PAPER – III

CHEMICAL SCIENCE

Note : Attempt all the questions. Each question carries *two* (2) marks.

1. Bond order of He_2 and He_2^+ are

1) 0, 1/2 2) 1/2, 0
3) 1, 1/2 4) 0, 1

2. The ionisation potential of sodium is 5.48ev. Potassium is expected to have a value of

1) 5.48ev 2) 4.34ev
3) 5.68ev 4) 8.4ev

3. Which one of the following represents the electronic configuration of the most electropositive element?

1) $[He]\ 2S^1$ 2) $[Xe]6S^1$
3) $[He]\ 2S^2$ 4) $[Xe]2S^2$

4. Calculate the % of ionic character in KCl . The electronegativities of K and Cl are 0.50ev and 3.60ev respectively

1) 83.235 2) 12.965
3) 60.45 4) 50.58

5. If the molecules of HCl were totally polar, the expected value of dipolemoment would be 6.12D, but the experimental value of dipolemoment would be 1.03D. Calculate the % of ionic character

1) 50 2) 83
3) 17 4) 0

6. PK_a value of an acids are given below at 25°C. Indicate the strongest acid

1) 2 2) 2.5
3) 3.0 4) 4.0

7. A H_2O_2 sample is labelled 28% by volume . The normality of H_2O_2 is

1) 14 2) 7

3) 5 4) 2.5

8. Which of the following is the pseudo halogen?

1) IF_7 2) $(CN)_2$

3) ICl_2 4) I^{3-}

9. A 500g toothpaste sample has 0.2g fluoride concentration. What is the concentration of F-ions in terms of ppm level?

1) 250 2) 200

3) 400 4) 1000

10. The calculated value of magnetic moment of $_{22}Ti^{3+}$ is

1) 1.73 Bohr magneton 2) 2.83 Bohr magneton

3) 3.87 Bohr magneton 4) 4.90 Bohr magneton

11. The example of normal spinel is

1) $ZnFe_2O_4$ 2) $FeO - Fe_2O_3$

3) Mn_3O_4 4) Mn_2O_7

12. The oxidation state of iron in the brown ring complex formed at the time of qualitative analysis of nitrate is

1) 1 2) 2

3) 3 4) 0

13. Three complexes of Cr are $[Cr(H_2O)_6]Cl_3$, $[Cr(H_2O)_5 Cl]Cl_2.H_2O$, and $[Cr(H_2O)_4 Cl_2]Cl.2H_2O$, and when these treated with H_2SO_4, the % of weight loss are

1) 0%, 6.75% and 13.5% 2) 6.75%, 0%, and 13.5%

3) 13.5%, 6.75% and 0% 4) 6.75%, 13.5%, and 0%

14. Metal carbonyls which does not obey EAN rule is

1) $Fe(CO)_5$ 2) $Mo(CO)_6$

3) $Mn_2(CO)_{10}$ 4) $V(CO)_6$

15. A solution of 2.0g of brass was analysed for Cu electrogravimetrically using Pt gauze as electrode. The Weight of Pt-gauze changed form 14.5 to 16.0g. The weight of copper in brass is

1) 50 2) 55

3) 60 4) 75

16. Myoglobin contains

1) Iron II in the high spin state 2) Iron II in the low spin state

3) Iron III in the high spin state 4) Iron III in the low spin state

17. Type A heme are found in

1) Haemoglobin 2) Cytochrome a

3) Cytochrome b 4) Myoglobin

18. Haemoglobin binds

1) Two H^+ for every dioxygen molecules released

2) One H^+ for every dioxygen molecules released

3) Four H^+ for every dioxygen molecules released

4) It won't binds with H^+

19. The prosthetic group in carboxy peptidase A is

1) Zn^{+2} 2) Fe^{+2}

3) Cu^{+2} 4) Mn^{+4}

20. In the vibrational spectrum of CO_2, the number of fundamental vibrational modes common in both infrared and Raman are

1) 3 2) 2

3) 1 4) 0

21. Among the following, those can act a Mossbauer nuclei are

A. ^{129}I B. ^{57}Co C. ^{57}Fe D. ^{121}Sb

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

22. The radioactive isotope of caesium-137 of weight 8g was collected on 1st February 2006, and kept in a sealed tube. On 1st July 2006, it was found that only 0.25g of it remained. The half-life period of the isotope is

