

SEAT No. _____

No. of Printed Pages : 03

[1217]

SARDAR PATEL UNIVERSITY

EXTERNAL EXAMINATION, APRIL 2017

M.Sc. INDUSTRIAL CHEMISTRY-SEMESTER 4

PS04CICH 10: Introduction to reaction engineering and steam generation

11th April, 2017

Max. Marks: 70

Time : 2.00 p.m-5.00 p.m

Answer all the questions.

Figures to the right side indicate marks

Q1

All questions carry 1 mark each (8 * 1 = 8 marks)

a. Variables affecting rate of a heterogeneous reaction are

- | | |
|---|--------------------------------|
| i. Composition, temperature, pressure | iii. Composition, pressure |
| ii. Composition, temperature, pressure, mass transfer | iv. Composition, Heat transfer |

b. Unit of rate constant for a first order reaction is

- | | |
|---|-------------------------|
| i. (concentration) ⁻¹ time ⁻¹ | iii. time ⁻¹ |
| ii. concentration/time | iv. moles/(vol * time) |

c. In the equation dependency of k on temperature $k \propto T^m e^{-E/RT}$, the value of m based on Arrhenius theory is

- | | | | |
|------|---------|----------|-------|
| i. 0 | ii. 1/2 | iii. 1/3 | iv. 1 |
|------|---------|----------|-------|

d. The heat energy of superheated steam is -----

- | | |
|---------------------------------|----------------------------------|
| i. more than that of dry steam | iii. less than that of wet steam |
| ii. less than that of dry steam | iv. equal to that of dry steam |

e. Steam at saturation temperature having no entrained water molecules is called-----.

- | | | | |
|--------------|---------------|------------------------|----------------------|
| i. Wet steam | ii. Dry steam | iii. Superheated steam | iv. dryness fraction |
|--------------|---------------|------------------------|----------------------|

f. Saturation temp of steam increases with -----

- | | |
|----------------------------|---------------------------|
| i. increase in pressure | iii. Decrease in pressure |
| ii. Unaffected by pressure | iv. None of these |

g. Reactions with a direct relation between rate equation and stoichiometry are called--- reactions.

- | | | | |
|-----------|--------------|-----------------|-----------------|
| i. Series | ii. Parallel | iii. Elementary | iv. homogeneous |
|-----------|--------------|-----------------|-----------------|

h. Boiler Thermal Efficiency is defined as

- heat used in producing steam / heat supplied by fuel
- heat supplied by fuel / heat used in producing steam
- heat supplied by fuel / enthalpy of fuel
- none of the above

Q2. Answer any seven (all questions carry 2 marks each $7 \times 2 = 14$ marks)

- Distinguish between elementary and non-elementary reactions
- Distinguish between internally fired & externally fired boilers
- A reaction with pure reactant A undergoes the reaction $A + 2B \rightarrow 3R + 2S$. Calculate its fractional change in volume (ϵ_A)
- Distinguish between space time and reaction time
- Write the principle of He-Hg method for porosity determination
- Distinguish between rate of reaction and global rate of reaction
- Why is the conversion in PFR more than that in a CSTR of the same volume?
- How are boilers classified according to pressure?
- Distinguish between fire tube and water tube boilers

Q3 a. The decomposition of phosphine proceeds with an activation energy of 10000 cal/mole. How faster is the decomposition at 800 K than at 500 K? Find the answer using Arrhenius, Transition and Collision theories ($R = 1.98$ cal/gmol K) (06)

Q3 b. Derive the integral analysis equation for ANY ONE of the following reversible reactions and describe the procedures for calculating rate constant. (06)

- $A \leftrightarrow R$.
- $2A \leftrightarrow R + S$

Q4 a. A first order reaction of stoichiometry $A \rightarrow R$ when carried out in a PFR requires 32 litres volume reactor for converting 99 % A. If the reaction stoichiometry is $A \rightarrow 3R$, what volume of reactor is required to get the same conversion (06)

Q4 b. 100 gm of silica gel catalyst of surface area 90×10^4 cm²/gm is subjected to helium-mercury penetration test. Calculate the porosity and average pore radius using the following data. (06)

