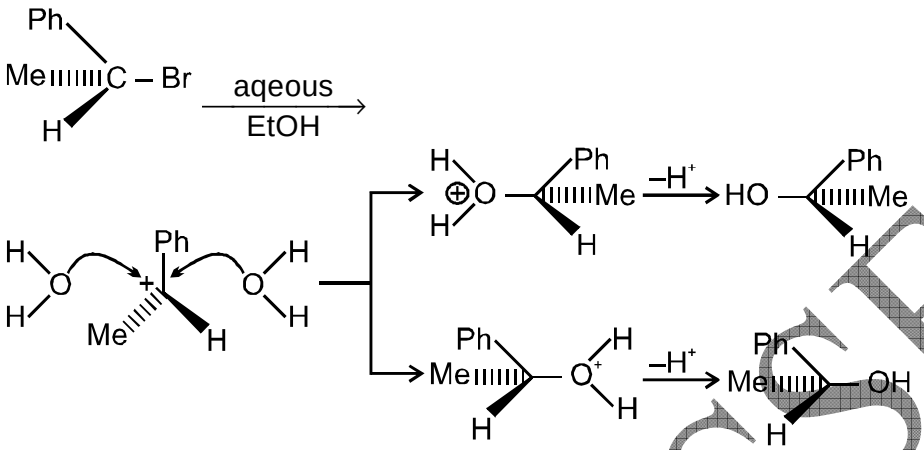


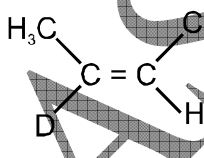
4R, 2E

17.(B) β-Keto carboxylic acids and β, γ-unsaturated carboxylic acids undergo decarboxylation easily because the corresponding carbanion is quite stable due to resonance.

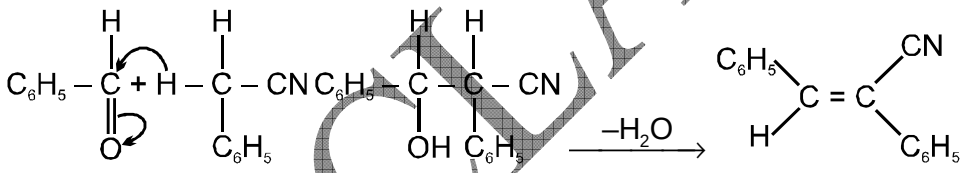


18.(D)



19.(B) $H_3C - C \equiv C - CH_3$ $\xrightarrow[(ii)\ CH_3COOD]{(i)\ BH_3,\ THF}$ 

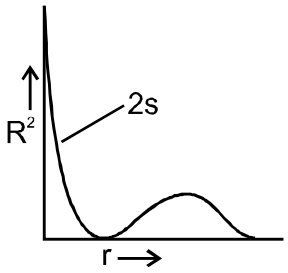
20.(C)



21.(C) $R_H = 109678\ cm^{-1}$

Wave number of the limiting line in Balmer Series of $He^+ = R_H.Z^2 = \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) 109678 \times (2)^2 \left[\frac{1}{(2)^2} - \frac{1}{\infty}\right]$

$= 109678\ cm^{-1}$.



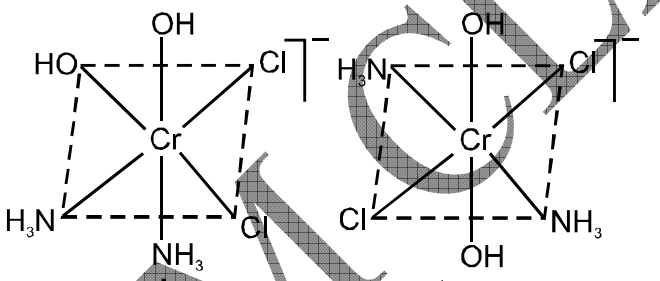
22.(A)

23.(D) If gas is allowed to expand above its inversion temperature it causes heating effect.

