QUIZ #1 SOLUTION.

3.38 / +3.34

GIVEN: a) R-134a $T = -20°C$, $P = 150\ kPa$
b) R-134a $P = 300\ kPa$, $v = 0.072\ m^3/kg$
c) ~~R-410~~ CH_4 (methane) $T = 155K$, $v = 0.04\ m^3/kg$
d) CH_4 $T = 350K$, $v = 0.25\ m^3/kg$

FIND: Phase and missing Property P, T, v, x
Also show location on P-v and T-v diagram

a) FROM TABLE B.5.1 $P_{sat} = 133.7\ kPa$ when $T = -20°C$

$P > P_{sat}$ ∴ we have compressed liquid.
$v \sim v_f = 0.000738\ m^3/kg$
X = undefined.

b) FROM TABLE B.5.2 when $P = 300\ kPa$, $v_g = 0.06787\ m^3/kg$

$V > v_g$ ∴ we have a superheated vapour
v is between 10°C and 20°C ∴ use linear interpolation to solve for T

$$T = 10°C + (20°C - 10°C)\left(\frac{0.072 - 0.07111}{0.07441 - 0.07111}\right) = 12.7°C$$

X = undefined.

c) FROM TABLE B 7.1 for $T = 155K$, $v_g = 0.04892\ m^3/kg$
$v_f = 0.002877\ m^3/kg$
$v_f < v < v_g$ ∴ we have a 2-Phase mixture

$P = P_{sat} = 1295.6\ kPa$

$$X = \frac{v - v_f}{v_{fg}} = 0.806$$

d) FROM TABLE B.7.1 ~~what T=350K~~

The critical Point is $T_c = 190.6\,K$

$v_c = 0.00615\ m^3/kg$

$T > T_c$ and $v \gg v_c$ ∴ we have a superheated vapour

Use table B.7.2 ⇒ At $T = 350\,K$,

$v = 0.25\ m^3/kg$ is found between $P = 600$ and $P = 800\ kPa$.

∴ Interpolate to find P

$$P = 600 + 200\left(\frac{0.25 - 0.30067}{0.2251 - 0.30067}\right) = 734\ kPa$$

X = undefined.