Q1)

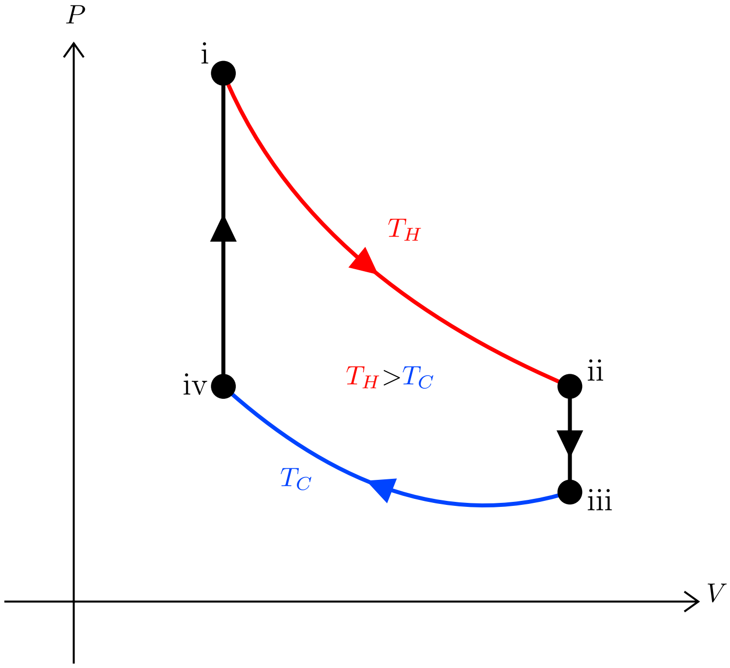

Figure 1: Stirling engine cycle's PV diagram

Q2)

$$e \approx 1 - \frac{H_4 - H_1}{H_3 - H_1}$$
$$T_1 = 30°C; \quad T_3 = 400°C$$
$$P_1 = 0.042\ bar; \quad P_3 = 100\ bars$$

$S_3 \to S_4$ is adiabatic, therefore we need to solve this to know the ratio between steam and water:

$$S_4 = xS_w + (1-x)S_s \implies x = \frac{S_4 - S_s}{S_w - S_s} = \frac{6.212 - 8.453}{0.437 - 8.453} = 0.2796$$

x here is the ratio of water to steam, we now need to solve this to get H_4:

$$H_4 = xH_w + (1-x)H_s = 0.2796 * 126 + (1 - 0.2796) * 3097 = 2266\ kJ \implies e = 1 - \frac{2266 - 126}{3097 - 126} = 27.970\%$$

Q3)

$$e = 1 - \frac{H_4 - H_1}{H_3 - H_2}$$

$$\Delta H = \Delta U + V\Delta P = \cancelto{0}{W} + V\Delta P = H_2 - H_1 \implies H_2 = H_1 + V\Delta P$$
$$at\ P = 0.042\ bar \&\ T = 30°, \quad V = 0.001004\ m^3$$
$$\therefore H_2 = 126 + 0.001004 * (100 - 0.042) = 126.1\ kJ \implies e = 1 - \frac{2266 - 126}{3097 - 126.1} = 27.968\%$$

The % difference is negligible: $\frac{27.970 - 27.968}{27.970} = 0.007\%$