

Question Bank

(Unit 1 and Unit 2)

PILOT PPLANT STUDIES

1. Explain in detail what is meant by principles of similarity and methods by which it is established.
2. Classify and elaborate the different similarity criteria required in scale up.
3. Explain geometric similarity, mechanical similarity, thermal similarity and chemical similarity.
(Hint: Answer for Q2 and Q3 is same)
4. Explain how a process development is carried out in practice.**(need not to write case history)**
5. How a process is developed to predict the performance of a commercial unit? Discuss and Justify it by considering the case history of any process development.
(Hint: Answer for Q3 and Q 4 will be same: case history of naphtha process development can be considered)
6. Explain clear the need of pilot plant study.
7. Write limitations of scale up.**(Hint: In brief about lack of data, ignorance in observation, miss communication by considering case history)**
8. Conclude briefly how the lack of communication on the part of process development group can rise to difficulty in operating a process. Consider a case history.
(Q 7 and Q 8 are almost same)
9. Dimensional homogeneity: Q:-Contemplate an example and elucidate the principle of dimensional homogeneity.
10. Develop the Reynolds model law for time and velocity ratio for incompressible liquids.
11. From dimensional analysis obtain a relation between power and the variables involved in agitation process **(agitation in the tank is the function of tank diameter , no. of rotation, viscosity and density)**
12. Consider a steady flow of an incompressible Newtonian fluid through a long, smooth walled, horizontal circular pipe. Measure the pressure drop per unit length of the pipe and find the number of non-dimensional parameters involved in the problem. Also, it is desired to know the functional relation among these dimensionless parameters. **(Use Buckingham Pai method of analysis).**
13. Illustrate the difference between following terms: Model, Prototype, element, distorted model and scale ratio.
14. Discuss physical significance of any three dimensional number. **(Reynolds number, Prentle number, Froude no.)**
15. Explain the following terms with sketch if necessary:
 1. Geometric Similarity
 2. Static Similarity
 3. Kinematic Similarity
 4. Dynamic Similarity
 5. Thermal Similarity

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6. Chemical Similarity

16. By using the method of dimensional analysis, obtain Navier stokes equation.
17. A fluid is flowing through a pipe, which is heated from outside. The temperature of the wall of the pipe is higher than the average temperature of the fluid by a constant value ΔT . The change in temperature of the fluid is due to the heat transfer from the walls, and not due to frictional heating generated by the flow. Using dimensional analysis predict the rate of transfer of heat, per unit area of the wall of the pipe, so that the length of pipe required for the heat exchanger can be designed.

(Hint $\frac{qD}{k\Delta T} = \Phi \left(\frac{L}{D}, \frac{\rho U D}{\mu}, \frac{c_p \mu}{k} \right)$ **Forced convection**)

18. Derive the relationship between various dimensionless groups for natural convection heat transfer. Explain the significance of the groups.
19. Correct use of dimensional analysis has many advantages; discuss.
20. Explain in detail about linear scale ratio.
21. A pipe of diameter 1.5 m is required to transport oil of specific gravity 0.9 and viscosity 3×10^{-2} poise at the rate of $3 \text{ m}^3/\text{S}$. Tests were conducted on a 15 cm diameter pipe using water at 20°C . Viscosity of water = 0.01 poise. Find the velocity and volumetric flow rate in the model. Assume dynamic similarity.
22. A spillway model is to be built to a geometrically similar scale of 1/50 across a flume of 600 mm width. The prototype is 15m high and maximum head on it is expected to be 1.5m.
1. What height of model and what head on the model to be used
 2. If the flow over the model at a particular head is 12 litres per second, what flow per meter length of the prototype is expected?
 3. If the negative pressure in the model is 200mm, what is the negative pressure in the prototype? [upto 8 marks]