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CHEMICAL ENGINEERING REFRESHER PROGRAM

CHEMICAL REACTION ENGINEERING SET 2

1. The reactor volume of an ideal PFR is equivalent to a/an
   a. infinite series of CSTR's with equal volumes
   b. PFR of equal volume with infinite recycle
   c. CSTR of equal volume without recycle
   d. infinite parallel of PFR's with different volumes

2. A PFR with an infinite recycle ratio is equivalent to a/an
   a. infinite series of CSTR with recycle
   b. infinite series of PFR without recycle
   c. ideal PFR
   d. CSTR

3. Which of the following is false regarding independent reactions?
   a. The number of independent reactions indicates the number of equations to be solved to determine the reactor composition.
   b. Different sets of independent reactions can be selected to determine the change from one state to another.
   c. The number of independent reactions indicates the smallest number of design equations needed to describe the reactor operation.
   d. Any species compositions can be selected to provide information on all other species.

4. Which of the following may exhibit steady-state multiplicity?
   a. homogeneous PFR
   b. non-isothermal CSTR
   c. endothermic CSTR
   d. exothermic PFR

5. This is the is the slowest step of a chemical reaction that determines the speed at which the overall reaction proceeds.
   a. fast step
   b. reversible step
   c. rate-determining step
   d. reverse step

6. Which of the following catalyst geometry has the highest effectiveness factor at low Thiele modulus for a first order rection?
   a. slab
   b. cylinder
   c. sphere
   d. none of the above

7. This catalyst deactivation may be caused by attrition or erosion and subsequent loss as fines.
   a. thermal
   b. chemical
   c. masking
   d. mechanical

8. Using a multi-tubular reactor, what catalyst is conventionally used to produce gaseous phosgene from carbon monoxide and chlorine gas?
   a. platinum
   b. activated carbon
   c. zeolite
   d. nickel

9. Which of the following reactors is best suited to slow reactions with a limiting reaction rate?
   a. pipeline
   b. stirred tank
   c. bubble column
   d. tray tower

10. This process spontaneously transforms a solid reagent into products due to the exothermic heat of combustion.
   a. sintering
   b. polymerization
   c. combustion synthesis
   d. supercritical oxidation

11. What is the most common use of a trickle bed reactor?
   a. absorption
   b. emission control
   c. adsorption
   d. hydrogenation

12-13. An irreversible gas-phase reaction is carried out in a batch reactor at 25°C. The reaction is: A + B → C with a rate of $-r_A$ = 3.5E-5 $C_A C_B$ in mol/m^3-s. The reactor is filled with an equal amount of moles of A and B. The initial concentration of A is 50 mol/m^3.

12. Calculate the conversion of A after 5000 s for a variable-volume batch reactor in which the pressure is held constant.
   a. 95.43%
   b. 86.68%
   c. 93.65%
   d. 89.51%

13. If the reaction is changed to: A + B → 2C + D while other initial conditions and variables held constant, what is the conversion of A after 5000 s?
   a. 95.43%
   b. 93.65%\
   c. 89.51%
   d. 86.68%

14. 14. An irreversible liquid phase second order reaction, 2 A → B, with a rate constant of 0.04 M-1s-1, is carried out in a flow reactor. A 2.5-M solution of A enters at a volumetric flow rate of 5 L/s. It is desired to reach a conversion such that the exiting concentration of A is reduced to 0.25 M. What is the ratio of reactor volumes of CSTR to PFR to be use separately?
   a. 10
   b. 20
   c. 30
   d. 100

15. 15. One mole each of A and B produces together one mole each of D and U in separate parallel non-elementary reactions. The reaction order of A to produce D is greater than its reaction order to produce U while the reaction order of B to produce U is greater than its reaction order to produce D. If D is the desired product, which of the following is the best configuration of reactor to increase the selectivity?
   a. high concentration of A at inlet with multiple side entries of B in PFR
   b. high concentrations of A and B at inlet in PFR
   c. low concentrations of A and B at start of CSTR
   d. high concentration of B and low concentration of A at start of CSTR