24.(B) $T_2 = \dfrac{P_2V_2T_1}{P_1V_1} = \dfrac{1.20 \times 760 \times 3.20 \times 303}{710 \times 2.60}$ = 479 K = 206°C

25.(D) $V_f = \dfrac{P_iV_i}{P_f} = \dfrac{(5\text{ bar}) \times (2\text{ dm}^3)}{1\text{ bar}}$ = 10 dm^3

work $w = -P_{ext}(V_f - V_i) = -(1\text{ bar})(10 - 2)\text{ dm}^3 = -1 \times 10^5\text{ Pa} \times 8 \times 10^{-3}\text{ m}^3 = -800$ J



26.(A)

Cis isomer can show optical isomerism also because it has three different types of unidentate ligand.

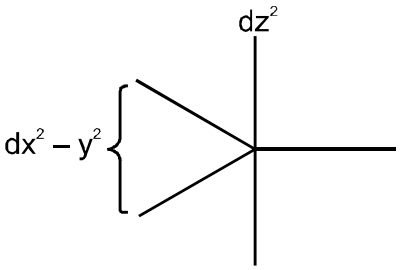
27.(A) $2Cr(OH)_3 + 3[O] + 4NaOH \rightarrow 2Na_2CrO_4 + 5H_2O$

(from Na_2O_2) yellow colour

28.(D) Number of equivalents in 2.50 g NaOH = $\dfrac{2.50\text{ g}}{40.0\text{ g/eq}}$ = 0.0625 eq NaOH

Therefore, 0.0625 eq H_2SO_4 is required.

(0.0625 eq) $\left(\frac{1\,L}{5.00\ eq}\right)$ = 0.0125 L = 12.5 mL of 5.00 N solution

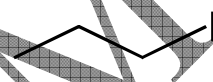


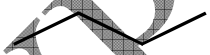
29.(D)

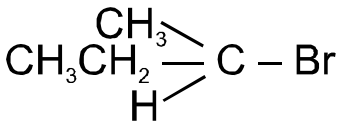
In the trigonal bipyramidal crystal field the d-orbital with the Highest energy is dz^2.

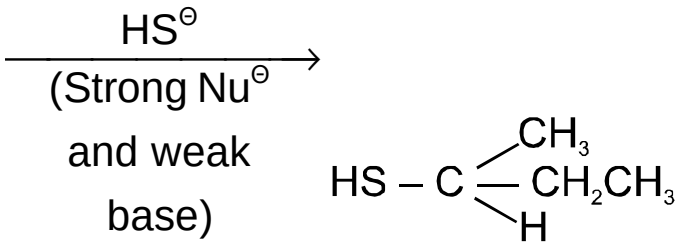
30.(C) The balanced equation is $4H_2O + 3N_2H_4 + 4CrO_4^{2-} \rightarrow 3N_2 + 4Cr(OH)_4^- + 4OH^-$

(24.0 g K_2CrO_4) $\left(\frac{1\,mol\,K_2CrO_4}{194.2\,g\,K_2CrO_4}\right)\left(\frac{3\,mol\,N_2H_4}{4\,mol\,CrO_4^{2-}}\right)$ = (0.0927 mol N_2H_4) = $\left(\frac{32.0\,g}{mol}\right)$ 2.97 g

31. (A), (B), (D) (A)  $+ CH_3\overset{\ominus}{O} \xrightarrow[50^oC]{CH_3OH} CH_3CH_2CH_2OCH_3$

 is a 1º halide. The base/Nu^- is a $CH_3\overset{\ominus}{O}$ strong base (not a hindered one) and a Nu^-. Hence it give mainly SN^2 product.

