八十五學年度 動力机械 系(所) 甲 組碩士班研究生入學考試

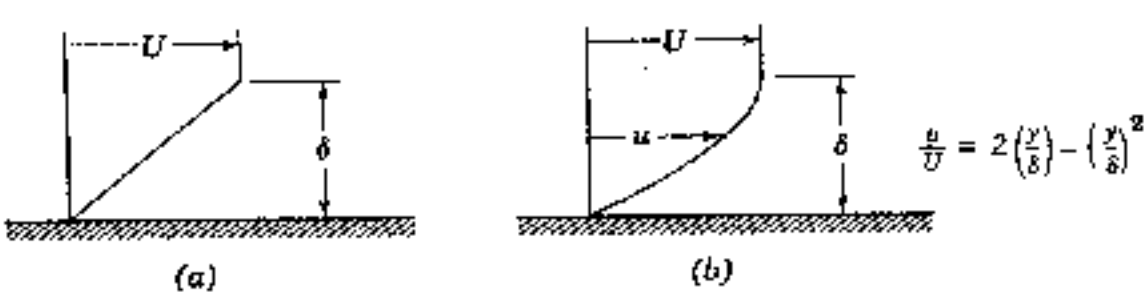
科目 熱流學(II) 科號 2501 共 2 頁第 1 頁 *請在試卷【答案卷】內作答

Fluid Mechanics

1a. Two hypothetical boundary-layer velocity profiles are shown. Derive the expression for the momentum flux of each profile. (10 %)

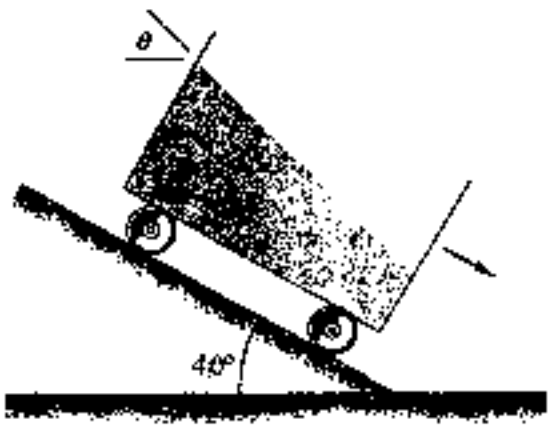
1b. If the pressure gradient conditions are the same for both cases, which would be more likely to separate first ? Why? (10 %)

Fig. 1



2. The tank of water in Fig. 2 accelerates uniformly by freely rolling down a 40° incline. If the wheels are frictionless, what is the angle θ ? Why ? (5 %)

Fig. 2



Heat Transfer

3a. Derive the differential equation of heat transfer problem for a fully developed laminar flow between parallel plates in which one plate is insulated and the other is heated uniformly with q_o. Please list all assumptions (8 %)

3b. Find the solution for the temperature distribution and Nusselt number. (8 %)

3c. If the blackbody radiation between two plates is not negligible, how will you modify the governing equations ? (4 %)

4. What distinguishes gas radiation from blackbody radiation ? (5 %)

5. Please predict one change in natural phenomena or engineering application,

(a) if there is no maximum density for water at 4 °C,

(b) if the viscosity of oil increases with the increase in temperature,

(c) if the density of air increases with the increase in temperature,

(d) the reflectivity of metal is small (near zero),

(e) if the temperature of gases increase with expansion.

and explain the reason for the change for each item. (20%)

6. A long circular rod insulated circumferentially is kept initially at temperature T_0 . The length of the rod is L. The temperature at both ends of the rod is drop to T=0 at t>0. Please give the one-dimensional governing equation for the temperature and the associate boundary conditions, and solve the problem. (15%)

7. A long square bar with side length D, the temperatures at X=0 and Y=0 are maintained at 0, and the temperatures at X=D and Y=D are kept at 1.0. Please find the steady state temperature at positions (X,Y)=(1/3, 1/3), (1/3, 2/3), (2/3, 1/3), and (2/3, 2/3). The steady 2-D heat conduction equation is

$$\partial^2 T/\partial X^2 + \partial^2 T/\partial Y^2 = 0$$

Please use finite difference method and a grid size 1/3 in both X and Y directions. (15%)