Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL

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IV SEMESTER B.TECH.

MAKE-UP EXAMINATIONS, 2017

SUBJECT: INTRODUCTION TO CHEMICAL ENGINEERING [CHE3281]

REVISED CREDIT SYSTEM

Time: 3 Hours   MAX. MARKS: 100

1A.	Calculate the volume of carbon dioxide formed at STP in 'dm^3' by the complete thermal decomposition of 3.125 g of pure calcium carbonate (Relative atomic mass of Ca=40, C=12, O=16)	**6**
1B.	Define zeroth law of thermodynamics. State pascal's law. The speed limit on the Coquihalla Highway in British Columbia is 110 km/h. What is the equivalent speed in units of mi/h.	**6**
1C.	Define Chemical Engineering. Explain about any six applications of chemical engineering?	**8**
2A.	Write the formula for calculating the concentration in ppm and ppb. How many moles of NaCl are contained in 250.mL of solution with a concentration of 1.25 M?	**7**
2B.	Baker's yeast is to be grown in a continuous fermentation system using a fermenter volume of 20 m^3 in which the flow residence time is 16 h. A 2% inoculum containing 1.2 % of yeast cells is included in the growth medium. This is then passed to the fermenter, in which the yeast grows with a steady doubling time of 2.9 h. The broth leaving the fermenter then passes to a continuous centrifuge which produces a yeast cream containing 7% of yeast, 97% of the total yeast in the broth. Calculate the rate of flow of the yeast cream and of the residual broth from the centrifuge.	**8**
2C.	What is the difference between batch, semibatch and continuous processes? Explain clearly with the help of an example.	**5**
3A.	Write three differences between ideal and real gases.	**6**
3B.	The composition of the stoichiometric combustion products of methane is: 1 volume CO_2 7.52 volumes N_2 2 volumes H_2O Give a total product volume, per volume of fuel burned, if 10.52 if water is in the vapor phase, or 8.52 if the water is condensed to a liquid.	**8**

3C.	Define fluid mechanics. For a stationary mass of a static fluid, derive $$\frac{p_b - p_a}{\rho} = \frac{g}{g_c}(Z_a - Z_b)$$	6
4A.	An aqueous soln of NaCl is created using 133 g of NaCl diluted to a total soln volume of 1.00 L.Calculate the molarity, molality, and mass percent of the soln, given a density of 1.08 g/mL and MW of NaCl = 58.442 g/mol.	8
4B.	Classify the following processes as batch, continuous, or semibatch, and transient or steady state. 1. A balloon is filled with air at a steady rate of 2 g/min. 2. A bottle of milk is taken from the refrigerator and left on the kitchen table. 3. Water is boiled in an open flask. 4. Carbon monoxide and steam are fed into a tubular reactor at a steady rate and react to form carbon dioxide and hydrogen. Products and unused reactants are withdrawn at the other end. The reactor contains air when the process is started up. The temperature of the reactor is constant, and the composition and flow rate of the entering reactant stream are also independent of time. Classify the process (a) initially and (b) after a long period of time has elapsed.	7
4C.	Define the term colligative property and list those physical properties of a solution that can be classified as colligative properties.	5
5A.	In the following reaction: $2Al(s) + 6HCl(aq) \longrightarrow 2AlCl_3(aq) + 3H_2(g)$ If 35.5mL of $H_2(g)$ is collected over water at 26°C and a barometric pressure of 755mmHg, how many moles of HCl must have been comsumed? (The vapor pressure of water at 26°C is 25.2mmHg)	5
5B.	A pipe 200 m long has a slope of 1 in 100 and tapers from 1.2 m diameter at the high end to 0.6 m diameter at the low end. The pipe carries 100 litre/s of oil of specific gravity 0.8. If the pressure gauge at the higher end reads 60 kN/m2 determine (i) Velocities at the two ends and (ii) Pressure at the lower end. Neglect all losses. Note, flow is from higher end to lower end.	7
5C.	At 29.6 °C, pure water has a vapor pressure of 31.1 torr. A solution is prepared by adding 86.8 g of "Y", a nonvolatile non-electrolyte to 350. g of water. The vapor pressure of the resulting solution is 28.6 torr. Calculate the molar mass of Y.	8