BHU

CHEMISTRY

SOLVED SAMPLE PAPER

* DETAILED SOLUTIONS

9001894070

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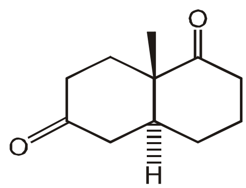
BHU CY **CHEMISTRY** **FMTP**

Note : Attempt all 120 questions. Each question carries 3 marks. 1 negative mark for each wrong answer.

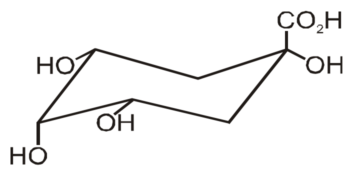
Duration : 120 Minutes **MAX. MARKS : 360** **MARKS SCORED :** ☐

1. The configurations (R, S-notation) at C_1 and C_6 of the compound given below are



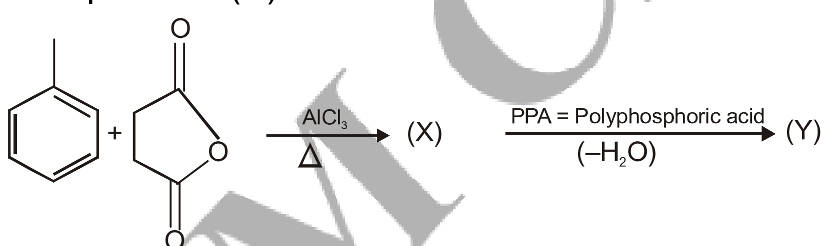
(A) 1S, 6S (B) 1S, 6R (C) 1R, 6R (D) 1R, 6S

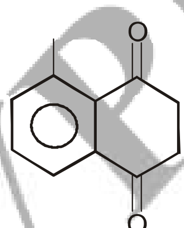
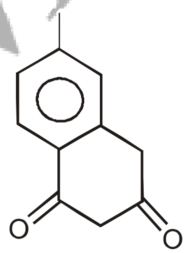
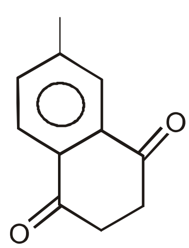
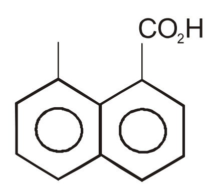
2. The following molecule has a



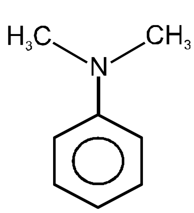
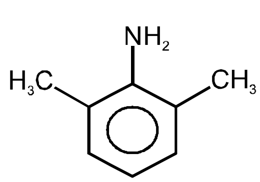
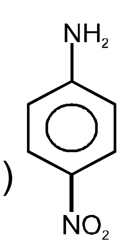
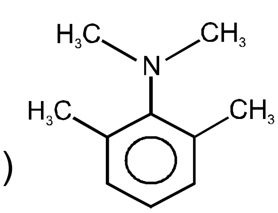
(A) centre of symmetry (B) plane of symmetry
(C) axis of symmetry (D) none of the above

3. The product (Y) of the reaction is :

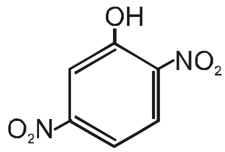
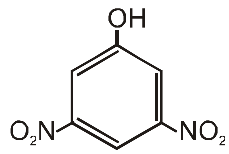
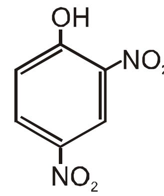
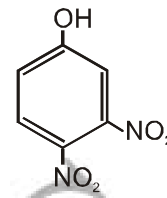


(A)  (B)  (C)  (D) 

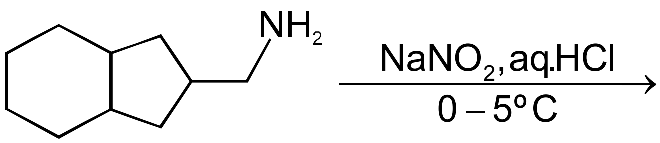
4. Which of the following is the strongest base ?

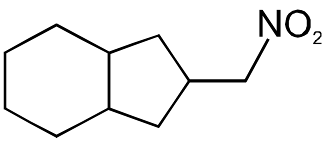
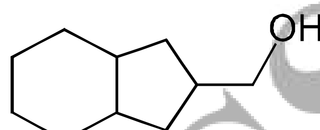
(A)  (B)  (C)  (D) 

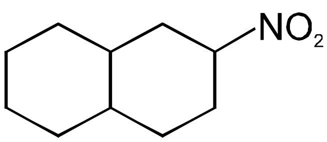
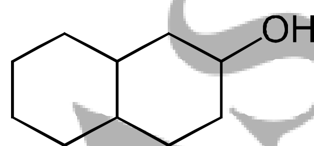
5. The phenols with highest Ka values is

(A)  (B)  (C)  (D) 

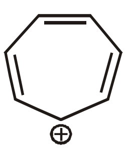
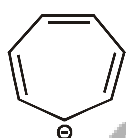
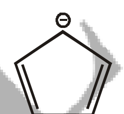
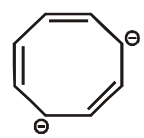
6. The major product formed in the reaction given below is



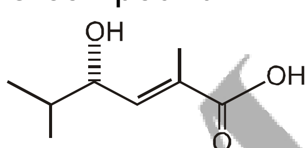
(A)  (B) 

(C)  (D) 

7. The compound that is NOT aromatic is

(A)  (B)  (C)  (D) 

8. For the compound



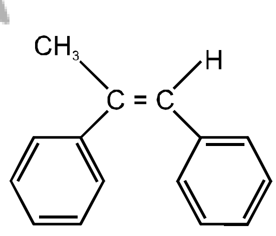
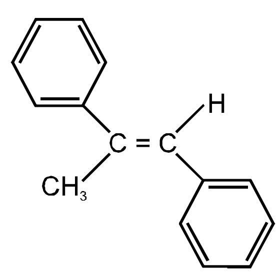
the stereochemical notations are

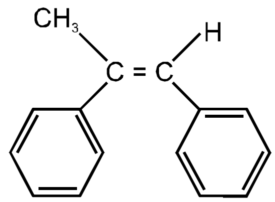
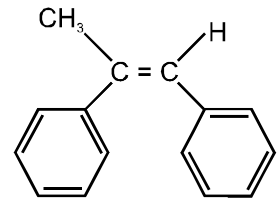
(A) 2Z, 4R (B) 2Z, 4S (C) 2E, 4R (D) 2E, 4S

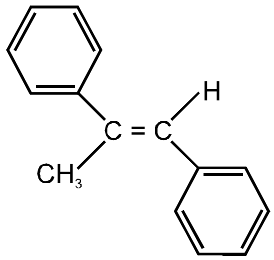
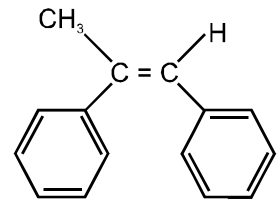
9. Which alkene will be formed in an E2 reaction of each of the following compounds

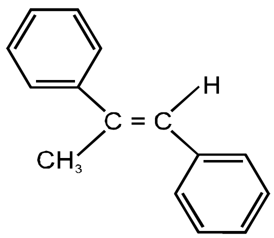
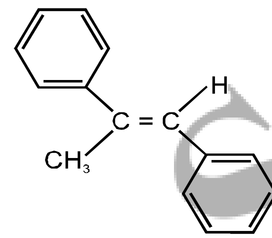
(a) (1*S*, 2*S*)-1-bromo-1,2-diphenylpropane

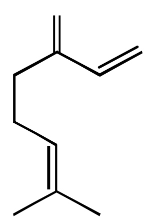
(b) (1*S*, 2*R*)-1-bromo-1,2-diphenylpropane

(A) **(a)**  **(b)** 

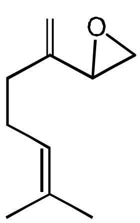
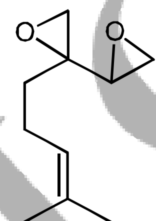
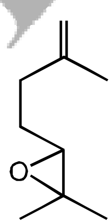
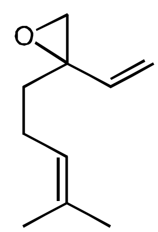
(B) **(a)**  **(b)** 

(C) **(a)**  **(b)** 

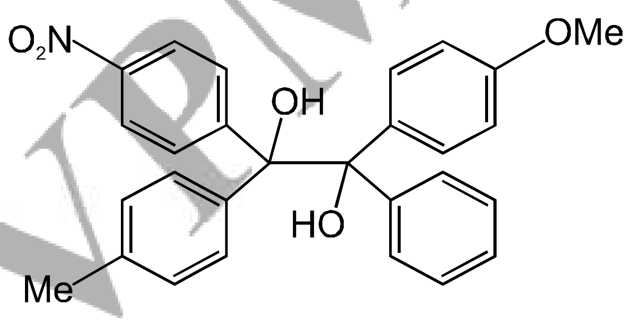
(D) **(a)**  **(b)** 

10.  $\xrightarrow{\text{m – CPBA}}$ [X] ; (mcPBA 1eq.)

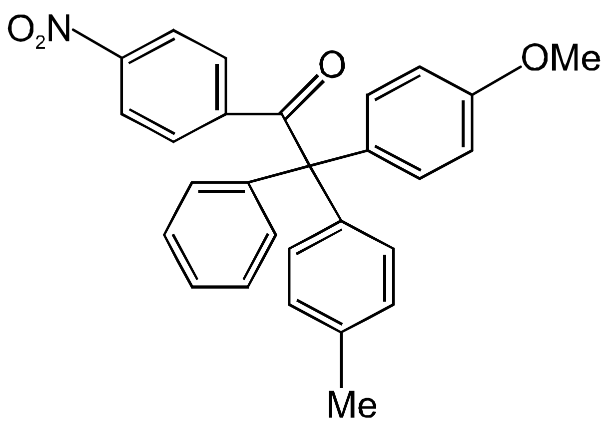
[X] will be

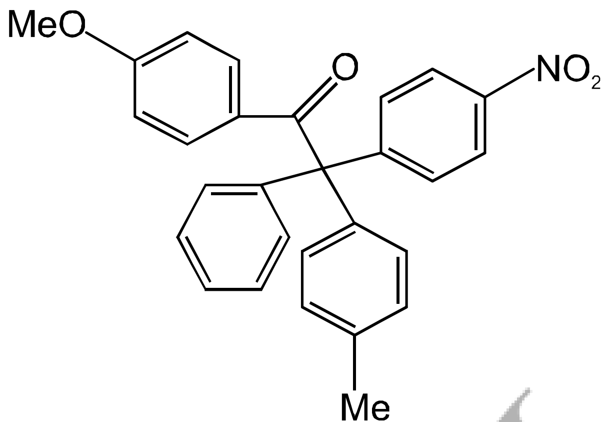
(A)  (B)  (C)  (D) 

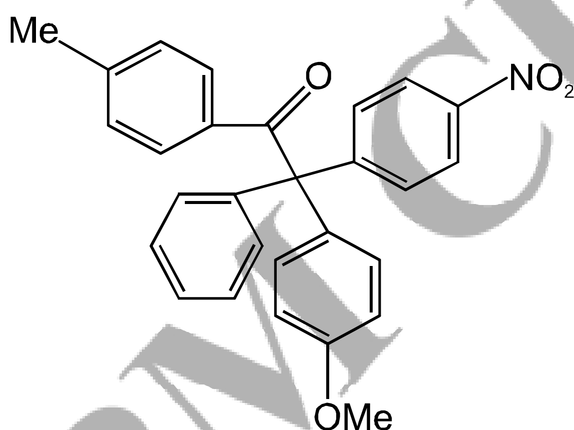
11. The major product formed in the reaction given below is

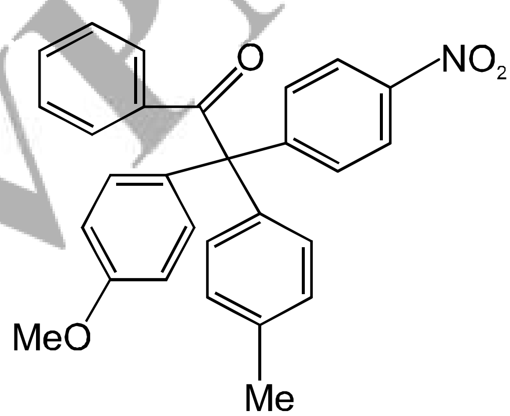


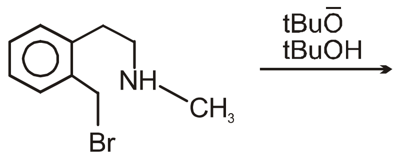
$\xrightarrow{\text{conc.}H_2SO_4}$

(A) 

(B) 

(C) 

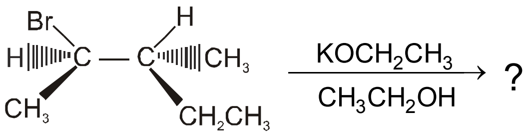
(D) 

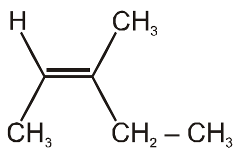
12. 

The Mechanism of the given reaction is possibly

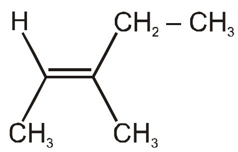
(A) SN^2 (B) $ArSN^2$ (C) E_2 (D) SN^1

13. Select the formula representing the major product(s) of the following reaction



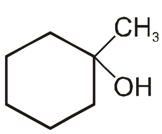
(A) 

(B) $CH_2 = CH - CH(CH_3) - CH_2 - CH_3$

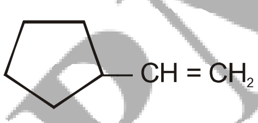
(C) 

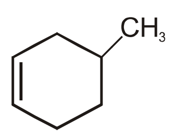
(D) Both (A) and (B) are formed in approximately equal amounts.

