



MANIPAL INSTITUTE OF TECHNOLOGY MANIPAL

(A constituent institution of MAHE, Manipal)

## III SEMESTER B.TECH. (BIOTECHNOLOGY) END SEMESTER EXAMINATIONS

SUBJECT: Bioprocess Calculations [BIO 2152]

## **REVISED CREDIT SYSTEM**

Time: 50 Minutes

MAX.30

## Instructions to Candidates:

✤ Answer ALL the questions.

✤ Missing data may be suitable assumed.

1	Which of the following is the correct representation of a general balance equation? Input – Output – Generation – Consumption = Accumulation Input – Output + Generation – Consumption = Accumulation Input – Output + Generation + Consumption = Accumulation Input – Output – Generation + Consumption = Accumulation Ans: Input – Output + Generation – Consumption = Accumulation	CO3	1
2	If 200g of 45.0% methanol in water is combined with 300 g of 70.0% methanol in water, what is the composition of the product? 40% water 57.5% water 60% water 42.5% water Ans: 40% water	C01	6
3	The combustion equations of carbon and carbon monoxide are as follows: $C + O_2 \rightarrow CO_2$ ; $\Delta H = -394 \text{ kJ/kmol}$ $CO + 0.5O_2 \rightarrow CO_2$ ; $\Delta H = -284.5 \text{ kJ/kmol}$ The heat of formation of CO is kJ/kmol -109.5 +109.5 -678.5 +678.5	CO5	6

	Ans: – 109.5								
	Match the following:								
	Quantity	SI Unit	AE Unit						
	a) Temperature	1) meter	i. Rankine						
	b) Mass	2) Kelvin	ii. pound						
	c) Amount of	3) kilogram	iii. foot						
	substance					1			
4	d) Length	4) gram-mole	iv. pound-		CO1				
			mole						
	a-2-i, b-3-ii, c-1-iv, d-4-iii								
	a-2-i, b-3-iv, c-4-ii, d-1-iii								
	a-2-i, b-3-ii, c-4-iv, d-1-iii								
	a-4-1, b-3-11, C-2-1V, d-1-111								
	Ans: a-2-i, b-3-ii, c-4-iv, d-:	1-iii							
	At 25 °C, an aqueous solut	tion containing 35% H2SO4	4 has a specific gravity of 1	.2563. A quantity of					
	35% H2SO4 solution that (	contains 195.5 kg of H2SO	4 is needed. Calculate the	required volume of					
	the solution in liters.								
	445								
5	420 l				CO2	6			
	4701								
	4381								
	Ans: 445 l								
	A drug solution has a co	oncentration of 50 mg/ml	L. What amount of drug	is contained within					
	20.5 mL of the solution?								
	1.314 g					6			
6	1.025 g	.025 g				Ŭ			
0	1.471 g								
	1.546 g								
	Ans: 1.025 g								
	Gas leaving a fermenter	r at close to 1 atm pres	ssure and 25°C has the	following					
	composition (mole%):	78.2% nitrogen, 19.2%	oxygen, 2.6% carbon die	oxide. Calculate the					
	29.184	in of the fermenter off-g	as.						
	33.253								
7	25.132				CO2				
	26.134					6			
	Ans: 29.184								
1									

8	Equal masses of CH <sub>4</sub> and H <sub>2</sub> are mixed in an empty container. The partial pressure of hydrogen in this container expressed as the fraction of total pressure is 1/9 1/2 8/9 5/9 Ans: 8/9	CO2	6
9	Biomass is found to contain 50% C, 7% H, 33% O and 10% N by weight. If the molecular weight of the Biomass is 144, determine the molecular formula of the Biomass $C_8H_{10}NO_3$ $C_6H_5NO_3$ $C_6H_{10}NO_5$ $C_6H_{10}NO_3$ Ans: $C_6H_{10}NO_3$	CO3	4
10	A Biochemist is interested in preparing 1 liter 2N HCl solution. Find the grams of HCl needed to prepare the solution. Molecular weight of HCl is 36.5. 65 g 67 g 63 g 73 g Ans: 73 g	CO2	4
11	One hundred pounds of water is flowing through a pipe at the rate of 10 ft/s. what is the kinetic energy of this water in (ft)*(lb <sub>f</sub> )? 135 (ft)*(lb <sub>f</sub> ) 141 (ft)*(lb <sub>f</sub> ) 155 (ft)*(lb <sub>f</sub> ) 122 (ft)*(lb <sub>f</sub> ) Ans: 155 (ft)*(lb <sub>f</sub> )	C01	3
12	The volume of a microbial culture is observed to increase according to the relation $V (cm^3) = e^{3t}$ where t is in seconds. What is the unit of constant 3? cm 1/s $cm^2$ 1/cm Ans: $1/s$	C01	5

