

ROSE-HULMAN INSTITUTE OF TECHNOLOGY
Foundation Coalition Sophomore Engineering Curriculum

ES 202 - Fluid & Thermal Systems

Water: PHASES & PROPERTIES

1. Provide the information requested in the table for WATER. When specifying the phases use the following abbreviations:

CL = compressed (subcooled) liquid
SL = saturated liquid
SM = saturated mixture
SV = saturated vapor
SHV = superheated vapor

Use "NA" for items that are not applicable at a particular state.

State	Phase	Pressure, P [kPa]	Temperature, T [°C]	Quality, x	Specific Volume, v [m ³ /kg]	Specific Internal Energy, u [kJ/kg]	Specific Enthalpy, h [kJ/kg]	Specific Entropy, s [kJ/(kg-K)]
1	SHV	500	350	NA	0.5701		3167.7	
2	CL	500	140	NA	0.00108		589.28	1.7391
3	SL	500	151.86		0.00109		640.23	1.8607
4	SM	500	151.86	0.1875	0.07118	1000		
5	SV	500	151.86	1.0		2561.2	2748.7	
6	SM	101.33	100	0.30	0.5026			3.1213
7	SHV	91.17	100	NA	2.0		2677.3	
8	SM	101.33	100	0.7760	1.2984			6.0
9	SL	101.33	100	0.0	0.00104	418.94	419.04	1.3069
10	CL	5000	100	NA	0.00104	417.52	422.72	1.3030
11	SL	5000	263.99	0.0	0.00129	1147.81	1154.23	2.9202

2. States 9 and 11 are approximations of State 10. Which approximation is more accurate? State 9 is a more accurate approximation of State 10. In the compressed liquid region, the properties are less sensitive to changes in pressure than those in temperature. Hence, the compressed liquid properties can be approximated as:

$$u(P, T) \cong u_f(T)$$

$$v(P, T) \cong v_f(T)$$

$$s(P, T) \cong s_f(T)$$

$$h(P, T) \cong h_f(T) + [P - P_{sat}(T)]v_f(T)$$

3. Plot the states on the three phase diagrams (P - T , P - v , T - s). Positions may be approximate but relative positions should be correct when compared with other states and saturation curves.

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ES 202 - Fluid & Thermal Systems

R-134a: PHASES & PROPERTIES

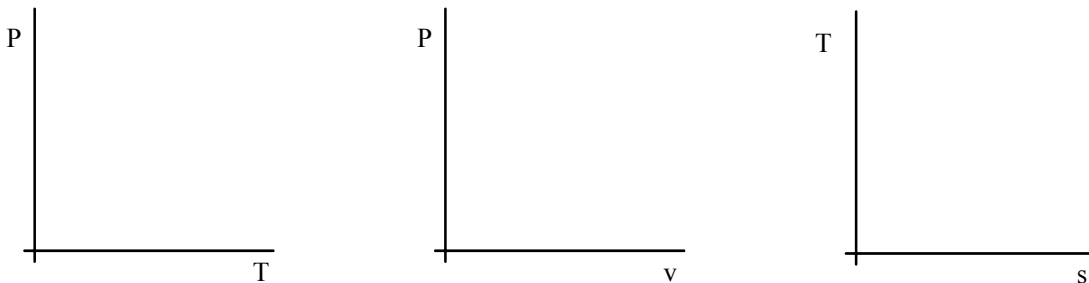
4. Provide the information requested in the table for R-134a. When specifying the phases use the following abbreviations:

- CL = compressed (subcooled) liquid
- SL = saturated liquid
- SM = saturated mixture
- SV = saturated vapor
- SHV = superheated vapor

Use "NA" for items that are not applicable at a particular state.

State	Phase	Pressure, P [kPa]	Temperature T [°C]	Specific Volume, v [m ³ /kg]	Specific Internal Energy, u [kJ/kg]	Specific Enthalpy, h [kJ/kg]	Specific Entropy, s [kJ/(kg-K)]	Quality, x
1	CL	240	-12	.000750			0.1388	NA
2	SHV	240	20	.09339		266.85		NA
3	SL	240	-5.37		42.77		0.1710	0.0
4	SM	240	-5.37		139.2	150		0.5355
5	SV	240	-5.37	0.0834		244.09		
6	SM	770.06	30	0.01108		159.2		0.4
7	SM	770.06	30	0.0188			0.7332	0.7014
8	SL	770.06	30		90.84		0.3396	0.0
9	SV	770.06	30	0.0265	243.1	263.5	0.9070	1.0
10	CL	1400	30		90.84	91.49		NA
11	SHV	1400	60	0.01495		283.1		NA

5. Plot the states on the three diagrams below. Positions may be approximate but relative positions should be correct when compared with other states and saturation curves.



Phases & Properties