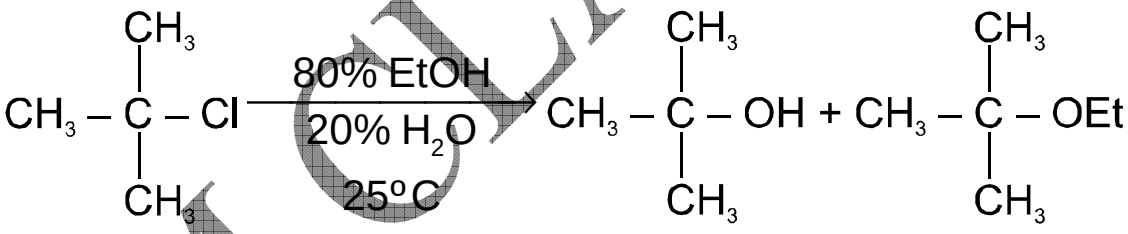
(B)  **(Stereocenter)**



[(R)Stereoisomer]

SN^2 with inversion

(D) $Br - CH_2 - CH_2 - C_6H_5$ **(1° halide)** $\xrightarrow[SN^2]{KOH}$ $C_6H_5CH_2CH_2OH$

(C) 

SN^1 mechanism

32. (A), (B), (C), (D) Bauxite — $Al_2O_3.2H_2O$

Cryolite — Na_3AlF_6

Corundum — Al_2O_3

Kaolin (China Clay) — $Al_2Si_2O_7.2H_2O$

33. (A), (C), (D) The sulphur system consist 6 stable curve & 4 metastable curve.

The sulphur system consist four triple point. At the triple point

$F = C - P + 2 = 1 - 3 + 2 = 0$

At the eutectic point

$F = C - P + 1 = 2 - 3 + 1 = 0$

In water system the triple point exist at .0078ºC temperature & 4.58 mm of Hg pressure.

34. (B), (C), (D) $^{234}_{90}Th \longrightarrow {}^{206}_{82}Pb$

Decrease in mass = 234 – 206 = 28

Mass of α-particle = 4

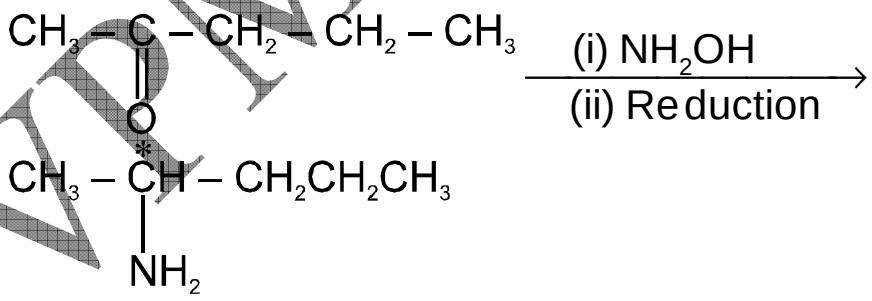
So no. of α-particle = $\frac{28}{4} = 7$

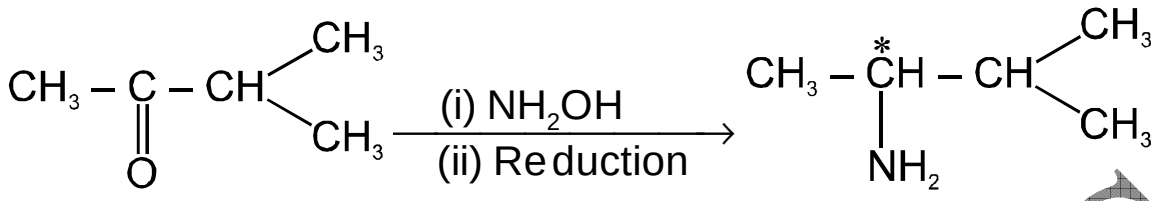
Mass of the α-particle emitted is $7 \times 4 = 28$

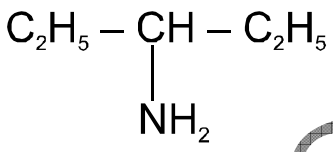
No. of β-particle emitted = (2 × no. of α-particle) – (atomic no. of parent – at. no. of end product) = 14 – (8) = 6

Mass of the emitted β-particle is = zero.

