

TFY4115 Fysikk

Mekanikk:

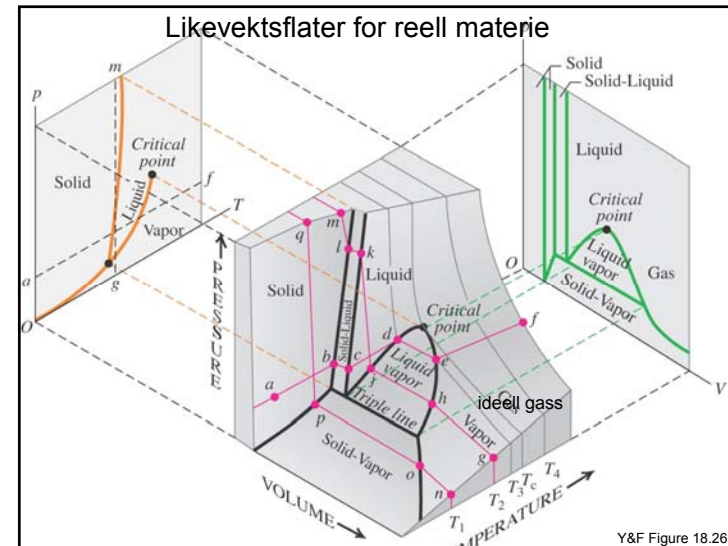
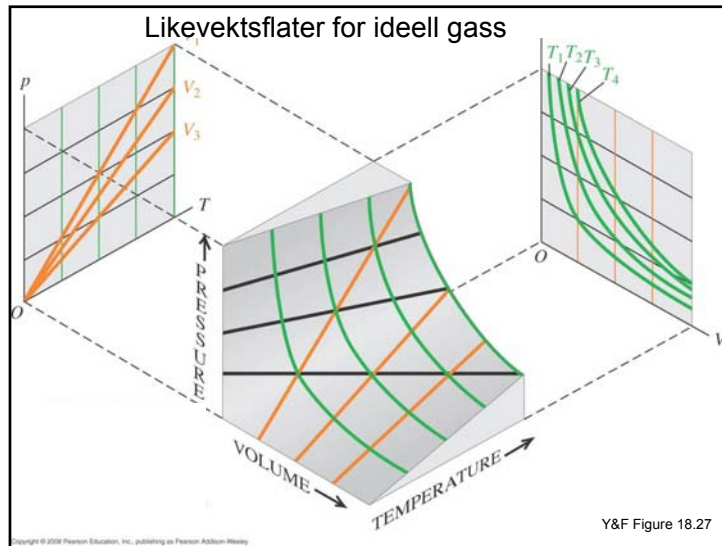
Newton's lover (kap. 2)
 Svingninger (kap. 6)
 Energi, bevegelsesmengde, kollisjoner (kap. 3)
 Rotasjon, spinn (kap. 4 + 5)
 Statisk likevekt (kap. 4.6+4.7)

Termodynamikk:

Temperatur og varme [+ 1, hovedsetning] (kap. 8)
 Kinetisk gassteori (kap. 9)
 Faseoverganger [smelting, koking] (kap. 10)
 Termodynamikkens 1, lov [Ulike prosesser] (kap. 11)
 Termodynamikkens 2, lov (kap. 12)
 Varmetransport [konveksjon, ledning, stråling] (kap. 13)

Varme Q tilført et legeme kan:

- 1) Varme opp stoff: $Q = C \cdot n \cdot \Delta T$
 der C = molar varmekapasitet
- 2) Smelte stoff: $Q = L_s \cdot \Delta m$
 der L_s = spesifikk smeltevarme (J/kg)
- 3) Fordampe stoff: $Q = L_f \cdot \Delta m$
 der L_f = spesifikk fordampingsvarme (J/kg)
- 4) Utvide en gass isotermt $Q = \int p \, dV$



