

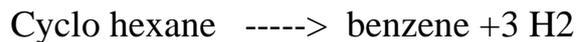
Petroleum Refining and Petrochemical Technology- VIII  
(Reactor Design & Catalysis) MCQ's

Unit 1

1. Catalyst used in dehydrogenation of vegetables and animals oil is?

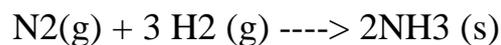
- |                                    |                                   |
|------------------------------------|-----------------------------------|
| A. V <sub>2</sub> O <sub>5</sub> . | C. Pt                             |
| B. Raney Ni.                       | D. Al <sub>2</sub> O <sub>3</sub> |

2.. Name the reaction and also name the catalyst used in the reaction



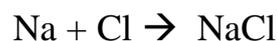
- A. Homogeneous Catalytic reaction- Pt-Al<sub>2</sub>O<sub>3</sub>.H<sub>2</sub>O
- B. Heterogeneous Catalytic reaction- V<sub>2</sub>O<sub>5</sub>
- C. Heterogeneous Catalytic reaction- (C<sub>2</sub>H<sub>5</sub>)<sub>4</sub>- Pb
- D. Heterogeneous Catalytic reaction- Pt-Al<sub>2</sub>O<sub>3</sub>.H<sub>2</sub>O

3. The following reaction is an example of



- |                             |                       |
|-----------------------------|-----------------------|
| A. Homogeneous Catalysis.   | C. Mixed Catalysis    |
| B. Heterogeneous catalysis. | D. Demoivre Catalysis |

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- A. Homogeneous Catalysis.
- B. Heterogeneous catalysis.
- C. Mixed Catalysis
- D. Demoisre Catalysis

6. Which theory relatively suits for heterogeneous catalysis?

- A. Intermediate
- B. Absorption
- C. Nucleate
- D. Paratoid

7. The equilibrium constant  $k$ , of a chemical reaction depends on ?

- A. temperature only
- B. pressure only
- C. temperaure & pressure
- D. ratio of the reactants

8. With increases in temperature in temperature, the rate constant obeying Arhenius equation ?

- A. Initial concentration of the reactants
- B. temperature of the system
- C. time of reaction
- D. extent of reaction

9. For a homogeneous reaction of  $n^{\text{th}}$  order , the dimension of the constant is given by

- A.  $1/(\text{time})^n$
- B.  $(\text{concentration})^{1-n} / \text{time}$
- C.  $(\text{concentration})^{1-n} * \text{time}$
- D. None of these

10. In case of unimolecular type elementary reaction as shown in below , the PFR as compared to mixed reactor is



- A. More
- B. same
- C. less
- D. unpredictable

## UNIT – 02

1. The catalyst deactivation caused by deposition on surface and pores of catalyst is called as.....

- a. Adsorption
- b. fouling
- c. aging
- d. desorption

2. Which of the following represents series type deactivation model? (where R is the product & P is the poison )

- a.  $A \rightarrow R \rightarrow P$
- b.  $A \rightarrow R + P$
- c.  $A \rightarrow P$
- d.  $A \rightarrow R, A \rightarrow P$

3. Which of the following reactor arrangements causes fastest deactivation?

- a. mixed flow for fluid
- b. plug flow for fluid
- c. fluidized bed reactor
- d. batch for solid

4. The activity of catalyst at time  $t=0$  is?

- a. negative
- b. zero
- c. unity
- d. infinite

5. If  $k_d$  is the rate constant of deactivation and  $d$  is the order of deactivation, then the rate equations representing independent deactivation are?

- a.  $-r_a' = k' C_a^n$  .a -  $(da/dt) = k_d a^d$
- b.  $-r_a' = k' a$  -  $(da/dt) = k_d a^d$
- c.  $-r_a' = k' C_a^n$  .a -  $(da/dt) = k_d$
- d.  $-r_a' = k' C_a^n$  -  $(da/dt) = k_d a^d$

6. The activity of catalyst pellet is defined as the ratio of ?

A .rate of adsorption of reactants to the catalyst catalyse to the rate at which the catalytic pellet converts the reactant

B.rate at which the catalytic pellet converts the reactant of the rate of adsorption of reactants to the catalyst

C. rate at which the catalytic pellet converts the reactant of the rate of reaction with a fresh pellet

D. the rate of reaction with a fresh pellet to the rate at which the catalyse pellets converts the reactant

7. The slope of the curve of  $(\ln C_a/C_{a0})$  and  $t$  for batch solid fluid independent deactivation system is ?

- a.  $\ln(\ln k_d)$
- b.  $\ln(k_d)$
- c.  $k_d$
- d.  $-k_d$

8. If the rate of deactivation is given by  $-da/dt = 0.0064 \text{ day}^{-1}$ . The expression relating activity and time is ?