35. **(B)** **&** **(C)**

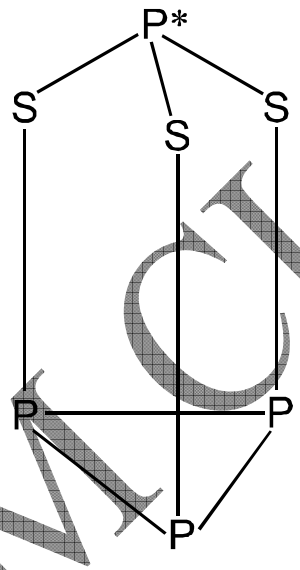






[A] ⇒ Non resolvable compound is formed.

[D] ⇒ It is a Aldehyde.



36. (A), (B) P_4S_3

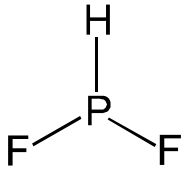
$\Rightarrow I_P = \frac{1}{2}$

⇒ give 2-signal.

$\Rightarrow {}^{31}P$ NMR $= 2 \times 3 \times \frac{1}{2} + 1 = 4$ peak

^{31}P NMR = $2 \times 1 \times \frac{1}{2} + 1 = 2$ peak

So ^{31}P NMR give quadrat doublet signal & for ^{32}S = I = 0 so does not give signal in NMR spectroscopy.

$\Rightarrow HPF_2 \Rightarrow$ 

$I_P = \frac{1}{2}$, $I_F = \frac{1}{2}$, $I_H = \frac{1}{2}$.

^{31}P NMR = $\left(2\times2\times\frac{1}{2}+1\right)\times\left(2\times1+\frac{1}{2}+1\right)$

= 3 × 2 = 6 peak

^{19}F-NMR = $\left(2\times1\times\frac{1}{2}+1\right)\times\left(2\times1\times\frac{1}{2}+1\right)$ = 4 peak

^{1}H-NMR give = $\left(2\times2\times\frac{1}{2}+1\right)\left(2\times1\times\frac{1}{2}+1\right)$ = 3 × 2 = 6 peak

37. (A, C, D) Oxyacids of bromine HOBr, $HBrO_3$ and $HBrO_4$

38. (A, D) Mol. mass of ethyl alcohol = C_2H_5OH = 46

No. of moles of ethyl alcohol = $\frac{60}{46}$ = 1.304

Mol. mass of methyl alcohol = CH_3OH = 32

No. of moles of methyl alcohol = $\frac{40}{32}$ = 1.25

'X_A' mole fraction of ethyl alcohol = $\frac{1.304}{1.304+1.25}$ = 0.5107

'X_B' mol fraction of methyl alcohol = $\frac{1.25}{1.304+1.25}$ = 0.4893

Partial pressure of ethyl alcohol = $X_A P_A^o$ = 0.5107 × 44.5 = 22.73 mm Hg

Partial pressure of methyl alcohol = $X_B P_B^o$ = 0.4893 × 88.7 = 43.40 mm Hg

Total vapour pressure of solution = 22.73 + 43.40 = 66.13 mm Hg

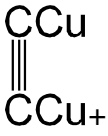
Mol. fraction of methyl alcohol in the vapour = $\frac{\text{Partial pressure of } CH_3OH}{\text{Total vapour pressure}}$

= $\frac{43.40}{66.13}$ = 0.6563

39. (A, B, C, D)

		P_H **range**
Potassium acid phthalate + Dipotassium phthalate	⇒	4.0 – 6.2
$Na_2HPO_4 + NaH_2PO_4$	⇒	5.9 – 8.0
Boric acid + Borax	⇒	6.8 – 9.2
Borax + NaOH	⇒	9.2 – 11.0

40. (A, C, D) $6CH_4 + O_2 \rightarrow 2HC \equiv CH + 2CO + 4H_2$



$$+ 2HCl \rightarrow 2CuCl\downarrow + CH \equiv CH$$

$$CHI_3 + 6Ag + I_3HC \xrightarrow{\Delta} CH \equiv CH + 6AgI$$

$$BrCH_2CH_2Br \xrightarrow{2NaNH_2} CH \equiv CH$$

$$\downarrow NaNH_2$$

$$Br - CH = CH_2$$

41. 14422.9

From the given data, if N_0 denotes original amount of ^{14}C, $t_{0.5}$ = 5577 years; N = $\frac{N_0}{6}$