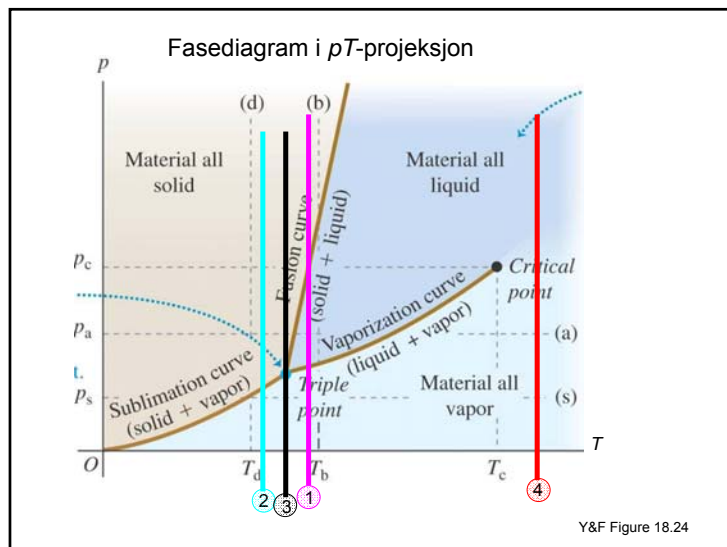
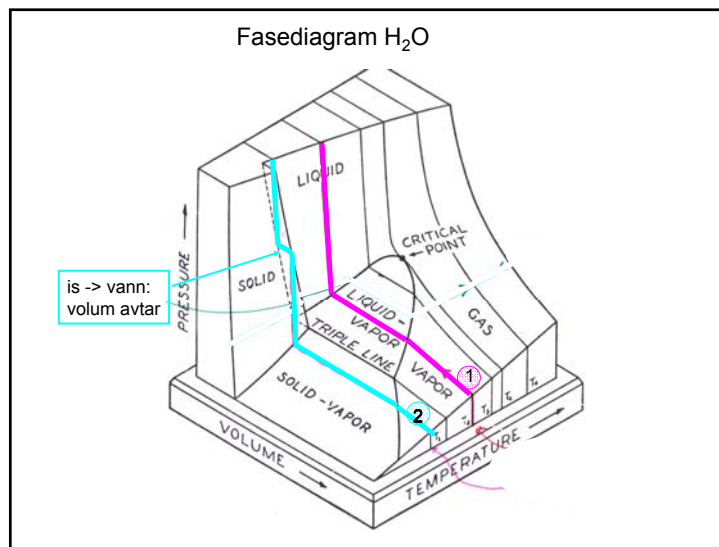
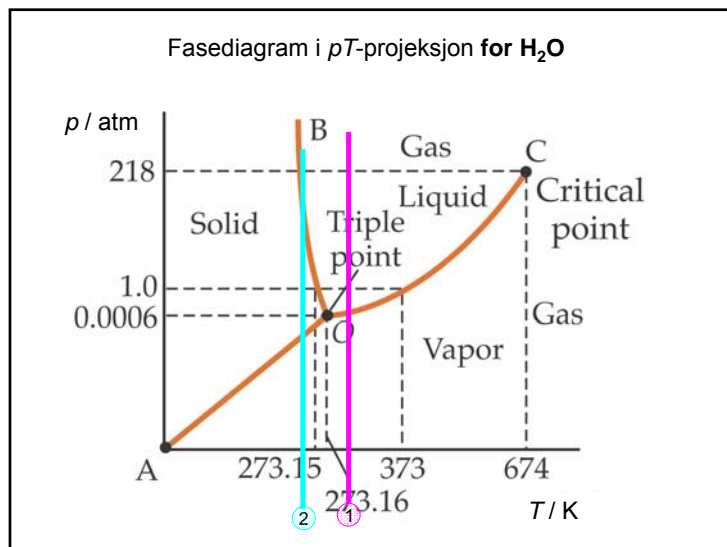


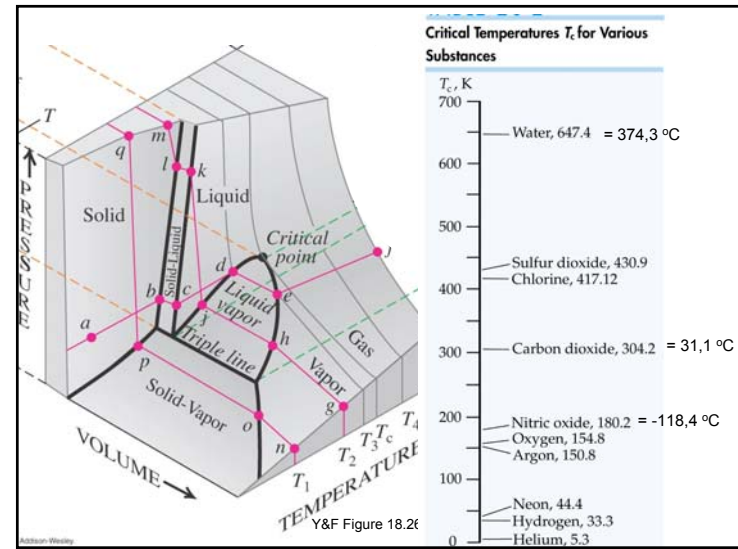
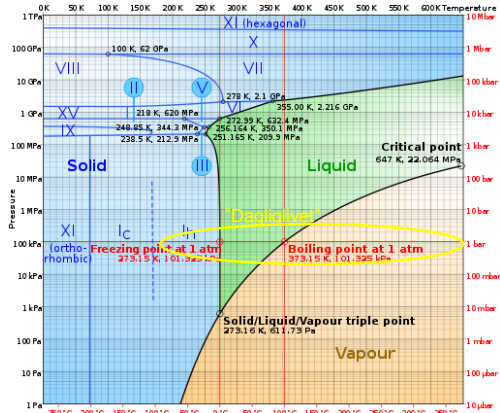
Table 18.3 Triple-Point Data

