In Class Exercise
Reading A Phase Diagram
SOLUTIONS

1.) Label all of the two phase regions.

To label regions on the phase diagram, look at what binds that region to the left and right. See some examples on the phase diagram below.

2.) Label all the solvus, solidus, and liquidus lines.

See examples of these on the phase diagram below.

Solvus: divides to solid regions (representing the point where solid solubility is exceeded and you begin to have a second solid phase)

Solidus: divides regions of solid and solid + liquid (representing the point where the liquid is finished solidifying/ solid begins melting)

Liquidus: divides regions of liquid and solid+liquid (representing the point where the liquid begins solidifying/solid is done melting)

3.) List the phases present at points A, B, and C.

A: is on the liquidus: liquid and AlNi are present

B: is in a one phase region: solid AlNi is present

C: is a eutectic point: liquid, (Al) and Al_3Ni are present

4.) If you have liquid that is 50 wt % Ni and AlNi present, what temperature are you at and what is the composition of the AlNi?

To solve this problem, you need to draw a line at 50 wt% Ni, then find where that intersects the liquidus in the two phase (l+AlNi) region. Use a tie line to figure out the composition of AlNi in that region (65 wt% Ni) and the temperature (1400ºC). See the purple lines on the phase diagram below.

5.) A liquid was slow cooled to 800°C resulted in 0.3 Al_3Ni and 0.7 Al_3Ni_2. What must the wt% Ni of the liquid been?

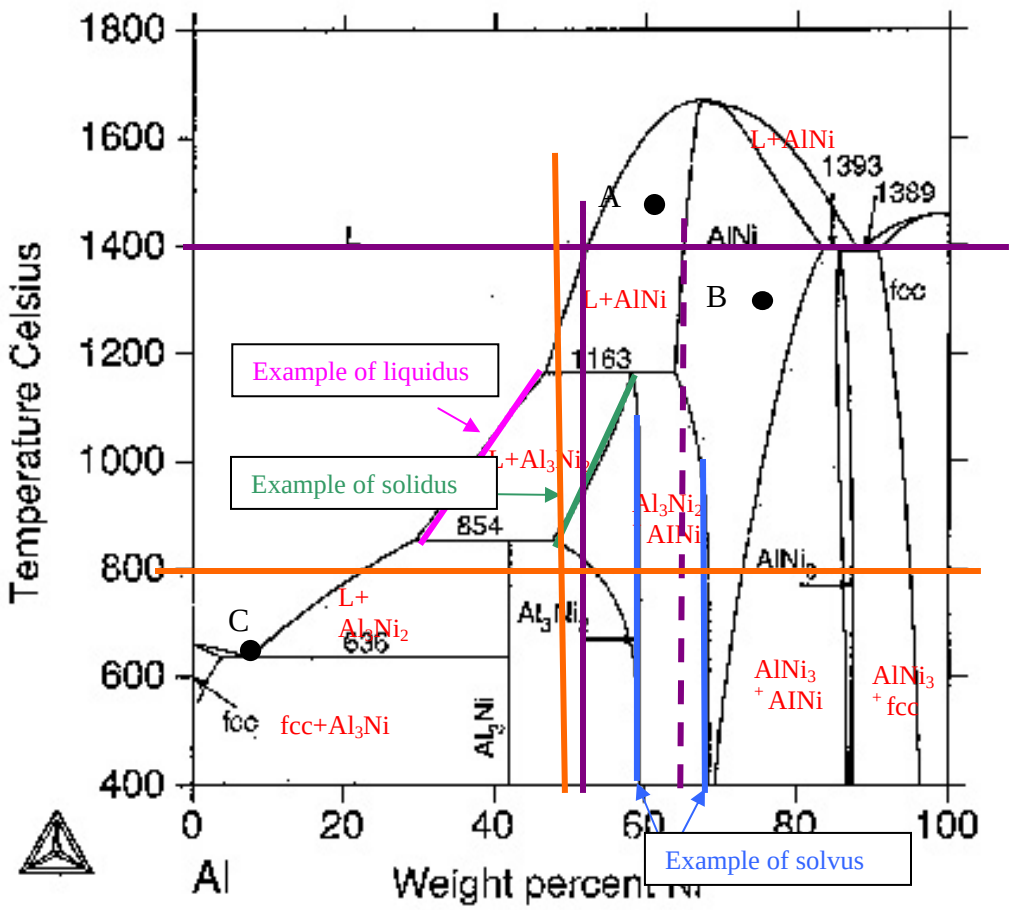
~50 wt% Ni, You can do this by estimating with the lever rule- so that the segment of line opposite the Al_3Ni section is about 30% of the whole line. See the set of orange lines on the phase diagram.

6.) Find the temperature and compositions of the invariant points and congruent melting points.

- There are three congruent points (regions where we go from solid to liquid without a two phase (solid + liquid) region//in other words, a direct transformation from one phase to another of the same composition). They are 0wt% Ni at 660°C, 100 wt% Ni at 1455, and 68 wt% Ni at 1638°C.
- There are two eutectics ($L \rightarrow \alpha + \beta$). They are at 8 wt% Ni at 636°C, 90 wt% Ni at 1389°C.
- There are 3 peritectics ($\delta + L \rightarrow \varepsilon$) at 58 wt% Ni at 1163°C, 42 wt% Ni at 855°C, and 88wt% Ni at 1393°C

7.) Discuss what compositions you think would be useful for high temperature applications.

AlNi has the highest melting point though other factors (such as mechanical properties) would need to be factored in for the final materials selection.



Al-Ni Crystal Structure Data

Phase	Pearson Symbol	Strukturbericht	Prototype	Model
fcc	cF4	A1	Cu	RK
Al_3Ni	oP16	$D0_{11}$	CFe_3	CE
Al_3Ni_2	hP5	$D5_{13}$	Al_3Ni_2	CE
AlNi	cP2	B2	CsCl	CE
$AlNi_3$	cP4	$L1_2$	$AuCu_3$	CE

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