ſ		A solution of ZnBr <sub>2</sub> in water contains 130 g salt per 100 mL solution at 293 K. The specific gravity of the solution is 2. Calculate the concentration of ZnBr <sub>2</sub> in weight percent.			
		40%			
12	55%				
	12	65%			
		80%			
-		Ans: 65% Which one is the most concentrated solution.			
		20 g of NaOH in 100 mL of water			
		150 g of NaOH in 200 mL of water			
	14	180 g of NaOH in 300 mL of water	CO2	4	
		250 g of NaOH in 600 mL of water			
_		Ans: 150 g of NaOH in 200 mL of water Densities for and do not change significantly at ordinary conditions with			
		pressure.			
		Gas, liquids			
	15	Liquids, solids	CO2	4	
	15	Solids, gas			
		None of the mentioned			
		A T 1 1 1 1			
		Ans: Liquids, solids Which one is not a dimension.			
		Length			
		Mass			
		Time		1	
		Kelvin			
	16		C01		
	10	Ans: Kelvin			

	are the means of explicitly expressing the dimensions.		
17	Units Dimensions Significant figures Neither unit nor dimension	C01	1
18	Real gases approach ideal behavior at High pressure and high temperature Low pressure and high temperature Low pressure and low temperature High pressure and low temperature Ans: Low pressure and high temperature	CO2	1
19	100 m <sup>3</sup> of a gas mixture containing 20% CO <sub>2</sub> is sent to an absorber in which 90% of CO <sub>2</sub> is absorbed. The temperature and pressure of the gas entering are the same as those of the gas leaving. What will be the pure – component volume of CO <sub>2</sub> in the gas leaving? 2 m <sup>3</sup> 80 m <sup>3</sup> 82 m <sup>3</sup> 100 m <sup>3</sup> Ans: 2 m <sup>3</sup>	CO2	6
20	What can be said about a set of data when its SD is small (but not zero)? The data are far apart. All of the data have the same value. The mean of the data can never be zero. The data are close together. Ans: The data are close together.	CO2	1
21	Na <sub>2</sub> SO <sub>4</sub> .10H <sub>2</sub> O crystals are formed by cooling 100 kg of 30% by weight aqueous solution of Na <sub>2</sub> SO <sub>4</sub> (Mol.Wt 142). The final concentration of the solute in the solution is 10%. The weight of crystals is 22.33 32.2 45.35 58.65 Ans: 58.65	CO3	6

22	<ul> <li>Which of the following statements is FALSE for the chemical equation given below in which nitrogen gas reacts with hydrogen gas to form ammonia gas assuming the reaction goes to completion?</li> <li>N<sub>2</sub> + 3H<sub>2</sub> → 2NH<sub>3</sub></li> <li>The reaction of one mole of H<sub>2</sub> will produce 2/3 moles of NH<sub>3</sub>.</li> <li>One mole of N<sub>2</sub> will produce two moles of NH<sub>3</sub>.</li> <li>One molecule of nitrogen requires three molecules of hydrogen for complete reaction. The reaction of 14 g of nitrogen produces 27 g of ammonia.</li> </ul>	CO4	5
23	How many moles of KBrO <sub>3</sub> are required to prepare 0.0700 moles of Br <sub>2</sub> according to the reaction: KBrO <sub>3</sub> + 5KBr + 6HNO <sub>3</sub> > 6KNO <sub>3</sub> + 3Br <sub>2</sub> + 3H <sub>2</sub> O 0.023 0.0732 0.0704 0.220 Ans: 0.023	CO4	6
24	The limiting reagent in a chemical reaction is one that: has the largest molar mass (formula weight). has the smallest molar mass (formula weight). has the smallest coefficient. is consumed completely. Ans: is consumed completely.	CO4	1
25	Yeast converts glucose to ethanol and carbon dioxide by glycolysis as per the following reaction: $C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$ . Assuming complete conversion, the amount of ethanol produced (in g) from 200 g of glucose is 180 g 115 g 95 g 102g Ans: 102g	CO4	6
26	The degree of reduction for acetic acid (C <sub>2</sub> H <sub>4</sub> O <sub>2</sub> ) is 2 8 4 3 Ans: 4	CO4	3

	are controlled or fixed during the experiment.		
27	Random errors Independent and Dependent Variables Dependent Variables Independent Variables Ans: Independent Variables	CO2	1
28	The deviation of an individual value from the mean is known as the Systematic error Random error Standard deviation Residual Ans: Residual	CO2	1
29	Which of the following is not a unit of energy W*sec kg*m/sec N*m Joule Ans: kg*m/sec	CO1	5
30	Medical herbs are extracted with hexane in batch extractors. The herbal material contain 20% oil, 68% solids and 12% moisture. At the end of the extraction process, the cake is separated from the hexane – oil mixture. The cake analysis yields 0.8% oil, 88% solids, and 11.2% moisture. Find the percentage recovery of oil. 91% 84% 97% 94%	CO3	6

Cognitive	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
Levels	1	2	3	4	5	6