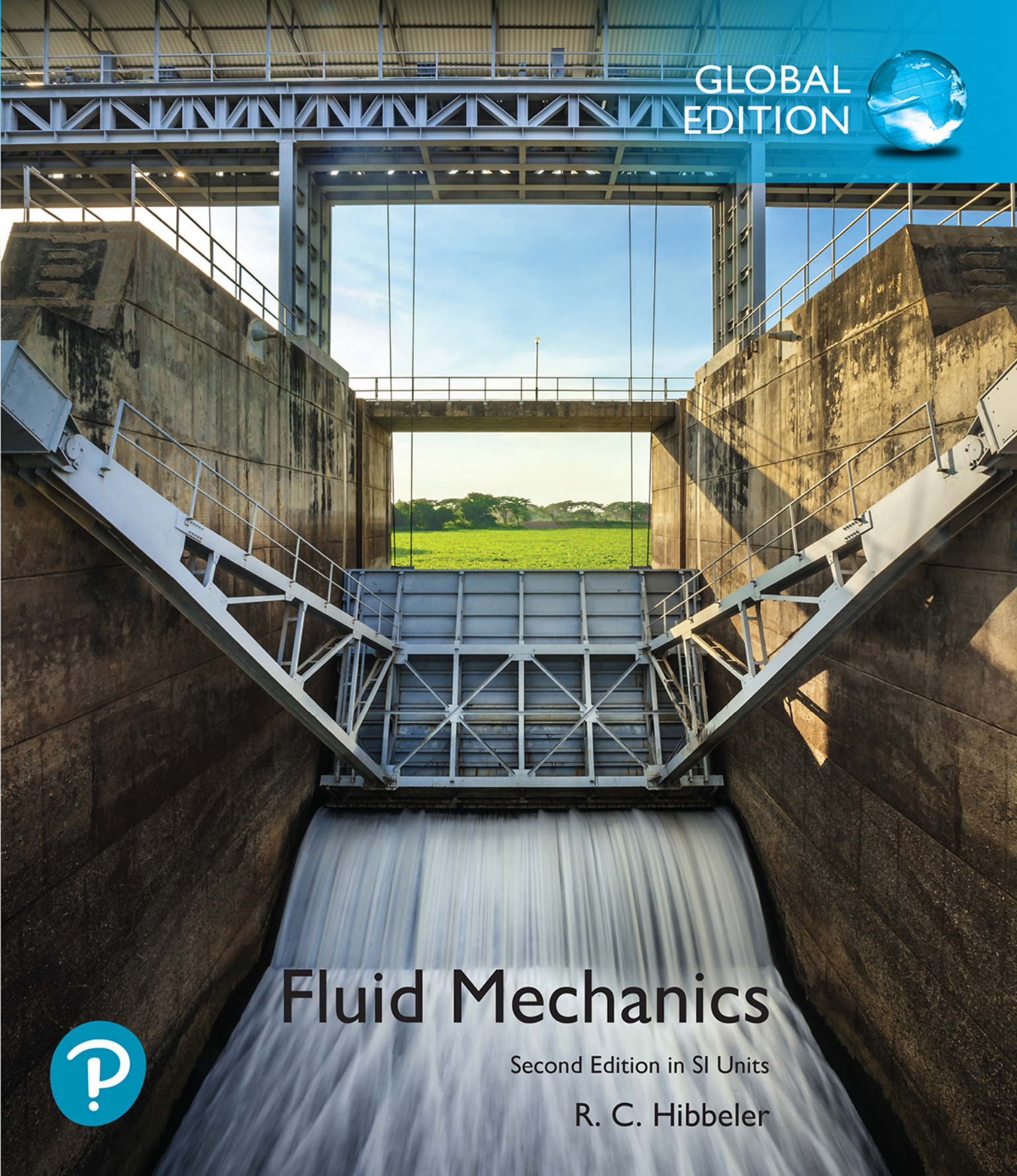

Fluid Mechanics

Second Edition in SI Units

R. C. Hibbeler

Fluid Mechanics

Second Edition in SI Units

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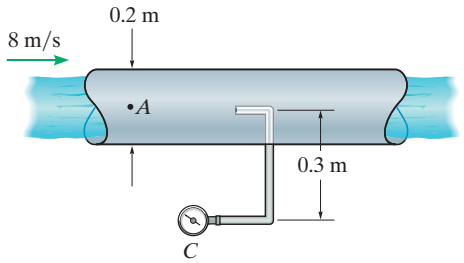
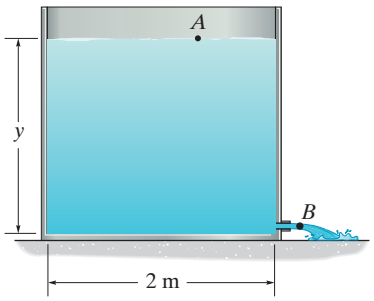
F5–4. Water flows through the pipe at 8 m/s. Determine the pressure at C if the pressure at A is 80 kPa.



