HVAC - Quiz I

Group A) A gas cylinder of R404A weighs 9,8 kg net and is of 12 lt volume. The gas cylinder is in a laboratory at 15 ^{o}C for 8 hours. Determine, (a) the pressure inside the gas cylinder, (b) mass percentages of liquid and gas phases, and (c) volume occupied by liquid and gas phases.

Group B) A gas cylinder of R404A weighs 1 kg net and is of 12 lt volume. The gas cylinder is in a laboratory at 25 ^{o}C for 8 hours. Determine, (a) the pressure inside the gas cylinder, (b) mass percentages of liquid and gas phases, and (c) volume occupied by liquid and gas phases.

Vapour Table, Wet Vapour Range Solkane®404A

t [°C]	p´ [bar]	p´´ [bar]	v´ [dm³/kg]	v´´ [dm³/kg]	ρ' [kg/dm³]	ρ´´ [kg/m³]	h´ [kJ/kg]	h´´ [kJ/kg]	r [kJ/kg]	s´ [kJ/kg K]	s´´ [kJ/kg K]
10	8.320	8.199	0.900	23.91	1.111	41.83	214.11	370.00	155.89	1.0494	1.6018
11	8.565	8.443	0.903	23.19	1.107	43.12	215.54	370.45	154.91	1.0543	1.6014
12	8.815	8.692	0.907	22.50	1.103	44.45	216.97	370.90	153.93	1.0593	1.6009
13	9.071	8.946	0.910	21.83	1.099	45.81	218.40	371.34	152.94	1.0642	1.6005
14	9.333	9.206	0.914	21.18	1.095	47.20	219.84	371.78	151.94	1.0692	1.6000
15	9.600	9.472	0.917	20.56	1.090	48.64	221.28	372.21	150.92	1.0741	1.5996
16	9.873	9.743	0.921	19.95	1.086	50.11	222.73	372.63	149.90	1.0790	1.5992
17	10.15	10.02	0.925	19.37	1.082	51.63	224.19	373.05	148.86	1.0840	1.5987
18	10.44	10.30	0.928	18.80	1.077	53.18	225.65	373.46	147.82	1.0889	1.5983
19	10.73	10.59	0.932	18.25	1.073	54.78	227.11	373.87	146.76	1.0939	1.5978
20	11.02	10.89	0.936	17.72	1.068	56.43	228.59	374.27	145.68	1.0989	1.5973
21	11.32	11.19	0.940	17.21	1.064	58.11	230.06	374.66	144.60	1.1038	1.5969
22	11.63	11.50	0.944	16.71	1.059	59.85	231.55	375.05	143.50	1.1088	1.5964
23	11.95	11.81	0.948	16.23	1.054	61.63	233.04	375.42	142.38	1.1138	1.5959
24	12.27	12.13	0.953	15.76	1.050	63.46	234.54	375.79	141.25	1.1188	1.5954
25	12.60	12.45	0.957	15.30	1.045	65.35	236.05	376.15	140.11	1.1238	1.5949
26	12.93	12.79	0.961	14.86	1.040	67.28	237.56	376.51	138.95	1.1289	1.5944
27	13.27	13.13	0.966	14.43	1.035	69.28	239.08	376.85	137.77	1.1339	1.5939
28	13.62	13.47	0.970	14.02	1.030	71.33	240.62	377.19	136.57	1.1389	1.5933
29	13.97	13.83	0.975	13.62	1.025	73.44	242.16	377.51	135.36	1.1440	1.5928

Quiz I

A) $v_{ave} = \frac{V}{m} = \frac{12\ dm^3}{9,8\ kg} = 1,2245\ dm^3/kg$

At 15 °C, $v_f = 0,917\ dm^3/kg$ and $v_v = 20,56\ dm^3/kg$

So R404A is wet-vapor at 9,6 ber. which is saturation pressure for T = 15 °C.

$v_{ave} = v_f(1-x) + v_v x$

$1,2245 = 0,917(1-x) + 20,56x$

$x = 0,0157$

mass of liquid phase, $m_f = m(1-x) = 9,8(1-0,0157) = 9,6466\ kg$

mass of vapor phase $m_v = mx = 9,8 \cdot 0,0157 = 0,1539\ kg$

Volume of liquid phase $V_f = m_f v_f = (9,6466\ kg)(0,917\ m^3/kg) = 8,85 dm^3$

Volume of vapor phase $V_v = V - V_f = 12 - 8,85 = 3,15\ dm^3 = 3,15\ lt$

B) Similar lg

$$v_{ave} = \frac{12\,dm^3}{1\,kg} = 12\,dm^3/kg$$

At 25°C | $v_f = 0{,}957\,dm^3/kg$ ↓ $v_v = 15{,}30\,dm^3/kg$

↓

$P = 12{,}45$ bar (saturation pressure for $T = 25\,^\circ C$)

$$v_{ave} = v_f(1-x) + v_v x$$

$$\Rightarrow x = 0{,}77$$

$$m_v = mx = (1\,kg)\,0{,}77 = 0{,}77\,kg$$

$$m_f = m - m_v = 1 - 0{,}77 = 0{,}23\,kg$$

$$V_v = m_v v_v = 0{,}77 \cdot 15{,}3 = 11{,}78\,dm^3$$

$$V_f = 0{,}22\,dm^3$$