Rayat Shikshan Sanstha's
Arts, Science and Commerce College,
Ramanandnagar (Burli)
Question Bank
B.Sc.I (CBCS)
Physical Chemistry

Topic 1) Chemical Energetics

A) Thermodynamics

MCQs

1) S.I. unit of energy is…….
   a) erg   b) calories

   c) Joule   d) gram

2) In cyclic process change in each state function is…..

   a) Zero   b) one

   c) Two   d) three

3) In adiabatic process …
   a) q = W   b) q ǂ 1

   c) q = 0   d) q = 1

4) Entropy of the universe tends towards………..
   a) maximum   b) minimum

   c) Zero   d) none of these

5) The process that does not occur of its own accord is called……..

   a) Non-spontaneous   b) spontaneous

   c) Isothermal   d) adiabatic

6) Efficiency of heat engine is always …..
   a) Greater than one   b) less than one

   c) Equal to one   d) all of these

7) A device that converts heat continuously into work is called ……..

   a) Engine   b) cold engine

   c) Hot engine   d) heat engine

8) In isochoric process ……….

   a) $\Delta P = 0$ b) $\Delta H = 0$

   c) $\Delta V = 0$ d) none of these

Short Answer Question

1) State first law of thermodynamic. Give its mathematical expression.
2) What do you mean by system and surrounding?
3) Explain the following thermodynamic processes.
   i)   Isothermal process
   ii)   Adiabatic process
   iii)   Isochoric process
   iv)   Isobaric process

4) Write short note on spontaneous process.

5) Write short note on non-spontaneous process.

6) State the second law of thermodynamics in different ways OR give any two statement of second law of thermodynamics.

7) State and explain Entropy and probability.

8) What is Carnot cycle? How is it represented by indicator diagram?

9) Explain the term efficiency of heat engine.

10) Entropy is a state function explains.

Long Answer Questions

1) What is thermodynamics? Explain any four basic terms involved in thermodynamics.

2) Explain with examples, spontaneous and non-spontaneous process.

3) Write details note on "Second law of thermodynamics ".

4) Derive the equations for heat energy absorbed and mechanical work done, on the basis of Carnot cycle.

5) Give the statement with examples of first law, second law and third law of thermodynamics.

6) Explain in details, concept of Entropy.

7) Write a precise note on "Carnot cycle".

8) Write note on "Absolute entropy and Evaluation of Absolute Entropy ".

B) Theromochemistry

MCQs

1) Bond energy is also known as bond....... Energy.
   a) dissociation   b) association

   c) Formation   d) none of these

2) According to convention used in chemical thermodynamics when
   ΔH = +ve, the reaction is .....
   b) exothermic   b) endothermic

   c) Reversible   d) irreversible

3) The difference between experimental value of heat of formation
   and that calculated by using bond energy data is called .....Energy
   of compound.

   a) Bond   b) resonance

   c) Internal   d) external

4) The equation represent the variation of heat change of reaction
   with temperature are known as ....

   a) Exothermic   b) graphic

   c) Kirchhoff's   d) Boltzmann

5) Standard enthalpy of formation of a compound is represented
   as....

   a) Hƒ   b) ΔHƒ

   c) $\Delta H^0 ƒ$ d) Hs

Short Answer Questions

1) What is thermochemistry? Define endothermic and exothermic reaction.
2) Explain the concept of Standard state.
3) Explain in short Bond energy and Bond dissociation energy.
4) What is standard enthalpy and absolute standard enthalpy?
5) What is thermochemical equation? Explain with suitable example.
6) What is Kirchhoff's equation? Represent Kirchhoff's equation.
7) How will you determine, Resonance energy?

Long Answer Question

1) Derive Kirchhoff's equations and give their application.
2) Describe in details, How to calculate Bond energy, Bond dissociation energy and Resonance energy from the thermochemical data.
3) Give important principles and definition underlying thermochemistry.
4) Explain in details standard enthalpies of formation as well as integral and differential enthalpies of solution and dilution.