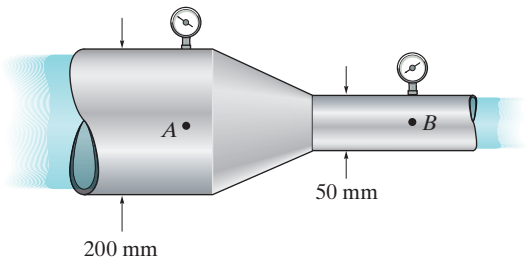
Prob. F5–4

F5–5. The tank has a square base and is filled with water to the depth of $y = 0.4$ m. If the 20-mm-diameter drain pipe is opened, determine the initial volumetric flow of the water and the volumetric flow when $y = 0.2$ m.



Prob. F5–5

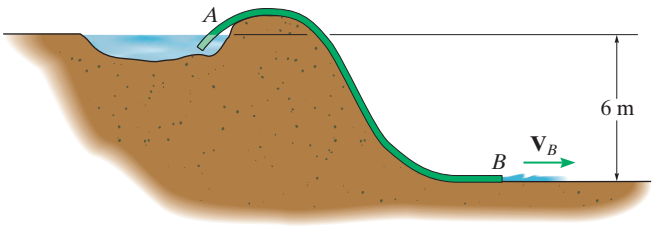
F5–6. Air at a temperature of 80°C flows through the pipe. At A, the pressure is 20 kPa, and the velocity is 4 m/s. Determine the pressure at B. Assume the air is incompressible.



Prob. F5–6

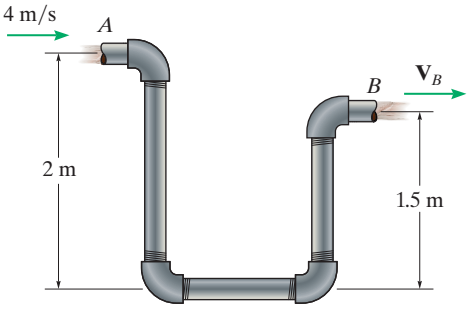
SEC. 5.4

F5–7. Water flows from the reservoir through the 100-mm-diameter pipe. Determine the discharge at B. Draw the energy grade line and the hydraulic grade line for the flow from A to B.



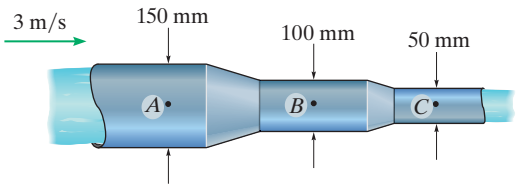
Prob. F5–7

F5–8. Crude oil flows through the 50-mm-diameter pipe such that at A its velocity is 4 m/s and the pressure is 300 kPa. Determine the pressure of the oil at B. Draw the energy grade line and the hydraulic grade line for the flow from A to B.



Prob. F5–8

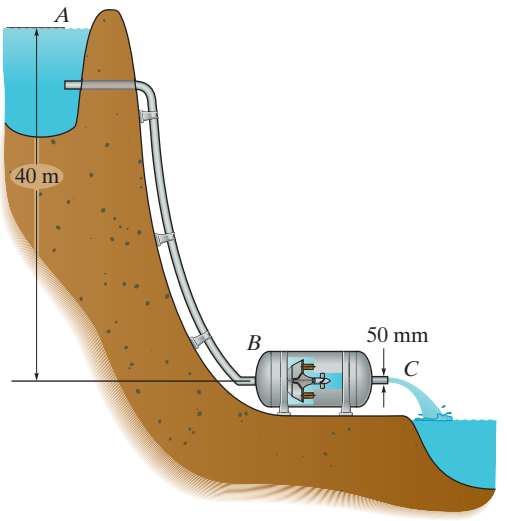
F5–9. Water at A has a pressure of 400 kPa and a velocity of 3 m/s. Determine the pressure and velocity at B and C. Draw the energy grade line and the hydraulic grade line for the flow from A to C.