- a.  $a = 0.0064t$
- b.  $a = 1 - 0.0064t$
- c.  $a = t$
- d.  $a = 0.0064 - t$

9. Which of the following is a catalytic poison?

- a. Potassium nitrate
- b. Aluminium oxide
- c. Aluminium nitrate
- d. chlorine

10. Which of the following is used as a catalytic promoter?

- a. Chlorine
- b. bromine
- c. nitrate
- d. helium

## UNIT – 03

1. Effectiveness factor of a catalyst pellet is a measure of the \_\_\_\_\_ resistance?
  - a. Pore diffusion
  - b. Gas film
  - c. Chemical reaction
  - d. None of these
2. Reducing the reaction rate  $r_{A,obs}$  improves the effectiveness of mass transfer aimed at increasing the reaction rate.
  - a) True
  - b) False
3. “Increasing the bulk concentration of substrate  $C_{Ab}$ ”, is included in which parameter?
  - a) Internal mass-transfer
  - b) External mass-transfer
  - c) Internal-External mass- transfer
  - d) Heat transfer
4. The internal effectiveness factor is symbolized by \_\_\_\_\_
  - a)  $\mu$
  - b)  $\Phi$
  - c)  $\eta$
  - d)  $\Omega$
5. The overall effectiveness factor is symbolized by \_\_\_\_\_
  - a)  $\mu$
  - b)  $\Phi$
  - c)  $\eta$
  - d)  $\Omega$

6. Rate of reaction over a finely crushed catalyst of radius of 0.5 mm was measured as  $10.0 \text{ mole/sm}^3$  catalyst. Temperature is 400 K and pressure is  $10^5 \text{ Pa}$  and mole fraction of reactant in the gas is 0.1. Find the rate for a catalyst of pellet radius of 3mm. (Assume  $\eta_C = 1$  for small catalyst).
- a)  $7.01 \text{ mole / m}^3\text{s}$
  - b)  $7.03 \text{ mole / m}^3\text{s}$
  - c)  $7.05 \text{ mole / m}^3\text{s}$
  - d)  $7.07 \text{ mole / m}^3\text{s}$
7. Accessibility of the surface area of the catalyst is typically non-limiting.
- a) True
  - b) False
8. Increase in pump speed does not change the overall reaction rate.
- a) True
  - b) False
9. The boundary layer is necessary for the analysis of data.
- a) True
  - b) False
10. Thiele modulus will increase with the decrease of the size of the catalyst.
- a) True
  - b) False

## UNIT 04

1. Effectiveness factor (E) of a catalyst pellet is defined as,  $E = (\text{actual rate within pore of catalyst}/\text{rate if not snowed by pore diffusion})$   
Effectiveness factor for a first order reaction is given by (where,  $T =$  Thiele modulus)

- A.  $\tan h(ml)/ml$
- B.  $\tan T/T$
- C.  $\tan hT/\tan T$
- D. None of these

2. The energy balance equation over a tubular reactor nuclear transport condition is .....

- A. An ordinary non linear diffusion differential equations
- B. An algorithmic differential equations
- C. A liner partial differential equations
- D. A non liner partial differential equations

3. Brunaur, Emmet and Teller (BET) equation is used to determine the specific surface area of a porous particle but not the pore volume & the porosity of the catalyst bed. Which of the following postulates is not used to derive BET equation?

- A. Langmuir
- B. There is no dynamic equilibrium between successive layer
- C. The adsorbed layer may be polymolecular in thickness and the heat of adsorption in each layer (except the first one) is involved in each of the evaporation process
- D. None of these

4. A space velocity of  $5 \text{ hr}^{-1}$  means that

- A. Five reactor volumes of feed (at specified conditions) are being fed into the reactor per hour

- B. After every 5 hours, reactor is being filled with the feed
- C. Cent per cent conversion can be achieved in at least 5 hours
- D. A fixed conversion of a given batch of feed takes 5 hours

5. An isothermal irreversible reaction is being carried out in an ideal tubular flow reactor the conversion in this -----with decrease in time

- A. Increase
- B. Decrease
- C. Increase exponentially
- D. Remain unchanged

6. For a tubular flow reactor with uniform concentration and temperature, the independent variable is

- E. Time
- F. Length
- G. Diameter
- H. None of these

7. Bulk diffusion in catalyst pore \_\_\_\_\_ with increase in pressure.

- A. Increases
- B. Decreases
- C. Remains unchanged
- D. Increases exponentially

