

Chemical engineering Test for Chapters 5 and 6

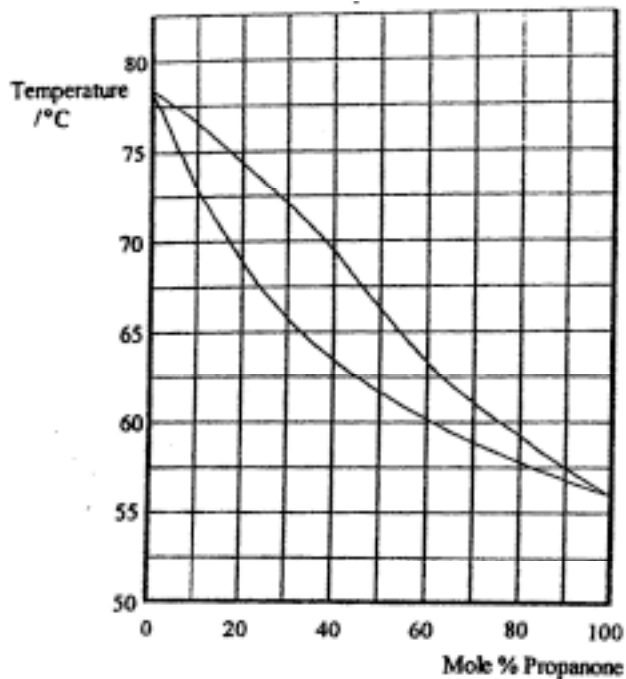
Time allowed: 20 minutes

1. A continuous stirred tank reactor (CSTR) operates according to a design equation

$$V/u = \tau = ([A]_0 - [A])/k[A]$$

- (a) What quantities do the symbols V and k represent ? (2)
- (b) Batch operation produces shorter reaction times than continuous operation but is slower overall. Why is this? (1)
- (c) For a reaction whose value of k is 0.020 min^{-1} , what mean residence time, τ , is required for the initial concentration of a reactant A to be reduced to one tenth of its original value ? (2)
- (d) Give **one** reason for preferring batch operation to continuous operation. (1)

2. The diagram shows the liquid/vapour curves for the ethanol/propanone system.



- (a) At what temperature does a mixture containing 50 mole% of ethanol boil ? (1)
- (b) What is the composition of the vapour when the mixture in (a) boils? (1)
- (c) Starting from the 50 mole% mixture, how many successive distillations would be needed to give a mixture containing 90 mole% of propanone ? (1)

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- 3 (a) What is the reason for packing a fractionating column or putting plates in it ? (1)
- (b) What is a 'sieve tray' in a plate-type column, and why is its use superceding that of bubble-caps in some modern applications ? (2)
- (c) Why are packed columns unsuitable for large-scale use ? (1)
- (d) Give **one** advantage of packed columns unconnected with your answer to the previous question. (1)
- (e) Give **one** advantage of plate columns unconnected with your previous answers. (1)

Total 15 marks

Chemical Engineering Test for Chapters 5 and 6 Answers

- 1 (a) V is the working volume of the tank; k is the rate constant of the reaction (2)
- (b) Account must be taken of the total cycle time/time for filling and emptying in batch operation (1)
- (c) Let $[A]_0$ be 10. Then $[A]$ is 1 so $[A]_0 - [A]$ is 9
9 divided by 0.02×1 is 450 minutes (2)
- (d) One of (1)
Less manpower
Easier to automate
Better degree of control
- 2 (a) 62 °C (1)
(b) 66% propanone / 34% ethanol (1)
(c) 3 (1)
- 3 (a) To promote equilibrium between the ascending vapour and the descending liquid (1)
- (b) A tray with a lot of small holes in it (1) cheaper than bubble-cap (1)
- (c) The packing would be too heavy/ there is a tendency for liquid to run down the sides (1)
- (d) Cheaper/better corrosion resistance (use of ceramics) (1)
- (e) Can cope with foaming liquids/more readily cleaned/easier to remove side-streams (1)

Total 15 marks