

Unit 5 - Week 3: Fundamentals of Material Balance

Course outline

How does an NPTEL online course work?

Week 0 : Prerequisite

Week 1: Introduction

Week 2: Process Variables and Rate

Week 3: Fundamentals of Material Balance

- Lecture 3.1: Principles of material balance and calculation
- Lecture 3.2: Material Balances on Processes with Recycle & Bypass
- Lecture 3.3: Material balances on reactive processes
- Lecture 3.4: Material balances on combustion reactions

Quiz : Assignment 3

Solution: Assignment 3

Feedback form

Week 4: Basic Principles of Compressible System

Week 5 : Basic principles of multiphase system

Week 6 : Energy and Its Forms

Week 7 : Energy Balances on Nonreactive Processes

Week 8 : Energy Balances on Reactive Systems

Week 9 : Balances on Transient Process

Week 10 : Computational Techniques

Week 11 : Computer-aided balance calculations

Week 12 : Case Study for a Process

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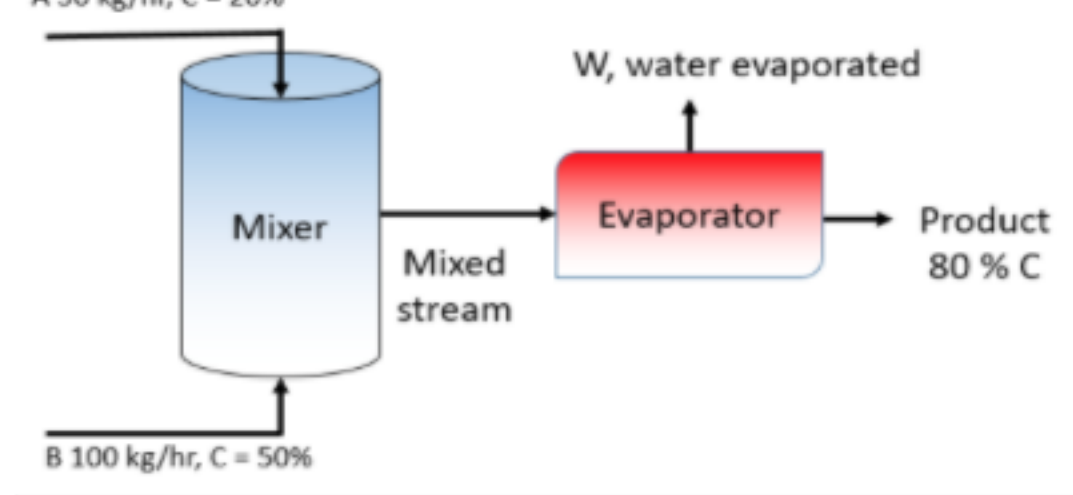
Assignment 3

The due date for submitting this assignment has passed. **Due on 2020-02-19, 23:59 IST.**
As per our records you have not submitted this assignment.

Module 3: Fundamentals of material balance

All questions are compulsory
The assignment consists of 15 questions
Each question carries equal marks (1 mark)
There is no any negative marking for selecting the wrong choice.
Assume the value of constants, if data is not provided in the problem

1) Stream A with mass flow rate of 50 kg/hr having solute (C) content 20% (wt %) is mixed with stream B having mass flow rate of 100 kg/hr (50% (wt %) solute (C) content) as shown in Figure below. Calculate the solute concentration (wt %) at outlet of mixer after mixing. **1 point**



- 20 %
- 50 %
- 40 %
- 70 %

No, the answer is incorrect.
Score: 0
Accepted Answers: 40 %

2) Evaporator is used to evaporate the solution of mixed stream as per figure shown in question 1 up to concentration of 80 % (wt %). The flowrate of product (P, kg/hr) from the evaporator is **1 point**

