

SEAT No. _____

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SARDAR PATEL UNIVERSITY

M. Sc. Semester - II Examination

Tuesday, April 2017

INDUSTRIAL CHEMISTRY

Subject: Unit processes

Date: 11/04/2017

Course No. : PS02CICH07

Time: 10:00 a.m. to 01:00 p.m.

Marks: 70

Q.1 Answer the following MCQ s (Attempt all)

[08]

- I. The difference in activation energy between various methods of chlorination depends on the _____ step.
 - a. Chain initiation
 - b. Chain termination
 - c. Chain propagation
 - d. None of these
- II. Bromination is carried out by _____.
 - a. Addition reaction
 - b. Replacement reaction
 - c. Substitution reaction
 - d. All of above
- III. DVS is ratio of _____.
 - a. $H_2SO_4:H_2O$
 - b. $HNO_3:H_2O$
 - c. $HCl:H_2O$
 - d. $HCl:HNO_3$
- IV. Which catalyst is used for production of benzoic acid?
 - a. Boron trifluoride
 - b. Vanadium oxide
 - c. Calcium chloride
 - d. Vanadium sulphate
- V. The mechanism of acid-catalyzed alcoholysis is similar to the _____.
 - a. Acid-catalyzed oxidation
 - b. Base-catalyzed esterification
 - c. Acid-catalyzed esterification
 - d. Base-catalyzed oxidation
- VI. The reaction between phenyl benzoate and sodium ethoxide give _____.
 - a. Ethyl benzoate
 - b. Sodium benzoate
 - c. Benzene
 - d. None of this
- VII. The vaporization salt scheme is suitable for the synthesis of alcohols containing _____ number of carbon atom.
 - a. 5
 - b. 7
 - c. 9
 - d. 11
- VIII. What is boiling point of methanol?
 - a. $60.5^{\circ}C$
 - b. $64.7^{\circ}C$
 - c. $67.5^{\circ}C$
 - d. $74.2^{\circ}C$

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

[14]

- I Enlist the types of alkylation.
- II Draw labelled diagram of externally cooled batch chlorinator.
- III Define nitration and unit operation.
- IV Enlist nitrating agents.
- V Define oxidation.
- VI What is direct hydration?
- VII Define hydrolysis with suitable example.
- VIII Draw the labelled diagram of extraction salt flow sheet.
- IX Draw the labelled diagram of triad flow sheet.

- Q.3 (a) Write explanatory note on types of alkylated compounds [06]
(b) With the help of labelled diagram explain construction and working of reactors used in alkylation. [06]
Or
- (b) With the help of suitable examples explain about important methods used for preparation of bromine compounds. [06]
- Q.4 (a) With the help of flow diagram explain continuous nitration of benzene. [06]
(b) With the help of flow diagram explain manufacture of benzene sulfonic acid [06]
Or
- (b) Write note on types of oxidative reactions. [06]
- Q.5 (a) Write note on acid hydrolysis and alkali hydrolysis. [06]
(b) With the help of flow diagram explain manufacture of ethyl acetate [06]
Or
- (b) With the help of flow diagram explain manufacture of ethanol. [06]
- Q.6 (a) With the help of flow diagram explain manufacture of iso-butyraldehyde. [06]
(b) With the help of flow diagram explain manufacture of methyl alcohol. [06]
Or
- (b) Write note on fischer tropesch synthesis. [06]

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SARDAR PATEL UNIVERSITY
EXTERNAL EXAMINATION, APRIL 2017

M.Sc. INDUSTRIAL CHEMISTRY-SEMESTER 2

HEAT TRANSFER OPERATIONS & STOICHIOMETRY- PS02CICH09

13th April, 2017

Max.Marks:70

Time:10.00 a.m-1.00 p.m

Answer all the questions.

Figures to the right side indicate marks

Q1 .Write the number of the correct statement. All questions carry 1 mark each. (8 *1=8marks)

a. Identify the correct relation.

- i. $W = 1 \text{ J/s}$ ii. $1W = 1 \text{ kcal/s}$ iii. $1 W = 1 \text{ cal/s}$ iv. $1 W = 1 \text{ cal/hr}$

b. The -----component is always present in less than its stoichiometric proportion .