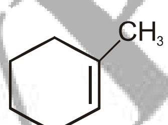
14. Alkene that will give the product (X) on oxymercuration reduction reaction

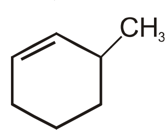
 is

(X)

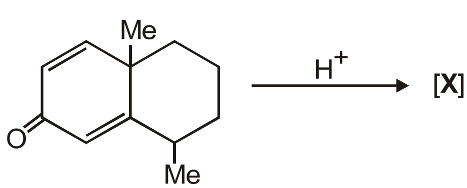
(A) 

(B) 

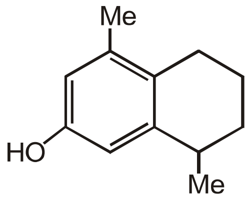
(C) 

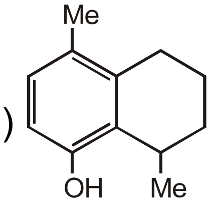
(D) 

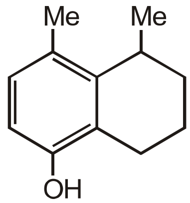
15. In the following reaction

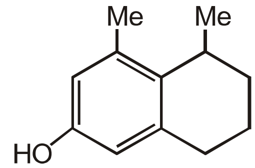


the major product [**X**] is

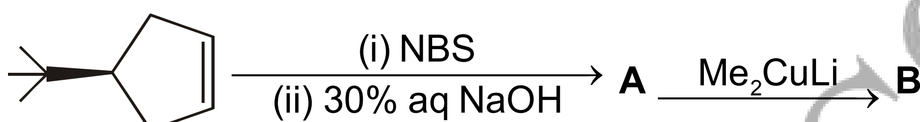
(A) 

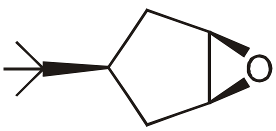
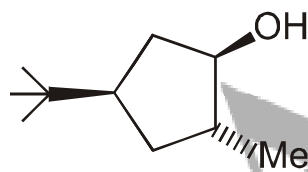
(B) 

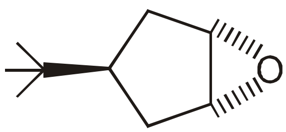
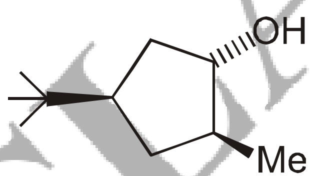
(C) 

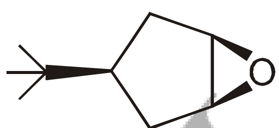
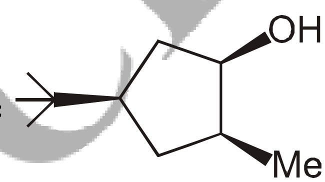
(D) 

16. The major products A and B in the following reaction sequence are



(A) **A** =  ; **B** = 

(B) **A** =  ; **B** = 

(C) **A** =  ; **B** = 

17. Match list - I (Name of Reaction) with List - II (Intermediate Species in Reaction) and select the correct answer using the codes given below the lists :

List I (Name of Reaction)	**List II (Intermediate Species in Reaction)**
a. Reimer - Tiemann reaction	1. Isocyanate
b. Pinacol - Pinacolone rearrangement	2. Dichlorocarbene
c. Hofmann - bromamide reaction	3. Carbanion
	4. Carbocation

Codes :	**a**	**b**	**c**		**a**	**b**	**c**
(A)	2	4	1	(B)	3	2	1
(C)	2	1	4	(D)	3	1	2

18. Thermal reaction of allyl phenyl ether generates a mixture of ortho- and para-allyl phenols. The para-allyl phenol is formed via

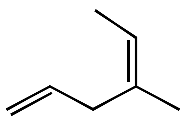
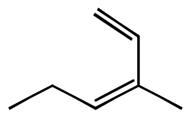
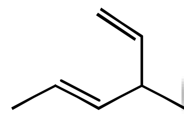
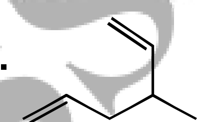
(A) a[3, 5]-sigmatropic shift

(B) first ortho-allyl phenol is formed, which then undergoes a [3, 3]-sigmatropic shift

(C) two consecutive [3, 3]-sigmatropic shifts

(D) dissociation to generate allyl cation, which then adds at para-position

19. Which one among the dienes **A-D** will undergo [3,3]-sigmatropic shift upon heating

A.  **B.**  **C.**  **D.** 

(A) A (B) B (C) C (D) D

20. Compound 'X' (C_5H_{10}) on ozonolysis gives two compounds D and E. Both D, E give positive Iodoform test. E responds to Tollen's test but D does not identify X.

(A) $(CH_3)_2C=CH-CH_3$

(B) $CH_3-C(=CH_2)-CH_2-CH_3$

(C) $CH_3-CH(CH_3)-CH=CH_2$

(D) $CH_3-CH=CH_2-CH_3$

21. $Cl-CH_2-\overset{\overset{\large O}{||}}{C}-OEt + 2CH_3MgI \xrightarrow[\text{by } H_2O]{\text{Followed}}$ product.

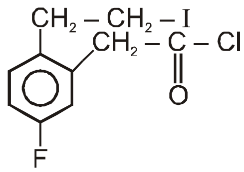
What is the product **?**

(A) $HO-CH_2-C(CH_3)(OH)-CH_3$

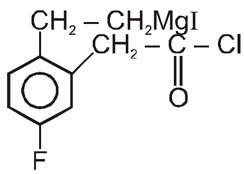
(B) $Cl-CH_2-C(CH_3)(OH)-OEt$

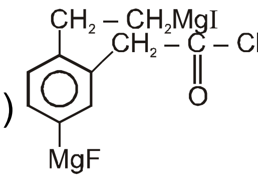
(C) $CH_3-CH_2-\overset{\overset{\large O}{||}}{C}-OEt$

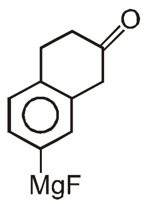
(D) $Cl-CH_2-C(CH_3)(OH)-CH_3$

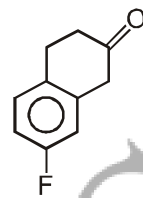
22.  $\xrightarrow{\text{(i) Mg/Ether}}$ product

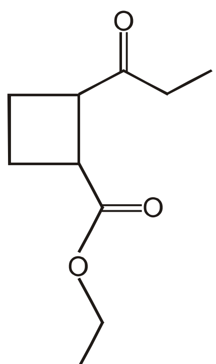
The final product of the reaction is

(A) 

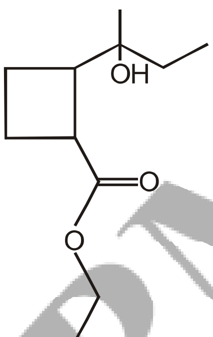
(B) 

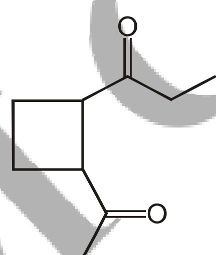
(C) 

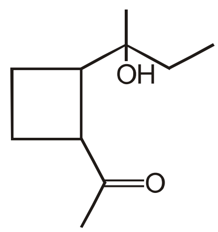
(D) 

23.  $\xrightarrow[+H_2O]{\text{1 mole } CH_3-Mg-X}$?

The product is

(A) 

(B) 

(C) 

(D) All of these

24. An IR spectrum of a hydrocarbon containing 10 per cent hydrogen gave two bands (i) 3295 cm^{-1} and (ii) 625 cm^{-1} along with a weak absorption band near 2130 cm^{-1}. What is the probable structure of the compound?

(A) $CH_3 - CH = CH_2$

(B) $CH_3 - C \equiv CH$

(C) $C_6H_5CH_2OH$

(D) $CH_3 - CH_2 - CHO$

25. In IR spectra, Toluene shows bands at 3030 cm^{-1}, 2850-2960 cm^{-1}, 1600, 1580, 1460 cm^{-1}, 730 cm^{-1}. The band at 3030 cm^{-1} stands for

(A) Ar – H str (B) C – H str in CH_3

(C) C = C str (D) C – H bending

26. ^{1}H-NMR spectrum of compound with molecular formula $C_4H_9NO_2$ shows δ 5.30 (broad, 1H), 4.10 (q, 2H), 2.80 (d, 3H), 1.20 (t, 3H) ppm. The structure of the compound that is consistent with the above data is

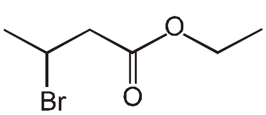
(A) $CH_3NHCOOCH_2CH_3$ (B) $CH_3CH_2NHCOOCH_3$

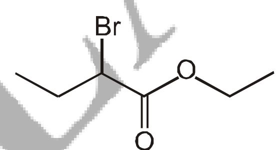
(C) $CH_3OCH_2CONHCH_3$ (D) $CH_3CH_2OCH_2CONH_2$

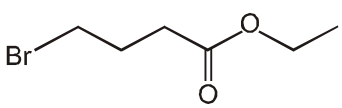
27. An organic compound having molecular formula $C_6H_{11}BrO_2$ exhibits the following peaks in 1H NMR spectrum.

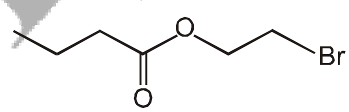
δ 4.1 (2H, q, J = 7.5 Hz), 4.0 (2H, t, J = 7.5 Hz), 1.5-2.2 (2H, m), 1.25 (3H, t, J = 7.5 Hz).

The structure of the compound is

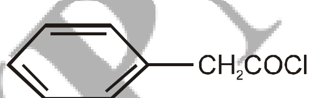
(A) 

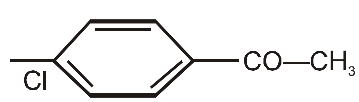
(B) 

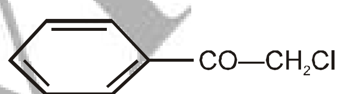
(C) 

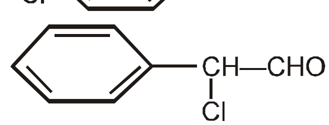
(D) 

28. A compound of molecular formula C_8H_7 ClO shows a promient band in its IR spectrum at 1690 cm^{-1}. ^{1}H NMR spectrum revealed only two major types of protons in the ratio of 5 : 2. Which one of the following structures best fits the above data ?

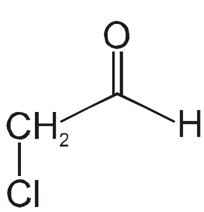
(A) 

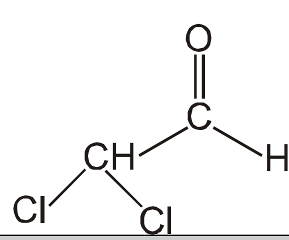
(B) 

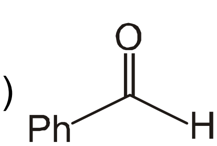
(C) 

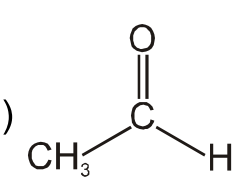
(D) 

29. Which of the following has the highest value of carbon streching frequency in IR region?

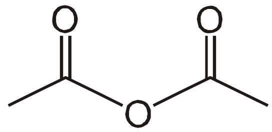
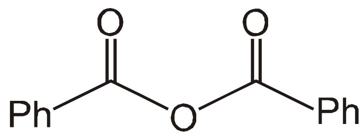
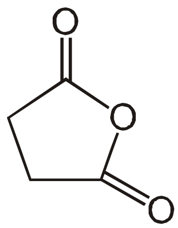
(A) 

(B) 

(C) 

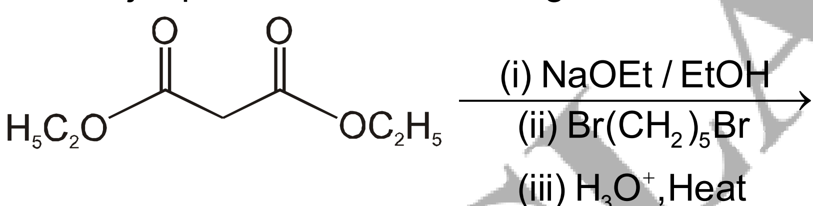
(D) 

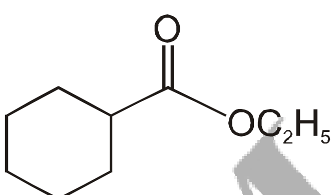
30. Match the following :

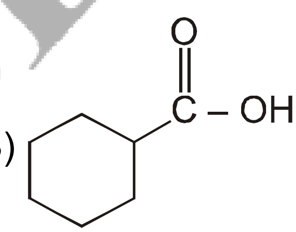
Column-I		Column-II ($\nu_{>C=O}$) streching
(i) 	(a)	1865, 1780 cm^{-1}
(ii) 	(b)	1815, 1750 cm^{-1}
(iii) 	(c)	1775, 1720 cm^{-1}

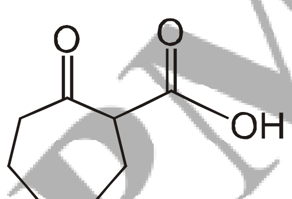
(A) i-a, ii-b, iii-c (B) i-b, ii-c, iii-a (C) i-b, ii-a, iii-c (D) i-c, ii-b, iii-a

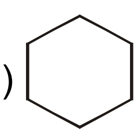
31. The major product in the following reaction is :



(A) 

(B) 

(C) 

(D) 

32. The shape of BrF_3 is :

(A) Trigonal pyramidal (B) Trigonal planar

(C) Trigonal bipyramidal (D) T-shaped

33. A large jump between the values of second and third ionization potentials of an atom would correspond to the electronic configuration,