8. According to freudlich adsorption isotherm, the amount of gas adsorbed at very high pressure

- A. Reaches a constant limiting value
- B. Goes on increasing with pressure
- C. Goes on decreasing with pressure
- D. Increase first and decreasing later with pressure

9. Unreacted core model' represents the reaction involving

- A. Combustion of coal particles
- B. Roasting of sulphide ores
- C. Manufacture of carbon disulphide from elements

D. None of these

10. The effectiveness factor for large value of Thiele modulus ( $L\sqrt{K/D_1}$ ) of a solid catalysed first order reaction is equal to (where,  $L$  = length of the reactor, cm,  $D_1$  = diffusion co-efficient,  $\text{cm}^2/\text{second}$ )

A.  $L\sqrt{K/D_1}$

B.  $1/(L\sqrt{K/D_1})$

C. 1

D.  $\infty$

## UNIT -05

1. A irreversible 1<sup>st</sup> order reaction is being carried out in a CSTR and PFR of same volume. The liquid flow rates are same . The relative conversion will
  - A. Be more in CSTR than in PFR
  - B. Be more in PFR than in CSTR
  - C. Be same in both cases
  - D. Depend on the temperature
2. Fluid flow in a real packed bed can be approximated as \_\_\_\_\_ model?
  - A. Plug flow
  - B. mixed flow
  - C. Dispersion
  - D. Tank in series
3. Semi-batch reactor is preferred , when an
  - A. A highly exothermic reaction is to be controlled
  - B. Undesirable side reaction (at high concentration of the reactants is to be avoided )
  - C. A gas is to be reacted with liquid ( eg. Hydrogenation of fat)
  - D. All A, B & C.
4. What is the dispersion number for a CSTR?
  - A. 0
  - B. 1
  - C. infinity
  - D. < 1

5. A batch reactor is characterized by ?
- A. Constant residence time
  - B. variation is extent of reaction & properties of the reaction mixture with time
  - C. variation in reactor volume
  - D. very low conversion
6. A batch reactor suffers from the following disadvantages?
- A. poor product quality control
  - B. high labour and handling cost
  - C. high shutdown time requirements for emptying cleaning & refilling
  - D. All the Above
7. The residence time distribution of an ideal CSTR is? where ( $T = \tau$ )
- A.  $(1/T) \cdot e^{(-t/T)}$
  - B.  $e^{(-t/T)}$
  - C.  $T \cdot e^{(-t/T)}$
  - D.  $(1/T) \cdot (-t/T)$
8. The exit age distribution curve  $E(t)$  for an ideal CSTR with the average time,  $T$  is given by
- A.  $e^{(-t/T)/T}$
  - B.  $1 - e^{-t/T}$
  - C.  $e^{-t/T}$
  - D.  $1 - e^{-(T/T)}$
9. The vessel dispersion number ( $D/uL$ ) for PFR is \_\_\_\_\_?
- A. 0
  - B. infinity

- C. 500
- D. 700

10. "n " number of PFR in series with totla volume (v) gives the same conversion as one P.F.R. of

- A.  $v/n$
- B.  $v.n$
- C.  $v$
- D.  $1/v$

## UNIT - 06

1. Slurry reactors are characterized by the \_\_\_\_\_?

- a. Lack of intraparticle diffusion resistance
- b. Presence of two mobile phases
- c. Both A & B
- d. Neither A nor B

2. A trickle bed reactor is the one, which\_\_\_\_\_?

- a. Has altogether three streams either entering or leaving
- b. Processes three reactants at different flow rates
- c. Processes three reactants with same flow rate
- d. Employs all the three phases (i.e. solid, liquid and gas)

3. The oil- circulation process is similar to which process?
- Fine particles
  - Moderate size
  - Large size
  - None of the mentioned
4. Which synthesis process is similar to catalytic cracking of hydrocarbons?
- German fixed- bed process
  - Both of the mentioned
  - Slurry process
  - Fluid bed process
5. What is meant by “ Hot gas recycle” ?
- Removal of Heat
  - Supplying of heat
  - Reflux heat
  - None of above
6. The shape and size of catalyst is not very important.
- True
  - False
7. What happens to the velocity of gas, as heat-transfer coefficients increases?
- Increases
  - Decreases
  - No change
  - None of above
8. Heat removal can only be done directly
- True
  - False
9. What does slurry consist of ?
- Fine particles

- b. Pulverized particles
- c. Large particles
- d. None of above

10. What is the application of geman-fixed bed reactor?

- a. Heat removal
- b. Complex design
- c. Low capacity
- d. All of the mentioned