Prob. F5–9

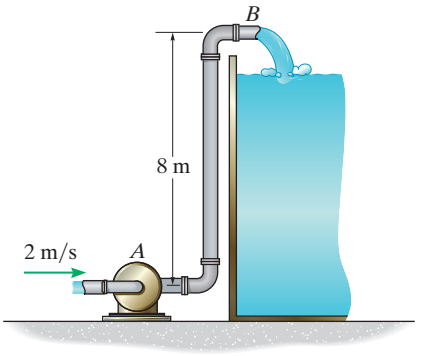
SEC. 5.5

F5–10. Water from the reservoir flows through the 150-m-long, 50-mm-diameter pipe into the turbine at B. If the head loss in the pipe is 1.5 m for every 100-m length of pipe, and the water exits the pipe at C with a velocity of 8 m/s, determine the power output of the turbine. The turbine operates with 60% efficiency.



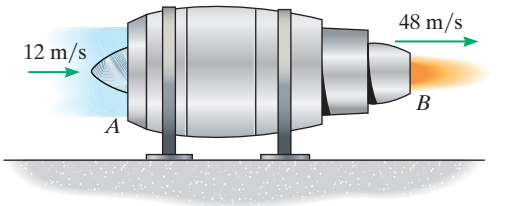
Prob. F5–10

F5–11. Water is supplied to the pump at a pressure of 80 kPa and a velocity of $V_A = 2$ m/s. If the discharge is required to be 0.02 m^3/s through the 50-mm-diameter pipe, determine the power that the pump must supply to the water to lift it 8 m. The total head loss is 0.75 m.



Prob. F5–11

F5–12. The jet engine takes in air and fuel having an enthalpy of 600 kJ/kg at 12 m/s. At the exhaust, the enthalpy is 450 kJ/kg and the velocity is 48 m/s. If the mass flow is 2 kg/s, and the rate of heat loss is 1.5 kJ/s, determine the power output of the engine.



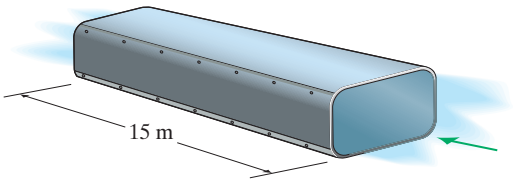
Prob. F5–12

PROBLEMS

SEC. 5.1

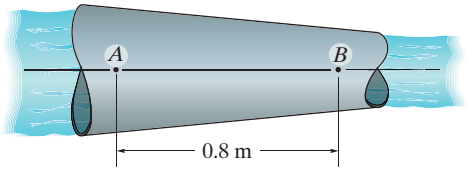
5–1. Air at 20°C flows through the horizontal tapered duct. Determine the acceleration of the air if on a streamline the pressure is 101.3 kPa and 15 m away the pressure is 100.6 kPa.

5–2. Air at 20° C flows through the horizontal tapered duct. Determine the average change in pressure in 15 m, so that the air has an acceleration of 50 m/s^2.



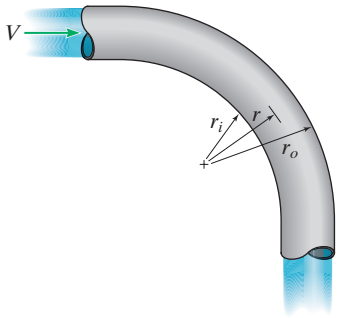
Probs. 5–1/2

5–3. Determine the required average change in pressure if the water flows from A to B with an acceleration of 15 m/s^2 along a horizontal streamline. Take $\rho_w = 1000\ kg/m^3$.



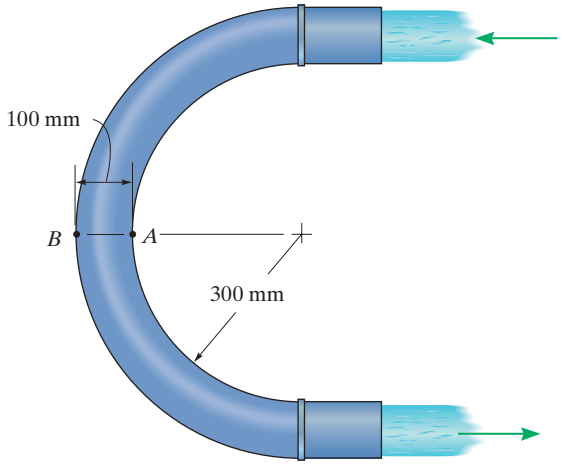
Prob. 5–3

*__5–4.__ An ideal fluid having a density ρ flows with a velocity V through the *horizontal* pipe bend. Plot the pressure variation within the fluid as a function of the radius r, where $r_i \le r \le r_o$ and $r_o = 2r_i$. For the calculation, assume the velocity is constant over the cross section.



