

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. FIRST SEMESTER EXAMINATION, DECEMBER 2013

FIRST YEAR

INDUSTRIAL CHEMISTRY (Honours)

Date : 14/12/2013

Time : 11 am – 3 pm

Paper : I

Full Marks : 75

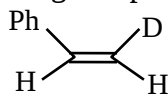
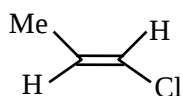
[Use separate Answer Book for each group]

Group – A

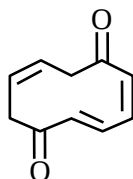
Unit – I

(Answer any three questions)

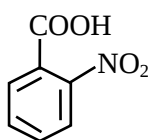
1. a) Calculate the specific rotation of (+) glyceraldehydes, if a solution containing 2.0g/10ml is placed in dm polarimetre tube and its observed rotation at 25°C using sodium D line is +1.74°.
- b) Predict E or Z nomenclature of the following compounds :



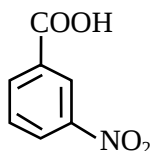
- c) Draw Fischer projection of D(–) mandelic acid. [2+2+1]
2. a) What will be the fate of reaction if solvent of the following reaction have been changed from methanol to N, N-dimethyl formamide?
- $$\text{CH}_3\text{I} + \text{N}_3^- \rightarrow \text{CH}_3\text{N}_3 + \text{I}^-$$
- b) The compound below exists 100% in keto form. Explain why?



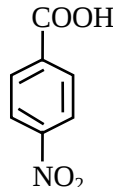
- c) Give IUPAC name of the following compound : $\text{H}_3\text{CCOCH}_2\text{COOH}$ [2+2+1]
3. a) Arrange the following in order of their increasing acid strength. Justify.



(I)

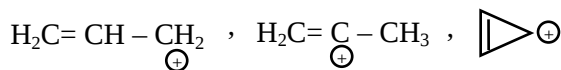


(II)



(III)

- b) How can E1cB pathway be distinguished from the kinetically indistinguishable E2 pathway? [3+2]
4. a) Arrange the following carbocations in order of their increasing stability with reasons.



(I)

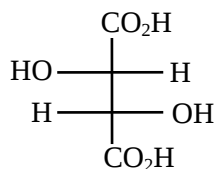
(II)

(III)

- b) Which one is more acidic between phenol and benzoic acid? —Explain. [3+2]
5. a) Justify the trend in pK_a values for the following acids :

	pK_{a1}	pK_{a2}
Maleic acid	1.92	6.04
Fumaric acid	3.03	4.44

- b) Give R/S configurational nomenclature of the following molecule.



(1)

- c) Trichloroacetic acid is stronger than acetic acid. Explain why. [2+2+1]

Unit – II

(Answer **any four** questions)

6. a) From de Broglie's concept derive the Bohr's postulate of quantisation of angular momentum for an electron.
b) State Hiesenberg's uncertainty principle. [3+2]
7. a) Predict the structure and bonding of the following molecules in the light of VBT.
(i) BF_3 (ii) PCl_5
b) Arrange the following species in order of their increasing bond dissociation energy. Give reasons.
 O_2 , O_2^+ , N_2^+
c) Write down the sets of quantum numbers for the electrons present in the ground state of Li^+ ion. [2+2+1]
8. a) Discuss the shape of $3p_y$ orbital.
b) What are the differences between a Bohr atom and a wave mechanical atom? [3+2]
9. a) Deduce Henderson's equation for a buffer made from a weak acid and its salt, (say, citric acid & sodium citrate)
b) Calculate the pH of a solution containing 0.1(M) ammonia and 0.2 (M) ammonium chloride. pK_b for ammonia is 4.7. [3+2]
10. a) Explain how will you choose an indicator in an acid-base titration.
b) Calculate the pH of a 0.01 molar solution of sodium acetate at 25°C .
[k_a for acetic acid = 1.8×10^{-5}] [3+2]
11. a) Which of the following electronic arrangements in p-orbitals is not correct?

$\begin{array}{|c|c|c|} \hline \uparrow & \uparrow & \\ \hline \end{array}$
I

$\begin{array}{|c|c|c|} \hline \uparrow & \downarrow & \\ \hline \end{array}$
II

$\begin{array}{|c|c|c|} \hline \uparrow\uparrow & & \\ \hline \end{array}$
III

$\begin{array}{|c|c|c|} \hline \uparrow\downarrow & & \\ \hline \end{array}$
IV

b) Explain the structure of $[\text{BrF}_4]^-$ ion using valence bond theory.
c) Explain in the electrical conductivity of lithium using bond theory for metals. [1+2+2]

Unit – III

(Answer **any three** questions)