From Eqn,

$$t_{0.5} = \frac{0.693}{\lambda} = 5577 \text{ years}$$

∴ The disintegration constant of ^{14}C,

$$\lambda = \frac{0.693}{5577} \text{ year}^{-1}$$

Substituting the value of

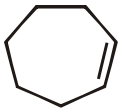
$$\lambda = \frac{0.693}{5577} \text{ and } N = \frac{N_0}{6} \text{ in Equ, we get}$$

$$\lambda = \frac{2.303}{t} \log \frac{N_0}{N}$$

$$\frac{0.693}{5577} = \frac{2.303}{t} \log \frac{N_0}{N_0/6} = \frac{2.303}{t} \log 6 = \frac{2.303 \times 0.7782}{t}$$

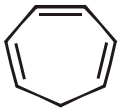
Thus, t, the age of wood = $\frac{2.303 \times 0.7782 \times 5577}{0.693}$ = **14422.9 years.**

42. 25/5.9

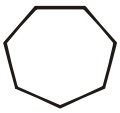


Given **Cycloheptene** + H_2 $\xrightarrow{\Delta H^o = -110 \text{ kJ}(-26.3 \text{ kcal})}$  **Cycloheptane**

and assuming that there is no resonance stabilization in 1,3,5-cycloheptatriene, we predict that its heat of hydrogenation will be three times that of cycloheptene or 330 kJ/mol (78.9 kcal/mol). The measured heat of hydrogenation is



1,3,5-Cycloheptatriene

+ H_2 $\xrightarrow{\Delta H^o = -305 \text{ kJ}(-73.0 \text{ kcal})}$  **Cycloheptane**

Therefore

Resonance energy = 330 kJ/mol (predicted for no delocalization) – 305 kJ/mol (observed)

= 25 kJ/mol (5.9 kcal/mol)

The value given in the text for the resonance energy of benzene (152 kJ/mol) is six times larger than this. 1,3,5-Cycloheptatriene is not aromatic.

43. 0.8263

Since the concentration cell with transference includes in it the liquid junction potential while the cell without transference does not, the liquid junction potential would be given by

$$E_{l.} = E_{w.t.} - E_{w.o.t.} = 0.02802 - 0.01696 = 0.01106 \text{ V}$$

As during the operation of the cell, there is transfer of HCl from a solution of higher activity to one of lower activity, therefore we have

$$E_l = (t_- - t_+)\frac{RT}{F} \ln \frac{(a_\pm)_2}{(a_\pm)_1} = (t_- - t_+) \times 0.0591 \log \frac{0.009408}{0.01751}$$

$$0.01106 = (t_1 - t_+) \times (-0.016946) \quad \text{or} \quad t_+ - t_- = \frac{0.01106}{0.01694} = 0.6527$$

Since $t_+ + t_- = 1$, hence $t_+ = 0.8263$

Thus, the transference number of H^+ ion = **0.8263**

44. 27.08

Molar volume of liquid water, $V_l = 18 \text{ cm}^3 \text{ mol}^{-1} = 18 \times 10^{-6} \text{ m}^3 \text{ mol}^{-1}$

Molar volume of steam, $V_g = 18 \times 1673 \text{ cm}^3 \text{ mol}^{-1} = 30114 \times 10^{-6} \text{ m}^3 \text{ mol}^{-1}$

Heat of vaporisation, $\Delta H_V = 9700 \text{ cal mol}^{-1} \times 4.184 \text{ J cal}^{-1} = 40584.8 \text{ J mol}^{-1}$

$$\frac{dP}{dT} = \frac{\Delta H_v}{T(V_g - V_l)}$$

In this case, dT = 1 K and T = 273 + 100 = 373 K

$\therefore$ dP = $\frac{40584.8\ J\ mol^{-1} \times 1\ K}{373\ K(30114-18)\times 10^{-6} m^3 mol^{-1}}$ = **0.00361 × 10^6 N m^{-2}** (J = newton metre)

= 0.03561 atm = **27.08 mm of Hg** (1 atm = 101325 N m^{-2})

Thus, the vapour pressure of water increases by about 27 mm of Hg by 1ºC rise in temperature, at 100ºC.

