Please note that the fluid properties i used are not exact and yours may differ and still be correct.

2NE3 2022 FALL TERM   QUIZ #3   Sept 27, 2022   Name: NOVOG

Note this quiz has 2 sides.

1. [15 marks] Air inside a piston-cylinder is at an initial state is 100kPa and 27 C. It is first heated under constant volume conditions until its pressure reaches 200kPa. Then the air is expanded under a constant temperature process back to 100kPa. After this, the air is then cooled under a constant pressure process until the specific volume returns to its initial state. R for air is 0.287 kJ/kg-K.
   a) Determine the initial specific volume and the specific volume and temperature at the state point corresponding to 200kPa.
   b) Determine the specific work involved in the transition from 100kPa to 200 kPa [kJ/kg]
   c) Determine the specific work involved during the constant temperature process from 200 to 100 kPa. [kJ/kg]
   d) Determine the specific work involved in the final constant pressure compression back to the initial state. [kJ/kg]
   e) Sketch the P-V diagram and determine the net specific work [kJ/kg] involved in this cycle.

Air

a) $P_1 v_1 = RT_1$ $v_1 = \frac{R(27+273)}{100} = \frac{(0.287)(300)}{100}$

$v_2 = v_1 =$ ______

$T_2 = \frac{P_2 v_2}{R} = \frac{(200) v_2}{R} =$ ____ K

b) $\Delta v = 0$ $w_{21} = 0$

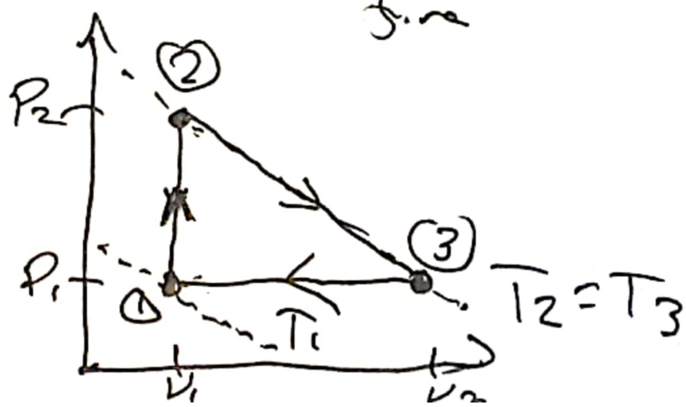
c) $T_3 = T_2$ $P_3 = 100$ kPa $v_3 = \frac{T_3 R}{P_3} =$ ______

$w_{23} = RT_2 \ln\left(\frac{v_3}{v_2}\right) =$ ______

d) $w_{13} = P_1(v_1 - v_3) = -100$ ______

final   initial   -ve

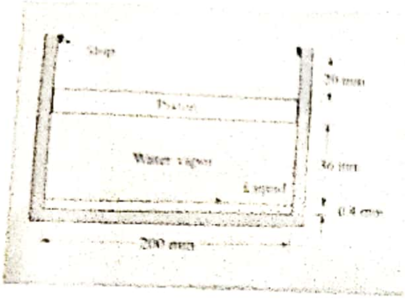
e)



$w_{net} = \Sigma w =$ ______

2. [15 marks] A piston cylinder has 200mm diameter with the piston head mass of 64kg (atmospheric pressure can be considered 100kPa). Initially the liquid occupies 0.4mm of height at the bottom of the cylinder and the remaining 36mm is in vapour state. The piston may move upwards a distance of up to 20mm but can move no further because of stops installed to stop the piston head. The system is heated until the temperature reaches 250C.

a) Determine the initial pressure, temperature, and quality.
b) Determine the quality when the piston just touches the stops.
c) Determine the final pressure in kPa.
d) Determine the specific work performed in the process [kJ/kg].
e) Sketch the process on a P-v diagram.



① $P = P_{atm} + \frac{F}{A} = 100 + \frac{(64)(9.81)}{\pi(.2)^2/4 \ (1000)}$

$\approx 120 \text{ kPa}$

Saturated so $T = T_{sat} \approx 105\,°C$

$v_f = 0.001047$
$v_g = 1.4186$

$m_T = m_v + m_f$

$= \frac{V_v}{v_g} + \frac{V_f}{v_f} = \frac{\pi D^2/4\,(0.036)}{1.4186} + \frac{\pi D^2/4\,(0.0004)}{0.001047}$

$= \underline{0.0128} \text{ kg}$

$v_1 = \frac{V_T}{m_T} = \frac{\pi D^2/4\,(0.0364)}{m_T} = \underline{0.089102}$

$x_1 = \frac{v_1 - 0.001047}{1.4186 - 0.001047} = \underline{0.0621}$

b) ② $v_2 = \frac{\pi D^2/4\,(.036 + .0004 + 0.020)}{m_T}$

$= \underline{0.138} \text{ m}^3/\text{kg}$

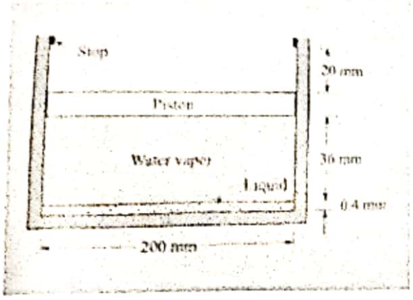
$=P_1$

$x_2 = \frac{v_2 - 0.001047}{1.4186 - 0.001047} = \underline{0.096}$

CamScanner

...th the ... ttom o... furthe...

2. [15 marks] A piston cylinder has 200mm diameter with the piston head mass of 64kg (atmospheric pressure can be considered 100kPa). Initially the liquid occupies 0.4mm of height at the bottom of the cylinder and the remaining 36mm is in vapour state. The piston may move upwards a distance of up to 20mm but can move no further because of stops installed to stop the piston head. The system is heated until the temperature reaches 250C.
   a) Determine the initial pressure, temperature, and quality.
   b) Determine the quality when the piston just touches the stops.
   c) Determine the final pressure in kPa.
   d) Determine the specific work performed in the process [kJ/kg].
   e) Sketch the process on a P-v diagram.



Cont

c) @250°C

we know $v_3 = v_2 =$ 0.138

from A-6 @ table 250°C look for v_3.

its in between P=1.6 MPa and P=1.8 MPa

$P_3 = 1.62$ MPa

2NE3 2022 FALL TERM QUIZ #3 Sept 27, 2022 Name: NOVO6

Note this quiz has 2 sides.

[15 marks] Air inside a piston-cylinder is at an initial state is 100kPa and 27 C. It is first heated under constant volume conditions until its pressure reaches 200kPa. Then the air is expanded under a constant temperature process back to 100kPa. After this, the air is then cooled under a constant pressure process until the specific volume returns to its initial state. R for air is 0.287 kJ/kg-K.

a) Determine the initial specific volume and the specific volume and temperature at the state point corresponding to 200kPa.
b) Determine the specific work involved in the transition from 100kPa to 200 kPa [kJ/kg]
c) Determine the specific work involved during the constant temperature process from 200 to 100 kPa. [kJ/kg]
d) Determine the specific work involved in the final constant pressure compression back to the initial state. [kJ/kg]
e) Sketch the P-V diagram and determine the net specific work [kJ/kg] involved in this cycle.