# ME 200 Homework 7

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Due: Oct 18 Edit: October 18, 2024

1. a)

$$\eta = \frac{750 - 300}{750} = 0.6 = 60\%$$

b)

$$Q_{12} - W_{12} = m(u_2 - u_1) = 0 (\text{As Ideal gas})$$
$$Q_{12} = W_{12} = 60 \text{ kJ}$$
$$W_{12} = \int_{V_1}^{V_2} p \mathrm{d}V = \int_{V_1}^{V_2} \frac{mRT_H}{V} \, dV = mRT_H \ln\left(\frac{V_2}{V_1}\right) = 60\,\text{kJ}$$
$$\ln\left(\frac{V_2}{V_1}\right) = \frac{60}{2 \times \frac{8.314}{28.97} \times 750} = 0.1394 \text{ m}^3$$
$$V_1 = 0.348$$
$$pv = nRT$$
$$p_1 = 1237 \text{ kPa}$$

c)

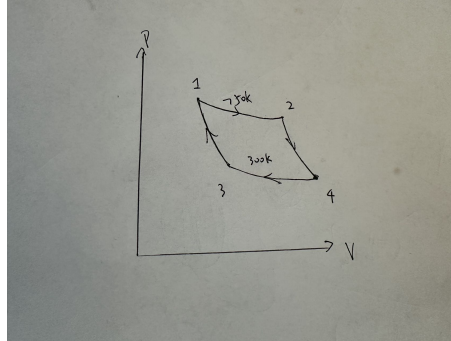$$Q_{12} = W_{12} = 60 \text{ kJ}$$
$$Q_{23} = 0$$
$$W_{23} = 2 \times (551.99 - 214.07) = 676 \text{ kJ}$$
$$Q_{34} = W_{34} = 60 \times \frac{300}{750} = 24\text{kJ}$$
$$Q_{41} = 0$$
$$W_{41} = -W_23 = -\,676\text{kJ}$$

d)

2.

$$h_2 = h_f = 1341.96$$
$$s_2 = s_f = 3.2139$$
$$h_3 = h_g = 2769.32$$
$$s_1 = s_2, \ s_3 = s_4$$
$$h_4 = h_f + xh_g = 105.005 + 0.652 \times 2442.845$$
$$= 1697.74$$
$$s_2 = s_1 = s_f + xf_g$$
$$3.2139 = 0.3671 + x \times 8.1926$$
$$x = 0.3475$$
$$h_1 = h_f + xh_g$$
$$= 953.8553$$

Apply those numbers that were just calculated, we get:

$$Q_{12} = 0$$
$$W_{12} = h_2 - h_1 = 388.105$$
$$Q_{23} = h_3 - h_2 = 1427.41$$
$$W_{23} = 0$$
$$Q_{34} = 0$$
$$W_{34} = h_4 - h_3 = -1071.6$$
$$Q_{41} = h_4 - h_1 = 743.8847$$
$$W_{41} = 0$$