45. 63.2

	$N_2O_4(g)$	$2NO_2(g)$
Initial	1	0
At equilibrium	(1 – x)	2x

Total moles = (1 – x) + 2x = (1 + x)

$$p_{N_2O_4} = \left(\frac{1-x}{1+x}\right)P, p_{NO_2} = \frac{2x}{(1+x)}.P$$

Given, x = 0.25 and P = 1 atm.

$$p_{N_2O_4} = \left(\frac{1-0.25}{1+0.25}\right)\times 1 = 0.6 \text{ atm.}$$

$$p_{NO_2} = \left(\frac{2\times 0.25}{1+0.25}\right)\times 1 = 0.4 \text{ atm.}$$

$$K_p = \frac{(p_{NO_2})^2}{p_{N_2O_4}} = \frac{0.4\times 0.4}{0.6} = 0.267 \text{ atm}$$

Let the degree of dissociation of N_2O_4 at 0.1 atm be 'α', then

$$p_{N_2O_4} = \left(\frac{1-\alpha}{1+\alpha}\right)\times 0.1 \quad \text{and} \quad p_{NO_2} = \frac{2\alpha}{(1+\alpha)}\times 0.1$$

$$K_p = \frac{0.4\alpha^2}{(1-\alpha^2)} \text{ or } \quad 0.267 = \frac{\left(\frac{2\alpha}{1+\alpha}\right)^2 \times (0.1)^2}{\left(\frac{1-\alpha}{1+\alpha}\right) \times 0.1} = \frac{4\alpha^2 \times 0.1}{(1-\alpha)(1+\alpha)} = \frac{0.4\alpha^2}{(1-\alpha^2)}$$

or $0.267 = 667\alpha^2$

$\alpha = 0.632$

Hence dissociation of N_2O_4 = 63.2%.

46. 9.04

Given that $K_{sp}\ Mg(OH)_2 = [Mg^{2+}][OH^-]^2$

$1.2 \times 10–11 = [0.1][OH^-]^2$

$[OH^-]^2 = 1.2 \times 10^{-10}$

$[OH^-] = 1.095 \times 10–5$ M

$pOH = -\log_{10}(1.095 \times 10^{-5}) = 4.96$

$pH = 14 – 4.96 = 9.04$

Thus at 9.04 pH, precipitation will not take place.

47. 55.50

The production of n-butane may be represented by the following equation.

$C_2H_6 + Br_2\ C_2H_5Br + HBr$ 90% Bromination

$2C_2H_5Br + 2Na\ C_4H_{10} + 2NaBr$ 85% Wurtz reaction

Mass of n-butane to be produced = 55 gm

Molecular mass of C_4H_{10} = 4x 12 + 10 x 1 = 58 gm/ mol.

Mole of C_4H_{10} in 55gm = $\frac{55gm}{58gm/mol} = 0.948mol.$

From wurtz reaction ,we find that

1 mol C_4H_{10} = 2 mol C_2H_5Br when yield is 100%

0.948 mol C_4H_{10} = 2x 0.948 x $\frac{100}{85}$ mol C_2H_5Br

(when yield is 85%)

= 2.23 mol C_2H_5Br

For bromination reaction of 90% yield it is found that

1 mol C_2H_5Br = 1 mol C_2H_6 when yield is 100 %

= 1x $\frac{100}{90}$ mol C_2H_6 when yield is 90%

2.23 mol C_2H_5Br = 2.23 x $\frac{100}{90}$ mol C_2H_6

= 2.478 mol C_2H_6

1 mol C_2H_6 = 22.4L at STP

2.478 mol C_2H_6 = 2.478 x 22.4L = 55.50 L

48. 27419.2

Wave number = $\frac{1}{\lambda} = \bar{v} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$R_H \Rightarrow$ Rydberg constant = 109677 cm^{-1}