- i. excess reactant ii. stoichiometric reactant iii. limiting reactant iv. none of these

c. Natural Convection is characterized by

- i. Peclet number ii. Grashoffs number iii. Reynolds number iv. Stanton Number

d. The centre-centre distance between 2 tubes is called

- i. tube clearance ii. tube pitch iii. tube sheet iv. tie rods

e. ----- increases turbulence in a heat exchanger

- i. fins ii. baffles iii. Tube sheet iv. None of these

f. The effect of scale formation is to ----- the heat transfer co-efficient

- i. increase ii. decrease iii. rotate iv. none of these

g. Grashoffs number is defined as

- i. $L^2 \rho^2 g \beta \Delta T / \mu^2$ ii. $L^3 \rho g \beta \Delta T / \mu^2$ iii. $L^3 \rho^2 g \beta \Delta T / \mu$ iv. $L^3 \rho^2 g \beta \Delta T / \mu^2$

h. Which is most suitable for the evaporation of cold viscous feed?

- i. Forward feed ii. Backward feed iii. Mixed feed iv. Parallel feed

Q2. Answer any seven (each question carry two marks) (7*2=14 marks)

- Define fouling factor in heat exchanger
- Distinguish between individual and overall heat transfer co-efficient
- Distinguish between pitch and clearance
- Why are tie rods and spacers used in heat exchangers?
- Enlist the conditions when maximum heat transfer rate occurs in a heat exchanger
- Define the term NTU used in heat exchanger calculations
- Define LMTD of parallel & counter flow heat exchangers
- Distinguish between limiting reactant and excess reactant
- Define selectivity and yield of reaction

Q3.

a. A fluid of density 13500 kg/m^3 and at 80°C is pumped through a pipe of 0.02 m ID kept at 30°C at 15000 m/hr . At the average temperature of 55°C , the properties of fluid are as follows. Calculate the heat transfer co-efficient. (06)

C_p (kJ/kg K):0.14	k (kJ/hr m K):29	μ (kg/ hr m K):3
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b. A pipe 0.15 m dia & 1 m length and at temperature of 573 K is covered with 2 layers of insulation. The first layer is 0.05m thick with a k value of 0.062 W/m K and the second layer is 0.06 m thick with a k value of 0.8 W/m K. The outer surface of second layer covering is at a temperature of 330 K. Calculate the heat loss and the interface temperature. (06)

OR

b. A horizontal cylinder 0.025 m dia and 0.6 m long is suspended in water at 20 °C. Calculate the heat transfer co-efficient if the cylinder surface is at 55 °C. (06)

ρ (kg/m ³)	Npr	k (kJ/hr mK)	β (K ⁻¹)	μ (kg/hr m)
992	4.64	2.376	3.96×10^{-4}	2.47

Q4.

a. A fluid (Cp=3.3 kJ/kg K) flowing at 20000 kg/hr enters a parallel flow heat exchanger of 40 % efficiency at 120 °C. Water (Cp= 4.186 kJ/kg K) flowing at 50000 kg/hr which is used as the coolant enters at 20 °C. If a heat transfer area of 10 m² is available, what will be the heat transfer co-efficient? (06)

b. Find the length of a double pipe exchanger required to heat 4000 kg/hr of oil from 10 °C to 20 °C using hot water at 70 °C flowing at 690 kg/hr. The hot water flows through the inner pipe of ID 0.018 m and OD 0.021 m. The ID of the outer pipe is 0.03 m. k for pipe= 0.008 kJ/hr m K. (06)

	Cp(kJ/kgK)	k (kJ/hr mK)	ρ (kg/m ³)	μ (kg/hr m)
Water	4.18	2.376	1000	1.458
Oil	1.885	0.504	850	2.163

Do the calculation for

A parallel flow exchanger

OR

A counter flow exchanger

Q5.

a. 100 kg of a solution containing 55 % benzene, 28 % toluene, and 17 % xylene by weight is in contact with its vapour at 373 K. Calculate the total pressure and molar composition in liquid phase. (06)

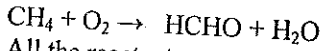
	Benzene (MW:78)	Toluene (MW:92)	Xylene (MW:106)
Vap. Pr (kpa)	178.6	74.6	28

b. A combustion reactor is fed with 50 kmol/h of butane and 2000 kmol/h of air.
 $C_4H_{10} + 6.5 O_2 \rightarrow 4CO_2 + 5H_2O$.
 Calculate the % excess air and the composition of gases leaving the combustion reactor assuming complete combustion. (06)