(A) $1s^2 2s^2 2p^6$ (B) $1s^2 2s^2 2p^6 3s^2$

(C) $1s^2 2s^2 2p^6 3s^2 3p^1$ (D) $1s^2 2s^2 2p^6 3s^2 3p^2$

34. XeF_2 on hydrolysis yields

(A) $XeOF_4$ (B) XeO_3 (C) XeO_2F_2 (D) Xe

35. The valence shell electron of sodium has the quantum number values (*n*, *l*, *m*, *s*)

(A) $2, 1, -1, -\frac{1}{2}$ (B) $3, 0, 0, +\frac{1}{2}$

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

36. Which of the oxides is not an amphotric oxide:

(A) ZnO (B) SnO_2 (C) Al_2O_3 (D) BeO

37. Electron affinity is positive when

(A) O^- is formed from O (B) O^{2-} is formed from O^-

(C) O^+ is formed from O (D) $Na^{\oplus} + e^- \rightarrow Na$

38. The correct sequence which shows decreasing order of the ionic radii of the elements is :

(A) $Al^{3+} > Mg^{2+} + Na^+ > F^- > O^{2-}$ (B) $Na^+ > Mg^{2+} > Al^{3+} > O^{2-} > F^-$

(C) $Na^+ > F^- > Mg^{2+} > O^{2-} > Al^{3+}$ (D) $O^{2-} > F^- > Na^+ > Mg^{2+} > Al^{3+}$

39. The correct order of the bond energies in the Hydrides is,

(A) HI > HBr > HCl > HF (B) HF > HCl > HI > HBr

(C) HCl > HF > HBr > HI (D) HF > HCl > HBr > HI

40. The correct order of increasing hydration energy of the following ions is

(A) $Fe^{2+} < Co^{2+} < Fe^{3+} < Al^{3+}$ (B) $Fe^{2+} < Co^{2+} < Al^{3+} < Fe^{3+}$

(C) $Al^{3+} < Fe^{3+} < Co^{2+} < Fe^{2+}$ (D) $Fe^{3+} < Al^{3+} < Co^{2+} < Fe^{2+}$

41. Among the following compounds, the one that is polar and has the central atom with sp^2 hybridisation is.......

(A) H_2CO_3 (B) SiF_4 (C) BF_3 (D) $HClO_2$

42. In which of the following molecules , all the bonds are not equal?

(A) NF_3 (B) ClF_3 (C) BF_3 (D) AlF_3

43. The molecular shapes of SF_4, CF_4 and XeF_4 are

(A) different with 1,0 and 2 lone pairs on central atom.

(B) different with 0,1,2 lone pairs on central atom.

(C) same with 1,1,1 lone pairs on central atom.

(D) same with 2,0,1 lone pairs on central atom.

44. Which of the following contains maximum number of lone pairs on the central atom

(A) ClO_3^- (B) XeF_4 (C) SF_4 (D) I_3^-.

45. The correct order of the bond angles is

(A) $NH_3 > H_2O > PH_3 > H_2S$ (B) $NH_3 > PH_3 > H_2O > H_2S$

(C) $NH_3 > H_2S > PH_3 > H_2O$ (D) $PH_3 > H_2S > NH_3 > H_2O$

46. The shape of O_2F_2 is similar to that of

(A) C_2F_2 (B) H_2O_2 (C) H_2F_2 (D) C_2H_2

47. Among KO_2, AlO_2^-, BaO_2 and NO_2^+, unpaired electron is present in –

(A) NO_2^+ and BaO_2 (B) KO_2 and AlO_2^-

(C) KO_2 only (D) BaO_2 only

48. The planar structure of $N(SiH_3)_3$ is due to _____ bonding.

(A) **dsp**^{2} hybridisation (B) Sp^3 hybridisation

(C) **$p\pi - p\pi$ bonding** (D) **$d\pi - p\pi$ bonding**

49. The gaseous product of the reaction of boron trifluoride with tetrahydroborate ion is

(A) F_2 (B) HF (C) H_2 (D) B_2H_6

50. Phosphorus pentoxide, P_4O_{10} on hydrolysis gives

(A) H_3PO_3 (B) H_3PO_4 (C) HPO_3 (D) H_3PO_2

51. In $Na_2[Fe(CN)_5NO]$, sodium nitroprusside

(A) oxidation state of Fe is +2 (B) this has NO^+ as ligand

(C) Both (A) and (B) are correct (D) None of the above is correct

52. Which of the following compounds is diamagnetic ?

(A) $ZnCl_2$ (B) $CrCl_3$ (C) $CuSO_4$ (D) $NiCl_4^{-2}$

53. Which of the following oxide of **chromium** is amphoteric in nature ?

(A) CrO (B) Cr_2O_3 (C) CrO_3 (D) CrO_5

54. Which of the following has three ionisable chlorine atoms ?

(A) $CoCl_3.5NH_3$ (B) $CoCl_3.3NH_3$ (C) $CoCl_3.6NH_3$ (D) None

55. Which of the following complexes show linkage isomerism ?

(A) $[CO(en)_2Cl_2]Cl$ (B) $[Pd(dipy)(SCN)_2]$

(C) $[CO(NH_3)_4Cl_2]Cl$ (D) $CrCl_3.6H_2O$

56. Spin only magnetic moment of the compound $Hg[Co(SCN)_4]$ is

(A) $\sqrt{3}$ (B) $\sqrt{8}$ (C) $\sqrt{15}$ (D) $\sqrt{24}$

57. Which of the following shows linkage isomerism?

(A) $[Co(en)_3]Cl_3$ (B) $[Co(NH_3)_6][Cr(en)_3]$

(C) $[Co(en)_2NO_2Cl]Br$ (D) $[Co(NH_3)_5Cl]Br_2$

58. Which of the following will give maximum number of isomers ?

(A) $[Co(NH_3)_4Cl_2]$ (B) $[Ni(en)(NH_3)_4]^{2+}$

(C) $[Ni(C_2O_4)(en)_2]$ (D) $[Cr(SCN)_2(NH_3)_4]^+$

59. Which of the following will exhibit maximum ionic conductivity ?

(A) $K_4[Fe(CN)_6]$ (B) $[Co(NH_3)_6]Cl_3$

(C) $[Cu(NH_3)_4]Cl_2$ (D) $[Ni(CO)_4]$

60. Which of the following shell form an octahedral complex ?

(A) d^4 (low spin) (B) d^8(high spin) (C) d^6(high spin) (D) None of these

61. Which of the following ions has zero crystal field stabilisation energy in octahedral field ?

(A) Mn^{3+} (low spin) (B) Co^{2+} (low spin)

(C) Cu^{2+} (high spin) (D) Fe^{3+} (high spin)

62. Which of the following species represent the example of dsp^2 hybridization?

(A) $[Fe(CN)_6]^{3-}$ (B) $[Ni(CN)_4]^{2-}$ (C) $[Ag(CN)_2]^-$ (D) $[Co(CN)_6]^{3-}$

63. Which of the following organometallic compounds of σ and π bonded ?

(A) $[Fe(\eta^5-C_5H_5)_2]$ (B) $[PtCl_3(\eta^2-C_2H_4)]$

(C) $[Co(CO)_5NH_3]^{2+}$ (D) $Al(CH_3)_3$

64. In which case(s) there is change in oxidation number?

(A) SO_2 gas is passed into $Cr_2O_7^{2-}/H^+$

(B) $Cr_2O_7^{2-}$ is made alkaline

(C) CrO_2Cl_2 is dissolved in NaOH

(D) Aqueous solution of CrO_4^{2-} is acidified

65. Which of the following type of bonds are present in $CuSO_4.5H_2O$?

(1) Electrovalent (2) Covalent (3) Coordinate

(A) 1 and 2 only (B) 1 and 3 only (C) 2 and 3 only (D) 1, 2 and 3

66. For the reaction, $N_2 + 3H_2 \rightarrow 2NH_3$, $\frac{K_p}{K_c}$ is equal to

(A) RT (B) $\frac{1}{RT}$ (C) $(RT)^2$ (D) $\frac{1}{(RT)^2}$

67. What is the energy of radiation that has a frequency of 9.00×10^{11} cycles/sec? (Remember that Planck's constant, h, has a value of 6.63×10^{-34} J-sec.)

(A) 1.66×10^{-45} J (B) 5.97×10^{-22} J

(C) 4.99×10^{-27} J (D) 5.00×10^{-22} J

68. The approximate radius of a H-atom is 0.0529 nm and that of proton is 1.5×10^{-15} m. Assuming both the hydrogen atom and the proton to be spherical, calculate fraction of the space in an atom of hydrogen that is occupied by the nucleus.

(A) 2.3×10^{-14} (B) 2.3×10^{-13} (C) 2.3×10^{-12} (D) 2.3×10^{-11}

69. The normalized wave function of 1s orbital is:- $\psi = \sqrt{N}e^{-\frac{Zr}{a_0}}$

and the radial distribution function is = $4\pi r^2\psi^2$

Where $N = \frac{Z^3}{\pi a_0^3}$

Calculate the most probable distance at which the 1s electron of hydrogen-like atom with atomic number Z is to be found.

(A) $\frac{a_0}{2Z}$ (B) $\frac{a_0}{Z}$ (C) $\frac{2a_0}{Z}$ (D) $\frac{4a_0}{Z}$

70. The orbital angular momentum of an electron in 2s orbital is:-

(A) $+\frac{1}{2}.\frac{h}{2\pi}$ (B) zero (C) $\frac{h}{2\pi}$ (D) $\sqrt{2}.\frac{h}{2\pi}$

71. The energy of an electron in the first Bohr orbit of H atom is –13.6eV. The possible energy values (s) of the excited state(s) for electrons in Bohr orbits of hydrogen is(are):-

(A) –3.4eV (B) –4.2eV (C) –6.8eV (D) +6.8eV

72. If the shortest wavelength of H atom in Lyman series is "a" than longest wavelength in balmer series of He^+ is

(A) $\frac{9}{5}a$ (B) $\frac{6}{5}a$ (C) $\frac{a}{4}$ (D) $\frac{5a}{9}$

73. The radius of which of the following orbit is same as that of the first Bohr's orbit of hydrogen atom ?

(A) He^+ (n = 2) (B) Li^{2+} (n = 2) (C) Li^{2+} (n = 3) (D) Be^{3+} (n = 2)

74. In an atom, two electrons move round the nucleus in circular orbits of radii R and 4R. The ratio of the time taken by them to complete one revolution is:-

(A) 1 : 4 (B) 4 : 1 (C) 1 : 8 (D) 8 : 1

75. A particle X moving with a certain velocity has a debroglie wave length of 1 Å, If particle Y has a mass of 25% that of X and velocity 75% that of X, debroglies wave length of Y will be:-

(A) 3 Å (B) 5.33 Å (C) 6.88 Å (D) 48 Å

76. For which orbital angular probability distribution is maximum at an angle of 45° to the axial direction -

(A) $d_{x^2-y^2}$ (B) dz^2 (C) d_{xy} (D) P_x

77. The uncertainty relation cannot hold for the following pairs :

(A) Position and momentum (B) Energy and time

(C) Linear momentum and angle (D) Angular momentum and angle

78. The uncertainty in the location of a particle is equal to de-Broglie wavelength then the uncertainty in its velocity is

(A) V (B) $\frac{V}{2}$ (C) 2V (D) $\frac{3}{2}V$

79. The ground state energy of a particle in a one dimensional box of length L is E if the length is reduced to $\frac{L}{2}$ then the ground state energy becomes

(A) 2E (B) $\frac{E}{2}$ (C) 4E (D) $\frac{E}{4}$

80. If a 1.00 g body is travelling along the x-axis at 100 cm s^{-1} within 1 cm s^{-1}, what is the theoretical uncertainty in its position?

(A) 6.626×10^{-30} m (B) 3.313×10^{-30} m

(C) 2.524×10^{-30} m (D) None

81. Which is true about ψ –

(A) ψ represents the probability of finding an electron around the nucleus

(B) ψ represents the amplitude of the electron wave

(C) Both A and B

(D) None of these

82. The rates of diffusion of SO_2, CO_2, PCl_3 and SO_3 are in the following order:-

(A) $PCl_3 > SO_3 > SO_2 > CO_2$ (B) $CO_2 > SO_2 > PCl_3 > SO_3$

(C) $SO_2 > SO_3 > PCl_3 > CO_2$ (D) $CO_2 > SO_2 > SO_3 > PCl_3$

83. At a constant temperature what should be the percentage increase in pressure for a 5% decrease in the volume of gas –

(A) 5% (B) 10% (C) 5·26% (D) 4·26%

84. Equal masses of methane and oxygen are mixed in an empty container at 25ºC. The fraction of the total pressure exerted by oxygen is

(A) $\frac{1}{3}$ (B) $\frac{1}{2}$ (C) $\frac{2}{3}$ (D) $\left(\frac{1}{3}\right)\left(\frac{273}{298}\right)$

85. A gas has non - zero value of force of attraction between the molecules but has the molecules to be point masses. The vander Wall's equation for the gas will be

(A) PV = nRT + nbP (B) P (V - nb) = nRT

(C) PV = nRT (D) $PV = nRT - \frac{an^2}{V}$

86. For the Berthelot equation of state, what will be the value of critical compression factor (Z_c),Berthelot equation:- $P = \frac{RT}{V_m - b} - \frac{a}{TV_m^2}$

(A) $\frac{3}{8}$ (B) $\frac{1}{2}$ (C) $\frac{1}{3}$ (D) $\frac{1}{6}$

87. Van der waal's constant b of Ar gases 3.22×10^{-5} m^3 mol^{-1}. The molecular diameter of Ar will be

(A) 0.1472 nm (B) 0.2944 nm (C) 0.6186 nm (D) 0.7824 nm

88. For the following equation of state

$P = \frac{RT}{V_m} - \frac{B}{V_m^2} + \frac{C}{V_m^3}$; B and C are constants. the value of critical compression factor (Z_e) will be

(A) $\frac{3}{8}$ (B) $\frac{1}{2}$ (C) $\frac{1}{3}$ (D) $\frac{1}{6}$

89. A driver at a depth of 45 m exhales a bubble of air that is 1.0 cm in radius. Assuming ideal gas behaviour, what will be the radius of this bubble as it breaks the surface of water ?

(A) 1.80 cm (B) 1.75 cm (C) 1.70 cm (D) 1.65 cm

90. Two flasks of equal volume have been joined by a narrow tube of negligible volume. Initially both flasks are at 300K containing 0.60 mole of O_2 gas at 0.5 atm pressure. One of the flasks is then placed in a thermostate at 600 K. Calculate final pressure of O_2 gas in each flask.