$n_1 \Rightarrow 2$ for balmer series

$n_2 \Rightarrow \infty$ for shortest wavelength

$$\bar{v} = 109677 \text{ cm} \left[\frac{1}{(2)^2} - \frac{1}{(\infty)^2}\right]$$

$\bar{v} = 27419.2 \text{ cm}^{-1}$

49. 494.5

Energy of electromagnetic radiations $E = h\nu = \frac{hc}{\lambda}$

$h = 6.6 \times 10^{-34}$ JS

$c = 3 \times 10^8$ m/s

$\lambda = 242$ nm $= 242 \times 10^{-9}$ m.

$$E = \frac{hc}{\lambda} = \frac{6.6 \times 10^{-34} \text{ Jsec} \times 3 \times 10^8 \text{ m/sec}}{242 \times 10^{-9} \text{ m}}$$

$= 8.21 \times 10^{-19}$ J

Energy required to ionise one mole of Na atom = Energy needed to ionise one Na atom x Avogadro No.

$= E \times N_A$

$= 8.21 \times 10^{-19} \text{ J} \times 6.023 \times 10^{23} \text{ mol}^{-1}$

$= 4.945 \times 10^5 \text{ J mol}^{-1}$

I.E. of Na = 494.5 KJ mol^{-1}

50. 15.05

The Formula of ore is $Fe_{0.93}\ O_{1.00}$

Number of O atom per 100 unit of wustite = 100

Number of -ive charge due to O atom =200

Number of Fe atom per 100 unit of wustite =93

Number of +ive charge due to 93 Fe atom = 200

Total No. of Fe^{+2} ion = **X**

Total No. of Fe^{+3} ion = y

$x + y = 93$ &

& $x = 93 - y$.

$x\ Fe^{+2} + y\ Fe^{+3} = 200$

$(93 - y)\ Fe^{+2} + y Fe^{+3} = 200$

$93\ Fe^{+2} + (Fe^{+3} - Fe^{+2})y = 200$

$93 \times 2 + (3-2)y = 200$

$186 + y = 200$

$y = 200 - 186$

$y = 14$ = No of Fe^{3+} ion.

$$\% \text{ of } Fe^{3+} = \frac{14}{93} \times 100$$

$= 15.05\%$

51. 4

Identification of complex A

Complex A react with $AgNO_3$ to give a white precipitate which is readily soluble in dilute aqueous ammonia. This implies that complex A contains ionizable Cl^- group. Thus

Formula of A is $[Cr(NH_3)_4\ ClBr]Cl$

Identification of complex B.

Complex B react with $AgNO_3$ to give a pale-yellow precipitate which is soluble in concentrated ammonia. This implies that B contain ionizable Br^- group. Thus

Formula of B is $[Cr(NH_3)_4\ Cl_2]\ Br$

In Complex A & B

Cr present in +3 oxidation state

So

d^2sp^3 hybridization

& 3 unpaired e^- are present

So magnetic moment u= $\sqrt{n(n+2)}$

= 3.87 4 BM

52. 2

For the ionisation of indicator HIn $\rightleftarrows$ $H^+ + In^-$ the ionisation constant (Ka) is given by

$$Ka = \frac{[H^+][In^-]}{[HI]}$$

$$[H^+] = Ka \frac{[HI]}{[In^-]} = \frac{Ka}{[In^-]/[HIn]}$$

The colour of In^- is visible when $[In^-]/[HIn]>10$.

