

Morgan Phillips

2012414

ACMAS008

Thermofluids + Control

1st April

1.30 pm

1) Question

a) $Q = U \times A \times \Delta T$

$$245 = \frac{K_a}{\Delta x_a} \times 1 \times (T_2 - 110)$$

$$\therefore T_2 = \frac{245 \times 0.018}{0.04} + 110$$

$$T_2 = 220.25^\circ\text{C}$$

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Question 4

System

	mass balance	energy balance
entire heat exchange	$m_1 + m_2 = m_3 + m_4 = 64 \text{ kg/s}$ and $m_5 = m_6 = m_s = 18 \text{ kg/s}$	$-Q_L = (m_6 h_6 + m_4 h_4 + m_s h_3) - (m_1 h_1 + m_2 h_2 + m_s h_5)$ $-Q = m_5 h_6 + m_s h_3 + m_4 h_4 - m_1 h_1 - m_2 h_2$ $-Q = 18 h_6 + 36 h_3 + 28 h_4 - 18 h_5 - m_1 h_1 - m_2 h_2$
Feed water tank	$m_1 + m_2 = m_3 + m_4 = 64 \text{ kg/s}$	$Q_s - Q_L = m_3 h_3 + m_4 h_4 - m_1 h_1 + m_2 h_2$ $Q_s - 7\% Q_s = 36 h_3 + 28 h_4 - m_1 h_1 + m_2 h_2$
Steam Pipe	$m_5 = m_6 = m_s = 18 \text{ kg/s}$	$-Q_s = m_6 h_6 - m_s h_5$ $-Q_s = m_s h_6 - m_s h_5$ $-Q_s = 18(h_6 - h_5)$

~~Q_s = 1000000 W = 1000 kW~~

$T_1 = 25^\circ\text{C} = h_1 = 104.83 \text{ kJ/kg}$ $T_3 = 90^\circ = h_3 = 377.04$

$T_2 = 15^\circ\text{C} = h_2 = 62.98 \text{ kJ/kg}$ $T_4 = 90^\circ = h_4 = 377.04$

$T_5 = 600 \text{ K} = 250^\circ\text{C} = h_5 = 2957.6 \text{ kJ/kg}$ $T_3 = \frac{377.04}{36} = 10.473 \text{ kJ/kg}$

$T_6 = 50 \text{ kPa} = 297.62 \text{ kJ/kg}$ $T_4 = \frac{377.04}{28} = 13.466 \text{ kJ/kg}$

energy Pipe

$$- Q_s = 18 \times (h_6 - h_5)$$

$$- Q_s = 18 \times (2996.2 - 2957.6)$$

$$- Q_s = 334.8 \text{ kJ/s}$$

$$7\% = 23.436$$

energy tank

$$Q_s - 7\% = 36h_3 + 28h_4 - m_1 h_1 + m_2 h_2$$

$$334.8 - 23.436 = 36 \times \overset{10.473}{\cancel{88.124}} + 28 \times 13.466 - m_1 \times 104.83 + m_2 \times 62.98$$

$$311.364 = (377.028 + 377.048) - m_1 104.83 + m_2 62.98$$

$$m_1 104.83 + m_2 62.98 = 754.076 - 311.364$$

$$m_1 104.83 + m_2 62.98 = 442.712$$