

Problem Set 3

Due 2/12/09 before 2 PM

2-35 As a spherical ammonia vapor bubble rises in liquid ammonia, its diameter changes from 1 cm to 3 cm. Calculate the amount of work produced by this bubble, in kJ, if the surface-tension of ammonia is 0.02 N/m. *Answer: 5.03×10^{-8} kJ*

2-41 A damaged 1200-kg car is being towed by a truck. Neglecting the friction, air drag, and rolling resistance, determine the extra power required (a) for constant velocity on a level road, (b) for constant velocity of 50 km/h on a 30° (from horizontal) uphill road, and (c) to accelerate on a level road from stop to 90 km/h in 12 s. *Answers: (a) 0, (b) 81.7 kW, (c) 31.3 kW*

2-50 A classroom that normally contains 40 people is to be air-conditioned with window air-conditioning units of 5-kW cooling capacity. A person at rest may be assumed to dissipate heat at a rate of about 360 kJ/h. There are 10 lightbulbs in the room, each with a rating of 100 W. The rate of heat transfer to the classroom through the walls and the windows is estimated to be 15,000 kJ/h. If the room air is to be maintained at a constant temperature of 21°C, determine the number of window air-conditioning units required.

Answer: 2 units

2-54 A fan is to accelerate quiescent air to a velocity of 10 m/s at a rate of 4 m³/s. Determine the minimum power that must be supplied to the fan. Take the density of air to be 1.18 kg/m³. *Answer: 236 W*

2-69 Consider a classroom for 55 students and one instructor, each generating heat at a rate of 100 W. Lighting is provided by 18 fluorescent lightbulbs, 40 W each, and the ballasts consume an additional 10 percent. Determine the rate of internal heat generation in this classroom when it is fully occupied.

2-75 Water is pumped from a lake to a storage tank 20 m above at a rate of 70 L/s while consuming 20.4 kW of electric power. Disregarding any frictional losses in the pipes and any changes in kinetic energy, determine (a) the overall efficiency of the pump–motor unit and (b) the pressure difference between the inlet and the exit of the pump.

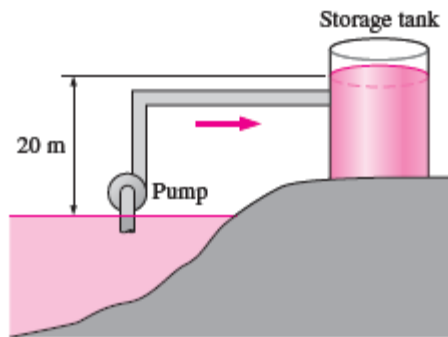


FIGURE P2-75