Bago University
Department of Chemistry
First Semester Examination, March 2019

Second Year BSc
(Chemistry Specialization)
Answer *any six* Questions

Chem-2102
Physical Chemistry I
Time Allowed: (3) hours

1. (a) Fill in the blanks with the correct word(s), unit(s), and etc., as necessary.
   (i) Thermodynamics is applicable to —— systems and not to microscopic systems.
   (ii) The totally of all the possible kinds of energy of a system, is called its ——.
   (iii) A spontaneous change is accompanied by —— of internal energy or enthalpy.
   (iv) The cycle of processes which occurs under reversible conditions is referred to as ——.
   (v) The efficiency of an irreversible Carnot cycle is always —— than that of a reversible one operating between the same two temperatures.
   (vi) At room temperature, —— gas warms on expansion.

   (b) Select the correct statement(s), word(s), unit(s) and etc., given in the followings.
   (i) Reversible process is extremely (fast, slow, small).
   (ii) A (heterogeneous, homogeneous, adiabatic) system is one which consists of two or more phases.
   (iii) If work is done on a system by the surroundings, it is taken to be (positive, negative, zero).
   (iv) Entropy is a measure of (order, disorder, random less) of a system.
   (v) In a system of ideal gases relation between chemical potential and pressure, the integration constant is (μ_i, μ_i^o, p_i^o) .
   (vi) Any (reversible, irreversible, complete) cycle may be regard as made up of a number of Carnot cycles.

2. (a) State the first law of thermodynamics in as many ways as possible. Derive the mathematical expression for the law with sign conventions.
   (b) What do you understand by C_p and C_v of gases? Why is the value of C_p always greater than *that* of C_v? How are they related?

3. (a) Derive an expression for the work done by a gas in isothermal reversible expansion of an ideal gas.
   (b) One mole of an ideal gas at 25°C is allowed to expand reversibly at constant temperature from volume 10 litres to 20 litres. Calculate the work done by the gas in Joules and calories. ($R = 8.314\ JK^{-1}\ mol^{-1}$)

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4. (a) Derive the Clapeyron-Clausius equation giving the temperature dependence of water indicating clearly the assumption involved.
   (b) An engine operates between 100°C and 0°C and another engine operates between 100°C (absolute zero). Find the efficiencies in two cases.

5. (a) Derive an expression for entropy change for ideal gas associated with temperature and pressure changes.
   (b) Calculate the total entropy change when 5 grams of ice at 0°C is converted into steam at 100°C.
   (Latent heat of evaporation of water =540 cal/g; C, for water = 18 cal/mole;
   Latent heat of water = 80 cal/mole)
   (Latent heat of vaporisation of water is 2.3 Id g^{-1} and R = 8.314 $JK^{-1}mol^{-1}$)

6. (a) What do you understand by partial molar quantities? Write the general expression for partial molar quantity of a component i in a mixture.
   (b) Describe the criteria for two-phase equilibrium of one-component system.

7. (a) Derive expressions for variation of chemical potential with temperature and with pressure.
   (b) Provide applications of Gibbs adsorption equation.

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