1) 37.5 days
2) 30 days
3) 25 days
4) 50 days

23. For a particle in a box at the energy level $n = 1$, the probability of particles, being between (1/2 0.011) and (1/2-0.011) is

1) 04
2) 0.03
3) 0.02
4) 0.01

24. Trans 1, 2- dichloro ethylene and Cis 1, 2 – dichloro ethylene belongs to

1) C_2h, C_2v point groups respectively
2) C_2h only
3) C_2v only
4) C_2v, C_2h point groups respectively

25. If a gas absorbs 2000 J of heat and expands against an internal pressure of 2 atm. from a volume of 0.5 L to 10.5 L, then the change in internal energy is

1) -26 J
2) 26 J
3) 2.6 J
4) -2.6 J

26. When two moles of $C_2H_6(g)$ are burnt, 3129 kj of heat is liberated. Calculate the heat of formation of $C_2H_6(g)$. ΔH_f for $CO_2(g)$ and $H_2O(l)$ are -393.5 and -286 kjmol^{-1} respectively.

1) -80.5 kj
2) 80.5 kj
3) 8.05 kj
4) -8.05 kj

27. The engine efficiency of heat is 21.84 %. If the temperature of the sink is 315, then find the temperature of the source

1) 403 K
2) 304 K
3) 400 K
4) 430 K

28. A carnot engine operating between 27°C and 127°C has efficiency equal to

1) 25 %
2) 24 %
3) 23 %
4) 21 %

29. An amount of heat Q is transformed from a heat reservoir at a temperature T_A to another heat reservoir at temperature T_B. What is the change in the entropy, ΔS, of the system?

1) $Q\left[\frac{1}{T_B}+\frac{1}{T_A}\right]$
2) $Q\left[\frac{1}{T_B}-\frac{1}{T_A}\right]$
3) $\left[\frac{1}{T_B}+\frac{1}{T_A}\right]$
4) $\left[\frac{Q}{T_B \times T_A}\right]$

30. In one of the Maxwell's relations, $\left(\frac{\partial s}{\partial p}\right)$ equals

1) $\left(\frac{\partial V}{\partial T}\right)V$
2) $-\left(\frac{\partial V}{\partial T}\right)p$
3) $-\left(\frac{\partial T}{\partial V}\right)S$
4) $\left(\frac{\partial P}{\partial T}\right)V$

31. Using vanderwaal's equation calculate the pressure exerts by one mole of a gas when it occupies a volume of 1.32 lit at 27°C ($a = 3.59$ atm L^2 mol^{-2}, $b = 0.0427$ L/mol, $k = 0.0821$ L atm k^{-1} mol^{-1})

1) 19.443 atm
2) 16.223 atm
3) 15.223 atm
4) 17.223 atm

32. If a reaction between A and B to give C shows first order kinetics in A and second order kinetics in B, the rate equation can be written as

1) $k\,[A]\,[B]^{1/2}$ 2) $k[A]^{1/2}\,[B]$

3) $k[A]\,[B]^2$ 4) $k\,[A]^2\,[B]$

33. The destruction of ozone layer of the atmosphere might involve the reaction

$NO + O_3 \longrightarrow NO_2 + O_2$

The reaction is first order in each reactant and the rate constant is equal to 1.3×106 L mol^{-1} s^{-1} at 298 K. For initial concentration of NO and O_3 both equal to 1.00×106 mol 1^{-1}, the concentration of NO at time t = 2.00 s

1) 2.8×10^{-7} mol L^{-1} 2) 4.2×10^{-7} mol L^{-1}

3) 3.8×10^{-7} mol L^{-1} 4) 8.4×10^{-7} mol L^{-1}

34. The effective rate constant for a gaseous reaction that has a Lindemann-Hinshelwood mechanism is $1.7 \times 10^{-3}\ s^{-1}$ at 1.09 kPa and $2.2 \times 10^{-4}\ s^{-1}$ at 25 kPa. The rate constant for the activation step in the mechanism is

1) 9.9 s^{-1} MPa^{-1} 2) 2.2 s^{-1} MPa^{-1}

3) 3.4 s^{-1} MPa^{-1} 4) 7.8 s^{-1} MPa^{-1}

35. At room temperature (20˚C) milk turns sour in about 64 h. In a refrigerator at 3˚C milk can stored three times as long before it sours. How long should it take milk to sour at 40˚C.

