1a) Throttling valves have a constant enthalpy process.

$h_i = h_e = 3423.1 \, kJ/kg$

$$\frac{3423.1 - 3344.9}{3457.2 - 3344.9} = \frac{T - 450}{500 - 450}$$

$T = 484.8174533°C$

$\approx 484.82°C$

b) $w = h_e - h_i$

$= 3423.1 - 2675.0$

$= 748.1 \, kJ/kg$

1c) $\frac{\cancel{V_i} A_i}{v_i} = \frac{\cancel{V_e} A_e}{v_e}$

$$\frac{A_e}{A_i} = \frac{v_e}{v_i} = \frac{v_g @ 100\text{kPa}}{v @ 484.82°C \text{ and } 3\text{MPa}}$$

$$\frac{3423.1 - 3344.9}{3457.2 - 3344.9} = \frac{v_i - 0.10789}{0.11620 - 0.10789}$$

$$v_i = 0.1136766607$$

$$\frac{A_e}{A_i} = \frac{1.6941}{0.113676607}$$

$$= 14.90279525$$

$$\approx 14.9$$

2a) Mass balance for both compressor and condenser:

$$\dot{m}_i = \dot{m}_e = \dot{m}$$

b) Assumptions:

- Change in kinetic and potential energy is 0.
- The compressor has a single inlet and outlet.

$$\dot{Q} - \dot{W} = \dot{m}(h_e - h_i)$$

$$\dot{W} = -0.2(293.25 - 253.81) \times 10^3 - 500$$

$$= -8388 W$$

$$= -8.388 kW$$

Power input is 8.388kW

2c) Heat loss of R134a $= \dot{m}(h_e - h_i)$

$$= 0.2\,(293.25 - 135.93)$$
$$= 31.464\ \text{kW}$$

Heat loss of R134a = Heat gained of air

$\therefore\ \dot{Q} = 31.464\,\text{kW}$

d) $\dot{Q} - \dot{W} = \dot{m} c_p (T_e - T_i)$

$$31.464 \times 10^3 = \frac{100 \times 10^3 \times 2}{0.287(273.15+25)}(T_e - 273.15 - 25)$$

$$T_e = 311.611 7229$$
$$\approx 38.46\,^\circ C$$

2e) $\dot{Q} - \dot{W} = \dot{m}(h_e - h_i)$

$$31.646 = \dot{m}(167.53 - 104.83)$$

$$\dot{m} = 0.5047208931$$

$$\approx 0.5 \text{ kg/s}$$