(A) 0.11 atm (B) 0.33 atm (C) 0.66 atm (D) 0.99 atm

91. Most probable speed, average speed and RMS speed are related as:-

(A) 1 : 1.128 : 1.224 (B) 1 : 1.128 : 1.424

(C) 1 : 2.128 : 1.224 (D) 1 : 1.428 : 1.442

92. Consider the two gaseous equilibria involving SO_2 and the corresponding equilibrium constant at 298 K

$SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$ ....K_1

$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$ ....K_2

The values of equilibrium constant are related as :

(A) $2K_1 = K_2^2$ (B) $K_2^2 = \frac{1}{K_1}$ (C) $K_1^2 = \frac{1}{K_2}$ (D) $K_2 = \frac{2}{K_1^2}$

93. K_1 and K_2 are equilibrium constant for reactions (1) and (2)

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ ....(1)

$NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$ ....(2)

Then,

(A) $K_1 = \left(\frac{1}{K_2}\right)^2$ (B) $K_1 = K_2^2$ (C) $K_1 = \frac{1}{K_2}$ (D) $K_1 = (K_2)^0$

94. A certain weak acid has a dissociation constant of 1.0×10^{-4}. The equilibrium constant for its reaction with a strong base is:-

(A) 1.0×10^{-4} (B) 1.0×10^{-10} (C) 1.0×10^{10} (D) 1.0×10^{14}

95. The hydrogen ion concentration of a slightly acidic water solution can be represented by:-

(A) 14 – pOH (B) Kw/pOH (C) 10^{-pOH} (D) $10^{-(14 - pOH)}$

96. The following equilibria are given :

$$N_2 + 3H_2 \rightleftharpoons 2NH_3 \quad .... K_1$$
$$N_2 + O_2 \rightleftharpoons 2NO \quad .... K_2$$
$$H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O \quad .... K_2$$

The equilibrium constant of the reaction

$2NH_3 + \frac{5}{2} O_2 \rightleftharpoons 2NO + 3H_2O$, in terms of K_1, K_2 and K_3 is –

(A) $K_1 K_2/K_3$ (B) $K_1 K_3^2/K_2$ (C) $K_2 K_3^3/K_1$ (D) $K_1 K_2 K_3$

97. Two flasks A and B of equal volume containing 1 mole and 2 mole of O_3 respectively, are heated to the same temperature. When the reaction $2O_3 \rightarrow 3O_2$ practically stops, then both the flasks shall have

(A) The same ratio $[O_2] [O_3]$ (B) The same ratio : $[O_2]^{3/2} [O_3]$

(C) Only O_2 (D) The same time to reach equilibrium

98. A saturated solution of Na_2SO_4, with excess of the solid, is present at equilibrium with its vapour in a closed vessel. How many phases and components are present respectively?

(A)2,3 (B) 1,4 (C) 1,3 (D) 2,5

99. According to Langmuir adsorption isotherm, the amount of gas adsorbed at very high pressures

(A) Reaches a constant limiting value

(B) Goes on increasing with pressure

(C) Goes on decreasing with pressure

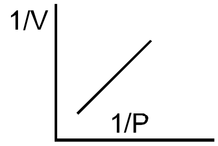
(D) Increase first and decreases later with pressure

100. When temperature is lowered and pressure is raised, the adsorption of a gas on a solid

(A) Decreases (B) Increases

(C) Remains unaffected (D) Decreases first then increases

101. The experimental adsorption data of a gas on a solid surface at temperature T exhibits the following variation with pressure. V is the volume of gas adsorbed.



Which of the following statements is true ?

(A) Heat of coverage varies linearly with temperature

(B) Adsorption is multilayer

(C) Heat of adsorption is independent of coverage

(D) Complete coverage cannot be determined

102. The coagulation power of an electrolyte for arsenious sulphide decrease in the order

(A) Na^+, Al^{+3}, Ba^{2+}

(B) PO_4^{-3}, SO_4^{-2}, Cl^-

(C) Al^{+3}, Ba^{+2}, Na^+

(D) Cl^-, SO_4^{-2}, PO_4^{-3}

103. What is R_M value?

(A) $R_M = \log (1/R_f + 1)$

(B) $R_M = \log (1/R_f - 1)$

(C) $R_M = \log (2/R_f - 1)$

(D) $R_M = \log (1/R_f - 2)$

104. Why are the mixtures of Zn(II) and Mg(II) usually separated employing anion exchanger rather than cation exchanger ? Choose the correct statement ,

(A) Zinc is absorbed from 2M acid while Magnesium is not

(B) Magnesium is absorbed from 2M acid while Zinc is not

(C) Zinc& Magnesium both are absorbed from 2M acid

(D) Zinc& Magnesium both are not absorbed from 2M acid

105. What is true about synergistic extraction?

(A) when two reagents are used together, extracted a metal ion with reduced efficiency

(B) when two reagents are used together, extracted a metal ion with enhanced efficiency

(C) when one reagent is used for extraction of two metal ions with enhanced efficiency

(D) when one reagent is used for extraction of two metal ions with reduced efficiency

106. Calculate the weight of Fe(III) left unextracted from 100 ml of a solution having 400 mg of Fe^{3+} in 6M HCl after two extractions with 25 ml of diethyl ether : D = 150?

(A) 0.54 mg (B) 0.14 mg (C) 1.27 mg (D) 0.27 mg

107. Which of the following adsorbent used for column adsorption chromatography has maximum adsorptive power?

(A) Silica gel (B) Magnesium oxide

(C) Aluminium oxide (D) Calcium carbonate

108. Which of the following adsorbent used for column adsorptive chromatography has maximum adorptive power?

(A) Sucrose (B) Magnesium carbonate

(C) Calcium oxide (D) Calcium sulphate

109. An increase in pH causes an increase in the sorption capacity if an ion exchanger contains

(A) –COOH group (B) –OH group (C) $–SO_3H$ group (D) All of these

110. An ion exchange process is reversible. The equilibrium of this process depends on

(A) the acidity of the solution

(B) the concentration and charge of the cations participating in the exchange

(C) temperature

(D) All of the above

111. What is the pH range in which strongly basic anion exchangers can be used?

(A) 1-14 (B) 1-9 (C) 1-6 (D) 7-14

112. Anion exchange resins with similar ionogenic groups are

(A) quaternary ammonium bases (B) tertiary amines

(C) quaternary sulphonium bases (D) All of the above

113. When amino acids are separated on ion exchange resins, the following variables are taken into consideration

(A) choice of ion exchanger

(B) pH

(C) concentration of ionic species in the eluting agent

(D) All of the above are correct

114. In hot alkaline solution, Br_2 disproportionates to Br^- and BrO_3^-

$$3Br_2 + 6OH^- \rightarrow 5Br^- + BrO_3^- + 3H_2O$$

hence, equivalent weight of Br_2 is

(molecular weight = M)

(A) $\frac{M}{6}$ (B) $\frac{M}{5}$ (C) $\frac{3M}{5}$ (D) $\frac{5M}{3}$

115. 10 L of hard water required 0.56 g of lime (CaO) for removing hardness. Hence, temporary hardness in ppm of $CaCO_3$ (parts per million i.e. 10^6) is :

(A) 100 (B) 200 (C) 10 (D) 20

116. 20 mL of x M HCl neutralises completely 10 mL of 0.1 M $NaHCO_3$ and a further 5 mL of 0.2 M Na_2CO_3 solution to methyl orange end-point. The value of x is :

(A) 0.167 M (B) 0.133 M (C) 0.150 M (D) 0.200 M

117. 10 mL of $NaHC_2O_4$ solution is neutralised by 10 mL of 0.1 M NaOH solution. 10 mL of same $NaHC_2O_4$ solution is oxidised by 10 mL of $KMnO_4$ solution in acidic medium. Hence, molarity of $KMnO_4$ is :

(A) 0.1 M (B) 0.2 M (C) 0.04 M (D) 0.02 M

118. 40 mL of 0.05 M solution of sesquicarbonate ($Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$) is titrated against 0.05 M HCl. x mL of HCl is used when phenolphthalein is the indicator and y mL of HCl is used when methyl orange is the indicator in two separate titrations, hence (y – x) is :

(A) 80 mL (B) 30 mL (C) 120 mL (D) none of these

119. I_2 obtained from 0.1 mol of $CuSO_4$ required 100 mL of 1 M hypo solution, hence, mole percentage of pure $CuSO_4$ is :

(A) 100 (B) 50 (C) 25 (D) 40

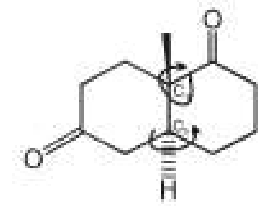
120. 10 mL of a blood sample (containing calcium oxalate) is dissolved in acid. It required 20 mL of 0.001 M $KMnO_4$ (which oxidises oxalate to carbon dioxide) hence, Ca^{2+} ion in 10 mL blood is :

(A) 0.200 g (B) 0.02 g (C) 2.00 g (D) 0.002 g

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Answer	A	B	C	D	C	D	B	D	A	C	A	A	C	C	B	A	A	B	D	A
Question	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Answer	D	D	A	B	A	A	C	C	B	B	D	D	B	C	B	D	B	D	D	B
Question	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Answer	A	B	A	D	A	B	C	D	D	B	C	A	B	C	B	C	C	D	A	A
Question	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Answer	D	B	C	A	C	D	B	A	B	B	A	B	D	A	B	C	C	A	C	D
Question	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Answer	D	D	C	A	D	A	B	C	B	C	A	C	C	C	D	C	B	A	A	B
Question	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Answer	B	C	B	A	B	D	C	C	B	D	A	D	D	C	B	D	C	A	A	D

Hint and Solution

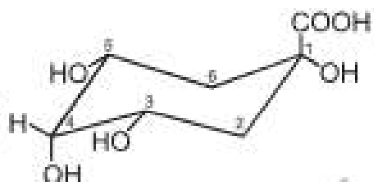
1.(A)



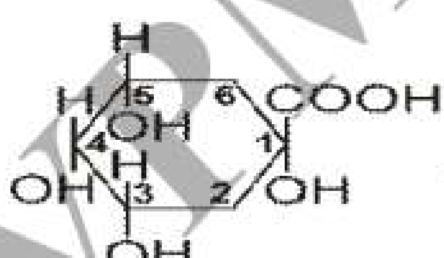
C_1^* = (C.W); Me (wedge) so (S)

C_6^* = (A.C.W); H (dash) so (S).

2.(B)

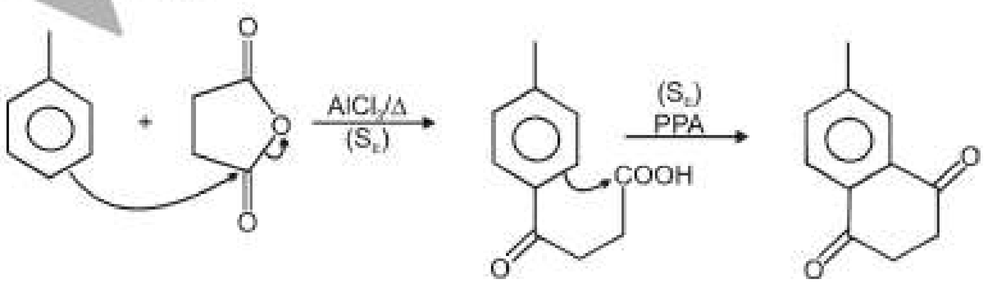


The cyclohexane ring has one plane of symmetry across 1, 4 positions, cutting all 4 substituents in to half. The similar groups in cis orientation at 1,3 positions also show plane of symmetry.



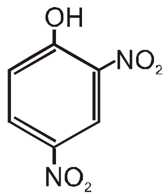
→ plane of (Symmetry)

3.(C)

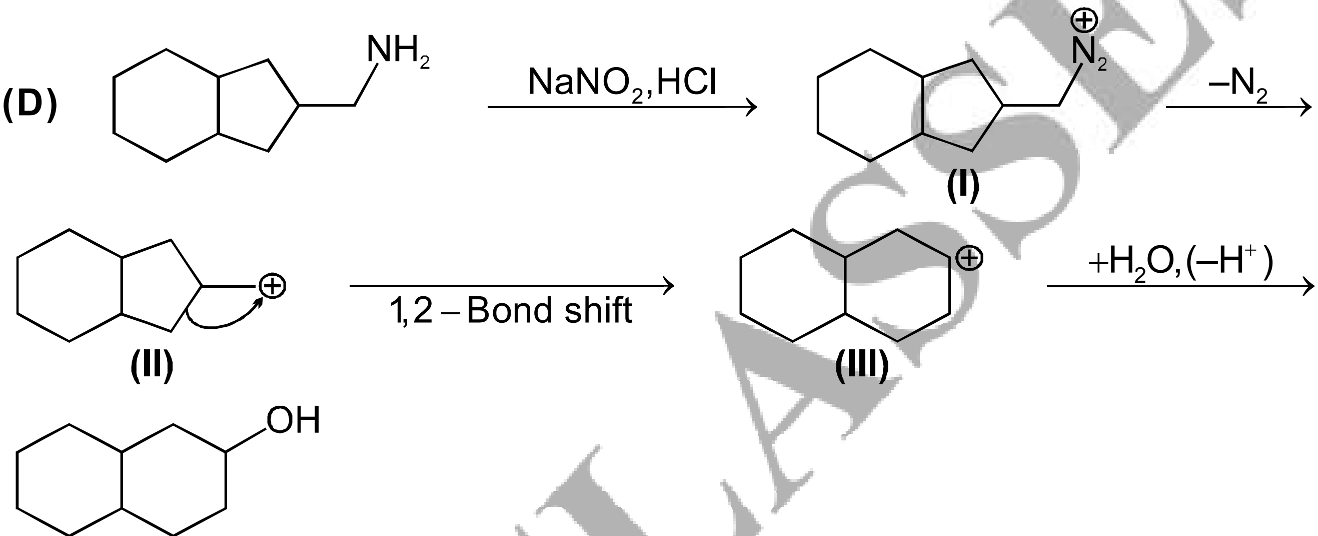


4.(D) Bulky groups present at ortho position inhibit delocalisation of lone pair of electrons present on nitrogen and thus increase basicity.