Substance	Temperature (K)	Pressure (Pa)
Hydrogen	13.80	0.0704×10^5
Deuterium	18.63	0.171×10^5
Neon	24.56	0.432×10^5
Nitrogen	63.18	0.125×10^5
Oxygen	54.36	0.00152×10^5
Ammonia	195.40	0.0607×10^5
Carbon dioxide	216.55 = -56.5 °C	$5.17 \times 10^5 = 5.1 \text{ atm}$
Sulfur dioxide	197.68	0.00167×10^5
Water	273.16 = 0.01 °C	$0.00610 \times 10^5 = 0.006 \text{ atm}$

Y&F Table 18.3



Fasediagram i log(p)-T-projeksjon for H₂O
Is har 15 ulike krystallfaser
 (fra en.wikipedia.org)



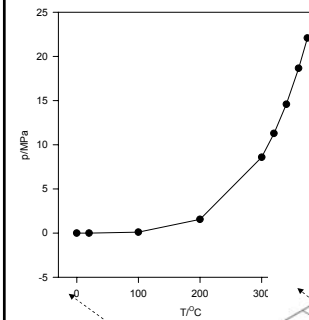
Data vanddamp og vann 0°C til 374°C

t/°C	p/MPa	v _g /(m ³ /kg)	v _l /(m ³ /kg)	l _f /(kJ/kg)	"R"
0,01	0,0006	0,001000	206,1	2501	8,31
20	0,0023	0,001002	57,8	2454	8,31
50	0,0123	0,001012	12,0	2383	8,23
100	0,1013	0,001044	1,67	2257	8,18
200	1,55	0,001157	0,127	1941	7,53
300	8,58	0,001404	0,0217	1405	5,84
320	11,27	0,001499	0,0155	1239	5,30
340	14,58	0,001638	0,0108	1028	4,62
360	18,65	0,001893	0,00695	721,0	3,66
374,14	22,09	0,003155	0,003155	0,0	1,97

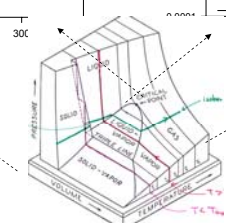
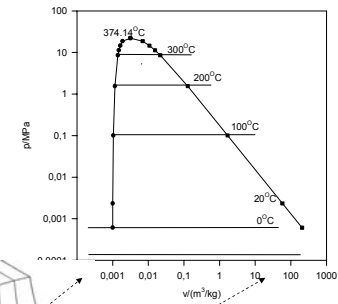
p-v-plott