1) 20.51 h 2) 40.23 h

3) 18.20 h 4) 25.20 h

36. Correct expression of representing the second order correction to the energy (En) in time independent perturbation theory is

1) $\sum_m^1 \left(\frac{|<m|\ \hat{H}\ |n>|^2}{En^0 - Em^0} \right)$ 2) $\left| < n \left| \hat{H} \right| n > \right|$

3) $\Psi_n^{(0)} + . \sum_m^1 \left(\frac{|<m|\hat{H}\ |n>|^2}{En^0 - Em^0} \right)$ 4) $\Psi_n^{(0)} - . \sum_m^1 \left(\frac{|<m|\ \hat{H}\ |n>|^2}{En^0 - Em^0} \right)$

37. The actual expression for the first order correction to the wave function $\left(\psi_n^{(1)}\right)$ is

1) $\Psi_n^{(0)} + \sum_m^1 \left(\frac{|< m|\ \hat{H}\ |n>|^2}{En^0 - Em^0} \right) | \Psi_m^{(0)}$

2) $E_n^{(0)} \times \Psi_n^{(0)}$

3) $E_n^{(0)} + < m \left|\hat{H}'\right| n >$

4) $E_n^{(0)} - < m \left|\hat{H}'\right| n >$

38. A cell $Ag / Ag^+ \| Cu^{2+} / Cu$ initially contains 1M Ag^+ and 1M Cu^{2+} ions. Calculate the change in cell potential after passing 9.65 amperes of current for 1 h

1) 0.0104 V

2) 0.2104 V

3) 0.0401 V

4) 0.1210 V

39. Gold numbers of protective colloids A, B, C and D are 0.50, 0.01, 0.10 and 0.005 respectively. The correct order of their protective power is

1) D < A < C <B

2) C < B < D < A

3) A < C < B < D

4) B < D < A < C

40. The adsorption of butane on NiO powder was measured at 0°C, the volumes of butane at STP adsorbed per gram of NiO are

p/k Pa	7.543	11.852	16.448	20.260	22.959
$\gamma / (cm^3 / g)$	16.46	20.72	24.38	27.13	29.08

Using BET isotherm, calculate the volume at STP adsorbed per gram when the powder is covered by a monolayer; P° = 103.2 kPa

1) 27.66 cm^3 / g

2) 276.60 cm^3 / g

3) 17.25 cm^3 / g

4) 174.30 cm^3 / g

41. The correct value of standard integral $\int_0^\infty e^{-ax^2} dx$ is

1) $\frac{1}{2}\sqrt{\frac{x}{a}}$

2) $\frac{2\pi}{a}$

3) $\frac{1}{2}\frac{\pi}{a}$

4) $\sqrt{\frac{2\pi}{a}}$

42. The molar specific heat capacity at constant volume for an electron gas

1) $\gamma \times T + AT^3$
2) $\gamma \times T / AT^3$
3) $\gamma \times T / AT^2$
4) $\gamma \times T - AT^2$

43. Calculate the frequency of the $J = 3 \leftarrow 2$ transition in two pure rotational spectrum of $^{12}C\ ^{16}O$. The equilibrium bond length is 112.81 pm

1) $3.4754 \times 10^{11}\ \text{sec}^{-1}$
2) $6.432 \times 10^{12}\ \text{sec}^{-1}$
3) $8.572 \times 10^{11}\ \text{sec}^{-1}$
4) $10.213 \times 10^{12}\ \text{sec}^{-1}$

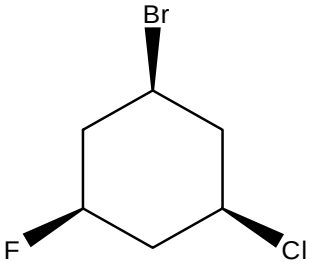
44. If 6.00g of urea is dissolved in 1.00 L of solution, calculate the osmotic pressure of the solution at $27°C$.

