CBE 320 Transport Phenomena
Spring 2008

Homework 9

DUE Friday, 28 March, 8:50 am
Read Ch. 9 (sections 1, 2, 7, 8; skim 3-5), Ch. 10 (all sections), *BSL*

Note: Exam 2 will be Tuesday, April 1 (Tues, 5-7 pm), location to be announced. The exam will be closed-book, closed-note and cover material through Homework 9 and through our November 5 class meeting.

1. Analogy building. Consider the laminar motion of a Newtonian fluid between two parallel flat plates, as shown in Fig. 1.1-1 of *BSL*.
   (i) To what extent does the steady-state (or long-time) velocity profile $v_x(y)$ depend on the viscosity μ of the fluid?
   (ii) How does the magnitude of the flux of x-momentum in the y-direction depend on the viscosity of the fluid?
   (iii) Consider now the laminar (no rippling) flow of a viscous isothermal liquid film down an incline, as shown in Fig. 2.2-3. To what extent does the steady-state (or long-time) velocity profile, $v_z(x)$ depend on the viscosity μ of the fluid? Compare or contrast this result with your result in part (i).
   (iv) For the flow in Fig. 2.2-3 how does the flux of z-momentum in the x-direction depend on the viscosity of the fluid? Compare or contrast this result with your result in part (ii).
   (v) Consider the transfer of energy as heat from one plate at temperature T_1 to another plate at temperature T_o as shown in Fig. 9.1-1. To what extent does the steady-state (or long-time) temperature profile T(y) depend on the thermal conductivity *k* of the material between the two plates? Compare or contrast this result with your answer to part (i) for momentum transfer.
   (vi) Consider the flux of energy as heat q_y in Fig. 9.1-1. To what extent does the magnitude of the steady-state (or long-time) flux depend on the thermal conductivity *k* of the material between the two plates? Compare or contrast this result with your answer to part (ii) for momentum transfer. What is the momentum-transport analog of a heat source?

2. Solve 10.A.1 Heat loss from an insulated pipe.

3. Solve 10.A.5 Free convection velocity.

4. Solve 10.A.6 Insulating power of a wall.

5. Solve 10.A.8 Temperature rise in an electrical wire.