- 50
- 65
- 70
- 75

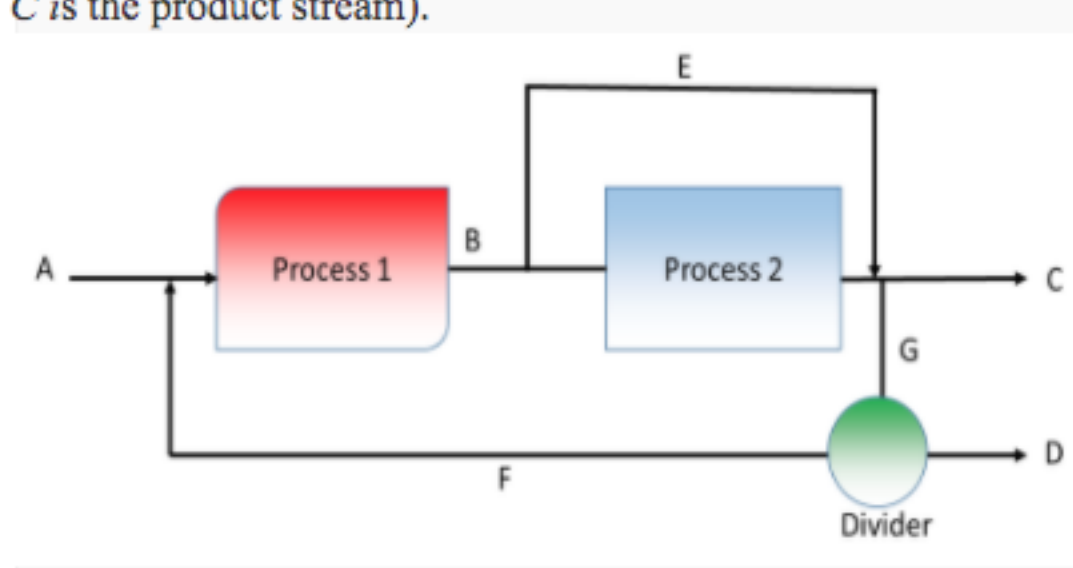
No, the answer is incorrect.
Score: 0
Accepted Answers: 75

3) The rate of water evaporation (W, kg/hr) as per figure shown in question 1 is (final solute concentration is 80 % from evaporator): **1 point**

- 50
- 65
- 70
- 75

No, the answer is incorrect.
Score: 0
Accepted Answers: 75

4) Process 1 and process 2 are connected using different flow streams as shown in figure. Identify the purge stream from the figure (if C is the product stream). **1 point**



- B
- E
- D
- F

No, the answer is incorrect.
Score: 0
Accepted Answers: D

5) For a steady state process without chemical reaction, general material balance equation is **1 point**

- Accumulation = Input – output + Generation – consumption
- Accumulation = Input – output
- Input – output + Generation – consumption = 0
- Input = output

No, the answer is incorrect.
Score: 0
Accepted Answers: Input = output

6) Limiting reactant for a reaction defined as (if reaction is fully completed) **1 point**

- the reactant that would be last depleted
- the reactant that would be least depleted
- the reactant that would be first depleted
- the reactant that would remain as a residue

No, the answer is incorrect.
Score: 0
Accepted Answers: the reactant that would be first depleted

7) For a reaction $A + 2B \rightarrow C + 3D$, identify the limiting reactant for 1 gmol of A and 6 gmol of B. **1 point**

- A
- B
- C
- No limiting reactant

No, the answer is incorrect.
Score: 0
Accepted Answers: A

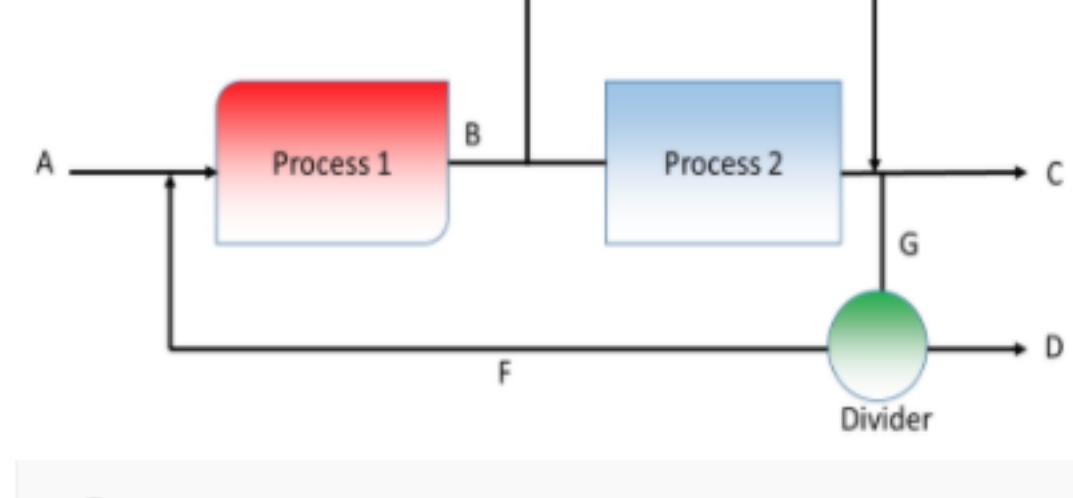
8) For a given parallel reaction, **1 point**

$A \rightarrow B$ (desired),
 $A \rightarrow C$ (undesired)
What is the conversion of A?

