AEI/17/CH/020

Total No. of printed pages = 8

END SEMESTER EXAMINATION – 2019

Semester : 4th

Subject Code : Ch-404

STOICHIOMETRY, THERMODYNAMICS AND KINETICS

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

PART – A

Marks – 25

Time – One hour

All questions of PART–A are compulsory.

1. Fill in the blanks : $1 \times 10 = 10$

(a) The law of reciprocal proportions was formulated by ———.

(b) The temperature of working substance remains constant in ——— process.

(c) 1 bar is almost equal to ——— atmosphere.

[Turn over

(d) Boyle's law states that for a fixed quantity of a gas the volume is ——— proportional to pressure at constant temperature.

(e) Half life period for a first order reaction is ———.

(f) Domestic refrigerator usually works on the ——— refrigeration cycle.

(g) Extensive properties of a thermodynamic system depend upon the ——— of the system.

(h) The value of gas constant R in cal / (mol.K) is ———.

(i) The formation of NH_3 from nitrogen and hydrogen illustrates the law of ———.

(j) On mole of gas at STP occupies ——— m^3.

2. Choose the correct answer from the following :

(a) Molecularity of a reaction $1 \times 5 = 5$

(i) Is always equal to the overall order of the reaction

(ii) May not be equal to the order of reaction

(iii) Cannot have a fractional value

(iv) Both (ii) and (iii)

(b) If 'n' is the order of a reaction, then unit of rate constant is

(i) $(\text{Time})^{-1}\ (\text{concentration})^{1-n}$

(ii) $(\text{Time})^{-1}\ (\text{concentration})^{n-1}$

(iii) $(\text{Time})^{n-1}\ (\text{concentration})$

(iv) None of the above

(c) The total number of atoms in 8.5 gms of NH_3 is

(i) 9.03×10^{23}

(ii) 3.01×10^{23}

(iii) 1.204×10^{23}

(iv) 6.02×10^{23}

(d) Number of gm moles of solute dissolved in 1kg of solvent is called its

(i) Normality (ii) Molarity

(iii) Molality (iv) Formality

(e) An unbalanced chemical reaction represents a violation of which law ?

(i) Law of conservation of mass

(ii) Law of constant proportions

(iii) Law of multiple proportions

(iv) Law of reciprocal proportions.

3. Write true or false : 1×10=10

(a) Evaporation is an example of unit process.

(b) Molecularity of reaction must be an integer.

(c) First law of thermodynamics deals with the direction of energy transfer.

(d) One mole of any gas has a volume of 22.4 L at STP.

(e) Internal energy of an ideal gas increases with increase in pressure.

(f) 1gm mole of methane contains 4 gm atoms of hydrogen.

(g) Volume percent for gases is equal to the weight pressure.

(h) Average molecular weight of air is 29 gm/mol.

(i) Rate determining set up in a reaction consisting of a number of steps in series is the fastest step.

(j) In a adiabatic process the temperature change is zero.

PART – B

Marks – 45

Answer any *five* questions from the following.

4. (a) Deduce the ideal gas law equation. 5

(b) Show that $C_p - C_v = R$ for an ideal gas. 4

5. (a) Liquid A decomposes by first order kinetics and in a batch reactor 50% of A is converted in 5min run. How much longer would it take to reach 75% conversion ? 4

(b) A gas occupies a volume of $100m^3$ at 373K and 125×10^5 N/m^2. What volume will the gas occupy at 275K and 1 bar ? 3

(c) State Charle's law. 2

6. (a) The solubility of sodium chloride in water at 290K is 35.8 kg/100kg of water. Express the solubility as the following : 6

(i) Mass fraction and mass percent of NaCl

(ii) Mole fraction and mole percent of NaCl

(iii) Kmol NaCl per 1000 kg of water.

(b) What do you mean by molecularity and order of a reaction ? 2

(c) What is multistage compressor ? 1

7. (a) What do you mean by Unit Operation and Unit Processes ? Give examples. 3

(b) A vapour compression refrigeration system with ammonia as the working fluid is to operate between 266K and 300K. Determine the COP, given that the enthalpy of saturated vapour at 266K = 656 KJ/Kg and enthlpy of saturated vapour leaving the compressor = 724 KJ/Kg. enthalpy of saturated liquid at 300K = 144 KJ/Kg. 4

(c) What do you mean by rate of a reaction ? 2

8. (a) What is a compressor ? State the advantages of a multistage compressor. 4

(b) How many molecules are present in 691 gm of K_2CO_3 ? 3

(c) State the law of reciprocal proportions. 2

9. (a) State the first law of thermodynamics. Mention some application. 3

(b) Given the reaction $2\ NO_2 + \frac{1}{2}O_2 \rightarrow N_2O_5$. What is the relation between the rates of formation and disappearance of the three reaction components ? 3

(c) A certain reaction has a rate given by 3

$$-r_A = 0.005\ C_A^2,\ \text{mol / cm}^3\text{.min.}$$

If the concentration is to be expressed in mol / lit and time in hours, what would be the value and units of the rate constant ? 3

10. Write short notes on any *three* topics of the following : 3×3=9

(i) Half life period

(ii) Reciprocal compressor

(iii) Catalysts in industrial reactions

(iv) Compressibility factor

(v) Basis of calculations.