OR

b. An evaporator is fed with 15000 kg/h of a solution with 10 % NaCl, 15 % NaOH and rest water. The water is evaporated and NaCl is precipitated as crystals. The thick liquor leaving the evaporator contains 45 % NaOH, 2 % NaCl and rest water. Calculate the amount of water evaporated, NaCl precipitated and thick liquor obtained. (06)

Q6.
 a. 100 moles of methane is oxidized with 50 % excess air to produce formaldehyde as per the reaction



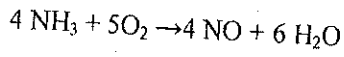
All the reactants enter at 311 K with 60 % conversion of methane. Calculate the heat that must be removed for the product stream to emerge at 478 K.

Component	Cp (311- 298 K) J/mol K	Cp (478-298 K) J/mol K	Std. heat of reaction = - 283000 J/mol
CH ₄	36.044	40.193	
O ₂			
N ₂			
HCHO		41.2902	
H ₂ O		34.2396	

(06)

b .Calculate the standard heat of reaction of the following reaction

(06)



Component	NH ₃	NO	H ₂ O
ΔHf (kJ/mol)	-45.94	90.25	-241.82

OR

b. 100 kg/h of methanol liquid at 303 K is to be obtained by removing heat from saturated methanol vapour. Find the amount of heat to be removed

(06)

Boiling point of methanol = 337.8 K,
 Cp of methanol = 2.7235 kJ/kg K

Latent heat of condensation = 1101.7 kJ/kg

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SARDAR PATEL UNIVERSITY

SEAT No. _____

M.Sc SEMESTER-II EXAMINATION

M.Sc INDUSTRIAL CHEMISTRY

PS02CICH10 PETROCHEMICAL TECHNOLOGY

TIME: 10:00A.M.-01:00P.M

17-04-2017, MONDAY

MARKS: 70

Q.1 ANSWER THE FOLLOWING MCQs

(08)

1. _____ is a naturally occurring mixture of light hydrocarbons accompanied by some non-hydrocarbon compounds

- A. Synthesis Gas B. Natural Gas C. Water Gas D. All of these

2. _____ is condensable heavier hydrocarbons that are recovered from natural gas.

- A. CNG B. LNG C. PNG D. NGL

3. In _____ process, part of the coke produced is used to provide the process heat.

- A. Delayed Coking B. Fluid Coking C. Viscosity Breaking D. Steam Cracking

4. The two major chemicals viz. ammonia and methanol are produced from _____

- A. Synthesis gas B. Natural gas C. Water gas D. None of these

5. _____ is produced as intermediate during urea production.

- A. Ammonium acetate B. Ammonium Carbamate C. Ammonium Chloride D. Ammonium nitrate

6. Reaction between ethylene oxide and _____ produces ethoxylates

- A. Fatty amines B. Fatty acids C. Fatty alcohols D. Fatty nitriles

7. _____ is produced from ethylene oxidation using wacker catalyst.

- A. Acetaldehyde B. Acetic acid C. Formaldehyde D. Formic acid

8. Alkylation of benzene produces _____

- A. LAB B. Ethyl Benzene C. Cumene D. All of these

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

(14)

1. Enlist various primary raw materials for petrochemicals.

2. Which are the different streams of NGL?

3. Explain briefly various types of crude oil.

4. Discuss the production of hydrazine from ammonia.
5. What is synthesis gas, Enlist the methods used to produce synthesis gas.
6. Enlist various chemical conversion processes for crude oil processing and explain vis-breaking.
7. What is wacker catalyst?
8. Enlist the important chemicals produced from toluene.
9. Why Ethylene is known as 'King of Petrochemicals'?

Q.3 (a) Define the terms: Petrochemicals, and discuss about the composition and properties of crude oils.

(06)

Q.3 (b) Discuss in brief various natural gas treatment processes

(06)

OR

Q.3 (b) Explain the terms: i. Associated and Non-Associated Natural gas

ii. CNG and LPG

(06)

Q.4 (a) Enlist various physical separation techniques for crude oil processing and write a note on Solvent extraction.