Topic 2) Chemical Equilibrium

MCQs

1) According to law of mass action, the rate of chemical reactions directly proportional to…….

    a) Volume of container   b) Nature of product

    c) Equilibrium constant   d) molar conc. of reactant

2) When an inert gas is introduced into the system, $2HI \rightarrow H_2 + I_2$, The degree of dissociation of HI gets……..

    a) Suppressed   b) unchanged

    c) Increased   d) doubled

3) The relation between free energy and equilibrium constant, K of reaction is…...

    a) $\Delta G = RT \ln k$ b) $\Delta G^0 = - RT \ln k$

    c) $\Delta G^0 = RT \ln k$ d) $\Delta G = - RT \ln k$

4) Chemical equilibria are …….in nature.

    a) Dynamic   b) gaseous

    c) Liquid   d) solid

5) Pressure has no effect on the reaction in which, Δn= …….

    a) One   b) two

    c) Three   d) zero

Short Answer Question

1) How is state of equilibrium attained? Explain diagrammatically.
2) Define the term
    i)   Chemical equilibrium
    ii)   Law of mass action
    iii) Equilibrium constant
3) Differentiate between ΔG and ΔG^0
4) What do you mean by K_p, K_c and K_x?
5) Explain the effect of catalyst and inert gas on a state of equilibrium.
6) Explain in Brief Homogeneous and heterogeneous equilibria.
7) Show, $K_p = K_c$ when $\Delta n = 0$
8) What is Le Chatelier's principle of mobile equilibrium?

Long Answer Question

1) What is reaction quotient? How can the value of reaction quotient predict the direction of reaction?
2) Derive the Relationships between K_p, K_c and K_x for reaction involving ideal gases.
3) What do you mean by forward and backward reactions? Explain the term chemical equilibrium and give its characteristics.
4) Derive thermodynamically the law of chemical equilibrium.
5) Explain the thermodynamic parameters, free energy change (ΔG) and standard free energy change (ΔG^0) in the chemical reaction.

Topic 3) Kinetic Theory of Gases

MCQs

1) Van der Waal's constant 'a' has the dimension of…….

    a) litre mole $^{-1}$

    b) Nm^{-2}

    c) N.m^{4}.mole^{-1}

    d) m

2) ……….gases obeys the gas laws at all temperature and pressures.

    a) Ideal

    b) non-ideal

    c) Real

    d) none of these

3) The expression PV = 1/3 mNu^{2}, is known as………

    a) Reduced equation

    b) Kinetic gas equation

    c) Both a and b

    d) none of these

4) According to……… law V à 1/P at constant T.

    a) Charle's

    b) Boyle's

    c) Avogadro

    d) Nemst's

5) The correction term b from van der Waal's equation is known as……

    a) Vibratory volume

    b) covolume

    c) Excluded volume

    d) all of these

6) Volume occupied by one mole of the gas at critical temperature and critical pressure is called …….

    a) Critical volume   b) molar volume

    c) NTP volume   d) normal volume

7) Gases which do not obey the gas law at all temperature and pressure are called ……..

    a) ideal gases   b) nonideal gases

    c) Perfect gases   d) gases

8) P_c, V_c and T_c are known as……..

    a) Gas constants   b) van der Waal's constants

    c) Velocity constants   d) Critical constants

Short Answer Question

1) What is Kinetic theory of gases? How it is formulated?
2) Write van der Waal's equation for one mole and 'n' moles of gases. What are the dimensions of van der Waal's constants?
3) What is Kinetic Gas equation in term of Kinetic energy?
4) What do you mean by isotherm and critical isotherm?

5) What is boyle point? Explain with respect to ideal and real gases.
6) What are different states of matter? Give the various properties of gaseous state.
7) Define critical pressure, critical volume and critical temperature of a gas. How this is expressed in term of van der Waal's constant.
8) Write short note on
    i)   Limitations of van der Waal's equation.
    ii)   Assumption of Kinetic theory.
    iii)   RMS velocity
    iv)   Average and most probable velocities.
9) Explain in brief, Exceptional behavior of Hydrogen and Helium.
10)   Give the explanation for the facts
    i)   Ideal volume of gas is less than the observed volume.
    ii)   Ideal pressure of the gas is more than the observed pressure.

Long Answer Questions

1) Using van der Waal's equation, explain the deviation of gases from Boyle's law.
2) Explain critical phenomenon with Andrews experiment on CO_2.

3) Derive the relations between critical constants and van der wall's constants equation.
4) Explain Gaseous state of matter. How is Kinetic energy applied to gases state? Give the assumptions of kinetic molecular theory of gases.
5) What are critical constants of gas? How are these constants calculated from van der Waal's constants?
6) Derive Kinetic gas equation with its usual notations.

