SAMPLE QUESTION PAPER

CHEMISTRY
(313)

Time : 3 hrs. **Maximum Marks : 80**

Note: (i) All question in Section A are compulsory.

(ii) Attempt only one out of two options in section B, i.e., attempt either Part I or Part II or Part III in Section B.

(iii) Marks for each question is indicated against it.

(iv) Use log tables if necessary.

Section A

1. What is the molar mass of NH_3? (1)
2. A Sample of nitrogen gas consists of 4.63×10^{22} nitrogen atoms. How may moles of N atoms are there? (1)
3. What is the lowest possible temperature in Kelvin units? (1)
4. Derive SI units for

   (i) Force (ii) Pressure (2)
5. Explain the geometry of the following:

   (i) NH_3 (ii) $B F_3$ (2)
6. A sample of nitrogen gas weighing 9.3 g at a pressure of 0.99 atm a accoutres a volume of 12.4 litres at 55K temperature. What do you expect its volume to be when the temperature is 220 k? Assume that pressure stays constant. (2)
7. What is the relationship between the standard free energy change and the equilibrium constant of the reaction? (2)
8. Calulate enthalpy for the following reaction:

   $2H_2 + O_2 (g) \rightarrow 2H_2O(g)$

   Given Bond energy of H-H bond = 436 KJ mol^{-1}

   Bond energy of O – H bond = 423 KJ mol^{-1}

   Bond energy of O = O bond 496.4 KJ mol^{-1} (2)
9. Arrange the following oxides in the increasing order of acidic property. Justify your answer.

   Al_2O_3, CO_2, SO_2, B_2O_3 (2)

10. Draw the structure of the following:

(i) H_3PO_3 (ii) P_4O_{10}

(iii) $H_2S_2O_3$ (iv) ClO_2 (4)

11. Explain the following giving suitable reasons

(i) BF_3 is weaker lewis acid as compared to BCl_3

(ii) CCl_4 does not hydrolyse but SCl_4 does.

(iii) N_2 is inert at room temperature.

(iv) SF_4 is known but SCl_6 is not. (4)

12. (i) What is le Chatelier's principle?

(ii) For the following reaction:

$C_2H_4(g) + I_2(g) \rightarrow C_2H_4I_2(g)$

the rate of recation is rate = $K[C_2H_4(g)/ I_2(g)]^{3/2}$

(a) What is the order of the reaction with respect to each reactant?

(b) What is the overall order of the reaction?

(c) What is the unit of K, if the concentrations are measured in mol dm^{-3} sec^{-1}? (4)

13. A cell is set up between Cr and Cu electrodes

(a) $Cr(s)|Cr^{3+}(aq)||Cu^{2+}(aq)|Cu(s)$

If the two lalf cells work under standard conditions, calculate the e.m.f. of the cell.

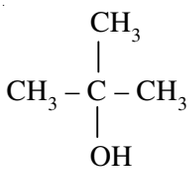
$E°\ Cr^{3+}|Cr = -0.74$ V ; $E°\ Cu^{2+}|Cu = +0.34$ V

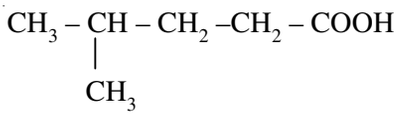
(b) Calculate K_P for the reaction $COCl_2$ $\rightleftharpoons$ $CO + Cl_2$ in atom and Nm^{-2}, The equilibrium partial pressure of $COCl_2$, CO and Cl_2 are 0.20, 0.16 and 0.26 atm. respectively. (1 atm = 101300 Nm^{-2}) (4)

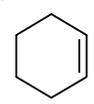
14. (a) Write down ideal gas equation.

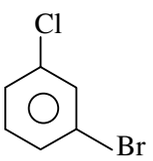
(b) Give three different values of R in the ideal gas equation. (4)

15. (a) Write the IUPAC names of the following organic compoumds :

(i) 

(ii) 

(iii) 

(iv) 

(b) Define the following (any two only)

(i) Electrophiles (ii) Nucleophiles

(iii) Catenation (iv) Isomerism (4)

16. (a) What is electrovalent bond? Explain the term lattice energy as applied to ionic crystal How is enthalpy of formation of NaCl calculated, using Born Habeis cycle?

(b) Why is sigma bond stronger than π – bond? (4)

17. (a) 0.0663g of an organic compound on combustion geve 0.621 g of CO_2 and 0.0381g of H_2O. st also

(b) What is the ratio of the mass of orygen that combines with 1.0g Carbon in carbon monoxide and carbon dioxide? (4)

18. (a) Write de Broglic expression.

(b) Write down Balmer formula and explain the terms imrowed, what is the wavelength of the light emitted when the electron in a hydrogen atom jumps from $N_2 = 4$ to $N_1 = 1$ levels?

