ME 24-221
Thermodynamics I

Solution Quiz No: 4
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Given:- Air; Ideal gas; constant specific heats
T_i= 20 C = 293 K
$P_i = 10^3$ kPa
P_2 = 500 kPa
m_e = 0.115 kg
$_1Q_2$ = -8.8 kJ
m_1 =0

Find: T_2 in K, Volume of tank in m^3

Solution: From continuity (or mass conservation equation),

$m_2 = m_i = 0.115$ kg

First law for USUF process:

$_1Q_2 + m_i h_i = m_2u_2$ (drop m_1, $_1W_2$, m_e terms and changes in KE, PE)

For constant specific heats:

$h = h_{ref} + C_p(T-T_{ref})$; $u = u_{ref} + C_v(T-T_{ref})$

Choose u_{ref}, h_{ref}, T_{ref} =0 for convenience. This does not matter because they cancel out anyway. Therefore

$_1Q_2 + m_i C_pT_i = m_2C_vT_2$

-8.8 + 0.115*1.004*293 = 0.115*0.717*T_2

T_2 = 303.56 K

$V = m_2RT_2/P_2 = 0.115*(8314/29)*303.56/(500x10^3)$ = **0.02 m^3**