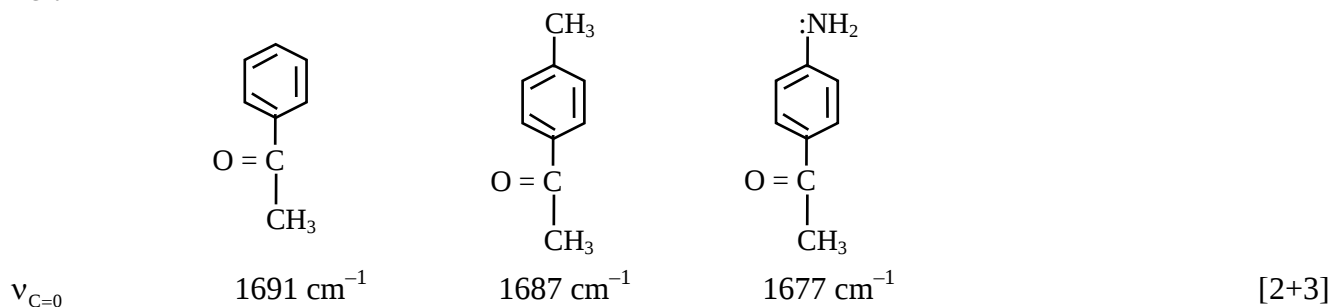
12. a) Discuss the causes of deviation of real gases from ideal behaviour.
b) How are these accounted for in the vander Waals gas equation. [2+3]
13. a) For a certain gas $T_C = 304.2\text{K}$, $P_C = 72.8\text{ atm}$. Calculate the vander Waals constants 'a' and 'b' for the gas.
b) Give an example in each of the cases where—
(i) $dG = 0$, ds is greater than zero and (ii) $dG < 0$, $dS < 0$ [3+2]
14. a) Prove that $\left(\frac{dV}{dT}\right)_P = -\left(\frac{dS}{dP}\right)_T$
b) Calculate the most probable velocity from one dimensional distribution. [2+3]
15. a) Work done during an expansion is greatest when the process is carried out reversibly. Explain with the help of P – V diagram.
b) An expansion is carried out from a state V_1 to V_2 isothermally and reversibly at a temperature T. Derive an expression for the total amount of work. [3+2]
16. a) From the definition of entropy, show that for any change of state, $\Delta S = C_v \ln \frac{T_f}{T_i} + R \ln \frac{V_f}{V_i}$

- b) When do you call a system to be (i) in thermodynamic equilibrium and (ii) in steady state.
 c) State whether the following are state function or path function (i) Internal energy (ii) Heat. [2+2+1]

Unit – IV

(Answer any one question)

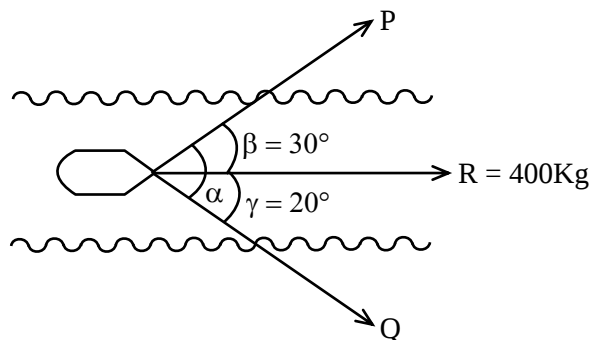
17. a) Calculate the solubility of $\text{Mg}(\text{OH})_2$ in moles/lit. Given, the solubility product of $\text{Mg}(\text{OH})_2$ is 5×10^{-12} .
 b) Explain how can you estimate CH_3COOH and HCl from their mixture using conductometric method of titration. [2+3]
18. a) On adding sodium hydroxide to an aqueous solution of p-nitrophenol, the colour deepens. Explain why.
 b) $\nu_{\text{C=O}}$ stretch for the following compounds are given below. Justify the data.



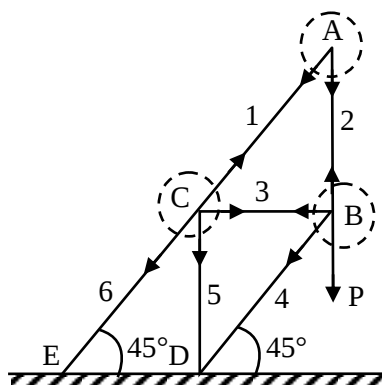
Group – B

(Answer any four questions)

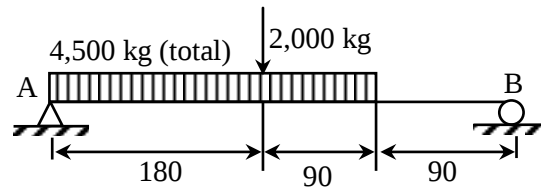
19. Explain in short at least 5 points, which a boiler operator has to ensure, for safe and efficient operation of the boiler. [5]
20. To move a boat uniformly along a canal at a given speed, requires a resultant force $R = 400 \text{ Kg}$. This is accomplished by two horses pulling with force P and Q on two ropes as shown below. If the angles that the two ropes make with the axis of the canal are $\beta = 30^\circ$ and $\gamma = 20^\circ$ what are the corresponding tensions in the ropes? [5]



21. Determine analytically the axial forces in the bars of the plane truss loaded and supported as shown in the figure. [5]



22. For the simple beam in the figure, evaluate the shear force and bending moment at a section just to the left of the point of application of 2000 Kg load. [5]



23. a) Calculate the membrane stress σ_1 and σ_2 for the thin-walled spherical vessel of radius 'r' and wall thickness 't' if it is subjected to uniform internal pressure of intensity 'p'. [2]
 b) Calculate the safe internal gas pressure 'p' for a spherical pressure vessel made of thin plate 0.25 cm thick if the mean diameter of the sphere is $D = 600$ cm and the allowable stress in tension is 900 Kg/cm^2 . [3]
24. a) Draw the stress-strain diagram of a prismatic steel bar which is stressed beyond its proportional limit. [2]
 b) Discuss in short the various features of this curve. [3]