(Rydberg Constant R = 109677 cm^{-1}) (6)

19. Define 'Entropy. what are its SI units?

Predict giving reasons, the sign of entropy change, ΔS for the following reaction:

$2SO_3(g) \rightarrow 2SO_2(g) + O_2(g)$

What is the significance of the term $T\Delta S$ in $\Delta G = \Delta H - T\Delta S$?

(b) The heat evolved in the combustion of glucose is shown in the following equation:

$C_6H_{12}O_6(s) + 60_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)\ \Delta H = -2840$ KJ

How much energy will be required for production of 1.08 g of glucose?

(Molar mass of glucose = 180 g mol^{-1}) (6)

20. (a) Explain with the help of the relevant structural changes, the stronger acidic character of Phenol than alcohols

(b) Identify the products A, B, and C the following reaction :

$$CH_3CHO \xrightarrow{NaOH} A \xrightarrow{NaOH(CaO)} B \xrightarrow{Cl_2/h\nu} C$$ (6)

Section - B

PART-I (ENVIRONMENTAL CHEMISTRY)

1. (a) Define any Two of the following terms

   (i) Pollutant (ii) Biosphere

   (iii) Eutrophication (iv) Biological oxygen Demand (BOD) (2)

   (b) List four effects of acid rain (2)

2. Describe with the help of diagram the three stages of treatment of waste water (6)

3. How does carbon get into the environment from dead organic mater. (1)

4. Show diagrammatically how heavy metals enter into the echo system. (2)

5. The increase in concertration of accumulated toxic chemicals as one goes higher in the food chain is termed as Bio magnification. Draw an appropriate food chain consisting of Mosquito, Marshy plant, Bird and fish and also label these components as producer, Primary consumer, Secondary consumer and tertiary consumer, showing in increase in concentration of toxic chemicals. (2)

PART-II (CHEMISTRY AND INDUSTRY)

1. Define any Four of the following :

   Dyes, Drugs medicines, paints, mother glass

   Petrochemicals, Polymerisation, (4)

2. (a) Distinguish between thermoplastic and thermosetting polymers (4)

   (b) Differentiate between analgesics and antipyretics

   (c) Differentiate between antiseptics and disinfectants (2)

3. What do you understand by Reinforced concrete Construction (RCC). (1)

4. Each of the following monomer polymerises to give different product. Show the formation of the polymer

   products by using the 3 monomer units each. (2)

   (i) $\begin{matrix} CH = CH_2 \\ | \\ Cl \end{matrix}$ (ii) $CH_2 = \overset{\overset{CH_3}{|}}{C} - COOCH_3$

5. Justify the superiority of Allopathic system of medicine over the alternative systems of medicine by giving atleast two advantages. (2)

MARKING SCHEME

CHEMISTRY

Question No. Expected value points
Distribution of Marks

1. The molar mass of NH_3 is 17
   $14 + 3 = 17$ — 1 mark

2. $\frac{4.63\times10^{27}\ \text{atom}}{6.02\times10^{23}\ \text{atoms/mol}}$ — 1/2 mark
   0.0769 mol — 1/2 mark
   If units are not given deduct $\frac{1}{2}$ mark

3. Zero Kelvin — 1 mark

4. (i) Force Mass × Accusation — 1/2 mark
   (ii) Pressure Force / Area — 1/2 mark
   (iii) Kg m^{-1} S^{-2} — 1/2 mark

5. (i) correct Geometry $\frac{1}{2}$ — 1/2 mark
   Pyramid Shape $\frac{1}{2}$ — 1/2 mark

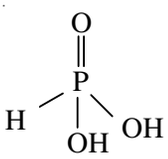
6. $V_1 = 12.42$, V = ? $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ — 1 mark
   $T_1 = 55$ k $T_2 = 220$ k
   $\frac{12.42}{55k} = \frac{V_2}{220k}$
   $V_2 = 4.92$ — 1 mark

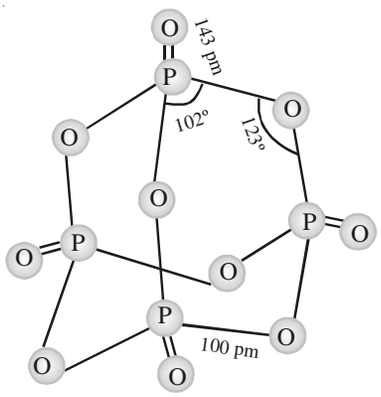
7. Correct relation — 2 mark

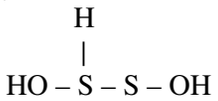
8. $2H - H$ $\quad$ $O - O$ $\quad$ $2H - O$ (with H) — 1 mark
   2×436 $\quad$ 496.4 $\quad$ 4×463
   $\Delta H = 1852 - 1368.4 = 483.6$ K J — 1 mark

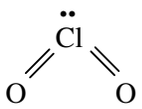
9. $B_2O_3 > Al_2O_3 > CO_2 > SO_2$ — 1 mark
   Justification — 1 mark
   Large the Size of cation less acidic will be the oxide.

