

Thermodynamics

Assignment on Chapter One

Instructions:-

- I. Read in detail for each of the following five question
- II. Use new page for solving the bolded question
- III. Use all steps of “*problem solving technique*” as it require
- IV. Neatness is valuable

1. Try to answer the following theoretical questions in your own language.

- 1.1. A large fraction of the thermal energy generated in the engine of a car is rejected to the air by the radiator through the circulating water. Should the radiator be analyzed as a closed system or as an open system? Explain.
- 1.2. What is the difference between intensive and extensive properties?
- 1.3. What is a quasi-equilibrium process? What is its importance in engineering?
- 1.4. Define the isothermal, isobaric, and isochoric processes.
- 1.5. What is a steady-flow process?

2. A gas is contained in a vertical, frictionless piston–cylinder device. The piston has a mass of 4 kg and across-sectional area of 35 cm² as shown in figure 2. A compressed spring above the piston exerts a force of 60 N on the piston. If the atmospheric pressure is 95 kPa, determine the pressure inside the cylinder.

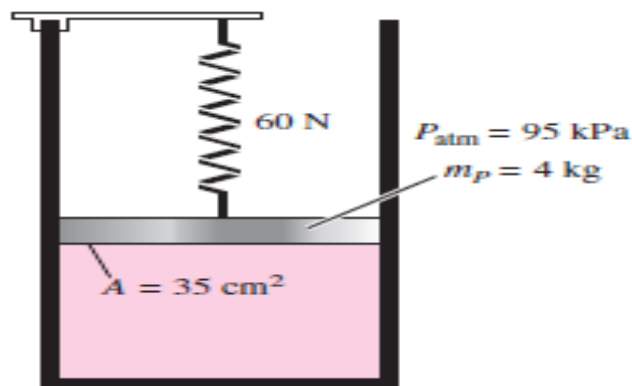


Figure 2

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3. A mercury manometer ($\rho = 13,600 \text{ kg/m}^3$) is connected to an air duct to measure the pressure inside. The difference in the manometer levels is 15 mm, and the atmospheric pressure is 100 kPa. (a) Judging from Fig. 3, determine if the pressure in the duct is above or below the atmospheric pressure. (b) Determine the absolute pressure in the duct.

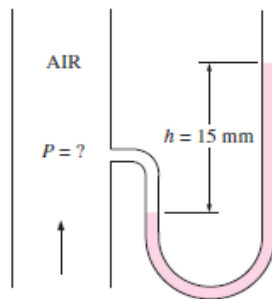


Figure 3

4. Freshwater and seawater flowing in parallel horizontal pipelines are connected to each other by a double U-tube manometer, as shown in Fig. 4. Determine the pressure difference between the two pipelines. Take the density of seawater at that location to be $\rho = 1035 \text{ kg/m}^3$. Can the air column be ignored in the analysis?

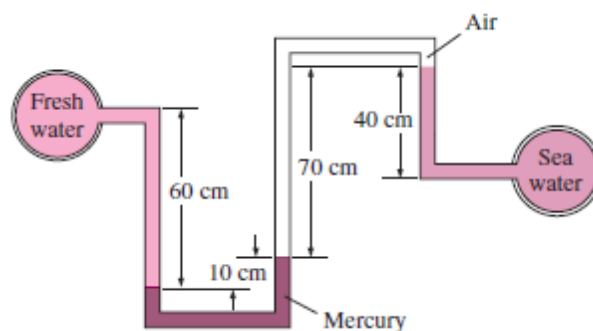


Figure 4

5. When measuring small pressure differences with a manometer, often one arm of the manometer is inclined to improve the accuracy of reading. (The pressure difference is

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still proportional to the vertical distance and not the actual length of the fluid along the tube.) The air pressure in a circular duct is to be measured using a manometer whose open arm is inclined 35° from the horizontal, as shown in Fig. 5. The density of the liquid in the manometer is 0.81 kg/L , and the vertical distance between the fluid levels in the two arms of the manometer is 8 cm . Determine the gage pressure of air in the duct and the length of the fluid column in the inclined arm above the fluid level in the vertical arm.

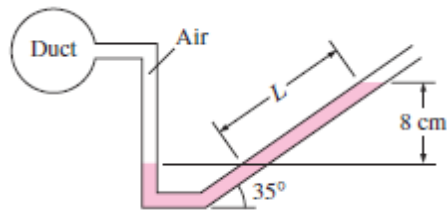


Figure 5