- moles of B obtained/moles of C obtained
- moles of B obtained/moles of A obtained
- moles of A reacted/moles of A fed
- 1 – (moles of A reacted/moles of A fed)

No, the answer is incorrect.
Score: 0
Accepted Answers: moles of A reacted/moles of A fed

9) Process 1 and process 2 are connected using different flow streams as shown in figure. Identify the bypass stream from the figure. **1 point**



- B
- E
- D
- F

No, the answer is incorrect.
Score: 0
Accepted Answers: E

10) Extent of reaction (ξ) at the start of reaction is **1 point**

- infinity
- 1
- Zero
- $0 < \xi < 1$

No, the answer is incorrect.
Score: 0
Accepted Answers: Zero

11) For an elementary reaction, $A + B \rightleftharpoons C + D$, 1 gmol of A and 1 gmol of B reacted to form C and D. At reaction temperature (T) the equilibrium reaction constant (K) is 1.00. Calculate the mole fraction of A at equilibrium. **1 point**

- 1
- 0.75
- 0.5
- 0.25

No, the answer is incorrect.
Score: 0
Accepted Answers: 0.25

12) For an elementary reaction, $A + B \rightleftharpoons C + D$, 1 gmol of A and 1 gmol of B reacted to form C and D. At reaction temperature (T) the equilibrium reaction constant (K) is 1.00. Calculate the moles of C obtained at equilibrium. **1 point**

- 1
- 0.75
- 0.5
- 0.25

No, the answer is incorrect.
Score: 0
Accepted Answers: 0.5

13) For an elementary reaction, $2A + 3B \rightleftharpoons C + 2D$, 1 gmol of A, 2 gmol of B fed initial in the reactor and 2 gmol of C and 1 gmol of D is obtained at equilibrium. What is the stoichiometric ratio (B/A)? **1 point**

- 0.5
- 1
- 1.5
- 2

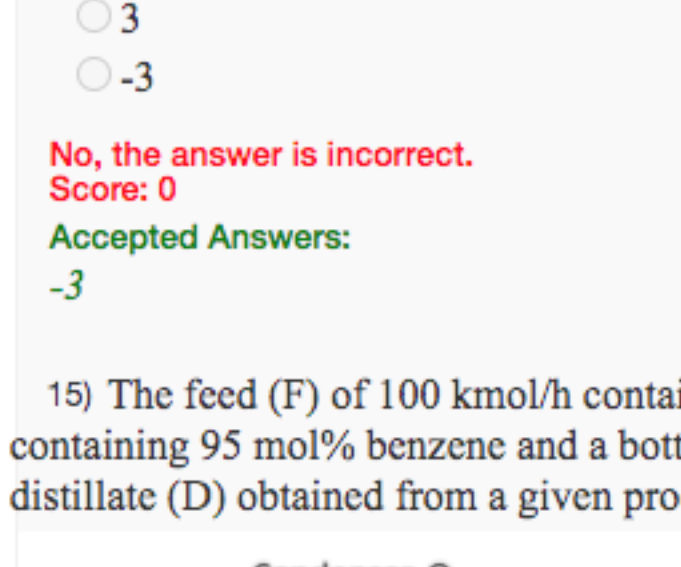
No, the answer is incorrect.
Score: 0
Accepted Answers: 1.5

14) For an elementary reaction, $2A + 3B \rightleftharpoons C + 2D$, 1 gmol of A, 2 gmol of B fed initial in the reactor and 2 gmol of C and 1 gmol of D is obtained at equilibrium. ν_1 is the stoichiometric number of i^{th} species in a reaction. What is the value of ν_2 ? **1 point**

- 2
- 2
- 3
- 3

No, the answer is incorrect.
Score: 0
Accepted Answers: -3

15) The feed (F) of 100 kmol/h containing 45 mol % benzene is fed to the distillation column as shown in figure. A distillate (D) containing 95 mol% benzene and a bottom product (B) containing 10 mol% benzene is to be obtained as per distillation process. the amount of distillate (D) obtained from a given process is **1 point**



- 58.83
- 45
- 55
- 41.17

No, the answer is incorrect.
Score: 0
Accepted Answers: 41.17