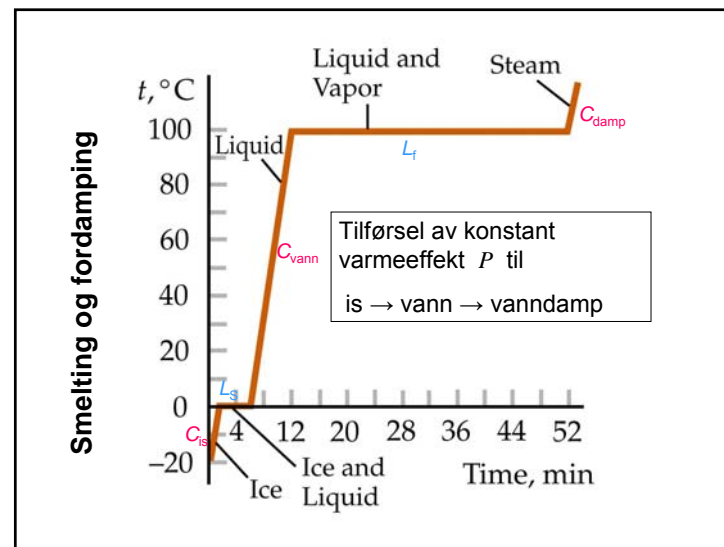
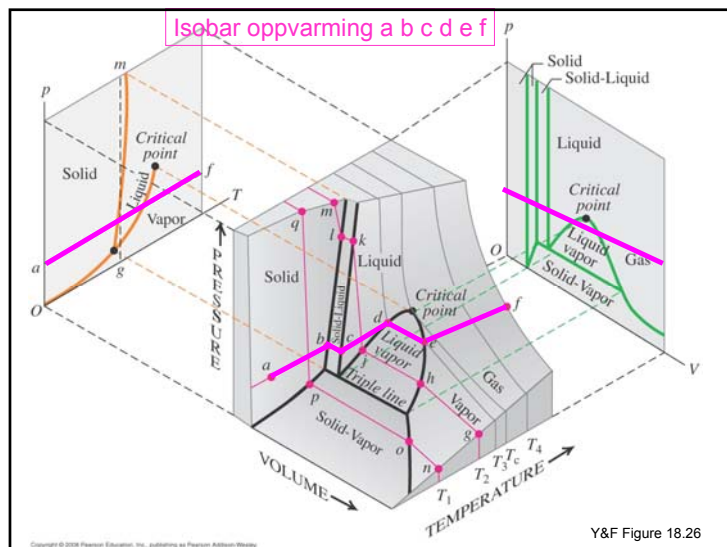
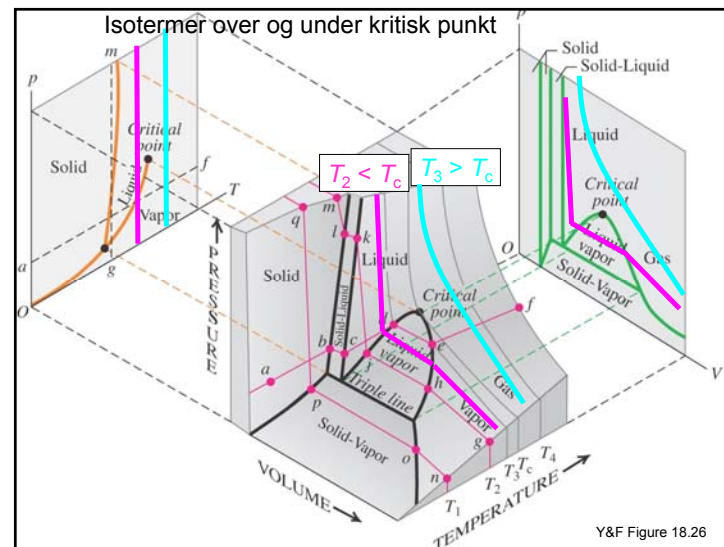
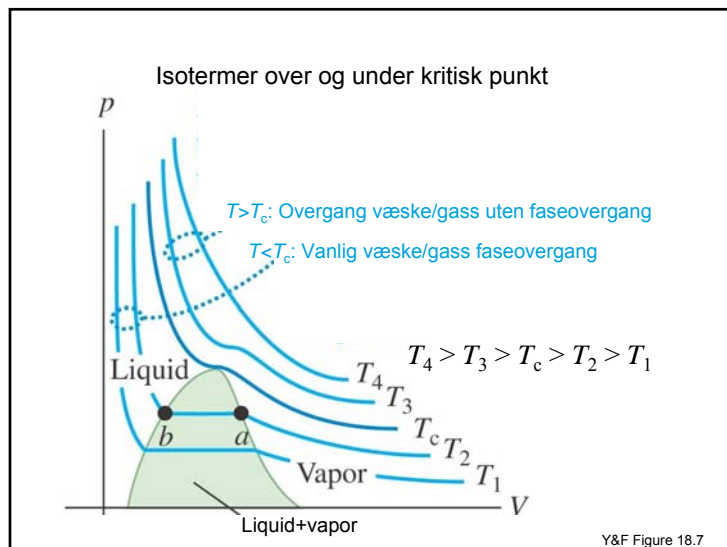
- p = vanddampens metningstrykk
- v_g = vannets spesifikke volum
- v_l = vanddampens spesifikke volum
- l_f = spesifikk fordampningsvarme
- "R" = p v_g / T (= R = 8,31 J/(K mol) hvis ideell gass)

