Registration No :										

Total number of pages : 02 **B.Tech.**

PCCH4203

4th Semester Back Examination 2017-18

CHEMICAL PROCESS AND CALCULATION

BRANCH : CHEM

Time : 3 Hours

Max Marks : 70

Q.CODE : C665

Answer Question No. 1 which is compulsory and any FIVE from the rest.

The figures in the right-hand margin indicate marks.

Assume suitable notations and any missing data wherever necessary.

Use of Humidity Chart is permitted. Answer all parts of a question at a place.

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Q1. **Answer the following questions :** **(2 x 10)**

(a) 6 kg of NaCl is mixed with 2 kg of KCl. What is the mole percent of NaCl in the mixture?

(b) A plastic body floats in water with three-fourths of it is submerged. What is the specific gravity of thebody?

(c) A wet paper pulp contains 75% water. After 100 kg of water is removed in a dryer, it is found thatthe pulp is now containing 30% water. The weight of the original pulp is _____ kg.

(d) The weight ratio of carbon to hydrogen in a paraffinic hydrocarbon fuel is found to be 5.25. Whatis the chemical formula for the fuel?

(e) A pure gas is above its critical temperature.Choose the correct one(s).

i. It can't be condensed by cooling at constant pressure
ii. It can't be condensed by compressing isothermally
iii. It can't be condensed by cooling or by compression
iv. It can be liquefied either by cooling or by compression

(f) In a dilute solution

i. The solvent obeys Henry's law
ii. The solute obeys Henry's law
iii. The solvent and solute obey Henry's law
iv. The solute obeys Raoult's law

(g) Assuming that CO_2 obeys the perfect gas law, calculate the density of CO_2 in kg/m^3at 540 K and 202 kPa.

(h) Mention the applicability of Kistyakowsky equation.

(i) The absolute temperature of an ideal gas gets doubled in an adiabatic process. If $C_P = 1.4\ C_V$, find the relation between theinitial volume V_1 and final volume V_2.

(j) Explain the adiabatic flame temperature.

Q2. **(a)** How many molecules are present in 691 g K_2CO_3? **(2)**

(b) How many moles of sodium sulphate will contain 100 kg of sodium? **(2)**

(c) Sulphur trioxide gas is obtained by the combustion of iron pyrites (FeS_2) according tothe following reaction: **(6)**

$4FeS_2 + 15O_2 \rightarrow 2Fe_2O_3 + 8SO_3$

How many kilograms of pyrites are burned to obtain 100 kg of sulphurtrioxide? How many kilogramsof oxygen are consumed in the production of 50 kg of SO_3?

Q3. **(a)** Pure water and alcohol are mixed to get a 60% (weight) alcohol solution. Thedensities (kg/m^3) of water, alcohol, and the solution may be taken to be 998, 798, and 895 respectively at 293 K. Calculate the volume percent of ethanol in the solution at 293 K, the molarity, and the molality. **(5)**

(b) A company has a contract to buy NaCl of 98 % purity for Rs. 300/- per 1000 kg salt delivered.Its last shipment of 1000 kg was only of 90% purity. How much they should pay for the shipment? **(5)**

Q4. Air is to be dehumidified by condensing the water vapour present in it by cooling atconstant pressure. 100 m^3 of air at 100 kPa and 300 K contains water vapour which exerts a partialpressure of 4 kPa. Keeping the pressure constant, this air is cooled to 275 K and the condensed wateris removed. The partial pressure of water in the air after cooling is found to be 1.8 kPa. Calculate the **(10)**

i. Volume of air after dehumidification in m^3 and
ii. Mass of water removed in kg.

Q5. An air–water vapour sample at 101.3 kPa has a dry-bulb temperature of 328 K and is10% saturated with water vapour. Using the psychrometric chart determine the following: **(10)**

i. the absolute humidity, kg water vapour per kg dry air
ii. the partial pressure of water vapour
iii. the absolute saturation humidity at 328 K
iv. the vapour pressure of water at 328 K
v. the percent relative saturation
vi. the dew point of the system

Q6. **(a)** The heat of combustion of methane, carbon, and hydrogen are –890.4,– 393.51, and – 285.84 kJ/mol respectively. Calculate the heat of formation of methane. **(5)**

(b) Calculate the standard heat of formation of acetylene (C_2H_2). **(5)**
Data:
Standardheat of combustion of acetylene is - 1299.61 kJ,
Standard heat of combustion of carbon is - 393.51kJ, and
Standard heat of formation of liquid water is - 285.84 kJ.

Q7. Hydrogen gas is burned in an adiabatic reactor with two times the theoreticalquantity of air, both air and hydrogen being at 298 K initially. What will be the temperature of thereaction products? The standard heat of formation of gaseous water is – 241.826 kJ/mol. The heatcapacities (kJ/kmol K) of the gases are given below: **(10)**

Water vapour: $C_P = 30.475 + 9.652*10^{-3}T + 1.189*10^{-6}T^2$
Nitrogen: $C_P = 27.034 + 5.815*10^{-3}T – 0.2889*10^{-6}T^2$
Oxygen: $C_P = 25.611 + 13.260*10^{-3}T – 4.2077*10^{-6}T^2$

Q8. **Write short notes on any TWO :** **(5 x 2)**

(a) Vapour pressure plots
(b) Recycle and purging operations
(c) Heat of solution and heat of mixing
(d) Effect of temperature on standard heat of reaction