1) 250 Kpc
2) 280 Kpc
3) 270 Kpc
4) 260 Kpc

45. Which of the following statements is correct?

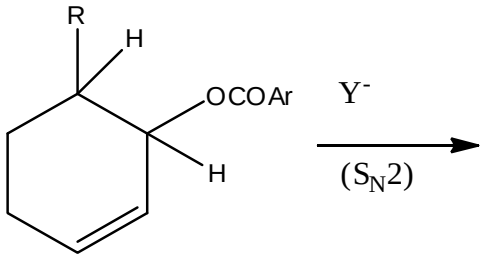
1) Conformation free energies of iodine and chlorine are almost equal
2) Conformation free energy of iodine is greater than that of chlorine
3) Conformation free energy of chlorine is greater than that of iodine
4) Conformation free energies of iodine and chlorine cannot be compared

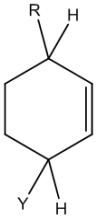
46. The correct stereochemistry of the following compound is

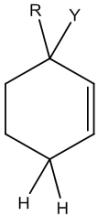


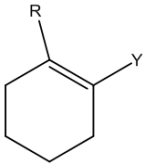
1) 1R-bromo-3S-chloro-5R-fluorocyclohexane
2) 1S-bromo-3S-chloro-5R-fluorocyclohexane
3) 1R-bromo-3R-chloro-5R-fluorocyclohexane
4) 1R-bromo-3S-chloro-5S-fluorocyclohexane

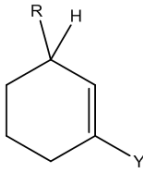
47. The product formed in the following reaction under S_N2 condition is



1) 

2) 

3) 

4) 

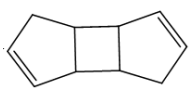
48. Which positions of phenanthrene are readily attached by reagents?

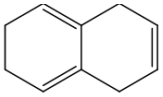
1) 1, 2 positions
2) 3, 4 positions
3) 6, 7 positions
4) 9, 10 positions

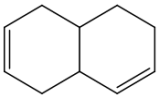
49. Which of the following is aromatic?

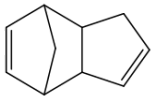
1) 1,3,5,7-tetramethylcyclooctatetraene
2) 1,3,5,7-tetramethylcyclooctatetraene cation
3) 1,3,5,7-tetramethylcyclooctatetraene anion
4) 1,3,5,7-tetramethylcyclooctatetraene dication

50. Cyclopentadiene cannot be sold as a pure compound because it undergoes a cycloaddition reaction at room temperature. Which of the following structures represents one of the two major products formed?

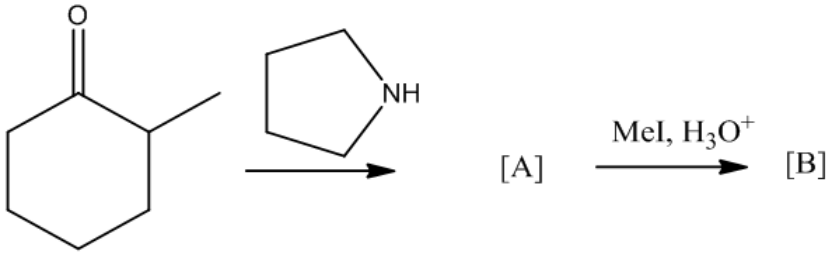
1) 

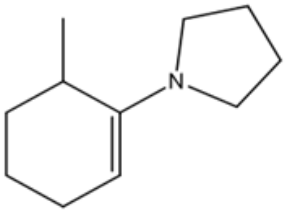
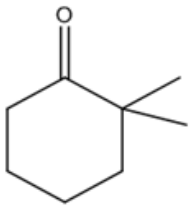
2) 

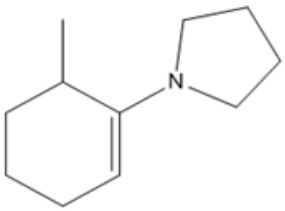
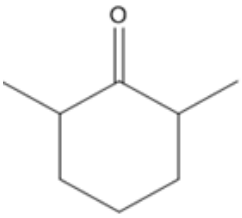
3) 

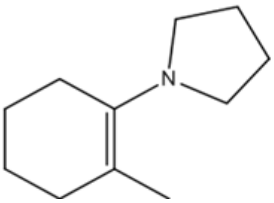
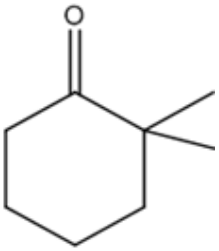
4) 

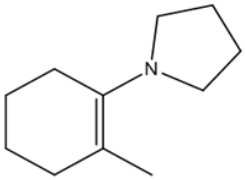
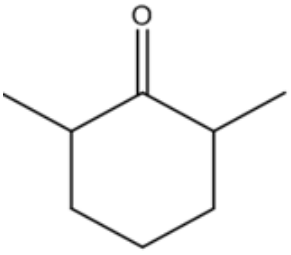
51. What is the product formed in the following reaction?



