CHE260: Tutorial Problems
Tutorial 2 Solutions

QiLin Xue

Fall 2021

1. We have

$$W = -\int_{V_1}^{V_2} A/V + B\,\mathrm{d}V \tag{1}$$
$$= [A\ln(V_1) + BV_1] - [A\ln(V_2) + BV_2] \tag{2}$$
$$= A\ln(V_1/V_2) + B(V_1 - V_2) = -12.59 \text{ kJ} \tag{3}$$

2. We first find the final pressure:

$$P_2 = P_1\left(\frac{V_1}{V_2}\right)^{1.35} = 2.00 \text{ bar.} \tag{4}$$

$$W = \frac{P_2V_2 - P_1V_1}{n-1} = -1284 \text{ kJ.} \tag{5}$$

3. The initial volume is given by V_1 such that

$$P_1V_1 = mRT \implies V_1 = \frac{mRT}{P_1} = 0.1259 \text{ m}^3. \tag{6}$$

so $PV^{1.2} = 49.91.$ and the final gas pressure is given by

$$P_2V_2 = mRT \implies P_2\left(\frac{85.87}{P_2}\right)^{0.833} = mRT \tag{7}$$

or

$$25.67P_2^{0.167} = mRT \implies P_2 = 1.10 \text{ bar} \tag{8}$$

where the error comes from lazy rounding. Using 1.03 from now on, we have

$$V_2 = \left(\frac{49.91}{P_2}\right)^{1/1.2} = 0.547 \text{ m}^3 \tag{9}$$

$$W = \frac{P_2V_2 - P_1V_1}{n-1} = \frac{4}{3} = -96.0 \text{ kJ.} \tag{10}$$

From the first law,

$$\Delta U = Q + W \tag{11}$$

and $\Delta U = mc\Delta T = -66.59$ kJ and plugging this in for Q gives $Q = 29.7$ kJ.

4. We have $P_1V_1 = P_2V_2$. Solving for V_2 gives $V_2 = 4$ m^3. We can determine the mass of air using the ideal gas law:

$$m = \frac{PV}{RT} = 4.64 \text{ kg.} \tag{12}$$

We have

$$W = P_2V_2\ln(V_1/V_2) = -277 \text{ kJ} \tag{13}$$

and finally $\Delta U = 0$ since it's an isothermal process so $Q = -W$.