四能二流體力學第一次期中考考古題

1. Please explain the following terms:
   (1) Streamline; (2) Pathline; (3) Streakline; (4) Cavitation;
   (5) No-slip condition

2. An idealized velocity distribution is given by $\vec{V} = \frac{x}{1+t}\vec{i} + \frac{y}{1+2t}\vec{j}$, please find the equations of (a) the streamline and (b) the pathline which pass through the point (x_0, y_0) at the time t=0.

3. Let two layers of fluid be dragged alone by the motion of an upper plate as shown in Fig. 1. The bottom is stationary. The top fluid puts a shear stress on the upper plate, and the lower fluid puts a shear stress on the bottom plate. Determine the ratio of these two shear stresses.

4. The viscosity of liquids can be measured through the use of a rotating cylinder viscometer of the type illustrated in Fig. 2. In this device, the outer cylinder is fixed and the inner cylinder is rotated with an angular velocity, ω. The torque T required develop ω is measured and the viscosity μ is calculated from these two measurements. Develop an equation relating μ, ω, T, ℓ, R_0, and R_i. Neglect end effects and assume the velocity distribution in the gap is linear.

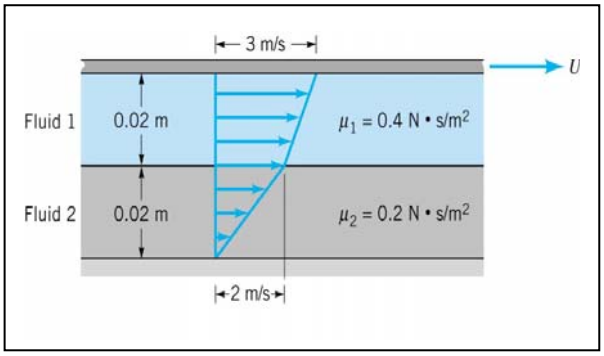

Fig. 1

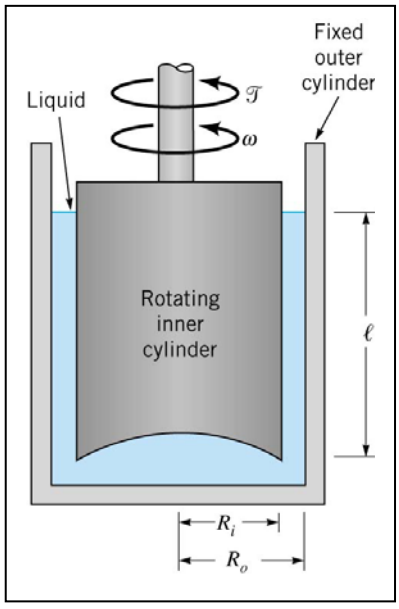

Fig. 2

5. An idealized velocity distribution is given by $\vec{V} = x(1+2t)\vec{i} + y\vec{j}$, please find the equations of (a) the streamline and (b) the pathline which pass through the point (1, 1) at the time t=0.

6. In Fig. 3, pipe A contains gasoline (SG=0.7), pipe B contains oil (SG=0.9), and the manometer fluid is mercury (SG=13.6). Determine the new differential reading if the pressure in pipe A is decreased 25 kPa, and the pressure in pipe B remains constant. The initial differential reading is 0.3 m as shown.

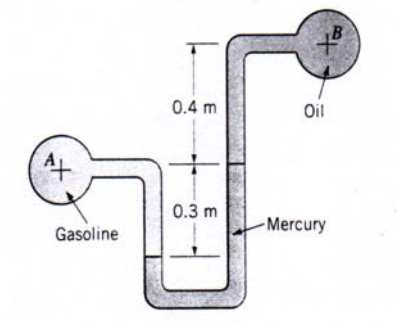

Fig. 3

7. The U-tube of Fig. 4 contains mercury and rotates about the off-center axis *a-a*. At rest, the depth of mercury in each leg is 150 mm as illustrated. Determine the angular velocity for which the difference in heights between the two legs is 75 mm.

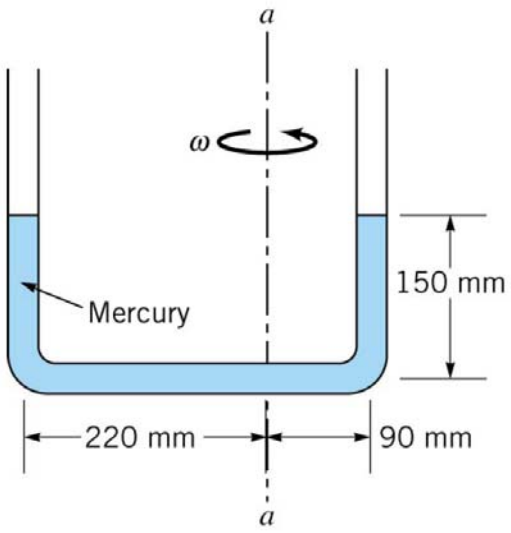

Fig. 4

8. Air at standard conditions (density= 1.2 kg/m^3) flows through the cylindrical drying stack shown in Fig. 5. If viscous effects are negligible and the inclined water-filled manometer reading is 20 mm as indicated, please determine the volume flow rate Q(m^3/s).

   Note: density of water= 1000 kg/m^3.

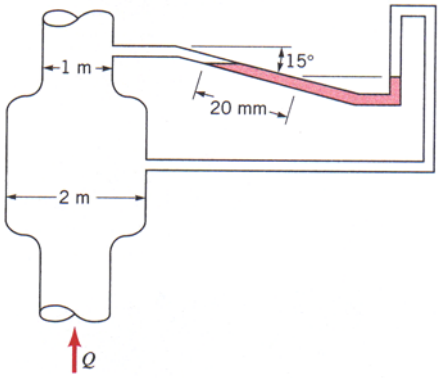

Fig. 5

9. The specific gravity of the manometer fluid shown in Fig. 6 is 1.07. Determine the volume flow rate, Q (m^3/s), if the flow is inviscid and incompressible and the flowing fluid is water.

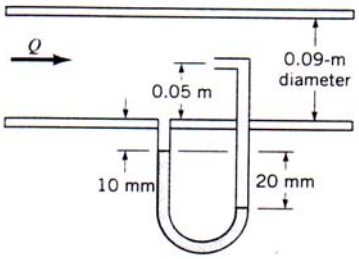

Fig. 6