Prob. 5–4

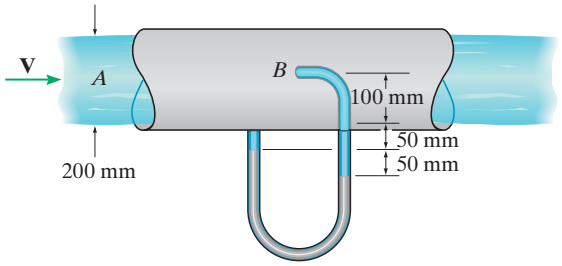
5–5. If the volumetric flow of water through the pipe is 0.05 m^3/s, determine the pressure difference between points A and B. The flow occurs on the horizontal plane. Assume the velocity is constant over the cross section.



Prob. 5–5

SEC. 5.2–5.3

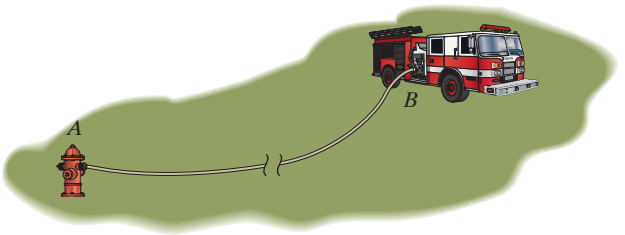
5–6. Determine the velocity of water through the pipe if the manometer contains mercury held in the position shown. Take $\rho_{Hg} = 13\,550\ kg/m^3$.



Prob. 5–6

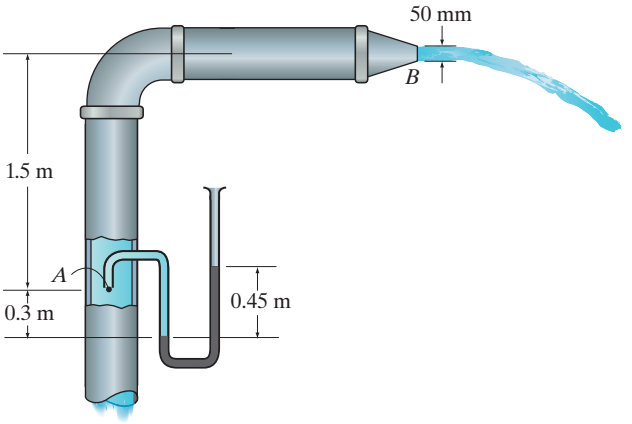
5

5–7. A fire hydrant supplies water under a pressure of 250 kPa. If a 100-mm-diameter hose is connected to it at A and the hose extends 40 m to the fire truck inlet at B, determine the pressure of the water as it arrives at B. The friction loss is 1.2 m for every 10 m of hose. The inlet at B is 0.5 m higher than the hydrant outlet.



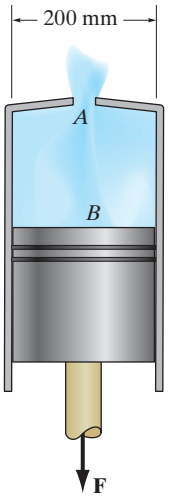
Prob. 5–7

***5–8.** The level of mercury in the manometer has the reading shown. Determine the velocity of the water flowing from the nozzle at B. Neglect any head losses. Take $\rho_{Hg} = 13\,550\ \text{kg/m}^3$.



Prob. 5–8

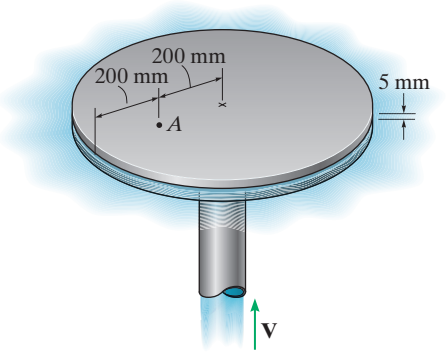
5–9. Air is drawn into the 200-mm-diameter cylinder through the opening at A. If the piston is moving downward at a constant velocity of 10 m/s, determine the average pressure within the cylinder and the force required to move the piston. Take $\rho_a = 1.23\ \text{kg/m}^3$.



