Application of Phase rule to one component system

From the phase rule, $F = C - P + 2$, it is clear that when $C = 1$, $P = 1$

$$F = 1 - 1 + 2 = 2$$

Thus all one component systems can be completely described graphically by stating two variables, pressure and temperature on appropriate axes.

One Component System ; Water System :

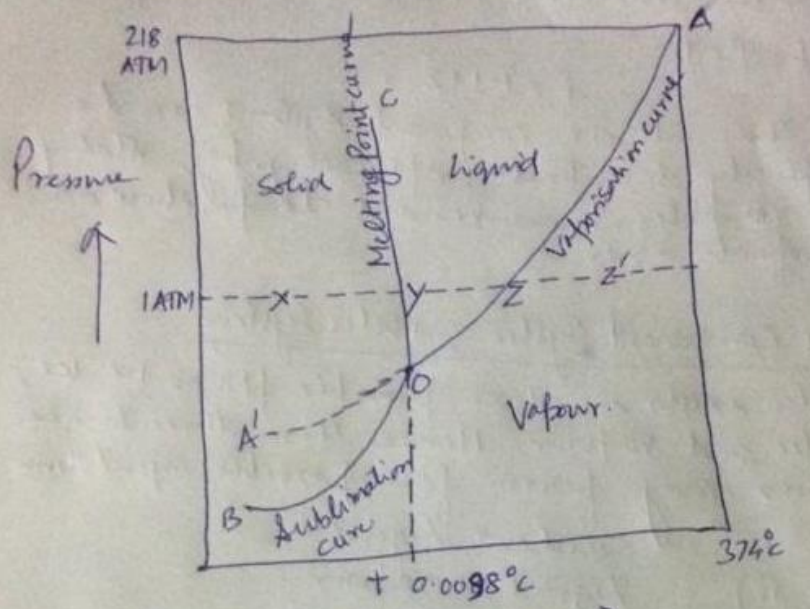
Water exists in three possible phases i.e. ice, water and vapour. Hence there three single phases may fourm four possible equilibria

i) Solid $\rightleftharpoons$ Liquid
ii) Liquid $\rightleftharpoons$ Vapour
iii) Solid $\rightleftharpoons$ Vapour
iv) Solid $\rightleftharpoons$ Liquid $\rightleftharpoons$ Vapour

The phase diagram of water system is given in figure. The diagram consists of

i) Three stable curves OB, OA and OC
ii) One metastable curves OA'
iii) Three areas AOB, COB and AOC
iv) Triple point O

Phase diagram of water.



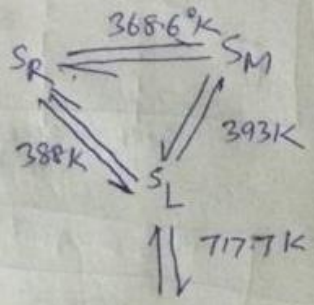
Table

Systems as given in the above diagram	Phase in equilibrium	Degree of freedom
Curves		
OA	water ⇌ vapour	1
OB	Ice ⇌ vapour	1
OC	Ice ⇌ water	1
OA'	water ⇌ Vapour	1
Areas		
AOB	Vapour	2
COB	Ice	2
AOC	Liquid water	2
Triple point	Ice ⇌ water ⇌ vapour	0
O		

One Component System : Sulphur System

The Sulphur system is a one component system displaying polymorphism and solid-solid transformation. Sulphur exists in four phases

i) Rhombic Sulphur (S_R)
ii) Monoclinic Sulphur (S_M)
iii) Sulphur Liquid (S_L)
iv) Sulphur vapour (S_V)



According to phase rule $F = C - P + 2$, when $F=0$, $C=1$ then $0 = 1 - P + 2$ or $P = 3$. Thus all the four phases can not coexist in equilibrium. The maximum number of phases which can coexist is three. The phase diagram of Sulphur system is given below

The phase diagram consists of

i) Six stable curves, BO, OA, AE, OC, CF and AC,
ii) four metastable curves GO, OD, AD and DC
iii) Four Areas BOCF, BOAE, FCAE and OCA
iv) Triple point O, A, C and D.

Phase diagram Sulphur System.

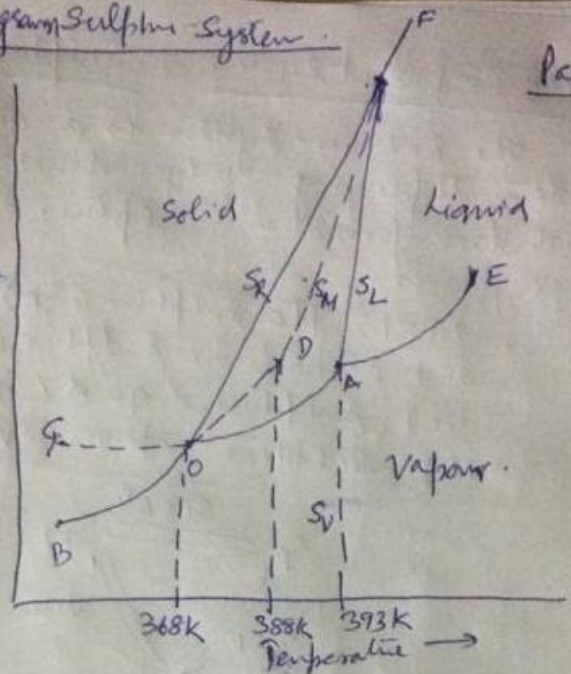


Table:

Name of System	Phase in equilibrium	Degrees of freedom
Curves		$F = C - P + 2$
i) BO (OD)	$S_R \rightleftharpoons S_V$	$= 1 - 2 + 2 = 1$
ii) OA (OG)	$S_M \rightleftharpoons S_V$	1
iii) AE (AD)	$S_L \rightleftharpoons S_V$	1
iv) DC (CF)	$S_R \rightleftharpoons S_L$	1
v) OC	$S_R \rightleftharpoons S_M$	1
vi) AC	$S_M \rightleftharpoons S_L$	1
Areas		$F = 1 - 1 + 2 = 2$
i) Below BOAE	S_V	2
ii) To the right of EACF	S_L	2
iii) Enclosed by OCA	S_M	2
iv) To the left of BOCF	S_R	2
Triple Point		$F = 1 - 3 + 2 = 0$
i) O	$S_R \rightleftharpoons S_M \rightleftharpoons S_V$	0
ii) A	$S_M \rightleftharpoons S_L \rightleftharpoons S_V$	0
iii) D	$S_R \rightleftharpoons S_M \rightleftharpoons S_L$	0
iv) D	$S_R \rightleftharpoons S_L \rightleftharpoons S_V$	