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| 216 | **5–6E** A garden hose attached with a nozzle is used to fill a 20-gal bucket. The inner diameter of the hose is 1 in and it reduces to 0.5 in at the nozzle exit. If the average velocity in the hose is 8 ft/s, determine (*a*) the volume and mass flow rates of water through the hose, (*b*) how long it will take to fill the bucket with water, and (*c*) the average velocity of water at the nozzle exit. | 5-6 A garden hose attached with a nozzle is used to fill a 75L bucket. The inner diameter of the hose is 2.5cm and it reduces to 1.25cm at the nozzle exit. If the average velocity in the hose is 2.5m/s, determine (a) the volume and mass flow rates of water through the hose, (b) how long it will take to fill the bucket with water, and (c) the average velocity of water at the nozzle exit. |
| 217 | **5–9E** Air whose density is 0.078 lbm/ft$^3$ enters the duct of an air-conditioning system at a volume flow rate of 450 ft$^3$/min. If the diameter of the duct is 10 in, determine the velocity of the air at the duct inlet and the mass flow rate of air. | 5-9 Air whose density is 1.25 kg/m$^3$ enters the duct of an air-conditioning system at a volume flow rate of 12.75m$^3$/min. If the diameter of the duct is 25cm, determine the velocity of the air at the duct inlet and the mass flow rate of air. |
| 218 | **5–23E** A differential thermocouple with sensors at the inlet and exit of a pump indicates that the temperature of water rises 0.072°F as it flows through the pump at a rate of 1.5 ft$^3$/s. If the shaft power input to the pump is 27 hp, determine the mechanical efficiency of the pump. *Answer:* 64.7 percent | 5-23 A differential thermocouple with sensors at the inlet and exit of a pump indicates that the temperature of water rises 0.072°C as it flows through the pump at the rate of 43L/s. If the shaft power input to the pump is 27hp, determine the mechanical efficiency of the pump. |
| 219 | **5–42E** The drinking water needs of an office are met by large water bottles. One end of a 0.25-in-diameter plastic hose is inserted into the bottle placed on a high stand, while the other end with an on/off valve is maintained 2 ft below the bottom of the bottle. If the water level in the bottle is 1.5 ft when it is full, determine how long it will take at the minimum to fill an 8-oz glass (= 0.00835 ft$^3$) (*a*) when the bottle is first opened and (*b*) when the bottle is almost empty. | 5-42 The drinking water needs of an office are met by large water bottles. One end of a 6mm diameter plastic hose is inserted into the bottle placed on a high stand, while the other end with an on/off valve is maintained 0.6m below the bottom of the bottle. If the water level in the bottle is 0.5m when it is full, determine how long it will take at the minimum to fill a 250ml glass. (a) when the bottle is first opened and (b) when the bottle is almost empty. |

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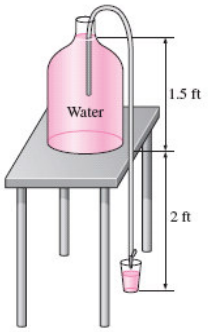
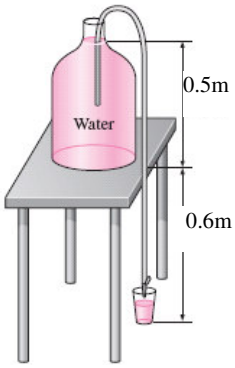
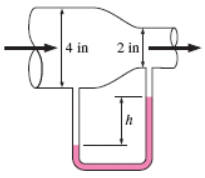
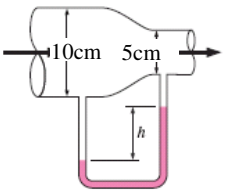
| 219 |  <br>FIGURE P5–42E |  <br>FIGURE P5-42 |
| 220 | **5–47E** A siphon pumps water from a large reservoir to a lower tank that is initially empty. The tank also has a rounded orifice 15 ft below the reservoir surface where the water leaves the tank. Both the siphon and the orifice diameters are 2 in. Ignoring frictional losses, determine to what height the water will rise in the tank at equilibrium. | 5-47 A siphon pumps water from a large reservoir to a lower tank that is initially empty. The tank also has a rounded orifice 5m below the reservoir surface where the water leaves the tank. Both the siphon and the orifice diameters are 5cm. Ignoring frictional losses, determine to what height the water will rise in the tank at equilibrium. |
| 220 | **5–49E** Water flows through a horizontal pipe at a rate of 1 gal/s. The pipe consists of two sections of diameters 4 in and 2 in with a smooth reducing section. The pressure difference between the two pipe sections is measured by a mercury manometer. Neglecting frictional effects, determine the differential height of mercury between the two pipe sections. *Answer:* 0.52 in | 5-49 Water flows through a horizontal pipe at a rate of 3.75L/s. The pipe consists of two sections of diameters 10cm and 5cm with a smooth reducing section. The pressure difference between the two pipe sections is measured by a mercury manometer. Neglecting frictional effects, determine the differential height of mercury between the two pipe sections. |
| 220 |  <br>FIGURE P5–49E |  <br>FIGURE P5-49 |
| 221 | **5–56E** Air is flowing through a venturi meter whose diameter is 2.6 in at the entrance part (location 1) and 1.8 in at the throat (location 2). The gage pressure is measured to be 12.2 psia at the entrance and 11.8 psia at the throat. Neglecting frictional effects, show that the volume flow rate can be expressed as<br>$\dot{V} = A_2\sqrt{\frac{2(P_1 - P_2)}{\rho(1 - A_2^2/A_1^2)}}$<br>and determine the flow rate of air. Take the air density to be 0.075 lbm/ft$^3$. | 5-56 Air is flowing through a venturi meter whose diameter is 6.5cm at the entrance part (location 1) and 4.5cm at the throat (location 2). The gage pressure is measured to be 84kPa at the entrance and 81.35kPa at the throat. Neglecting frictional effects, show that the volume flow rate can be expressed as |