Volume of helium displaced = 57 cm³

Volume of Mercury displaced = 85 cm³

OR

Q4 b. Explain the method of determining surface area of catalyst using BET method (06)

Q5 a. A boiler produces 18000 kg/hr of steam of dryness fraction 0.97 at 12.5 bar from feed water at 105 °C using coal of NCV 27400 kJ/kg as fuel at a rate of 2040 kg/hr. Calculate (06)

- Heat supplied per hour
- Thermal efficiency of boiler
- Equivalent evaporation

P(bar)	T _s (°C)	Sp. Enthalphy (kJ/kg)			Sp. Volume(m ³ /kg)		Cp water = 4.187 kJ/kg k
		hf	hfg	hg	water	Dry steam	
12.5	189.8	806.7	1977.4	2784.1	0.0012	0.157	

Q5 b. A vessel of volume 0.05 m^3 contains dry saturated steam at 18 bar. Determine the mass of this steam in the vessel and the enthalpy of this mass of steam. **(06)**

P (bar)	$T_s (^{\circ}\text{C})$	Sp. Enthalpy (kJ/kg)			Sp. Volume (m^3/kg)	
		hf	hfg	hg	water	Dry steam
18	207.1	884.6	1910.3	2794.8	0.001168	0.11

OR

Q5 b. Determine the specific volume and enthalpy of 1 kg of steam at 8 bar when the

- i. Dryness fraction is 0.9
- ii. When the steam is super heated to 280 C **(06)**

P (bar)	T_s	Sp. Enthalpy (kJ/kg)			Sp. Volume (m^3/kg)	
		hf	hfg	hg	water	Dry steam
8	170.4	720.9	2046.5	2767.5	0.001115	0.240

Q6a. Write the functions of the following accessories in a boiler **(06)**

Feed check valve	Steam stop valve	Man hole	Hand hole
Fire hole	Mud box	Blow off cock	fusible plug
steam separator	steam trap	Grate	Economiser

Q6b. A boiler has an equivalent evaporation of 5000 kg/hr . Coal of Calorific Value 31000 kJ/kg is supplied at a rate of 500 kg/hr . Calculate the thermal efficiency of the boiler. **(06)**

OR

Q6b. What is the amount of steam required to produce 10 kg super heated steam at 5 bar and 250°C from feed water at 35°C . **(06)**

P (bar)	T_s	Sp. Enthalpy (kJ/kg)			Cp water = 4.187 kJ/kg k Cp steam = 2.5 kJ/kg k
		hf	hfg	hg	
5	151.8	640.1	2107.4	2747.5	



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SARDAR PATEL UNIVERSITY

M.Sc SEMESTER EXAM, SEM-IV

INDUSTRIAL CHEMISTRY

PS04CICH11-PROCESS DEVELOPMENT IN CHEMICAL INDUSTRIES

TIME:2:00 to 5:00p.m.

13-04-2017

MARKS: 70

Q.1 ANSWER THE FOLLOWING MCQs

(08)

1. The task of process development is to _____ the chemical reaction to an Industrial Scale.

A. Extrapolate B. Interpolate C. Combine D. None of these

2. _____ process is preferred for exothermic reaction.

A. Batch B. Continuous C. Semi-batch D. Semi-continuous

3. The Grignard reaction refers to addition of RMgX to aldehydes and ketones to give _____

A. Alcohols B. Acids C. Phenols D. Amines

4. A _____ is a 50:50 mixture of two enantiomers.

A. Oxalate B. Acetate C. Racemate D. Carbamate

5. Solvents play a role in chemical industry as _____

A. Reaction Media B. Cleaning C. Purification D. All of these

6. _____ process is preferred for reaction involving toxic chemicals.

A. Batch B. Continuous C. Semi-batch D. Semi-continuous

7. _____ reactors are difficult to maintain and are very costly

A. CSTR B. Rubber lined C. Stainless steel D. Glass lined

8. _____ technology utilizes ultrasound for chemical change

A. Bio-technology B. Nano-technology C. Cryogenic D. Sonication

Q.2 Answer the following short questions (Any 7)

(14)

1. Stoichiometric technology V/s Catalytic technology- Differentiate

2. Define Atom Economy

3. What is Cryogenic Technology?

4. Give classification of polar and non-polar solvents

-1-

5. What are the advantages of using Phase Transfer Catalyst(PTC)?
6. What is work-up of a chemical reaction?
7. What are safety assessment techniques? Enlist some important techniques used in chemical industries.
8. Explain near critical water and super critical water.
9. What is enantiomeric excess(ee)?