Numerical Problems

1) Critical temperature and critical pressure of gas are 133K and $34.5 \times 1.013 \times 10^5$ Pa. find the van der Waal's constant a and b (R = 8.314 JK^{-1} $mole^{-1}$)
2) Calculate the pressure exerted by gas 1.5 mole of water vapour in 1×10^{-2} m^3 volume at 423 K using van der Waal's equation. for water a = 0.552 $Nm^4.mol^{-2}$.,b = 4.28 × 10^{-5} m^3 mol^{-1} and R = 8.31 JK^{-1} $mole^{-1}$.
3) Calculate the most probable velocity of nitrogen molecules (N_2) at 15^0C.
4) Calculate the average Kinetic energy of hydrogen molecule at 0^0C.

Topic 4) Chemical Kinetics

MCQs

1) In simple reactions, the rate of reaction………..with increase in concentration of reactant.

    a) Increases   b) decreases

    c) Remains same   d) none of these

2) The rate of second order reaction is directionally proportional to the product of concentration of……..reactant.

    a) Two   b) three

    c) Four   d) five

3) If one the reactant in a bimolecular reaction is present in large excess, the reaction become kinetically of ………….

    a) Second order   b) third order

    c) First order   d) fifth order

4) The number of………..taking part in chemical reaction is called molecularity of reactant.

    a) Molecules or atoms   b) ions

    c) Reactants   d) products

5) If the concentration unit for first order reaction is increased by 'x' times then the rate constant will be.

    a) k   b) kx

    c) k/x   d) k+x

6) The rate of reaction depends on ....

    a) temperature   b) pressure

    c) Concentration   d) all of these

7) .... of the first order reaction is independent of initial concentration of the reactant.

    a) Product   b) half life time

    c) Rate   d) none of these

8) Velocity constant k of second order reaction is expressed in ....

    a) $mol.lit.^{-1} s^{-1}$ b) $dm^{3.} Mol.lit.^{-1} s^{-1}$

    c) $mol.^{-1}lit.^{-1} s^{-1}$ d) all of these

9) The reaction in which number of molecules involved is more than one but they still obey the kinetic equation of the first order reaction are called as......of reaction

    a) pseudounimolecular reaction   b) first order reaction

    c) second order reaction   d) third order reaction

10) Inversion of sugar is an example of ………reaction.

a) first order

b) second order

c) third order

d) pseudomolecular

Short Answer Question

1) Explain in short :
   i) Velocity of chemical reaction
   ii) Velocity constant
   iii) Zero order reaction
   iv) Arrhenius equation
2) Define the term:
   i) Order of reaction
   ii) First order reaction
   iii) Pseudomolecular reaction
   iv) Rate of reaction
3) Explain Kinetic study of Inversion of cane sugar.
4) Show that the first order reaction, the value of velocity constant is independent of units of concentration.
5) Define second order reaction. Give the units of velocity constant of second order reaction.
6) Give the examples of first and second order reactions.
7) Explain the term, temperature coefficient or energy of activation.

8) What is the effect of temperature and concentration on the rate of chemical reaction?

Long Answer Question

1) Write note on
    I)   Order and molecularity
    II)   Characteristics of first order reaction
    III)   Factor affecting first order reaction
    IV)   Pseudounimolecular reaction
2) Give the Characteristics of second order reaction.
3) Derive the equation for rate constant of a second order reaction with unequal concentration of reactants.
4) Explain in brief, various factors influencing the rate of chemical reaction.
5) Write a note on, Energy of activation.
6) Give the comparison between, collision theories and activated complex theory.

Numerical Problems

1) A first order reaction is half completed in 500 seconds. In how much time it will be 9/10 th complete?
2) In an experiment to determine the order of reaction, the following results were obtained.

Initial concn. Of reactant ($mol.dm^3$)	1	1.2	1.5
Time for half change (s)	80	67.7	53.3

Find the order of reaction.

3) A second order reaction with equal initial concentrations (0.1 M each) is 10% complete in 30 min. Calculate velocity constant and the time for half of the reaction to complete.

4) In reaction in gas phase, the following result were obtained

| Initial pressure× 10^5 Pa | 0.263 | 0.461 | 0.658 |
| Time for half change (min) | 170 | 97 | 68 |

Find the order of reaction

5) 50% of gas is decomposed in second order reaction in 40 min. What would be the time taken for 75% of the gas to decompose?

6) The half life of a second order reaction is 40 min. when the initial concentrations of the reactants are 0.1 M each. what is the velocity constant? In what time will the reaction be 75% completed.