三流力

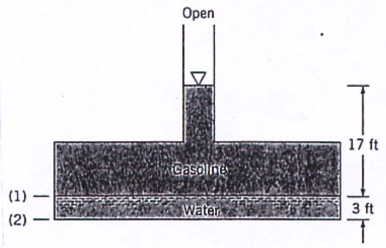
part(I)

1.

20%

Because of a leak in a buried gasoline storage tank, water has seeped in to the depth shown in Fig. E2.1. If the specific gravity of the gasoline is $SG = 0.68$, determine the pressure at the gasoline-water interface and at the bottom of the tank. Express the pressure in units of lb/ft^2, $lb/in.^2$, and as a pressure head in feet of water.

$\gamma_{H_2O} = 62.4\ lb/ft^3$



■ FIGURE E2.1

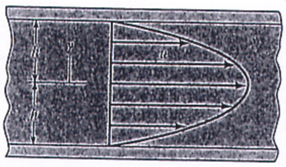
2.

15%

The velocity distribution for the flow of a Newtonian fluid between two wide, parallel plates (see Fig. E1.5) is given by the equation

$$u = \frac{3V}{2}\left[1 - \left(\frac{y}{h}\right)^2\right]$$

where V is the mean velocity. The fluid has a viscosity of $0.04\ lb\cdot s/ft^2$. When $V = 2$ ft/s and $h = 0.2$ in. determine: (a) the shearing stress acting on the bottom wall, and (b) the shearing stress acting on a plane parallel to the walls and passing through the centerline (midplane).

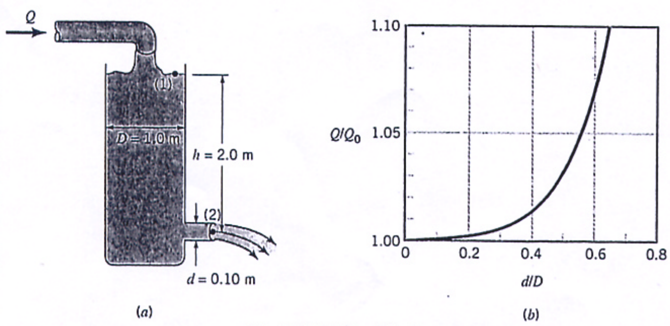


■ FIGURE E1.5

3.

15%

A stream of water of diameter $d = 0.1$ m flows steadily from a tank of diameter $D = 1.0$ m as shown in Fig. E3.7*a*. Determine the flowrate, Q, needed from the inflow pipe if the water depth remains constant, $h = 2.0$ m.



■ FIGURE E3.7

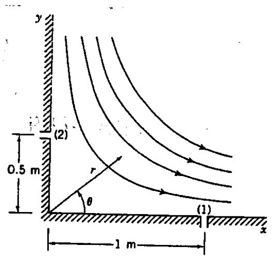
Fluid Mechanics Part II

1. (14%) A gas under standard conditions flows through a 5.0-mm-diameter drawn tubing with an average velocity of V = 50 m/s. For such conditions the flow would normally be turbulent. However, if precautions are taken to eliminate disturbances to the flow (the entrance to the tube is very smooth, the air is dust free, the tube does not vibrate, etc.), it may be possible to maintain laminar flow. (a) Determine the pressure drop in a 0.1-m section of the tube if the flow is laminar. (b) Repeat the calculations if the flow is turbulent. (ρ=1 kg/m^3, $\mu = 2 \times 10^{-5}$ N·s/m^2, $\varepsilon = 0.0015$)

2. (20%) The two-dimensional flow of a nonviscous, impressible fluid in the vicinity of the 90 corner of the following figure is described by the stream function

$$\psi = 2r^2 \sin 2\theta$$

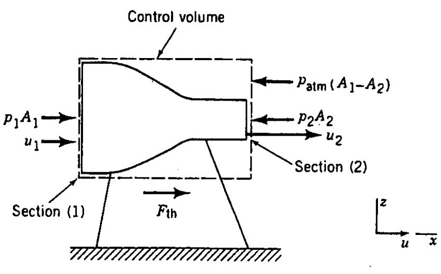
where has unit of m^2/s when r is in meters. (a) Determine, if possible, the corresponding velocity potential. (b) If the pressure at point (1) on the wall is 30 kPa, what is the pressure at point (2)? Assume the fluid density is 10^3 kg/m^3 and the x-y plane is horizontal – that is, there is no difference in elevation between points (1) and (2).



