

## Quiz 2: Process intensification

### Part 1: True-false

#### Circle T (true) or F (False)

- 1)  T  F For single reactant first order reactions of type  $A \rightarrow B$ , there is no influence of the degree of segregation on the conversion of reactant A.
- 2)  T  F For a same concentration set using the Villermaux-Dushman protocol, a decrease in the segregation index implies an increase in the mixing time.
- 3)  T  F For a homogeneous reaction, the characteristic reaction time is linearly dependent on the characteristic dimension of the reactor.
- 4)  T  F The Nusselt number is significantly higher in a COBR than in an unbaffled tube (under identical  $Re_n$  and  $Re_o$  conditions).
- 5)  T  F In the laminar regime, the Bodenstein number in a COBR is higher than in a smooth (unbaffled) tube (using identical  $Re_n$  and  $Re_o$ )

Short justification of your answer:

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- 6)  T  F In a RPB, the HETP is significantly higher than in a conventional packed column.
- 7)  T  F In a RPB, the liquid is delivered at the eye of the rotor.
- 8)  T  F A RPB can be used for stripping, gas absorption and distillation.
- 9)  T  F In a TF-SDR, the film thickness decreases with flowrate.
- 10)  T  F In a TF-SDR, the film thickness increases with disk rotational speed.
- 11)  T  F In a TF-SDR, the mixing time is short enough to carry out precipitations and obtain very low particle sizes with particularly narrow particle size distributions.
- 12)  T  F In a TF-SDR, the film thickness decreases with radial position.
- 13)  T  F In a PFR, there is no effect of segregation on the conversion of single reactant reactions of the type  $A \rightarrow P$ .

14) **T F** For a single reactant reaction of the type  $A \rightarrow P$  with a reaction order  $n > 1$ , a negative effect of segregation on the reaction rate is expected.

### Part 2: Multiple choice

**Choose the correct answer. Check only one box per question, as there is only one correct answer.**

15) The ratio of characteristic times between a homogeneous and a heterogeneous reaction ( $R$  = characteristic length of the reactor)

is independent of  $R$        increases with  $R$        decreases with  $R$

16) For the following competing scheme:  $A_1 + 2A_2 \rightarrow A_3$  (instantaneous) and  $A_4 + 3A_2 \rightarrow A_5$ , with  $c_{10} = 1$  and  $c_{40} = 2$ ,  $Y_{CS}$  is equal to

3/5       3/4       2/3

17) At equal values of  $t_{mx}$  and  $\tau$ , the segregation intensity in a CSTR is

larger than in a PFR       smaller than in a PFR       the same as in a PFR

18) For the following reaction:  $A_1 + A_2 \rightarrow P$ , first order in  $A_1$  and  $A_2$  with  $DalI_{mx} = 1$  (separate  $A_1$  and  $A_2$  feeds), the conversion in a given type of reactor at a given value of  $DalI$ , compared to the micromixed system, is expected to be

higher       lower       the same

19) For a single reactant reaction of the type  $A \rightarrow P$  carried out in a PFR, segregation has the following effect on conversion (compared to a micromixed PFR):

Increases the conversion       Decreases the conversion       No effect on conversion       Depends on the reaction order

20) In a PFR, the intensity of segregation

increases with  $Z$        decreases with  $Z$        is constant in the reactor

21) The segregation index was measured in two reactors using the Villermaux-Dushman protocol.  $X_s(\text{reactor 1}) > X_s(\text{reactor 2})$ . Which reactor has the lowest mixing time?

Reactor 1       Reactor 2       There is not enough information available to decide

Short justification of your answer:

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22) Which variables should preferably be kept constant for the scale-up of a COBR?

$\frac{L}{D}, \alpha, \psi, Str$

$\frac{L}{D}, Re_o, Str, \psi$

$\frac{L}{D}, \alpha, f, x_o$

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23) The RTD in a RS-SDR can be described by the following model:

Plug-flow

Combination of plug-flow and cascade of CSTRs

Cascade of CSTRs

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24) For a reaction with  $\Delta V^\neq > 0$ , an increase in the pressure

increases the reaction rate

decreases the reaction rate

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25) How do the following properties change when a liquid changes from standard (below critical  $p$  and  $T$ ) to supercritical conditions?

$D_m$

$\rho$

$\mu$

Increases

Increases

Increases

Decreases

Decreases

Decreases