Q.3 (a) Discuss the Goals and Objectives of process development. (06)

Q.3 (b1) Explain the stages in process development. (03)

Q.3 (b2) Discuss process development in relation to plant equipment. (03)

OR

Q.3 (b) Discuss the scope and limitations of project development. (06)

Q. 4 (a) What is Chiral Technology? Discuss factors responsible for the rapid growth of chiral technology. (06)

Q.4 (b) Explain in brief Telescoping and one-pot reactions. (06)

OR

Q.4 (b) Discuss following factors for choosing a reagent:

i. Safety assessment techniques ii. Toxicity iii. Efficacy rather than cost (06)

Q.5 (a) Discuss the effect of solvents on reaction rate and reaction course (06)

Q.5 (b) Explain in brief the following aspects of solvents: (06)

i. Impurities in solvent ii. Polarity of solvents

OR

Q. 5(b) Write a note on choosing a solvent based on safety considerations (06)

Q. 6(a) Write a detailed note on classical work-up (06)

Q.6 (b) Explain the following terms with respect to purity:

i. Chemical purity ii. Detection of impurities (06)

OR

Q.6 (b1) Discuss environmental problems associated with workup (03)

Q.6 (b2) Discuss simplification of reaction work-up (03)

Best of Luck

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SARDAR PATEL UNIVERSITY
M. Sc. Semester - IV Examination
Monday, 17th April 2017
INDUSTRIAL CHEMISTRY

Subject: Technology of chemical process industries

Date: 17/04/2017

Course No. : PS04CICH12

Time: 02:00 p.m. to 05:00 p.m.

Marks: 70

Q.1 Answer the following MCQs (Attempt all) [08]

- i. The process of roasting of iron sulphate at very high temperature to form iron oxide is known as _____.
(a) Oxidation (b) Reduction
(c) Calcination (d) Alkylation
- ii. _____ is known as red hematite.
(a) $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ (b) Fe_2O_3
(c) FeSO_4 (d) MnO_2
- iii. Aliphatic dicarboxylic acid influence on _____ of polyester resin.
(a) Surface hardness (b) Solubility
(c) Compatibility (d) Flexibility
- iv. Trans-esterification reaction is often accelerated by adding basic catalyst such as _____.
(a) Lead acetate (b) Lithium hydroxide
(c) Sodium hydroxide (d) All of these
- v. Polyurethane is formed by the polymerization of _____.
(a) Isobutylene & Isoprene (b) Phenol & Formaldehyde
(c) Diisocyanate & Diol (d) Urea & Formaldehyde
- vi. Which is the disadvantage of the unmodified epoxy resin?
(a) High viscosity (b) High rigidity
(c) High cost (d) All of these
- vii. _____ isomer of BHC has insecticidal properties.
(a) Alpha (b) Beta
(c) Gamma (d) Delta
- viii. Magnesium is _____ nutrient.
(a) Natural (b) Primary
(c) Secondary (d) Micro

Q.2 Answer the following short question (Any seven) [14]

- I. Differentiate between pigment and dyes.
- II. Draw the structure of anthanthrone orange and flavanthrone yellow.
- III. Define oleo-resinous media.
- IV. Write the classification of oil based on iodine value.
- V. Enlist the methods for preparation of phenol.
- VI. Define KB value.
- VII. Enlist the blocking agents used for one pack PU coatings.
- VIII. Define Fertilizer. Enlist the types of soils.
- IX. Define plant growth regulators, Herbicides.