Prob. 5–9

5–10. A fountain is produced by water that flows up the tube at $0.08\ \text{m}^3/\text{s}$, and then radially through two cylindrical plates before exiting to the atmosphere. Determine the velocity and pressure of the water at point A.

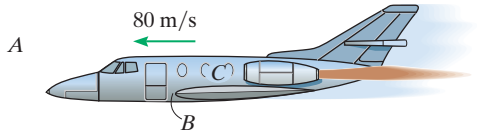
5–11. A fountain is produced by water that flows up the tube at $0.08\ \text{m}^3/\text{s}$, and then radially through two cylindrical plates before exiting to the atmosphere. Determine the pressure of the water as a function of the radial distance r. Plot the pressure (vertical axis) versus r for $200\ \text{mm} \le r \le 400\ \text{mm}$. Give values for increments of $\Delta r = 50\ \text{mm}$.



Probs. 5–10/11

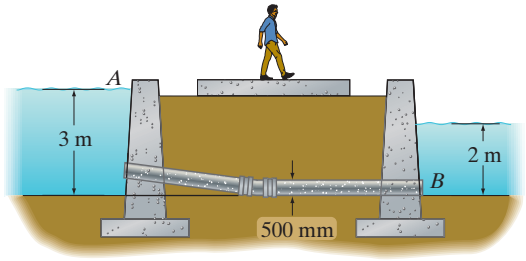
***5–12.** The jet airplane is flying at 80 m/s in still air, *A*, at an altitude of 3 km. Determine the absolute stagnation pressure at the leading edge *B* of the wing.

5–13. The jet airplane is flying in still air, *A*, at an altitude of 4 km. If the air flows past point *C* near the wing at 90 m/s, measured relative to the plane, determine the difference in pressure between the air near the leading edge *B* of the wing and point *C*.



Probs. 5–12/13

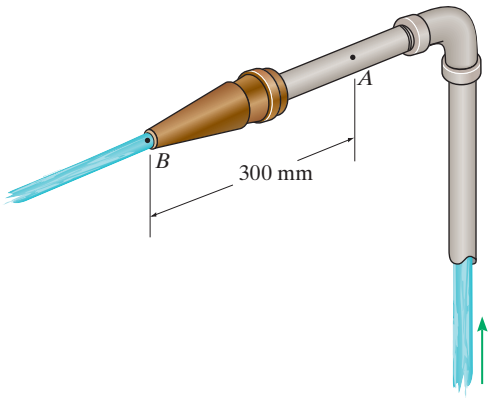
5–14. Drainage under a canal is provided using a 500-mm-diameter drainpipe. Determine the flow through the pipe. Neglect any head losses.



Prob. 5–14

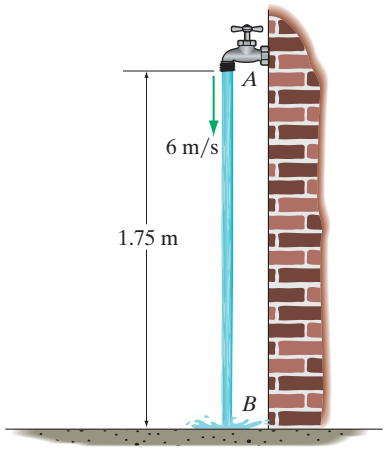
5–15. Water flows through the 30-mm-diameter pipe at 0.002 m^3/s and is ejected from the 10-mm-diameter nozzle at *B*. Determine the velocity and pressure of the water at point *A*.

***5–16.** Water flows through the 30-mm-diameter pipe and is ejected with a velocity of 25 m/s at *B* from the 10-mm-diameter nozzle. Determine the pressure and the velocity of the water at *A*.



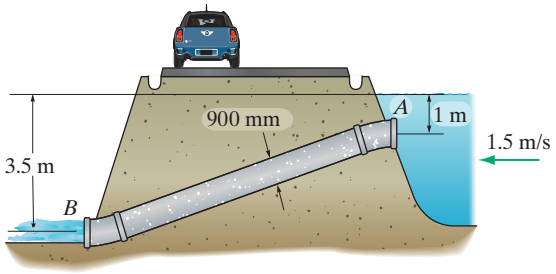
Probs. 5–15/16

5–17. Water flows out of a faucet at *A* at 6 m/s. Determine the velocity of the water just before it strikes the ground at *B*.