10. Correct Structure









1 × 4 marks

11. (i) Due to back bonding

(ii) Due to absence of d – orbital in C

(iii) Dissociation energy is very high

(iv) Due to larger size of Cl Six Cl can not be accommodated around S 1 × 4 = 4 marks

12. (a) It states that when a system at equilibrium is disturbed by a change in concentration, Pressure or temperature, a net charge occurs in it in a direction that tends to decrease the disturbing factor. 1 mark

(b) (i) First order with respect is $C_2 H_4$ and 1.5 w. r. t. I_2 1 mark

(ii) The overall order of reaction is 2 – 5 1/2 mark

(iii) $x = \dfrac{\sec^{-1}}{\left(\text{mol}\,dm^{-3}\right)^{3/2}}$ 1/2 mark

$= \text{mol}^{-3/2}\,\text{dm}^{9/2}\,\sec^{-1}$ 1 mark

deduct half mark if units are not given

13. (a) Anode reaction = Cr (S) $\rightarrow Cr^{3+} + 3e^-$

Cathode = Cu^{2+} (aq) + 2 $e^- \rightarrow$ Cu 1 mark

E Cell = E° Cell = 0.34 – (– 0.74) = 1.08 V 1 mark

K_P in atmosphere

$COCl_2$ (g) CO (g) + Cl_2 (g)

$$K_P = \frac{P\,CO \times PCl_2}{P\,CO\,Cl_2} = \frac{(0.16\ \text{atm})(0.26\ \text{atm})}{(0.20\ \text{atm})}$$ 1 mark

$$= \frac{0.16 \times 0.26}{0.20} = 0.21\ \text{atm}$$

(b) K_P in $N\ m^{-2}$

$K_P = 0.21$ atm and 1 atm = 101 300N m^{-2}

$\therefore$ $K_P = (0.21\ atm)\ (101300\ Nm^{-2}\ atm^{-1} = 21273\ nm^{-2}$ 1 mark

14. (a) V $\alpha \frac{1}{P}$ at Constant temp. (Boyle's Law)

V α T at Constant Pressure (Charles Law)

V α n at constant temp and pressure (Avogadro's Law)

V α n T/P or PV α nT

or PV = Constant × nT

PV = n R T 1/2 mark

(b) R = 0.082057 atm $mol^{-1}\ k^{-1}$

R = 8.314×10^7 erg $mol^{-1}\ k^{-1}$

R = 1.987×10^7 Cal $mol^{-1}\ k^{-1}$ ½ × 3 = 1½ marks

15. (a) (i) 2–methyl propane–2 ol (ii) 4–methyl pentanoic acid

(ii) Cyclohexene (iv) 3–bromo-chloro benzene 4 × ½ = 2 marks

(ii) An electrophile is positively charged species It is election setting, It attacks at position of high density. Examples H^+ NO_2^+, Ag^+

(iii) Nucleophile is a negatively charged species. It is nucleus seeking. It attacks a position of low election density examples OH– NO_2^- etc.

(iii) The property of linking of atoms of the same element with ano there to form chains or signs is known as catenation.

(iv) The substance which have the same molecular formula but differ in their physical and Chemical properties are called isomers. This general phenomenon is known as isomerism. 1 × 2 = 2 marks

16. (a) An electrovalent bond is formed when one or more electron from one atom gets completely transferred to another atom or atoms and each atom acquires a nearest noble gas Configuration.

Lattice energy is the amount of energy released when one mole of the substance is formed from its ions e.g.

$Na^+ (g)^+ Cl^-(g) \rightarrow Na^+ Cl^-(s) - \Delta H$

$\Delta H = -788.5$ K J mol^{-1} 1/2 mark

Born Haber Cycle

$\Delta H_f = \Delta H_S + I E + \Delta H_{diss} - E A + \Delta H$ Latter energy

Δ Hf = Heat of formation 1½ marks

1 E $\rightarrow$ 1 ionization enthalpy

Δ Hdis $\rightarrow$ Heat of dissociation

EA $\rightarrow$ Electron gain enthalpy

$\Delta H_{lattice} \rightarrow$ Lattice energy

(b) α-bond is formed due end overlap

π-bond is formed due is Side ways overlaping 1 mark

17. (a) % C = $\frac{0.621 \times 12}{44 \times 0.0663} \times 100 = 25.54$ $\frac{25.54}{12} = 2.128$ C = 1

