

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institution of Manipal University

III SEMESTER B.TECH. (BIOTECHNOLOGY) END SEMESTER EXAMINATIONS, Nov/Dec 2017

SUBJECT: Bioprocess Calculations [BIO 2104]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

✤ Answer ALL the questions.

✤ Missing data may be suitable assumed.

1A.	Briefly explain the role of Bioprocess engineer in Biotechnology industry?	2
1B.	In the SI system, thermal conductivity has the unit w/(m.k). The thermal conductivity of solid material can be calculated as $\mathbf{k} = (\mathbf{X} \mathbf{Q})/(\mathbf{A} \Delta \mathbf{T})$, where Q is the rate of heat transfer, X is the thickness of solid, A is the area of heat transfer and ΔT is the temperature across the solid. The following values were obtained experimentally. Q = 10,000 kJ/h, A = 1 m ² , X = 100 mm, and $\Delta T = 800$ K. (a) Calculate the thermal conductivity of the solid in w/(m.k). (b) Express the thermal conductivity in kcal/(h.m.°C) (c) If thermal conductivity of a second material is 0.15 Btu/(h.ft. °F) Which one will make a better thermal insulator?	4
1C.	It is desired to prepare a 40 % solution of NaCl in water at 300K. (a) How many Kg of anhydrous sodium chloride should be added to 0.05 cubic meter of pure water having a density of 0.998 g/mL at 300K. (b) If the salt contains 10 % water, how many kg of salt is required	4
2A.	 A solution of potassium chloride in water contains 384 g KCl (MW = 74.5) per litre of the solution at 300 K. The specific gravity of the solution is 1.6. Calculate the following: (a) The concentration in weight percent (b) The mole fraction of KCl (c) The molarity of the solution (d) The molality of the solution 	4
2B.	In the production of a drug having a molecular weight of 192, the exit stream from the reactor flows at the rate of 10.3 L/min. The drug concentration is 41.2% (in water), and the specific gravity of the solution is 1.025. Calculate the concentration of the drug (in kg/L) in the exit stream, and the flow rate of the drug in k mol/min	4
2C.	10 kg of liquid A of specific gravity 1.17 is mixed with 5 kg of liquid B of specific gravity 0.83. Assuming that there is no volume change on mixing, what is the specific gravity of mixture	2



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5A.	The relationship between the pressure P and volume V of the air in a cylinder during the upstroke of a piston in an air compressor can be expressed as $P*V^{K} = C$ Where K and C are constants. During a compression test, the following data are taken:P (mm76011401520228030403800Hg)2017.4V (Cm3)48.337.431.324.12017.4Determine the values of K and C that best fit the data. (Give both numerical values and units)								
5B.	 Production of recombinant protein by a genetically CH_{1.77}O_{0.49}N_{0.24} engineered strain of <i>E.coli</i> is proportional to cell growth. Ammonia is used as nitrogen source for aerobic respiration of glucose. The recombinant protein has an overall formula CH_{1.55}O_{0.31}N_{0.25}. The yield of biomass from glucose is measured as 0.48g/g the yield of recombinant protein from glucose is about 20% that for cells. (a) How much ammonia is required? (b) What is the oxygen demand? (c).If the biomass yield remains at 0.48 g/g, how much different are the ammonia and oxygen requirements for wild-type <i>E.coli</i> unable to synthesize recombinant protein? 								
5C.	The heat of combustion of methane, carbon and hydrogen are -890.4 kJ/mol, -393.51 kJ/mol and -285.84 kJ/mol respectively, calculate the heat of formation of methane?								