(06)

Q.4 (b) Write a detailed note on catalytic cracking

(06)

OR

Q.4 (b) Write a detailed note on steam reforming

(06)

Q.5 (a) Discuss in brief the chemicals based on direct reaction of Methane with reagents.

(06)

Q.5 (b) Write a note on synthesis gas and ammonia production starting from methane.

(06)

OR

Q.5 (b) Discuss the technology of methanol production from synthesis gas along with its major uses. (06)

Q.6 (a) Enlist various important chemicals produced from ethylene and discuss the production of vinyl chloride and vinyl acetate monomers from ethylene.

(06)

Q.6 (b) Give an explanatory note on the production technology of phenol and acetone from benzene via cumene.

(06)

OR

Q.6 (b) Write a note on chemicals produced from propylene.

(06)

Good Luck

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SEAT No. _____

SARDAR PATEL UNIVERSITY

M. Sc. (Industrial Chemistry), Second (2nd) Semester Examination

April - 2017

PS02EICH06: AIR POLLUTION CONTROL TECHNOLOGY

Wednesday, 19th April, 2017

Time: 10:00 a.m. to 01:00 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)

1. Fossil fuel combustion accounts for almost all anthropogenic _____ emissions.
 - a) sulphur
 - b) fog
 - c) nitrogen
 - d) PSA
2. _____ are the primary natural sources of VOC emissions.
 - a) Forests
 - b) Sea
 - c) Automobile
 - d) Land erosion
3. Photochemical smog forms primarily as a result of interactions among _____.
 - a) carbon monoxide
 - b) phosphorous
 - c) nitrogen
 - d) carbon
4. The sampling height of about _____ meter from the ground level.
 - a) 3 to 10
 - b) 1 to 2
 - c) 8 to 9
 - d) 15 to 20
5. _____ is the primary metrological parameter.
 - a) Mixing height
 - b) Humidity
 - c) Precipitation
 - d) Visibility
6. _____ is used as an absorbing media in SO₂ determination.
 - a) NEDA
 - b) Pararosaniline HCl
 - c) starch
 - d) KI solution
7. The NAAQS monitoring should be done for 24 hours and minimum _____ days in a year.
 - a) 365
 - b) 104
 - c) 106
 - d) 360
8. Data recorded in an arbitrary manner after their collection from the field of enquiry are called _____.
 - a) study data
 - b) raw data
 - c) secondary data
 - d) presentation data

- Q-2** Answer the following short questions. Each question carries equal mark. (Any Seven) (14)
1. List out the air pollutants from farm animals.
 2. What are the different types of damage to leaves due to pollution?
 3. Write the classification of sampling methods for air pollution.
 4. Define secondary meteorological parameter 'precipitation'.
 5. Write the aldehydes photochemical reaction.
 6. When does fanning plume occur?
 7. How to mitigate carbon footprint?
 8. Define: Relative frequency.
 9. Briefly explain with illustration the distinction between qualitative and quantitative data.

Q-3 (a) What are the causes of acid rain? (06)

Q-3 (b) What are the effects of air pollution on human health? (06)

OR

Q-3 (b) Write note on Volatile Organic Compounds (VOCs) as a pollutant. (06)

Q-4 (a) Discuss in brief the sampling and analytical technique for NO₂ pollutant. (06)

Q-4 (b) Write a note on plume behavior. (06)

OR

Q-4 (b) i) Briefly discuss the criteria for selecting location for air sampling. (03)

ii) Write a note on wind direction and speed as a factor of air pollution. (03)

Q-5 (a) Briefly explain the causes and effects of 'Chernobyl Disaster'. (06)

Q-5 (b) i) How to mitigate carbon footprint? (03)

ii) What is carbon sink? Define natural and artificial sinks. (03)

OR

Q-5 (b) Explain the theory of photochemical smog formation. (06)

Q-6 (a) Distinguish between census and sample survey. (06)

Q-6 (b) i) Monthly average concentration of Ozone at BSZ Marg (ITO), New Delhi during 2015 is given below. Calculate mean and standard deviation concentration of ozone. (03)

Month	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct.	Nov	Dec
Ozone ($\mu\text{g}/\text{m}^3$)	15	25	36	30	31	33	41	54	36	42	26	24

ii) Explain with suitable example frequency distribution. (03)

OR

Q-6 (b) i) Explain with suitable examples descriptive and inferential statistics. (03)

ii) What is stack sampling? (03)