$$\% \text{ H} = \frac{0.6381 \times 2}{18 \times 0.0663} = 6.38 \qquad \frac{6.38}{1} = 6.38 \qquad \text{H} = 3$$

$$\frac{68.1}{32} = 2.128 \qquad \text{S} = 1 \qquad \text{3 marks}$$

(b) $CO = 4 : 3$
$CO_2 = 8 : 3$ 1 mark

18. (a) $E = h\nu \qquad \nu = \frac{c}{\lambda}$

$$\lambda = \frac{h}{mc} \text{ or } \lambda = \frac{h}{p}$$ 1 mark

(b) $$\nu = \frac{1}{\lambda} = \left(n_1^2 - \frac{1}{n_2^2}\right)$$ 1 mark

$$= 109677 \left(\frac{1}{(1)^2} - \frac{1}{(2)^2}\right)$$

$$= 109677 \times \frac{15}{16} = 102\ 822\ \text{Cm}^{-1}$$ 1 mark

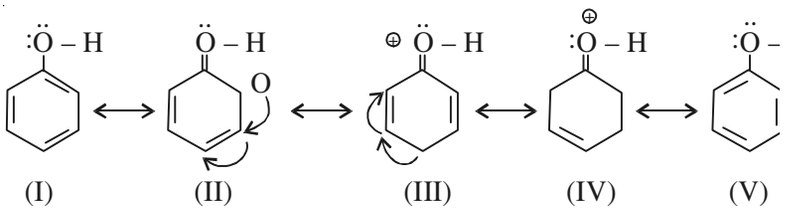
$$\lambda = \frac{1}{\nu} = \frac{1}{102822} = 9.7 \times 10^{-6}\text{cm} = 97\ \text{nm}$$ 1 mark

19. (a) The entropy is measure of disorder or randomness in a system. the greater the disorder in a system, the greater is the entropy of the system 1 mark
SI unit = J mol^{-1} K^{-1} 1/2 mark
entropy decrease
It Δ S total is positive then section will be spontaneous
Δ G Syst = – T Δ S univ 1/2 mark

(b) 1 mol = – 2840 K J
180 = – 2840 K J

$$1.08 = \frac{-2840}{180} \times 1.08 = \text{K J} = \Delta \text{H}$$ 1 mark

$\Delta E = \Delta H - \Delta V_{2q} RT$
$\Delta H - O. R T = \Delta H$
= 17.04 K J 1 mark

20. (a) 

(I) (II) (III) (IV) (V) 1½ marks

(b) A = CH_3 COO Na
B = CH_4
C = CH_3 Cl 4 × ½ markw

SECTION B

PART-I ENVIRONMENTAL CHEMISTRY

1. (a) 1 Mark for each of the two correct definitions — 2 marks

   (b) $\frac{1}{2}$ Mark for each of four correct effects — 2 marks

2. Correct explanation and diagram of stages for primary treatment — 2 marks
   Correct explanation and diagram of stages for Secondary treatment — 2 marks
   Correct explanation and diagram of stages for Tertiary treatment — 2 marks

3. Through Decay and decomposition due to micro-organisms — 1 mark

4. For indicating correct sources — 1 mark
   For showing correct pathways — 1 mark

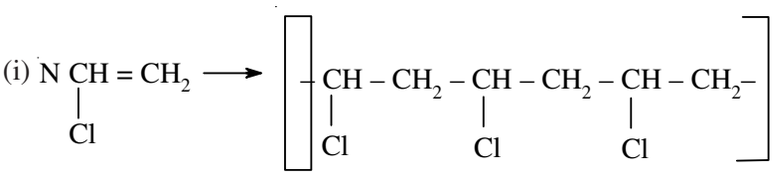
5. Marshy Plant $\longrightarrow$ Mosquito $\longrightarrow$ Fish $\longrightarrow$ Bird
   Producer **Pri-consumer** **Sec-consumer** **Ter-consumer**
   Correct food chain — 1 mark
   Correct labelling — 1 mark

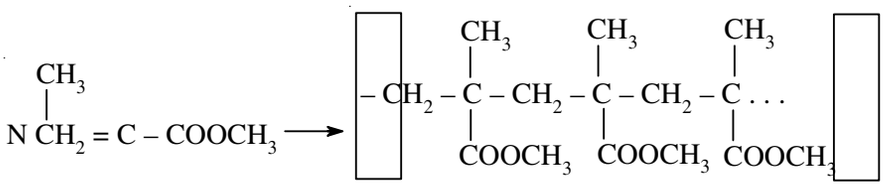
PART-II CHEMISTRY AND INDUSTRY

1. 1 Mark for each of the Four correct definition — 4 marks

2. (a) 1 Mark for each definition — 4 marks

3. correct description — 4 marks

4. (i) 

   (ii)  — 1 mark

5. Correct Advantages
   1 mark for each — 2 marks