1) A is  and B is 

2) A is  and B is 

3) A is  and B is 

4) A is  and B is 

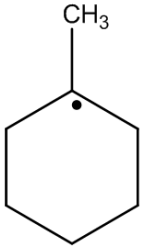
52. Which of the following statements is correct?

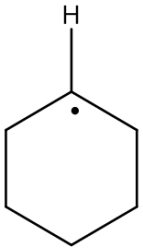
1) Menthyl chloride on sodium ethoxide treatment gives 3-menthene alone while neo-menthyl chloride gives a mixture of 2-menthene and 3-menthene under the same condition
2) Neo-Menthyl chloride on sodium ethoxide treatment gives 2-menthene alone while menthyl chloride gives a mixture of 2-menthene and 3-menthene under the same condition
3) Menthyl chloride on sodium ethoxide treatment gives 2-menthene alone while neo-menthyl chloride gives a mixture of 2-menthene and 3-menthene under the same condition
4) Neo-Menthyl chloride on sodium ethoxide treatment gives 3-menthene alone while menthyl chloride gives a mixture of 2-menthene and 3-menthene under the same condition

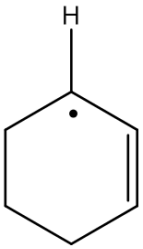
53. Which of the following statements is correct?

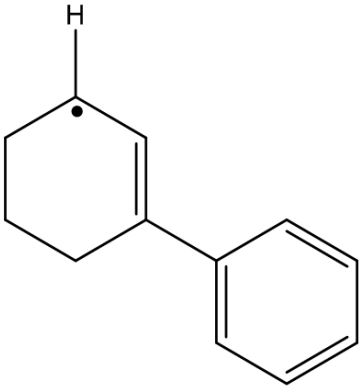
1) D-threo-3-phenyl-2-butyl tosylate on solvolysis by HOAc gives 96% recemicthreo acetate but D-erythro isomer gives only D-erythro acetate
2) D-erythro-3-phenyl-2-butyl tosylate on solvolysis by HOAc gives 96% recemicerythro acetate but D-threo isomer gives only D-threo acetate
3) Both D-erythro and D-threo isomers of 3-phenyl-2-butyl tosylate on solvolysis by HOAc gives 96% recemic D-erythro and D-threo acetates respectively
4) Both D-erythro and D-threo isomers of 3-phenyl-2-butyl tosylate on solvolysis by HOAc gives only D-erythro and D-threo acetates respectively

54. Which one of the following is the most stable radical?

1) 

2) 

3) 

4) 

55. Which of the following statements regarding diazines is wrong?

1) They are weaker bases than pyridines
2) Their resonance energies are higher than that for benzene
3) Compared to pyridine, N-alkylaton is difficult in diazines
4) Nucleophilic attack is easier in diazines than in benzene

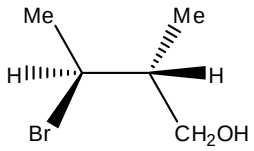
56. Pyridine on treatment with 20% oleum with little mercuric sulfate at 220°C gives 70% of

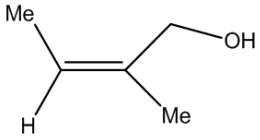
1) pyridine-2-sulfonic acid
2) pyridine-3-sulfonic acid
3) pyridine-4-sulfonic acid
4) pyridine-2,4-disulfonic acid

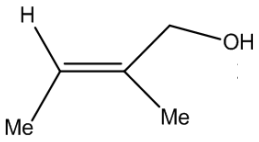
57. The synthetic equivalent for acyl anion is

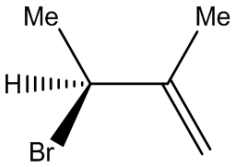
1) $CH_2 = C\ (OMe)\ Li$
2) CH_3COBr
3) $CH_3COOCOCH_3$
4) CH_3COOEt

