

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

FIRST YEAR [2017-20]

B.A./B.Sc. FIRST SEMESTER (July – December) 2017

Mid-Semester Examination, September 2017

Date : 13/09/2017

CHEMISTRY (General)

Time : 12 noon – 1 pm

Paper : I

Full Marks : 25

Answer any five questions from the following :

[5×5]

1. a) Give an example of pseudo-1st order reaction and explain why it is called so. [3]
b) A radio-isotope bromine-82 sample is used as a tracer for organic materials in environmental studies. Its half-life is 35.3 hours. Calculate the fraction of a sample of bromine-82 that remains after one day. [2]
2. a) Show that in the graphical plot of $\ln k$ vs $1/T$, for the simple reaction following the Arrhenius equation, the slope is equal to the activation energy. [3]
b) Given the following rate data, for the reaction : $2\text{NO}_2(\text{g}) + \text{O}_3(\text{g}) \rightarrow \text{N}_2\text{O}_5(\text{g}) + \text{O}_2(\text{g})$

$[\text{NO}_2]$	$[\text{O}_3]$	rate of reaction (M sec^{-1})
0.65	0.80	2.61×10^4
1.10	0.80	4.40×10^4
1.70	1.55	1.32×10^4

Determine the order of the reaction. [2]
3. a) What are the criteria of a thermodynamic reversible process? [1]
b) For an isothermal expansion of an ideal gas $q = -w$. Justify. [1]
c) Deduce the expression for maximum work done when 'n' molecules of an ideal gas expand reversibly and isothermally. [3]
4. a) State the Zeroth law of thermodynamics and hence define temperature. [2]
b) 2 mole of an ideal gas is expanded reversibly and isothermally from a volume of 1 litre to 10 litre at 27°C . Calculate q , W , ΔU and ΔH for the process. [3]
5. a) Heat capacity at constant pressure is greater than heat capacity at constant volume. Why? [1]
b) Identify intensive and extensive variables from the following list (i) Electrochemical potential, (ii) heat capacity, (iii) mole fraction, (iv) surface tension. [2]
c) Two moles of an ideal gas at 27°C are enclosed in a leak proof cylinder fitted with movable frictionless piston and thermally insulated from its surroundings. The pressure on the piston is released very slowly to effect a quasi-static expansion to double its volume. Calculate the final temperature. ($\bar{C}_v = 1.5R$) [2]
6. a) What is meant by standard enthalpy of a reaction? [1]
b) State and explain Hess's law of constant heat summation. [1]
c) Given the following heats of reaction at 25°C
 $\text{C}_2\text{H}_4(\text{g}) + 3\text{O}_2(\text{g}) = 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) \quad \Delta_r H^\circ = -337.3 \text{ Kcal}$
 $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) = 2\text{H}_2\text{O}(\text{l}) \quad \Delta_r H^\circ = -136.6 \text{ Kcal}$
 $2\text{C}_2\text{H}_6(\text{g}) + 7\text{O}_2(\text{g}) = 4\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{l}) \quad \Delta_r H^\circ = -745.6 \text{ Kcal}$
Calculate $\Delta_r H^\circ$ for the following reaction at 25°C .
 $\text{C}_2\text{H}_4(\text{g}) + \text{H}_2(\text{g}) = \text{C}_2\text{H}_6(\text{g})$. [3]

7. What is the basis of Pauling electronegativity? Calculate the Pauling electronegativity of chlorine from the following data; bond energies (Kcal/mole) for H_2 (104), Cl_2 (57), HCl (102), electronegativity of 'H' is 2.1. [2+3]
8. a) Arrange the following ions in increasing order of their ionic radii, give reasons.
 F^- , O^{2-} , Na^+ , Mg^{2+} , N^{3-} , Al^{3+} . [2]
- b) According to Bohr's model calculate the size of Ne^{9+} . [2]
- c) Electron affinities of Noble gases are zero. Explain. [1]

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