5.(C) –m, –I effect of $-NO_2$ group at o, p position.



6. (D)



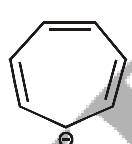
(i) This is the diazotisation reaction of 1º-NH_2 group.

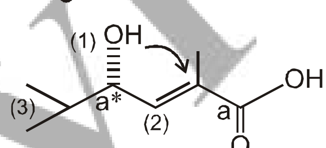
(ii) Initially a diazonium ion (I) is formed.

(iii) Then N_2 is lost, a carbocation (II) is formed.

(iv) The carbocation rearranges by 1,2-bond shift (ring expansion) and another carbocation (III) is formed.

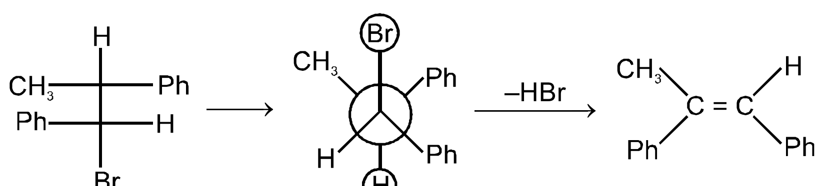
(v) Finally H_2O molecule attacks and alcohol is formed.

7.(B)  — $8\pi e^-$ — This compound is not aromatic. It is antiaromatic.

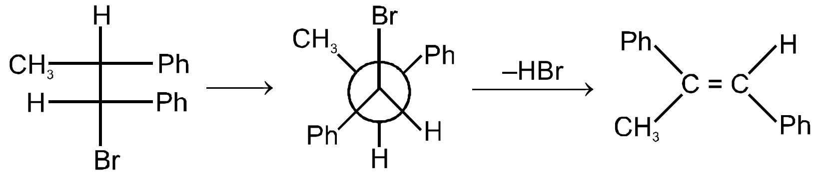
8.(D) 

2E, 4S

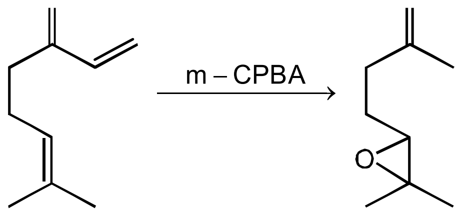
9.(A) (a) 1S, 2S-1-bromo-1, 2-diphenylpropane



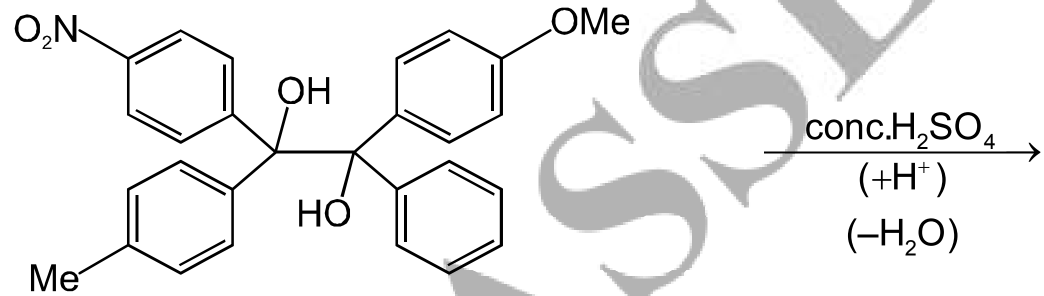
(b) 1S, 2R-1-bromo-1, 2-diphenylpropane

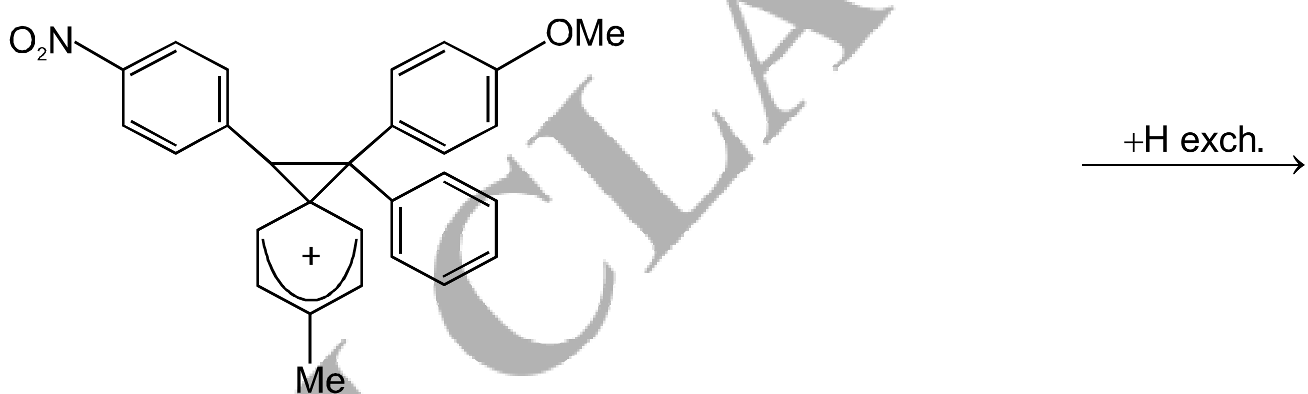


10.(C)

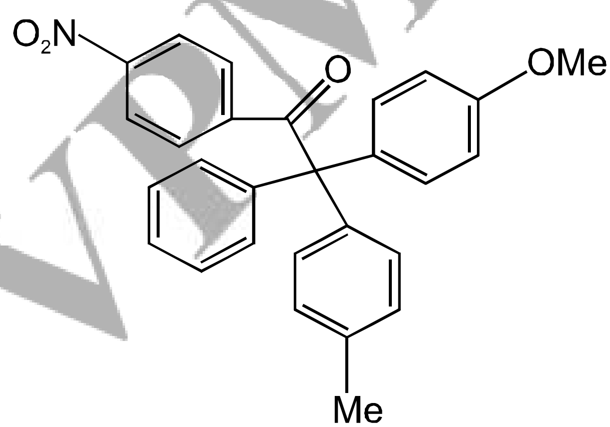


11. **(A)**





Intermediate Nonclassical Carbocation

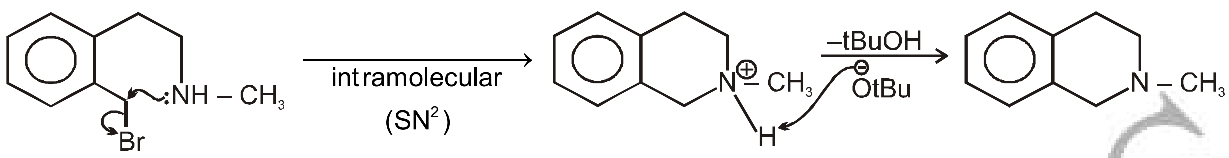


(i) This is Pinacol-Pinacolone rearrangement reaction.

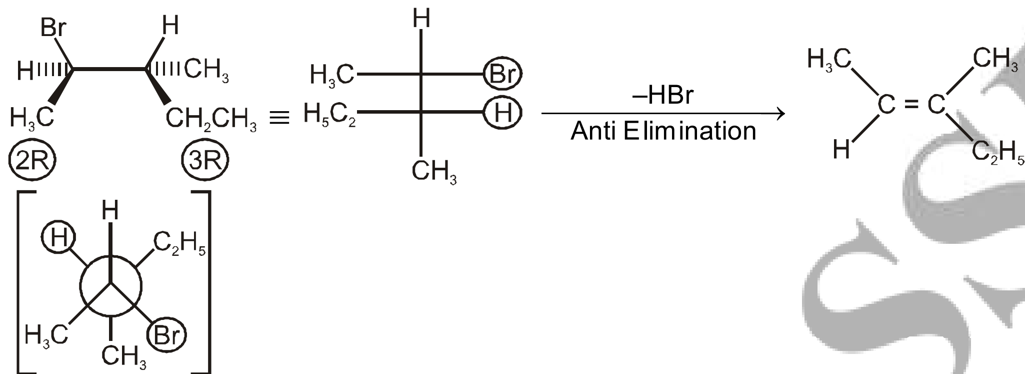
(ii) In step-1, the most stable C^+ is formed, by loss of $-H_2O$ molecule.

(iii) Simultaneously this is accompanied by an aryl shift (of e^- rich ring, to form the non classical Phenonium ion). After H^+ exchange the final product, a ketone is formed.

12.(A)

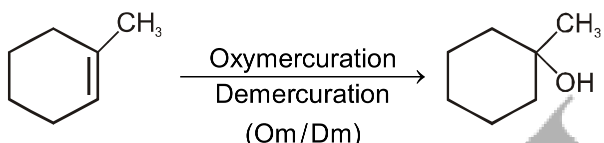


13.(C) $(E_2) \rightarrow$ Anti elimination



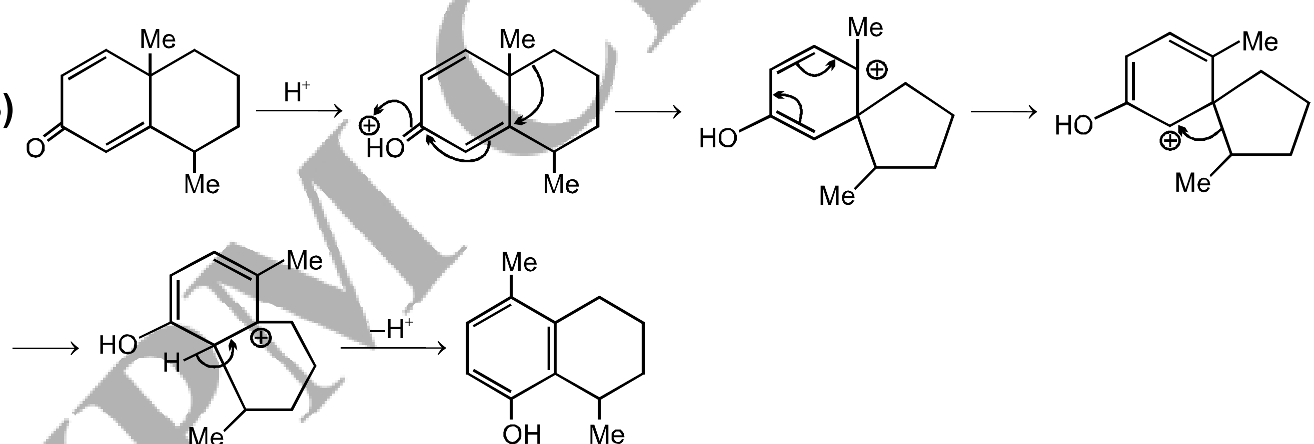
Anti Conformation

14.(C)

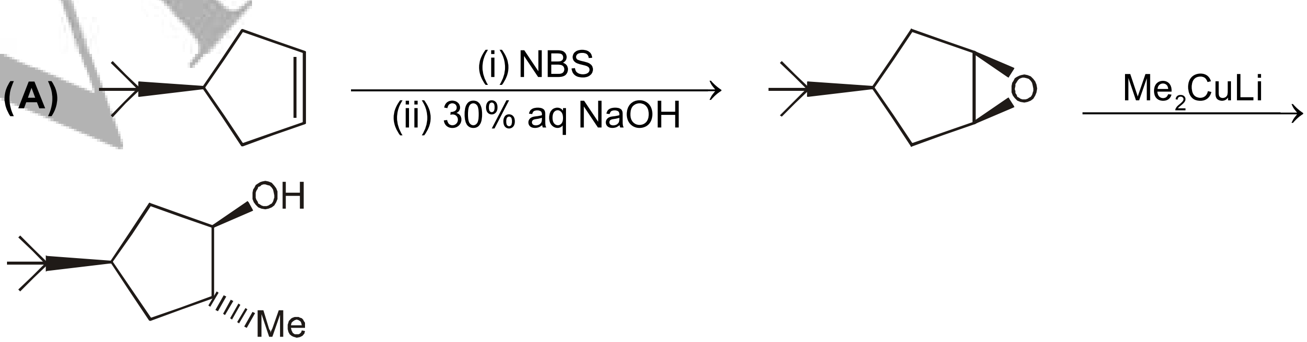


In Om/Dm = Markownikov's Addition occurs, rearrangement does not occur.