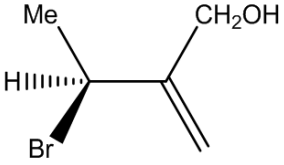
58. The main product formed when the following compound is treated with sodium methoxide in methanol is



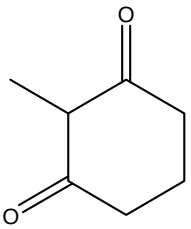
1) 

2) 

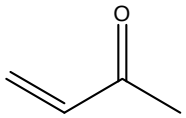
3) 

4) 

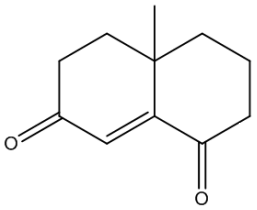
59. The reaction of A and B leads to

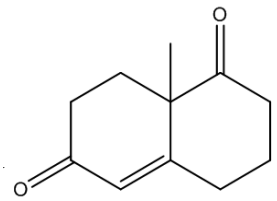


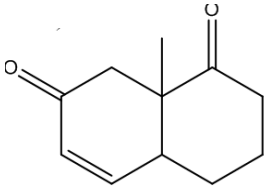
A

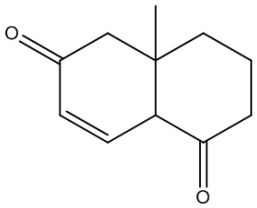


B

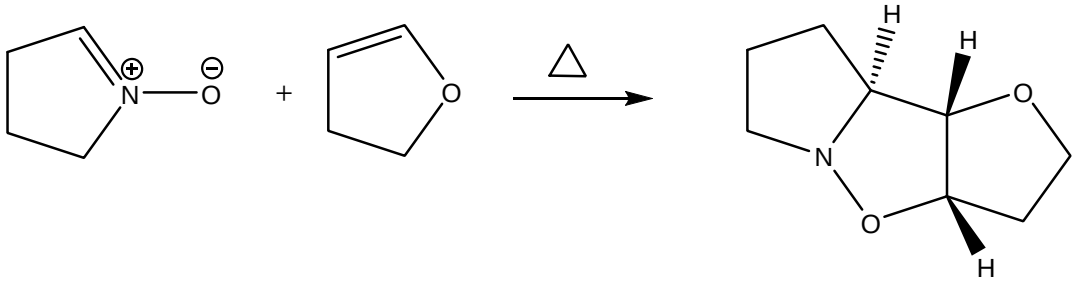
1) 

2) 

3) 

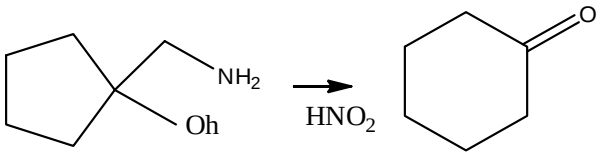
4) 

60. What is true about the following reaction?



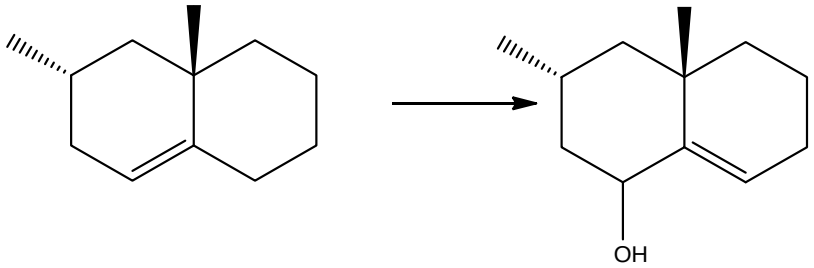
1) It is thermally allowed 1,3-dipolar addition reaction
2) It is photochemically allowed 1,5-dipolar addition reaction
3) The reaction is not stereospecific
4) It is a 2+2 addition reaction

61. The following reaction is known as



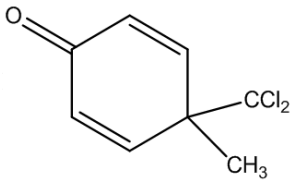
1) TiffineuDemyanov reaction
2) Wieland reaction
3) Semi pinacol-pinacolone rearrangement
4) Wagner Meerwin rearrangement

