

Chemical Engineering Test for Chapters 3 and 4

Time allowed 20 minutes

1. (a) Why does it require less energy to pump a liquid in streamline rather than in turbulent flow? (1)
 - (b) Give **two** reasons why turbulent flow is nevertheless preferred. (2)
 - (c) What important flow phenomenon is shown by a fluid close to a pipe wall in turbulent flow conditions ? (1)
 - (d) In a 'variable area' flow meter a spinning metal float is suspended in a graduated tube up which a fluid is flowing. What is the essential feature of the shape of the tube? (1)
 - (e) The Reynolds number, Re , for fluid flowing in a pipe is given by
$$Re = \frac{u\rho d}{\mu}$$
What quantities do the symbols ' u ' and ' μ ' represent? (2)
 - (f) Why is the viscosity of lubricating oil greater than that of petrol ? (1)
 - (g) Fluids are often made to pass through 'packed beds' of solid particles touching each other. Mention one application of this method. (1)
2. What is the essential principle behind each of the following ways of moving materials from place to place ?
 - (a) hydraulic conveying
 - (b) use of a screw feeder (2)
3. In a heat-exchanger
 - (a) what is meant by 'counter-current' flow ?
 - (b) why is counter-current flow generally preferred to parallel-current flow? (2)
4. The performance of a heat exchanger may be described by the equation
$$Q = U \times A \times \Delta t_m$$
 - (a) What quantity does Q represent ? (1)
 - (b) Mention **one** factor which affects the value of U , the heat transfer coefficient. (1)
 - (c) Why is an average (mean) value necessary for Δt_m , ? (1)

Total 15 marks

Chemical Engineering Test for Chapters 3 and 4 Answers

1. (a) In streamline, fluid is all moving in the same direction whereas in turbulent there are back eddies (1)
(b) Any two of (2)
 - Efficiency of heat transfer
 - Efficient mixing
 - Can use cheaper narrow-bore pipework(c) Flow is streamline close to pipe wall (1)
(d) It has a wider cross-section at the top than at the bottom (1)
(e) u is the mean fluid velocity; μ is the fluid viscosity (2)
(f) van der Waals forces greater (1)
(g) One of (1)
 - Filtration
 - Catalysis
 - Drying of gases
- 2 (a) Solid conveyed by a moving fluid (1)
(b) Turning screw carries material along/up in its spiral groove (1)
- 3 (a) Hot and cold fluids move in opposite directions (1)
(b) Mean temperature difference is greater (1)
- 4 (a) The 'duty' of the heat exchanger/ heat transferred per hour (1)
(b) One of (1)
 - Thickness of walls
 - Material /thermal conductivity of walls(c) Temperature difference varies from one end to the other (1)

Total 15 marks