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GIET UNIVERSITY, GUNUPUR – 765022

B. Tech (Third Semester – Regular) Examinations, December – 2020

BPCCH3040 – Chemical Process Calculations

(Chemical Engineering)



Maximum: 50 Marks

The figures in the right hand margin indicate marks.

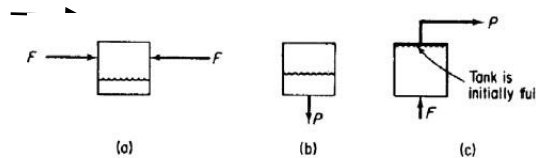
PART – A: (Multiple Choice Questions)

(1 x 10 = 10 Marks)

Q.1. Answer ALL questions

	[CO#]	[PO#]
a. The freezing point of water at 760 mm of Hg pressure is 273 K if you convert this into °R scale temperature what is the freezing point of water (i) -40 (ii) -23 (iii) 40 (iv) 32	CO1	PO2
b. Convert 2000 W to Kg f. m/s (i) 301 Kg f. m/s (ii) 201 Kg f. m/s (iii) 328 Kg f. m/s (iv) 318 Kg f. m/s	CO1	PO2
c. For constant pressure process of an ideal gas the change in heat (gained or released from) is (i) Change in internal energy (ii) Depends of shaft work (iii) Change in enthalpy (iv) None of the above	CO2	PO4
d. A condensable vapor at its dew point in a non-condensable gas is a (i) Saturated gas (ii) Saturated vapor (iii) Saturated liquid (iv) None of the above	CO2	PO4
e. What is recycle ratio (i) Ratio of feed stream to mixed stream (ii) Ratio of recycle stream to mixed stream (iii) Ration of mixed stream to recycle stream (iv) Ration of recycle stream to fresh feed stream	CO3	PO2
f. A conversion of a reactant in a process with recycle based on the fresh feed of the reactant and the overall products is (i) Fractional yield (ii) Pass conversion (iii) Overall conversion (iv) None of the above	CO3	PO1
g. What is an open system (i) Interaction of mass and energy takes place across system boundary (ii) Interaction of energy takes place across system boundary (iii) Opened such that a steady state condition is maintaining (iv) None of the above	CO3	PO1
h. A stream blend off from the process to remove the accumulation on inerts of unwanted material that might otherwise build up in the recycle stream is (i) Main stream (ii) Bypass stream (iii) Recycle stream (iv) Purge stream	CO3	PO1
i. An enthalpy change that does not involve a phase transition (i) Sensible heat (ii) Heat of fusion (iii) Latent heat (iv) None of the above	CO4	PO4
j. Heat of reaction accompanying the formation of one mole of a compound from its element at a given temperature and pressure is (i) Standard heat of formation (ii) Heat of combustion (iii) Heat of formation (iv) None of the above	CO4	PO1

- Q.2. Answer ALL questions
- | | [CO#] | [PO#] |
|---|-------|-------|
| a. A 25 L vessel is to contain 1.1g moles of nitrogen. The vessel can with stand a pressure of only 20kPa above atmospheric pressure (taking into account a suitable safety factor). What is the maximum temperature to which the N ₂ can be raised in the vessel in K | CO1 | PO3 |
| b. What is Raoult's law? | CO2 | PO1 |
| c. Define the term degrees of freedom? | CO2 | PO1 |
| d. Examine the following processes in the figure each box represents a system. For each state represent weather the process is steady state, unsteady state, or unknown condition. And also find weather the system is closed, opened, neither or both closed and opened. The wavy line represents the initial fluid level when the flow begins. In case (c) the tank stays full. | CO3 | PO4 |



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| e. What is heat of formation and write heat of formation reaction for H ₂ SO ₄ . | CO4 | PO1 |
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PART – C: (Long Answer Questions)**(6 x 5 = 30 Marks)**

Answer ANY FIVE questions:

- | | Marks | [CO#] | [PO#] |
|---|-------|-------|-------|
| 3. By electrolyzing mixed brine, a gaseous mixture is obtained at the cathode having the following composition by weight. Cl ₂ =67%, Br ₂ =28% and O ₂ =5%. Then (a) the calculate the composition of gas by volume as Cl ₂ , Br ₂ and O ₂ respectively (b) Density of gas mixture in g/lit at 25 ^o C & 740 mm Hg & also specific gravity of the mixture. | (6) | CO1 | PO3 |
| 4. Explain the different ways of expressing composition of liquid mixture | (6) | CO1 | PO1 |
| 5. A mixture of acetone vapour and N ₂ contains 20% acetone by volume. Calculate a) the relative saturation and b) percentage saturation of the mixture at 20 ^o C and 760 mm Hg. Vapour pressure of acetone at 20 ^o C = 184.8 mm Hg. | (6) | CO2 | PO3 |
| 6. Define (a) Henry's law (b) Vapor pressure, (c) adiabatic saturation temperature (d) Antoine equation, | (6) | CO2 | PO1 |
| 7. In the production of Sulphur trioxide 100 kmol of SO ₂ and 100 kmol of O ₂ are fed to a reactor. If the percent conversion of SO ₂ is 80, the reaction is given below
$\text{SO}_2 + 0.5\text{O}_2 \rightarrow \text{SO}_3$ <ol style="list-style-type: none"> 1. What is the mole % of O₂ in the product stream 2. What is the quantity of SO₂ in the product stream in kmol 3. What is the quantity of O₂ reacted in this process in kmol 4. What is the mole % of SO₃ in the product stream | (6) | CO3 | PO3 |
| 8. A solution containing 53.8 g MgSO ₄ /100 g water is cooled from 353 K to 323 K. In the process 6% of the water evaporates. How many kg of MgSO ₄ .7H ₂ O crystals are obtained per 100kg of the original solution? At 323K the solution contains only 0.3 mass fraction of MgSO ₄ . | (6) | CO3 | PO3 |
| 9. Calculate the heat of formation of phenol (C ₆ H ₅ OH) crystals at 298.15K from its elements using the following data:
Standard heat of formation of CO ₂ = - 393.51 KJ/mol.
Standard heat of formation of H ₂ O = - 285.83 KJ/mol.
Heat of combustion of phenol crystals at 298.15K = -3050.25KJ/mol. | (6) | CO4 | PO3 |
| 10. Heat capacity of air can be expressed as Cp= 26.693+7.365x 10 ⁻³ T, Cp in J/mol ^o K and T in ^o K. Determine the heat given off by 1 mole of air when cooled at 1 atm from 500 ^o C to -100 ^o C. | (6) | CO4 | PO3 |

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