Problem I

Determine the amount of work

$$W = \frac{P_2 V_2 - P_1 V_1}{1 - n} \quad n \neq 1 \qquad 5$$

$$P_1 = \frac{m R T_1}{V_1} = 150 \text{ kPa} \qquad 10$$

$$V_2 = \sqrt[1.2]{\frac{P_1 V_1^{1.2}}{P_2}} = 0.327 \text{ m}^3 \qquad 10$$

$$W = -33.75 \text{ kJ} \qquad 5$$

Problem II

a) Amount of work to raise piston to position 2

$$v_1 = v_f + x\, v_{fg} = 0.3397 \text{ m}^3/\text{kg} \qquad 5$$

$$V_1 = m\, v_1 = 1.3586 \text{ m}^3 \qquad 5$$

$$V_2 = \pi r^2 d_2 \quad ; \quad r = \sqrt{\frac{V_1}{\pi d_1}} = 1 \text{ m} \qquad 10$$

$$V_2 = 7.7468 \text{ m}^3 \qquad 5$$

$$W = \overset{100\text{ kPa}}{P} (V_2 - V_1) = 638.82 \text{ kJ} \qquad 10$$

b) The amount of heat supplied.

$$\Delta U = Q_{in} - W_{out} \longrightarrow Q_{in} = \Delta U + W_{out}$$

$$\downarrow$$

@ P = ct

$$Q_{in} = m\,(h_2 - h_1).$$

$$h_1 = h\Big|_{\substack{100\ kPa \\ x = 0.2}} = 869.01\ kJ/kg. \quad 5$$

$$h_2 = h\Big|_{\substack{300\ kPa \\ 986\ °C}} = 4607.7\ kJ/kg. \quad 5$$

$$Q_{in} = 14954\ kJ \quad 5$$

<u>Problem III</u>

a). $h = u + P\upsilon \quad ; \quad h = \dfrac{H}{m}.$ 5

b) a process in which the system remains "infinitesimally close to equilibrium at all times during the process" 5

c) $h = u + P\upsilon \implies h = u + RT$ 5

$$\implies dh = du + R\,dT$$

$$\implies \frac{dh}{dT} = \frac{du}{dT} + R$$

$$\implies C_p = C_\upsilon + R \quad \text{or} \quad C_p - C_\upsilon = R$$

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d) Bose-Einstein Condensate.