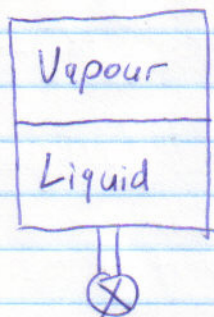


Quiz 4 Solution

(24)



$$V_{vap} = 0.375 \text{ m}^3$$

$$V_{liq} = 0.375 \text{ m}^3$$

$$T = 250^\circ\text{C} \\ = \text{constant}$$

NOTE: DO NOT USE $x=0.5$, x is a mass fraction, we are given volume fraction!

From tables

Liquid

$$v_f = 0.001251$$

$$u_f = 1080.37$$

$$h_f = 1085.34$$

Vapour

$$v_g = 0.0508$$

$$u_g = 2602.37$$

$$h_g = 2801.52$$

First law

no CV work

no mass enters CV

$$\frac{dE_{cv}}{dt} = \dot{Q}_{cv} - \dot{W}_{cv} + \dot{m}_i h_i - \dot{m}_e h_e$$

integrate

$$m_2 u_2 - m_1 u_1 = Q_2 - m_e h_e$$

$$Q_2 = m_2 u_2 - m_1 u_1 + m_e h_e$$

State 1

$$m_{\text{liq}} = \frac{0.375}{0.001251} = 299.76,$$

$$m_{\text{vap}} = \frac{0.375}{0.05013} = 7.48$$

$$m_1 = 307.24 \text{ kg}$$

$$m_1 u_1 = m_{\text{liq}} u_{\text{liq}} + m_{\text{vap}} u_{\text{vap}} = 343,318 \text{ kJ}$$

Exit state

$$h_e = h_{\text{liq}} = 1085.34$$

$$m_e = \frac{1}{2} m_1 = 153.62$$

$$m_e h_e = 166,729 \text{ kJ}$$

State 2

$$v_2 = \frac{V_2}{m_2} = \frac{0.75}{153.62} = 0.004882$$

$$x = \frac{v_2 - v_f}{v_{fg}} = 0.0743$$

$$u_2 = u_f + x u_{fg} = 1080.37 + 0.0743 \times 1522 = 1193.46$$

$$m_2 u_2 = 183,339 \text{ kJ}$$

$$\therefore Q_2 = 6751 \text{ kJ}$$