3. (16%) A static thrust stand as sketched in the following figure is to be designed for testing a jet engine. The following conditions are known for a typical test:

Intake air velocity = 300 m/s
Exhaust gas velocity = 600 m/s
Intake cross-sectional area = 1 m^2
Intake static pressure = 90 kPa (abs)
Intake static temperature = 270 K
Exhaust static pressure = 100 kPa (abs)

Estimate the nominal thrust for which to design. (Assume the gas constant, R = 300 J/kg·K)



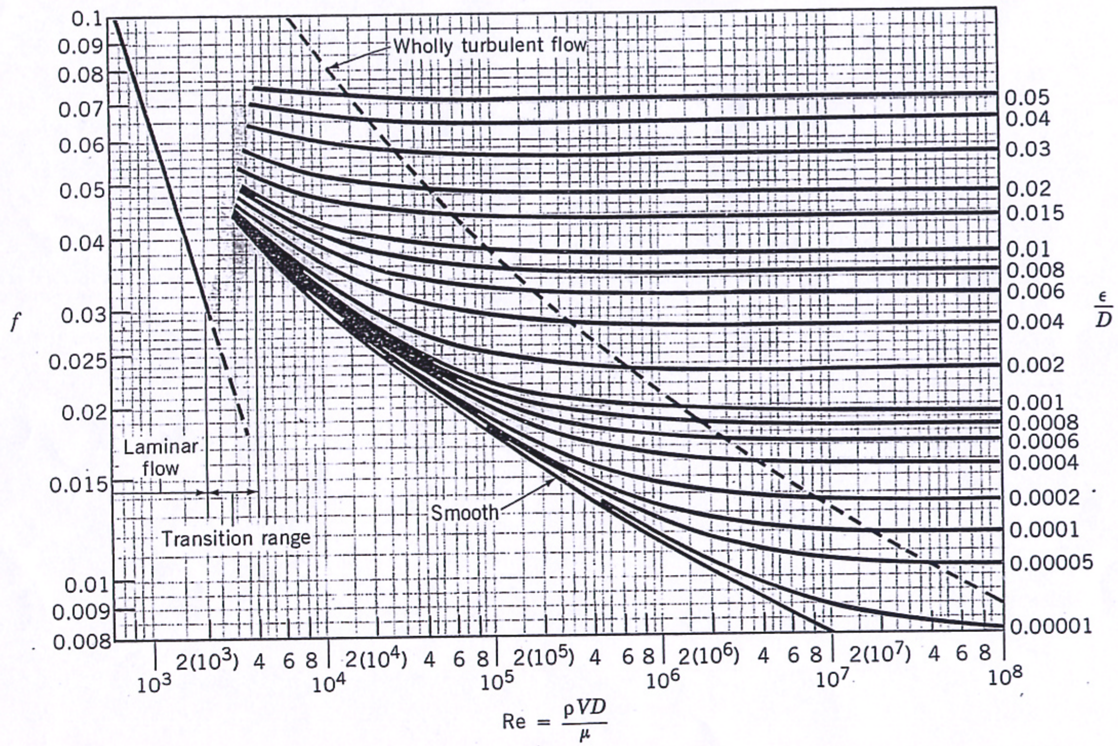


FIGURE 8.23 Friction factor as a function of Reynolds number and relative roughness for round pipes—the Moody chart (Data from Ref. 7 with permission).

(For part II, prob. 1)