15.(B)



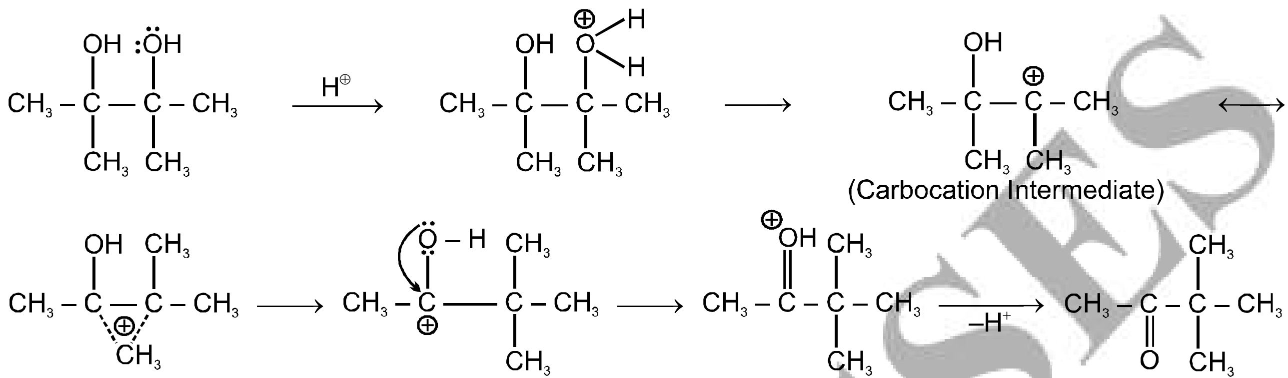
16. (A)



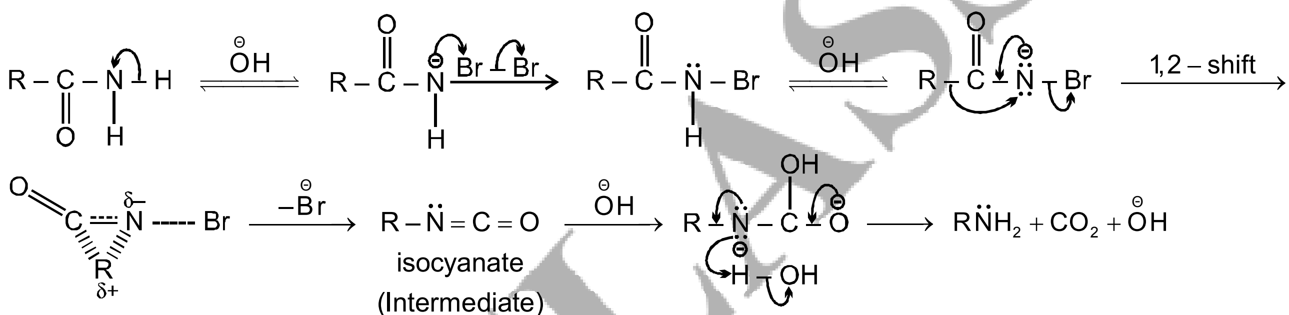
17.(A) Reimer-Tieamann reaction

$$CHCl_3 + \overset{\ominus}{O}H \rightleftharpoons :\overset{\ominus}{C}Cl_3 \longrightarrow \underset{\substack{\text{dichloro carbene}\\ \text{(Intermediate)}}}{:CCl_2}$$

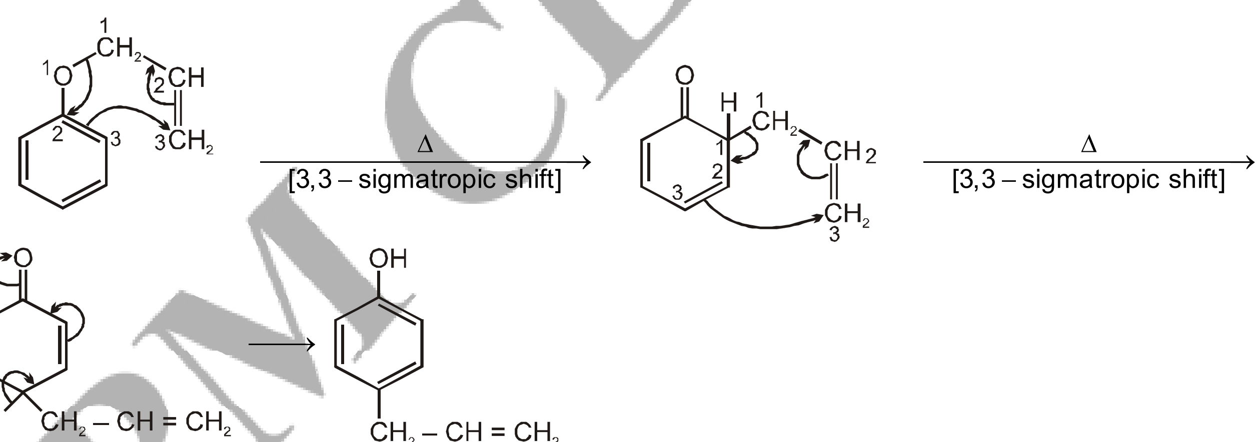
Pinacol-Pinacolone rearrangement



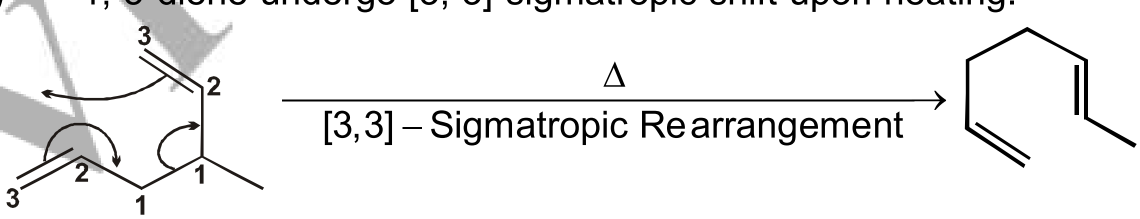
Hofmann bromamide rearrangement



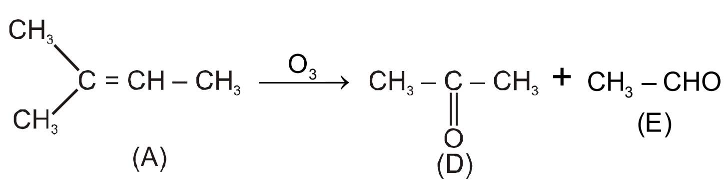
18.(B)



19. (D) 1, 5-diene undergo [3, 3]-sigmatropic shift upon heating.



20.(A)

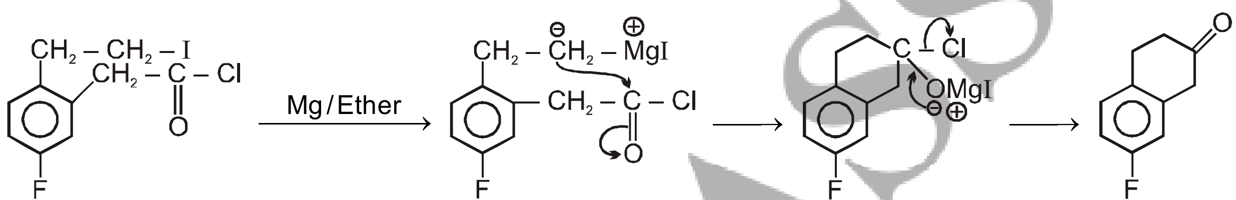


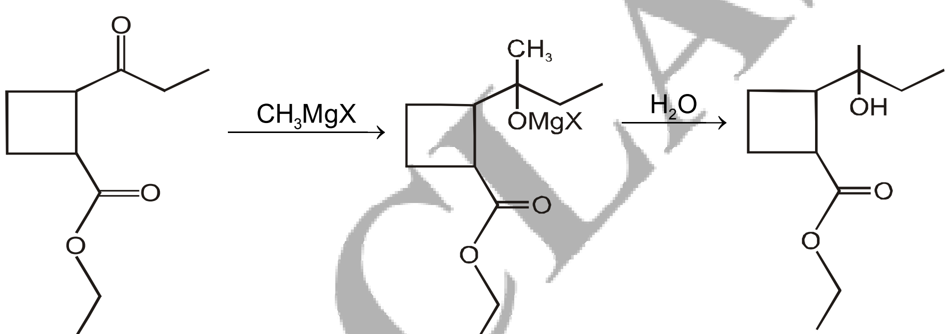
$$CH_3-\underset{\underset{\text{(D)}}{O}}{\overset{\|}{C}}-CH_3 \xrightarrow{NaOH + I_2} CHI_3 + CH_3-\underset{O}{\overset{\|}{C}}-\overset{\ominus\oplus}{ONa}$$

$$\underset{\text{(E)}}{CH_3-CHO} + Agt \xrightarrow[\text{reagent}]{\text{Tallen's}} RCOOH + 2Ag \text{ [Silver mirror]}$$

21.(D) $Cl-CH_2-\underset{O}{\overset{\|}{C}}-OEt + 1CH_3MgI \longrightarrow Cl-CH_2-\overset{CH_3}{\underset{\overset{\ominus\oplus}{OMgI}}{C}}-OEt \longrightarrow Cl-CH_2-\overset{CH_3}{\underset{O}{\overset{|}{C}}} \xrightarrow{CH_3MgI}$

$$Cl-CH_2-\overset{CH_3}{\underset{OMgI}{C}}-CH_3 \xrightarrow{H_2O} Cl-CH_2-\overset{CH_3}{\underset{OH}{C}}-CH_3$$

22.(D) 

23.(A) 

24.(B) Monosubstituted acetylenes show band at 2140 – 2100 cm^{-1} (– C ≡ C – stretch) & C – H stretching band appears in the region 3333 – 3268 cm^{-1} & C – H bending appears in the region 700 – 610 cm^{-1}. Thus, the probable structure of the compound is $CH_3 - C \equiv C - H$.

25.(A) Some of the important bands are :

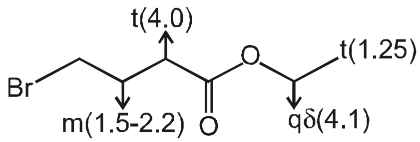
(i) Ar – H str ; ~3030 cm^{-1}

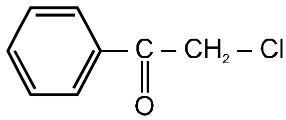
(ii) C – H str in CH_3 ; 2850 – 2960 cm^{-1}

(iii) C = C str ; 1600, 1580, 1460 , cm^{-1}

(iv) C – H bending for monosubstituted benzene; 730 – 770 cm^{-1}

26.(A) $\underset{\underset{(2.80)}{d}}{CH_3}-\underset{\underset{\underset{\delta\ 5.30}{\text{(broad)}}}{H}}{N}-\underset{O}{\overset{\|}{C}}-\underset{\underset{(4.10)}{q}}{OCH_2}-\underset{\underset{(1.20)}{t}}{CH_3}$

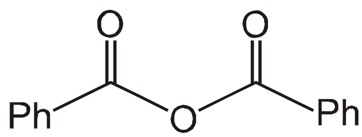
27.(C) 

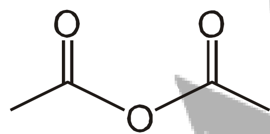
28.(C) 

The ratio of protons is 5 : 2. Due to aryl ketone this compound shows an emient band at 1690 cm^{-1}.

29.(B) $CHCl_2 - \overset{O}{\overset{\|}{C}} - H$ has minimum e^- density at >C = O. So maximum >C = O streching frequency.

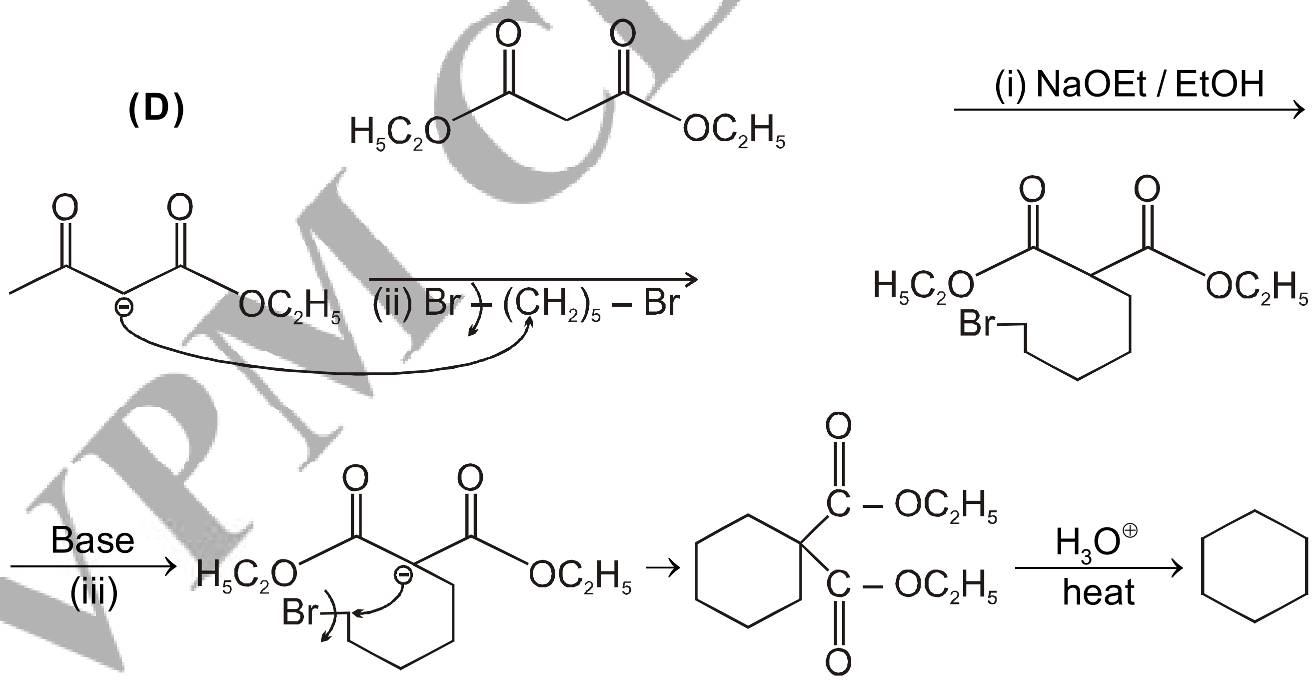
30.(B) Ring strain increase the carbonyl streching frequency.

(I) 

(II) 

e^- density at >C = O   I > II

$\nu_{>C=O}$ II > I

31. **(D)** 

+ $2C_2H_5OH + 2CO_2$.

32. (D) T-shaped, sp^3d hybridisation, two lone pairs are occupying eqatorial positions.

33.(B) The ionization will take place as follows :

$$1s^2\ 2s^2\ 2p^6\ 3s^2 \xrightarrow[(IE_1+IE_2)]{-2e^-} 1s^2\ 2s^2\ 2p^6 \xrightarrow[IE_3]{-e^-} 1s^2\ 2s^2\ 2p^5;$$

Here the electronic configurations of the product ions indicate the following order,

$IE_3 >> IE_2 > IE_1$**;** In third ionization the e^- is removed from completely filled subshell, so IE_3 is very high as compared to IE_2.

34. (C) $XeF_2 + H_2O \rightarrow XeO_2F_2$.

35. (B) Na = $1s^2\ 2s^2\ 2p^6\ 3s^1$

$$n = 3,\ \ell = 0,\ m = 0,\ s = +\frac{1}{2}$$

36. (D) BeO is basic oxide and reacts only with an acid to form the salt.

