Transport Phenomena 52:217

Homework 2

Due: February 10, 2005

Read Chapter 5 and 6 of Deen

1. A drop of fluid having a density ρ_1 is immersed in a second immiscible fluid having density ρ_2. Assuming a hydrostatic pressure distribution in fluid 1, show that the net force acting on the drop is the weight of the drop minus the weight of fluid 2 displaced (Archimedes Law, ca. 250 BC) regardless of the shape of the drop. (Hint: Consider the net pressure force exerted by fluid 2 on fluid 1).

   As a result of the buoyant force, the initially stationary drop in Problem 1 begins to accelerate. Suppose that at some later time, the pressure distribution corresponds to a potential flow around the drop which moves with instantaneous speed U(t),

   a. Calculate the pressure distribution on the surface of the drop, if the drop remains spherical.

   b. Calculate the net force on the moving drop.

   c. Will the pressure tend to deform the drop? If yes, qualitatively describe the shape change (i.e., elongate in direction of flow, perpendicular to flow).

2. Problem 5.1

3. Problem 5.2

4. Problem 5.3

5. Problem 5.4

6. Problem 6.1

7. Problem 6.5