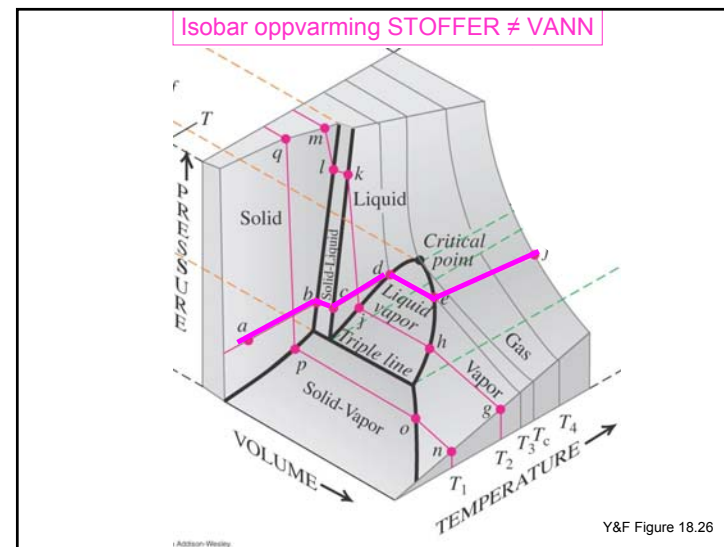
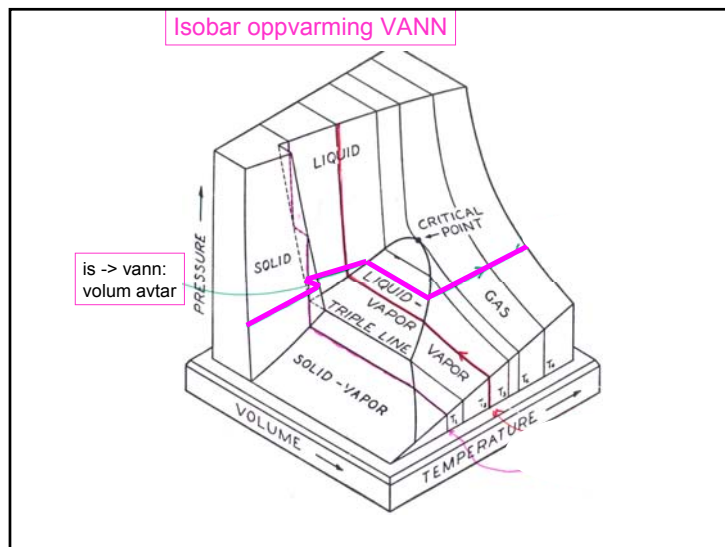
p-T-plott vanddamp/vann



p-v-plott vanddamp/vann







Normal Melting Point (MP), Latent Heat of Fusion (L_f), Normal Boiling Point (BP), and Latent Heat of Vaporization (L_v) for Various Substances at 1 atm

Substance	MP, K	L_f /kJ/kg	BP, K	L_v /kJ/kg
Alcohol, ethyl	159	109	351	879
Bromine	266	67.4	332	369
Carbon dioxide	—	—	194.6 [*] = -79 °C	573 [*]
Copper	1356	205	2839	4726
Gold	1336	62.8	3081	1701
Helium	—	—	4.2	21
Lead	600	24.7	2023	858
Mercury	234	11.3	630	296
Nitrogen	63	25.7	77.35 = -196 °C	199
Oxygen	54.4	13.8	90.2	213
Silver	1234	105	2436	2323
Sulfur	388	38.5	717.75	287
Water	273.15	333.5	373.15 = 0.0 °C	2257
Zinc	692	102	1184	1768

^{*} These values are for sublimation. Carbon dioxide does not have a liquid state at 1 atm. ($p_{\text{triple}} = 5.1 \text{ atm}$)

10. Faseoverganger. Oppsummering

- Fasediagram i pT -rommet viser hvilke områder de tre faser fast, væske, gass kan eksistere hver for seg og sammen. Gjelder kun reine faser (én type stoff).
- I fasediagram i pT -projeksjon er sameksistensflatene kurver. Fasediagram i pV -projeksjon også ofte brukes.
- Smelting (fast \rightarrow væske): L_s = spesifikk smeltevarme (J/kg)
- Fordamping (væske \rightarrow gass) : L_v = spesifikk fordampingsvarme (J/kg)
- I pT -plott har sameksistenskurve væske/gass $dp/dT > 0$. Sameksistenskurve fast/væske har $dp/dT > 0$ for alle stoff unntatt H_2O fordi is har større volum enn vann.
- Sameksistenskurve væske/gass har et maksimalt (kritisk) punkt ($p_{\text{krit}}, T_{\text{krit}}$). For $p > p_{\text{krit}}$ og/eller $T > T_{\text{krit}}$ har væske og gass samme egenskaper.