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→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 <u>one</u> 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: $A_1 + 2A_2 \rightarrow A_3(\text{instantaneous})$ 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 τ, 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 $DaII_{mx} = 1$ (separate A_1 and A_2 feeds), the conversion in a given type of reactor at a given value of DaI, 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. $X_s(reactor\ 1) > X_s(reactor\ 2)$. 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?

☐ $\frac{L}{D}, \alpha, \psi, Str$ ☐ $\frac{L}{D}, Re_o, Str, \psi$ ☐ $\frac{L}{D}, \alpha, f, x_o$

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

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

☐ increases the reaction rate ☐ decreases the reaction rate

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

D_m	ρ	μ
☐ Increases	☐ Increases	☐ Increases
☐ Decreases	☐ Decreases	☐ Decreases

Solutions

1T, 2F, 3F, 4T, 5T (creation of radial velocity components in the COBR chambers which flatten the parabolic velocity profile; this is due to vortices forming when baffles interact with the flow), 6F, 7T, 8T, 9F, 10F, 11T, 12T, 13T, 14F.

15C, 16B, 17A, 18B, 19C, 20B, 21C (Segregation index can only be compared at equal concentration sets, which are not specified here), 22A, 23B, 24B, 25ABB