- Q.3 (a) With the help of flow diagram explain manufacture of titanium dioxide by sulphate process. [06]
(b) Write classification, manufacture, properties and uses of iron oxide pigments. [06]
Or
(b) Write classification, manufacture and properties of azo pigments. [06]
- Q.4 (a) With the help of labelled diagram explain manufacture of amino resin. [06]
(b) With the help of flow diagram explain manufacture of alkyd resin [06]
Or
(b) Write explanatory note on surface coating formulation of saturated polyester resin. [06]
- Q.5 (a) Write explanatory note on polyurethane coating systems [06]
(b) With the help of flow diagram explain manufacture of epoxy resin. [06]
Or
(b) Write note on curing system used for epoxy resin. [06]
- Q.6 (a) With the help of flow diagram explain manufacture of urea. [06]
(b) Write note on rodenticides and ethylene dichloride. [06]
Or
(b) With the help of flow diagram explain manufacture of super phosphate. [06]

Best of Luck.....

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No. of printed pages: 02

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SARDAR PATEL UNIVERSITY

M. Sc. (Industrial Chemistry), Fourth (4th) Semester Examination
April - 2017

PS04EICH06: ADVANCED ANALYTICAL CHEMISTRY

Wednesday, 19th April, 2017

Time: 02:00 p.m. to 05:00 p.m.

Total Marks: 70

Note: i) Attempt all the questions.
ii) Figures to right indicate full marks.
iii) Draw neat diagrams wherever it requires.

Q-1 Answer the following Multiple Choice Questions. (08)

- In earlier years Raman technique was preliminary used to study ____ states of simple molecules.
a) vibrational
b) rotational
c) rocking
d) symmetry
- In a molecule with a center of symmetry, it is seen that vibrations that are Raman active are IR inactive & vice – versa. This principle is called ____.
a) Mutual explosion
b) Mutual exclusion
c) balanced expanse
d) rocking exclusion
- ND - YAG laser wavelength is ____.
a) 1064 nm
b) 488.0 nm or 514.5 nm
c) 632.8 nm
d) 488.0nm
- Dry dispersion is not suitable for ____.
a) Fine powders
b) Very fine powders
c) big particles
d) b and c
- In particle size analysis, NIBS means ____.
a) Non – Ionic Back Scatter
b) Non – Invasive Back Scatter
c) Normal-isolated back scatter
d) New-ionic scatter
- In ICP analysis, the liquid samples are injected into _____ induced argon plasma using one of a variety of nebulizers.
a) furnace
b) radiofrequency
c) particle
d) electron
- Solid samples require extraction or _____ digestion so that the analytes will be present in a solution.
a) base
b) acid
c) acetone
d) high temperature
- The TEM sample should be thin, due to the _____ of the electron in the material
a) scattering
b) none of these
c) adsorption
d) absorption

Q-2 Answer the following short questions. Each question carries equal mark. **(Any Seven)** **(14)**

1. What is the principal of Raman spectroscopy?
2. Draw a schematic (optical) diagram of FT-Raman instrument.
3. Define Hydrodynamic diameter.
4. What is a rheological property?
5. Draw a schematic diagram of ICP torch.
6. Why ICP is known as inductive technique?
7. Write the working principle of TEM.
8. What is electrolytic polishing in TEM?
9. List out the different type of pneumatic nebulizers used in ICP.

Q-3 (a) Discuss Rayleigh scattering. Explain stocks & anti- stocks scattering with respect to energy. **(06)**

Q-3 (b) What is mutual exclusion principal of Raman spectroscopy? Explain it with the example of CO₂. **(06)**

OR

Q-3 (b) Write a note on applications of FT-Raman spectroscopy. **(06)**

Q-4 (a) Discuss wet & dry dispersion techniques for particle size analysis. **(06)**

Q-4 (b) Discuss dynamic light scattering technique of PSA. **(06)**

OR

Q-4 (b) Discuss with suitable example particle size distribution. **(06)**

Q-5 (a) Explain with neat diagram various nebulizers used in ICP. **(06)**

Q-5 (b) Write a note on various applications of ICP. **(06)**

OR

Q-5 (b) Explain hydride generation in ICP. Compare LOD values for the hydride generating elements with other conventional nebulization technique. **(06)**

Q-6 (a) Discuss the effects of electron interaction with specimen in TEM. **(06)**

Q-6 (b) Discuss various sample preparation techniques during TEM analysis. **(06)**

OR

Q-6 (b) i) What are the limitations of TEM? **(03)**

ii) Draw a schematic diagram of electron source (Gun) used in TEM. **(03)**