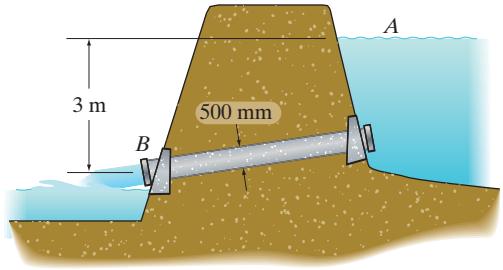
Prob. 5–17

5–18. The water in an open channel drainage canal flows with a velocity of $V_A = 1.5$ m/s into the drainpipe that crosses a highway embankment. Determine the volumetric discharge through the pipe. Neglect any head losses.



Prob. 5–18

5–19. Heavy rain has caused reservoir *A* to reach a height of 3 m above the pipe at *B*. Determine the flow through the concrete culvert buried beneath the embankment. Neglect any head losses.

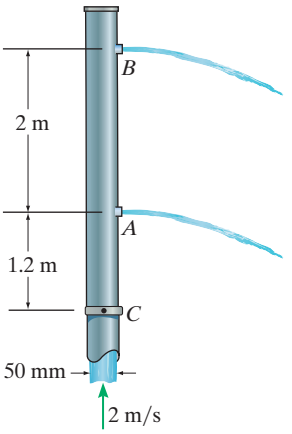


Prob. 5–19

5

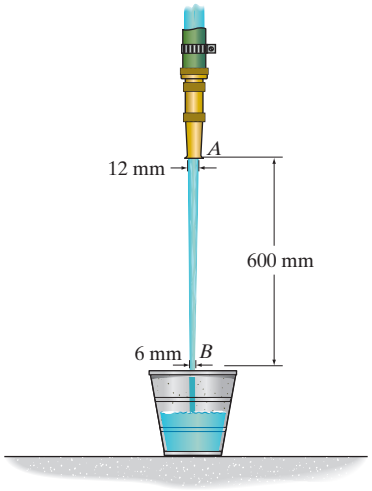
*5–20. A fountain ejects water through the two nozzles A and B, which have inner diameters of 10 mm. If the velocity of the flow at point C in the 50-mm-diameter pipe is 2 m/s, determine the pressure in the pipe at this point and the velocity of the water through each nozzle.

5–21. A fountain ejects water through the two nozzles A and B, which have inner diameters of 10 mm. Determine the velocity of the water stream passing through each of the nozzles and the pressure at point C if the flow through the 50-mm-diameter pipe is 0.005 m^3/s.



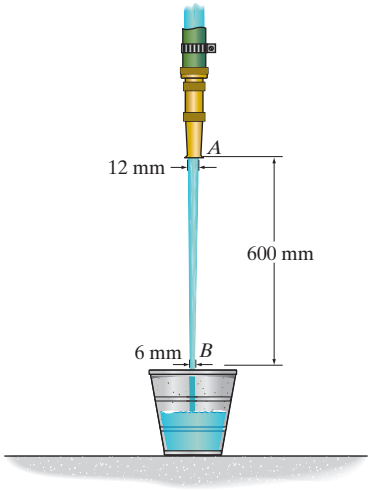
Probs. 5–20/21

5–22. Water from a nozzle tapers from a diameter of 12 mm to 6 mm after falling 600 mm. Determine the velocity of the water at A and at B.



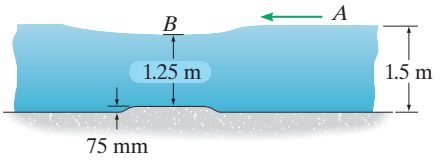
Prob. 5–22

5–23. Water from a nozzle tapers from a diameter of 12 mm to 6 mm after falling 600 mm. Determine the mass flow in kg/s.



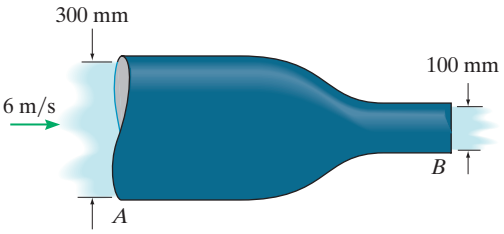
Prob. 5–23

*5–24. In order to determine the flow in a rectangular channel, a 75-mm-high bump is added on its bottom surface. If the measured depth of flow at the bump is 1.25 m, determine the volumetric discharge. The flow is uniform, and the channel has a width of 1.5 m.



Prob. 5–24

5–25. Air at a temperature of 40°C flows into the nozzle at 6 m/s and then exits to the atmosphere at B, where the temperature is 0°C. Determine the pressure at A.



Prob. 5–25