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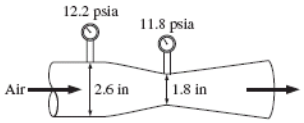
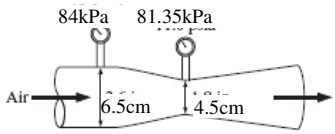
| | | $\dot{V} = A_2\sqrt{\frac{2(P_1 - P_2)}{\rho(1 - A_2^2/A_1^2)}}$ and determine the flow rate of air. Take the air density to be 1.2kg/m$^3$. |
| 221 |  FIGURE P5–56E |  FIGURE P5-56 |
| 221 | **5–61E** The air velocity in a duct is measured by a Pitot-static probe connected to a differential pressure gage. If the air is at 13.4 psia absolute and 70°F and the reading of the differential pressure gage is 0.15 psi, determine the air velocity. *Answer:* 143 ft/s | 5-61 The air velocity in a duct is measured by a pitot-static probe connected to a differential pressure gauge. If the air is at 92.39kPa absolute and 21.1°C and the reading of the differential pressure gage is 1.034kPa, determine the air velocity. |
| 222 | **5–71E** In a hydroelectric power plant, water flows from an elevation of 240 ft to a turbine, where electric power is generated. For an overall turbine–generator efficiency of 83 percent, determine the minimum flow rate required to generate 100 kW of electricity. *Answer:* 370 lbm/s | 5-71 In a hydroelectirc power plant, water flows from an elevation of 80m to a turbine, where electric power is generated. For an overall turbine-generator efficiency of 83 percent, determine the minimum flow rate required to generate 100kW of electricity. |
| 222 | **5–72E** Reconsider Prob. 5–71E. Determine the flow rate of water if the irreversible head loss of the piping system between the free surfaces of the source and the sink is 36 ft. | 5-72 Reconsider Prob. 5-71. Determine the flow rate of water if the irreversible head loss of the piping system between the free surfaces of the source and the sink is 11m. |
| 223 | **5–82E** The water level in a tank is 66 ft above the ground. A hose is connected to the bottom of the tank at the ground level and the nozzle at the end of the hose is pointed straight up. The tank cover is airtight, but the pressure over the water surface is unknown. Determine the minimum tank air pressure (gage) that will cause a water stream from the nozzle to rise 90 ft from the ground. | 5-82 The water level in a tank is 20m above the ground. A hose is connected to the bottom of the tank at the ground level and the nozzle at the end of the hose is ponted stright up. The tank cover is airtignt, but the pressure over the water surface is unknown. Determine the minimum tank air pressure (gage) that will cause a water stream from the nozzle to rise 27.5m from the ground. |
| 224 | **5–87E** A 73-percent efficient 12-hp pump is pumping water from a lake to a nearby pool at a rate of 1.2 ft$^3$/s through a constant-diameter pipe. The free surface of the pool is 35 ft above that of the lake. Determine the irreversible head loss of the piping system, in ft, and the mechanical power used to overcome it. | 5-87 A 73 percent efficient 12hp pump is pumping water from a lake to a nearby pool at a rate of 34L/s through a constant-diameter pipe. The free surface of the pool is 10.66m above that of the lake. Determine the irreversible head loss of the piping system, in m, and the mechanical power used to |

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| | | overcome it. |
| 225 | **5–99E** The water level in a tank is 80 ft above the ground. A hose is connected to the bottom of the tank, and the nozzle at the end of the hose is pointed straight up. The tank is at sea level, and the water surface is open to the atmosphere. In the line leading from the tank to the nozzle is a pump, which increases the water pressure by 10 psia. Determine the maximum height to which the water stream could rise. | 5-99 The water level in a tank is 24m above the ground. A hose is connected to the bottom of the tank, and the nozzle at the end of the hose is pointed straight up. The tank is at sea level, and the water surface is open to the atmosphere. In the line leading from the tank to the nozzle is a pump, which increases the water pressure by 69kPa. Determine the maximum height to which the water stream could rise. |