37.(B) $\underset{(2s^2p^5)}{O^-} + e^- \rightarrow \underset{(2s^2p^6)}{O^{2-}}$

It is endothermic. It is difficult to add e^- in –vely charge ion.

38.(D) O^{2-}, F^-, Na^+, Mg and Al^{3+} have same number of electrons (i.e. 10 electrons) but different nuclear charges and therefore, they are isoelectronic species.

For isoelectronic species ionic radii $\propto \frac{1}{\text{nuclear charge}}$.

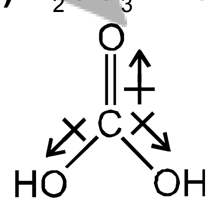
So, correct order is ${}_8O^{2-} > {}_9F^- > {}_{11}Na^+ > {}_{12}Mg^{2+} > {}_{13}Al^{3+}$.

39. (D) The bond energy is inversely proportional to the size of the two bonded atoms.

	HF	HCl	HBr	HI
Bond dissociation energy (Kcal/mol)	136	105	86	70

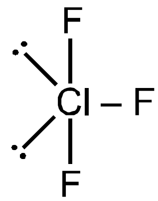
40.(B) Hydration energy increases with increase of **charge to size** ratio of the ion.

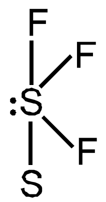
41.(A) $H_2CO_3 \rightarrow sp^2$ Hybridisation.



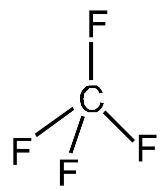
It has some value of dipole moment. So it is a polar.

42. (B) ClF_3 has T shape structure and axial bonds are longer than equatorial bond.

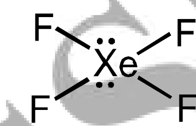
$ClF_3 \rightarrow sp^3d$ Hybridisation. 

43. (A) 

1 lone pair



0 lone pair

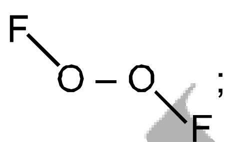
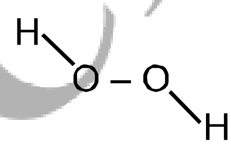


2 lone pairs

44. (D) The number of lone pairs of electrons on the central atom of various species is SF_4(one); ClO_3^-(One); XeF_4(2)l; I_3^-(3).

45.(A) Greater the electronegativity of central atom and more the number of lone pairs on it coprsses the bond angle. Thus, the bond order is :

$NH_3 > H_2O > PH_3 > H_2S$

46. (B) O_2F_2 =  ; H_2O_2 = 

47. (C) Unpaired e^- is present in KO_2 [In Antibonding unpaired e^-]

48. (D) $d\pi - p\pi$ bonding.

49. (D) $BF_3 + (HBO_3)_4 \rightarrow B_2H_6$.

50. (B) $P_4O_{10} + 6H_2O \longrightarrow 4H_3PO_4$

51.(C) $NO \rightarrow NO^+ + e^-$

$Fe^{3+} + e^- \rightarrow Fe^{2+}$

Oxidation state of Fe is +2 and NO^+ is ligand.

52.(A) $ZnCl_2$ — Zn^{2+} [$3d^{10}$]

no unpaired e^- - Diamagnetic

53.(B) Cr_2O_3 – Amphoteric (This oxide is in the intermediate oxidation states of Cr)

Cr (+3) = $\left.\begin{matrix} Cr_2O_3 \\ Cr(OH)_3 \end{matrix}\right]$ amphoteric $\left[\begin{matrix} Cr^{3+} \\ Cr(OH)_4^- \end{matrix}\right.$ chromium (II) (chromous) chromite

54. (C) $COCl_3.6NH_3$ has 3 ionisable chlorine atoms.

55. (B) $[Pd(dipy)(SCN)_2]$ $[Pd(dipy)(NCS)_2]$

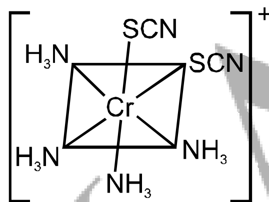
56.(C) $[Co(SCN)_4]^{2-}$, cobalt is +2 with three unpaired electrons in 3d. Thus, $\mu = \sqrt{15}$ BM.

57.(C) $[CO(en)_2NO_2Cl]Br$ shows linkage isomerism.

58.(D) Cis, trans and linkage isomers are shown by $[Cr(SCN)_2(NH_3)_4]^+$ complex.

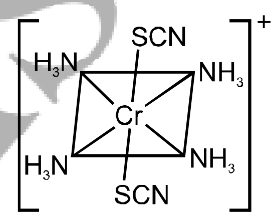
Linkage isomerism : $[Cr(SCN)_2(NH_3)_4]^+$; $[Cr(NCS)_2(NH_3)_4]^+$

Geometrical isomerism :



cis isomer

;



trans isomer

59.(A) $K_4[Fe(CN)_6]$ ionizes to give five ions giving maximum conductivity.

$K_4[Fe(CN)_6] \rightarrow 4K^+ + [Fe(CN)_6]^{-4}$

60.(A) d^4 low spin complex will have two d-orbitals vacant required for d^2sp^3 hybridization to give an octahedral complex.

61.(D) Fe^{3+} (high spin) — $t_{2g}{}^3\, eg^2$

CFSE = $-[0.4 \times nt_{2g} + 0.6\, n_{eg}] = -[0.4 \times 3 + 0.6 \times 2] = 0$

62.(B) $[Ni(CN)_4]^{2-}$ is square planar with dsp^2 hybridization.

63.(C) CO ligand is bonded to the metal through σ and π bonding.

64.(A) $Cr_2O_7^{2-}$ **(+6)** + SO_4 **(+4)** $\rightarrow$ SO_4^{2-} **(+6)** + Cr^{3+} **(+3)**

65.(C) $CuSO_4.5H_2O$ can be written as $Cu^{2+}SO_4^{2-}$. Hence, electrovalent (ionic) bond is present, coordinate bond is formed between Cu2+ and SO_4^{2-} and covalent bond is present in SO_4^{2-}.

66.(D) $K_p = K_c\,(RT)^{\Delta n} = K_c\,(RT)^{-2}$

$$\frac{K_p}{K_c} = (RT)^{-2} = \frac{1}{(RT)^2}.$$

67.(B) $E = h\nu = (6.63 \times 10^{-34}\text{ J-sec})(9.00 \times 10^{11}/\text{sec}) = 5.97 \times 10^{-22}$ J

68.(A) $V_{nucleus} = \frac{4}{3}\pi(r_N)^3$

$V_{hydrogen} = \frac{4}{3}\pi(r_H)^3$

0.0529 nm = 0.0529×10^{-9} m

$\frac{V_{nucleus}}{V_{hydrogen}} = \frac{r_N^3}{r_H^3} = \frac{(1.5 \times 10^{-15})^3}{(0.0529 \times 10^{-9})^3}$ **= 2.3 × 10^{-14}**

69.(B) $\frac{d}{dr}[4\pi r^2 N e^{-2Zr/a_0}] = 0$

$4\pi N e^{-2Zr/a_0}(2r) + 4\pi r^2 N e^{-2Zr/a_0}\left(\frac{-2Z}{a_0}\right) = 0$

$8\pi r N e^{-2Zr/a_0}\left[1 - \frac{rZ}{a_0}\right] = 0$

$\mathbf{r = \frac{a_0}{Z}}$

70.(B) Orbital angular momentum (m ν r) = $\frac{h}{2\pi}\sqrt{l(l+1)}$

For 2s orbital **l** (**azimuthal quantum number**) = 0

∴ orbital angular momentum = $\frac{h}{2\pi}\sqrt{0(0+1)} = \frac{h}{2\pi}\sqrt{0} = 0$

71.(A) The energy of an electron in Bohr's orbit of hydrogen atom is given by the expression.

$E_n = -\frac{\text{Constant}}{n^2}$

Where n takes only integral values. For the first Bohr's orbit, n = 1 and it is given that E_1 = –13.6eV

Hence, $E_n = -\frac{13.6\text{eV}}{n^2}$ of the given values of energy, only –3.4eV can be obtained by substituting n = 2 in the above expression.

72. (B) Shortest wavelength of H atom in Lyman series transition required maximium energy —

$n_2 = \infty$, $n_1 = 1$

$\frac{1}{\lambda} = R_H Z^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$\frac{1}{\lambda} = R_H 1^2 \times \frac{1}{1^2}$

$\frac{1}{\lambda} = R_H \quad \Rightarrow \lambda = \frac{1}{R_H} = a$

Longest wavelength in Balmer series of He^+

$n_1 = 2, n_2 = 3, z = 2$

$$\frac{1}{\lambda} = R_H \times 2^2\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = R_H \times 4\left[\frac{1}{4} - \frac{1}{9}\right] = R_H \times 4\left[\frac{9-4}{36}\right] = R_H \times 4 \times \left[\frac{5}{36}\right]$$

$$\lambda = \frac{1}{R_H} \times \frac{36}{20} = \frac{36}{20}a = \frac{6}{5}a$$

73.(D) $r = 0.529 \times \frac{n^2}{z}$

For Be^{3+} (n = 2)

$r = 0.529 \times \frac{4}{4}$

$r = 0.529$

74. (A) $\frac{t_1}{t_2} = \frac{(\text{Distance travelled})_1}{(\text{Distance travelled})_2} = \frac{2\pi R}{2\pi \times 4R} = \frac{1}{4}$

$t_2 = 4 \times t_1$

$\boxed{t_1 : t_2 = 1 : 4}$

75.(B) $\lambda = \frac{h}{mV}$

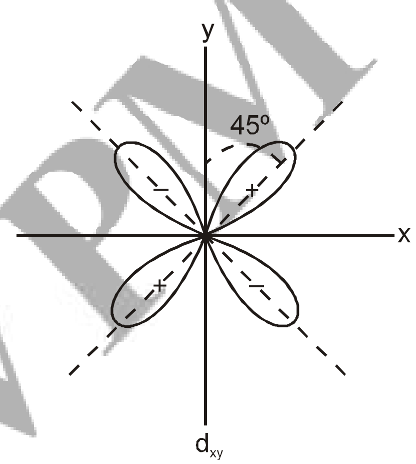
$\lambda_x = 1$ A°

$$\frac{\lambda_x}{\lambda_y} = \frac{h}{m_x V_x} \times \frac{.25m_x .75V_x}{h}$$

$$\frac{1}{\lambda_y} = \frac{3}{16}$$

$\lambda_y = 5.33$ A°

76.(C) d_{xy}



77.(C) $\Delta x \Delta p \geq \frac{\hbar}{2}$

$\Delta E \Delta t \geq \frac{\hbar}{2}$

$\Delta J \Delta O \geq \frac{\hbar}{2}$

Linear momentum does not correlate with angle.

78.(A) Δx = de-Broglie wavelength = $\frac{h}{mV}$

From uncertainty principle

$\Delta x \Delta p \sim h$

$\Delta p \sim \frac{h}{\Delta x} = \frac{h}{\frac{h}{mV}}$ = mV

$\Delta p = mV$ ...(i)

$p = \frac{mV}{\Delta p} = m\Delta V$ ...(ii)

Compare Equi. (i) and (ii)

$\boxed{\Delta V = V}$

79.(C) The ground state energy

$E = \frac{n^2h^2}{8mL^2}$ (n = 1)

if the length is reduced $\frac{L}{2}$

$L = \frac{L}{2}$

$E' = \frac{n^2h^2}{8m\left(\frac{L}{2}\right)^2} = \frac{4n^2h^2}{8mL^2}$ (n = 1)

E' = 4E

80.(D) $\Delta \upsilon = 101 - 99 = 2\ cm\ s^{-1} = 0.02\ m\ s^{-1}$

$\Delta x = \frac{h}{4\pi m \Delta \upsilon} = \frac{6.626 \times 10^{-34}}{4 \times \frac{22}{7} \times 1 \times 10^{-3} \times 0.02}$ = $\mathbf{2.636 \times 10^{-30}\ m}$

81. (D) (A) ψ is wave function and the probability of finding electron around nucles is given by $|\psi^2|$.

(B) ψ is complete wave function, not only amplitude of wave function. Amplitude of wave function is normalisation constant.

82.(D) Rate of diffusion $\propto \sqrt{\left[\frac{1}{M}\right]}$

83.(C) Use $P \propto \frac{1}{V}$

$\frac{P_2}{P_1} = \frac{V_1}{V_2}$ [x = percentage increase in pressure]

$\frac{P_1 + xP_1}{P_1} = \frac{V_1}{(1-.05)V_1}$

$1 + x = \frac{1}{1-.05} = \frac{1}{0.95} = \frac{100}{95}$

$x = \left(\frac{100}{95} - 1\right) \times 100 = \frac{5}{95} \times 100$ = 5.26%

84.(A) $n(CH_4) = \frac{m}{(16 gmol^{-1})}$; $n(O_2) = \frac{m}{(32 gmol^{-1})}$

$$\frac{P_{O_2}}{P} = \frac{\left(\frac{m}{32 gmol^{-1}}\right)}{\left(\frac{m}{16 gmol^{-1}}\right) + \left(\frac{m}{32 gmol^{-1}}\right)} = \frac{\left(\frac{1}{32}\right)}{\left(\frac{1}{16}\right) + \left(\frac{1}{32}\right)} = \frac{16}{32+16} = \frac{1}{3}$$

85.(D) For molecules to be point masses, b = 0

Hence $\left(P + \frac{an^2}{V^2}\right) V = nRT \text{ or } PV = nRT - \frac{an^2}{V}$

86.(A) Put $\frac{\partial P}{\partial V_m}$ = 0 & $\frac{\partial^2 P}{\partial^2 V_m}$ = 0 to get critical const.