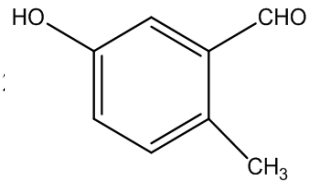
62. The following conversion can be effected by

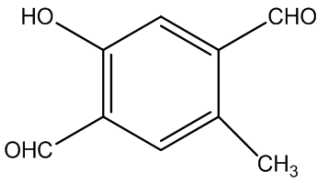


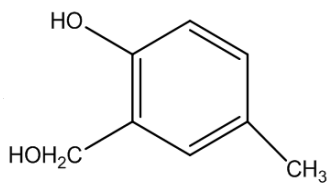
1) selenium dioxide in acetic acid
2) hydrogen peroxide on alkaline medium
3) singlet oxygen followed by hydrolysis
4) LDA treatment followed by hydrolosis

63. Which of the following compound is obtained during Reimer Tiemann reaction of para-cresol along with the expected 2-hydroxy-5-methylbenzaldehyde?

1) 

2) 

3) 

4) 

64. A systematic disconnection approach would lead the following as the precursor(s) for $CH_3CH_2COCH(CH_3)COOEt$

1) ethyl propionate
2) ethyl chloride and ethyl α-bromoacetate
3) propionic acid and acetyl chloride
4) methyl butyrate

65. What are the reagents employed for the conversion of ArI to ArCOOR?

1) $Ni(CO)_4$ and ROH as the reagents and hexane as the solvent
2) $Ni(CO)_4$ and ROH as the reagents and THF as the solvent
3) $Ni(CO)_4$ and ROH as the reagents and water as the solvent
4) $Ni(CO)_4$ and ROH as a reagent as well as solvent

66. When n-heptane is chlorinated with N-chloroamine and sulphuric acid, the chlorination occurs regiospecifically at

1) C1 carbon of n-heptane
2) C2 carbon of n-heptane
3) C3 carbon of n-heptane
4) C4 carbon of n-heptane

67. A self assembled monolayer (SAM) is primarily made of which basic components

1) A silane, thiol and phosponate
2) A high functionalisation region(HFR) compiled to a quantum filament
3) An adsorption nucleus and a lattice bridge both attached to a Langumur-Blodgett film
4) A tail group, back bone chain group and a head group.

68. If you were to measure the surface roughness of a sample on the nanoscale, what would give the best visual representation of this characteristic?

1) An SEM
2) Raman spectroscopy
3) An AFM (Atomic Force microscope)
4) XRD

69. Codeine differs morphine by

1) N-Methyl group
2) –Cl group
3) $-OCH_3$ group
4) –OEt group

70. Cyclodextrins have

1) hydrophilic surface and hydrophobic cavity
2) hydrophobic surface and hydrophilic cavity
3) hydrophobic surface and hydrophobic cavity
4) hydrophilic surface and hydrophilic cavity

71. Copper sulphate solution can't be kept in iron vessels

1) Iron is below Cu in the activity series
2) Iron is above Cu in the activity series
3) Iron and Cu will form alloy
4) The solution becomes toxic

72. What is the value of BOD for clean water

1) Less than 15 ppm
2) Less than 5 ppm
3) Less than 25 ppm
4) Less than 30 ppm

73. A student is asked to analyse a water sample from a stream for total solids (TS), dissolved solids (DS), and suspended solids(SS). She carried out the experiments below

A. A 25 ml portion of the water sample is evaporated to dryness in a pre-weighed evaporating dish to give mass 1

B. A separate 25 ml portion is filtered into second pre-weighed evaporating dish and evaporated to dryness to give mass 2.

How are value for TS, SS and DS (per 25 ml water) determined.

1) TS = mass 1, SS = mass 1-mass 2, DS = mass 2.
2) TS = mass 1, SS = mass 2, DS = mass 1-mass 2.
3) TS = mass 1 +mass 2, SS = mass 1, DS = mass 2.
4) TS = mass 1 + mass 2, SS = mass 2, DS = mass 2.

74. Photochemical smog is caused primarily by

1) CO
2) CO_2
3) O_3
4) NO_2

75. Biodiesel is an example of which of the 12 principle's of green chemistry

1) 1-waste prevention
2) 7-use of renewable feedstock
3) 9-Use of catalysis
4) 5-Safer solvents

ROUGH WORK

ROUGH WORK