Thus

$$[H^+] = \frac{Ka}{[In^-]/[HIn]^-} = \frac{1.0x10^{-5}}{10} = 10^{-6}$$

$pH = -\log[H^+] = -\log 10^{-6} = 6$

The colour of HIn is visible when $[HIn]/[In^-] > 10$ or

$[In^-]/[HIn] < 0.1$

Thus

$$[H^+] = \frac{Ka}{[In^-]/[HIn]} = \frac{1.0x10^{-5}}{0.1} = \frac{10^{-5}}{10^{-1}} = 10^{-4}$$

$pH = -\log [H^+] = -\log 10^{-4} = 4$

change of pH = 6-4 =2

53. 1611.6

$$\log\left(\frac{k}{A}\right) = \frac{-Ea}{2.303RT}$$

$$= \frac{-210000 Jmol^{-1}}{2.303x8.314 Jmol^{-1}K^{-1}x700K}$$

$= -15.668$

$K/A = \text{Antilog}\ (-15.668) = 2.1478 \times 10^{-16}$

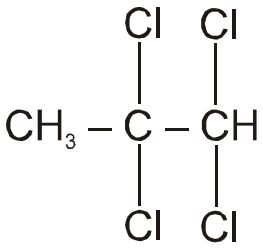
$k = 1.1478 \times 10^{-16} A$

$= 2.1478 \times 10^{-16} \times 2 \times 10^{12} 5^1 = 4.3 \times 10^{-4}\ sec^{-1}$

$$L_{\frac{1}{2}} = \frac{0.693}{4.3X10^{-4}5} = 1611.6\,sec.$$

54. 29.4

The dehalogenation of vicinal tetrahaloalkane gives alkyne .



$$+ 2ZN \xrightarrow{\Delta} CH_3 - C \equiv CH + 2ZNCl_2$$

mol. wt. = 182

$$CH_3 - C \equiv CH + AgNO_3 + NH_3 \xrightarrow{\Delta} CH_3C \equiv CAg + NH_4Cl$$

mol. wt. =147

182 gm of tetrahaloalkanes gives 147 gm ppt.

36.4 gm of tetrahaloalkane gives = $\frac{147 \times 36.4}{182}$

= 29.4 gm ppt

weight of silver prophnide = 29.4 gm

55. 0

Angular nodes = ℓ = 3

Radial nodes = n – ℓ – 1 = 4 – 3 – 1 = 0

56. 100

$H_3PO_2 + NaOH \longrightarrow NaH_2PO_2$; Equiv. mass of H_3PO_2 = molar mass = 66

Equivalents of $H_3PO_2 = \frac{0.66}{66} = 0.01 = x \times 0.1 \Rightarrow x = 0.1\ L = 100\ ml$

57. 4

The number of dipeptides that can be prepared from alanine and phenylalanine is 4 — Ala-phe, Ala-Ala, phe-phe, phe-Ala.

58. 0.25

$I = \frac{1}{2}[m_1z_1^2 + m_2z_2^2 + m_3z_3^2]$

$m_1(Na^+) = 0.1 + 2 \times 0.05 = 0.2$

$m_2(Cl^-) = 0.1$

$m_3(SO_4^{-2}) = 0.05$

$z_1 = 1;\ z_2 = 1;\ z_3 = 2$

$I = \frac{1}{2}\ [0.1 \times (1)^2 + 0.2 \times (1)^2 + 0.05 \times (2)^2] = \frac{1}{2}\ [0.5] = 0.25$

59. 0.463

$E = E^o - \frac{0.0592}{2} \log \frac{(QH)_2}{(Q)(H^+)_2} = E^o - 0.0592\ pH = 0.699 - 0.0592 \times 4 = 0.463\ V$

60. 0.0689

$NH_4CN(s)$ $NH_3(g) + HCN(g)$

At equ. $p + 0.25$ p

$K_p = [p_{(NH_3)}][p_{(HCN)}]$

$0.0222 = (p + 0.25)p$

$p^2 + 0.25p - 0.0222 = 0$

$$p = \frac{-0.25 \pm \sqrt{(0.25)^2 + (0.0222) \times 4 \times 1}}{2 \times 1} = 0.0689 \text{ atm}$$