$P_c = \frac{1}{12}\left(\frac{2aR}{3b^3}\right)^{\frac{1}{2}}$

$V_c = 3b$

$T_c = \frac{2}{3}\left(\frac{2a}{3bR}\right)^{\frac{1}{2}}$

$$Z_c = \frac{P_c V_c}{RT_c} = \frac{1}{12}\left(\frac{2aR}{3b^3}\right)^{\frac{1}{2}} \frac{3b}{R2(2a)^{\frac{1}{2}}} \times 3(3bR)^{\frac{1}{2}} = \frac{1}{12} \times \frac{3 \times 3\sqrt{3}}{\sqrt{3} \times 2} = \frac{9}{24} = \frac{3}{8}$$

87.(B) $b = 4 \times N_A \times \frac{4}{3}\pi r^3$

get r = 0.1472 and hence get d = 2r.

88.(C) Use $\left(\frac{\partial P}{\partial V_m}\right)$ = 0 & $\left(\frac{\partial^2 P}{\partial V_m^2}\right)$ = 0 to get

$P_c = \frac{B^3}{27C^2}$; $V_c = \frac{3C}{B}$ and $T_c = \frac{B^2}{3RC}$

Now, $P_c V_c = Z_c RT_c$ $Z_c = \frac{P_c V_c}{RT_c} = \frac{1}{3}$ $\Rightarrow$ (C)

89.(B) Atmospheric pressure = 1 atm.

Pressure due to depth of 45 m = ρgh

where ρ = density of water = 1g cm^{-3} = 1000 kg m^{-3}, g = 9.81 m s^{-2}, h = 45 m

$\rho gh = 1000 \times 9.81 \times 45$ N m^{-2} = $\frac{1000 \times 9.81 \times 45}{101325}$ atm = 4.36 atm

($\because$ 1 atm = 1.01325 × 10^5 N m^{-2})

$\therefore$ P_1 = atmospheric pressure + ρgh = 1 + 4.36 = 5.36 atm

P_2 = 1 atm

$V_1 = \frac{4}{3}\pi r^3 = \frac{4}{3} \times \pi \times (1)^3 cm^3$

$V_2 = \frac{4}{3}\pi r^3$ = volume of bubble at P_2 (at the surface)

using $P_1V_1 = P_2V_2$

$V_2 = \frac{P_1V_1}{P_2}$

$$\frac{4}{3}\pi r^3 = \frac{5.36 \times \frac{4}{3}\pi(1)^3}{1}$$

$r^3 = 5.36\ cm^3$

r = 1.75 cm

90.(C) For flask 1, $P_1V_1 = n_1RT_1$

For flask 2, $P_2V_2 = n_2RT_2$

Since, both flasks are of equal volume and have been joined by a narrow tube, hence pressure is also same in both flasks.

$\therefore$ $P_1V_1 = P_2V_2$

$\therefore$ $n_1RT_1 = n_2RT_2$

$\therefore$ $\frac{n_1}{n_2} = \frac{T_2}{T_1} = \frac{600}{300} = \frac{2}{1} = \frac{4}{2}$

but $n_1 + n_2 = 0.6$ mol

$\therefore$ n_1 = 0.4 mol at 300 K

n_2 = 0.2 mol at 600 K

volume of the flasks containing 0.3 mol O_2 in each, $V = \frac{nRT}{P} = \frac{0.3 \times 0.0821 \times 300}{0.5} L$

hence, final pressure $P_f = \frac{n_2RT_2}{V}\left(or = \frac{n_1RT_1}{V}\right) = \frac{0.2 \times 0.0821 \times 600 \times 0.5}{0.3 \times 0.0821 \times 300}$ = **0.66 atm**

91.(A) $u_{MP} : u_{AV} : u_{rms} :: \sqrt{\left(\frac{2RT}{M}\right)} : \sqrt{\left(\frac{8RT}{\pi M}\right)} : \sqrt{\left(\frac{3RT}{M}\right)}$

$u_{MP} : u_{AV} : u_{rms} :: \sqrt{2} : \sqrt{8/\pi} : \sqrt{3}$

$u_{MP} : u_{AV} : u_{rms}$ :: 1 : 1.128 : 1.224

92.(C) $SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$ ....K_1

$SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g)$ ....$\frac{1}{K_1}$

$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$ ....$\frac{1}{K_1^2}$

$\therefore \quad K_2 = \frac{1}{K_1^2}$ or $K_1^2 = \frac{1}{K_2}$.

93.(C) $N_2 + O_2 \rightleftharpoons 2NO$ ....K_1

$2NO \rightleftharpoons N_2 + O_2$ ....$\frac{1}{K_1}$

$NO \rightleftharpoons \frac{1}{2} N_2 + O_2$ ....$K_2 = \left(\frac{1}{K_1}\right)^{1/2}$

$K_2 = \left(\frac{1}{K_1}\right)^2$ or $K_2^2 = \frac{1}{K_1}$

$K_1 = \frac{1}{(K_2)^2}$.

94.(C) $\underset{weak}{HA} + \underset{strong}{BOH} \Rightarrow BA + H_2O$

$\therefore \quad HA + B^+OH^- \rightleftharpoons B^+ + A^- + H_2O$ or $HA + OH^- \Rightarrow A^- + H_2O$

$\therefore \quad K = \frac{[A^-]}{[HA[OH^-]}$ ...(1)

Also for weak acid, HA:- $HA \Rightarrow H^+ + A^-$

$K_a = \frac{[H^+][A^-]}{[HA]}$ ...(2)

By equation (1) and (2)

$\frac{K_a}{K} = K_w$ or $\frac{K_a}{K_w} = \frac{1\times10^{-4}}{1\times10^{-14}}$

K = **1 × 10^10**

95.(D) $pH = -\log[H^+]$

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

$pH + pOH = 14$

$pH = 14 - pOH$

$[H^+] = 10^{-(14-pOH)}$

96.(C) $N_2 + 3H_2 \rightleftharpoons 2NH_3$ ...... (1) – K_1

$N_2 + O_2 \rightleftharpoons 2NO$ ...... (2) – K_2

$H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O$ ...... (3) – K_3

from eq. (2) + eq. (3) × 3 – eq. (1)

we get $2NH_3 + \frac{5}{2}O_2 \rightleftharpoons 2NO + 3H_2O = \frac{K_2K_3^3}{K_1}$

97.(B) For reaction $K_C = \frac{[O_2]^3}{[O_3]^2}$ = constant

so $\sqrt{K_C} = \frac{[O_2]^{3/2}}{[O_3]}$ = constant = will be same for both the containers

98.(A) The two components are Na_2SO_4 and H_2O (proton transfer equilibria to give HSO_4^- etc. do not change the number of independent components) so $\boxed{C=2}$.

There are three phases present (solid salt, liquid solution, vapour), so $\boxed{P=3}$.

99.(A) According to Langmuir adsorption isotherm, the amount of gas adsorbed at very high pressures reaches a constant limiting value.

100.(B) Decrease of temperature and increase of pressure both tend to cause increase in the magnitude of adsorption of a gas on a solid.

101.(B) A/C to BET equation

$$\frac{P}{\nu_{total}(P_0 - P)} = \frac{1}{V_{mono}C} + \frac{C-1}{\nu_{mono}C}\left(\frac{P}{P_0}\right) \qquad \text{...(i)}$$

This equi. divided by P

$$\frac{1}{\nu_{total}(P - P_0)} = \frac{1}{PV_{mono}C} + \frac{C-1}{\nu_{mono}C(P_0)}$$

Let $y = \frac{1}{\nu_{total}}$

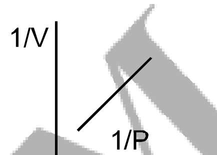
$x = \frac{1}{P}$

$m = \frac{1}{\nu_{mono}C}$

Constant C = $\frac{(C-1)}{\nu_{mono}CP_0}$

So this equation (ii) is the equation of straight line.

y = mx + C



BET theory assumes that physical absorption resulting in the formation of multilayers. So the Adsorption is multilayer.

102.(C) A/C to Hardy and Schulze Rules. The efficacy of an ion to cause coagulation depends upon its valency. Thus

$Al^{+3} > Ba^{+2} > Na^{+}$

103. (B) The R_f values of individual functional groups in a chemically related compounds are very close. So the term R_M is additive and is composed of the partial R_M values of the individual functional groups or other groupings of atoms in the molecule. Mathematically

$R_M = \log(1/R_f - 1)$.

104. (A) Several metal ions (e.g., Fe, Al, Zn, Co, Mn etc.) can be absorbed from hydrochloric acid solutions on anion exchange resins owing to the formation of negatively charged chloro complexes. Each metal is absorbed over a well defined range of pH and this property can be used as the basis of a method of separation. Zinc is absorbed from 2M acid while Magnesium is not thus by passing a mixture of Zn(II) and Mg(II) through a column of anion exchange resin a separation is effected. Zn(II) is eluted with dilute nitric acid.

105. (B) The phenomenon in which two reagents when used together, extracted a metal ion with enhanced efficiency compared to their individual action is called synergism. A common form of synergistic extraction is that in which a metal ion, M^{n+} is extracted by a mixture of an acidic chelating reagent, HR and an uncharged basic reagent, S. The joint action of the reagents is especially pronounced in those cases where the coordination capacity of the metal ion is not fully achieved in the MR_n chelate, then the extractant S gives a mixed complex, MR_nS_x which is extracted with much greater efficiency than the parent chelate. An example is the synergistic influence of zinc in the extraction and AAS (Atomic Absorption Spectrometric) determination of trace cadmium in water.

106. (D) Amount left unextracted,

$$W_n = W\left(\frac{V_W}{DV_0 + V_W}\right)^n$$

where, W = amount of solute, V_W = volume of aqueous solution, D = 150, V_0 = volume of organic phase.

$$\therefore \quad W_n = 400\left(\frac{100}{150 \times 25 + 100}\right)^2 = 400\left(\frac{100}{3850}\right)^2 = 0.269 \text{ mg} \; ; \; (0.27 \text{ mg Ans})$$

107. (C) The adsorptive power increase in the order : Calcium carbonate < silica gel < magnesium oxide < aluminium oxide.

108. (C) Sucrose < calcium sulphate < magnesium carbonate < calcium oxide.

109. (B) An increase in pH causes an increase in the sorption capacity if an ion exchanger contains weak groups like –COOH and –OH.

110. (D) The equilibrium process depends on all these factors.

111. (A) Strongly basic anion exchangers are used within a broad pH interval of 1-14 and weakly basic anion exchangers, within a narrower range of 1-9.

112. (D) Sulphonium bases are coordination compounds, derivatives of thioethers, e.g.,

$$2C_2H_5I + K_2S \rightarrow (C_2H5)_2S + 2KI$$

Sulphur adds alkyl halides, salts, etc.

$$(C_2H_5)_2S + CH_3I \rightarrow [(C_2H_5)_2S(CH_3)]I$$

113. (D) All these variables are taken into consideration.

114. (C) Each half-reaction, oxidation and reduction should involve equal number of electrons, balance it. $3Br_2 \equiv 5e^-$

In the disproportionation reaction.

net equivalent weight = $(\text{Eq. wt.})_O + (\text{Eq. wt.})_R$

$$\frac{1}{2}Br_2 \ \mathbf{(0)} \rightarrow BrO_3^- \ \mathbf{(+5)} \qquad (\text{Eq. wt.})_O = \frac{M}{10}$$

$$\frac{1}{2}Br_2 \ \mathbf{(0)} \rightarrow Br^- \ \mathbf{(-1)} \qquad (\text{Eq. wt.})_R = \frac{M}{2}$$

$$\text{Net} = \frac{M}{10} + \frac{M}{2} = 0.6\ M$$

115. (B) Temporary hardness is due to HCO_3^- of Ca^{2+} and Mg^{2+}

$Ca(HCO_3)_2$ + CaO **[56 g(0.56 g)]** $\rightarrow$ $2CaCO_3$ **[200 g(2 g)]** + H_2O

10 L (= 10^4 g) hard water contains = 2 g $CaCO_3$

10^6 g (ppm) hard water contains = 200 g $CaCO_3$

116. (D) Phenolphthalein indicates only 50% reaction of Na_2CO_3 upto $NaHCO_3$.

$Na_2CO_3 + HCl \rightarrow NaHCO_3 + NaCl$

5 mL of 0.2 M Na_2CO_3 (= 0.4 N) is neutralised

N_1V_1 **(HCl)** = N_2V_2 **(Na_2CO_3)**

x × 20 = 0.4 × 2.5

x = 0.05 N = 0.05 M HCl

117. (C) 10 mL of x M $NaHC_2O_4 \equiv$ 10 mL of 0.1 M NaOH $\left\{\begin{array}{l} H^+ \text{ ion is neutralised} \\ \therefore xM = xN \end{array}\right\}$

$\therefore$ 10 × x = 10 × 0.1

x = 0.1 M

with $KMnO_4$, $C_2O_4^{2-}$ is oxidised

$\therefore$ 0.1 M = 0.2 N $HC_2O_4^-$

$10 \times 0.2 = 10 \times N'(MnO_4^-)$

N' = 0.2 N

MnO_4^- is reduced to Mn^{2+}

Hence, $M(MnO_4^-) \times 5 = N'$

$\therefore$ $M(MnO_4^-) = 0.04$ M

118. (A) 40 mL of 0.05 M Cr^{3+} = 40 mL of x M H_2O_2

$40 \times 0.05 \times 3$ N Cr^{3+} = $40 \times 2x$ H_2O_2

x = 0.15 M

Cr^{3+} is oxidised to CrO_4^{2-} by H_2O_2 which is reduced to H_2O.

119. (A) $2CuSO_4 + 4KI \rightarrow Cu_2I_2 + I_2 + 2K_2SO_4$

$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$

$2CuSO_4 = 2Na_2S_2O_3$

$CuSO_4 = Na_2S_2O_3$

100 mL of 1 M hypo = 0.1 mol hypo = 0.1 mol pure $CuSO_4$

Hence, 100% pure

120. (D) $5C_2O_4^{2-} + 2MnO_4^- \rightarrow 10CO_2 + 2Mn^{2+}$

Also, 1 Ca^{2+} = 1 $C_2O_4^{2-}$

20 mL of 0.001 M MnO_4^- = 2×10^{-5} mol MnO_4^- = 5×10^{-5} mol $C_2O_4^{2-}$

= 5×10^{-5} mol Ca^{2+} = $5 \times 10^{-5} \times 40$ g Ca^{2+} = 0.002 g Ca^{2+}