ANNOUNCED QUIZ #3 – ME 3030 — Section 001 – Fall 2025

NAME: SOLUTION

This is an open book quiz. You may use a four function calculator. An unsigned honors pledge will result in a zero.

1. Consider a Carnot power cycle that uses 3.13 kg of ammonia as the working fluid. The isothermal compression occurs at a pressure of 1.25 bar and takes the fluid from a mixture with a quality of 91.00% to a quality of 12.00%. Determine (a) the work during this isothermal compression in units of kJ; (b) if the efficiency is 33.00%, what is the temperature of the isothermal expansion in K?

GIVEN: $m = 3.13\,kg$, NH_3, isothermal compression, $p = 1.25\,bar$, x_3, x_4, Carnot cycle

FIND (a) W_{23} ; T_H

ASSUME: All processes are reversible

ANALYSIS: (a) $W_{34} = m\int_3^4 p\,dv = mp\int_3^4 dv = mp(v_4 - v_3)$

DIAGRAM

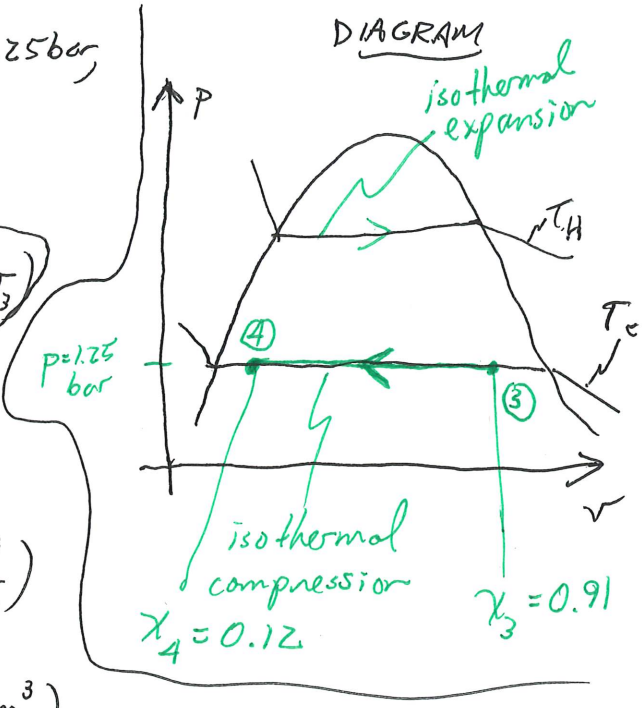

Table A-14 (NH_3)

$p = 1.25\,bar$, $T = -29.07°C$: $v_f = 1.4782 \times 10^{-3}\,m^3/kg$, $v_g = 0.9237\,m^3/kg$

$v = (1-x)v_f + xv_g$

$v_4 = (1 - .12)(1.4782 \times 10^{-3}\,m^3/kg) + 0.12(0.9237\,m^3/kg)$

$v_4 = 0.1121\,m^3/kg$

$v_3 = (1 - 0.91)(1.4782 \times 10^{-3}\,m^3/kg) + 0.91(0.9237\,m^3/kg)$

$v_3 = 0.8407\,m^3/kg$

$W_{34} = (3.13\,kg)(1.25\,bar)(100\,kPa/bar)(0.1121\,m^3/kg - 0.8407\,m^3/kg)$

$W_{34} = -285\,kJ$ ← ANS.

(b) $\eta = \eta_{rev} = 0.33 = 1 - \frac{T_c}{T_H} = 1 - \frac{(-29.07+273)K}{T_H}$

$T_H = 364\,K$ ← ANS.

Units Check

$k\left[kg\,Pa \cdot \frac{m^3}{kg}\right]$

$k\left[\frac{N}{m^2}\,m^3\right] = k[N \cdot m] = kJ$

I HAVE NEITHER PROVIDED OR RECEIVED HELP DURING THIS QUIZ.

SIGNATURE