3.091 OCW Scholar

# Self-Asessment

# Solid Solutions

# Supplemental Exam Problems for Study

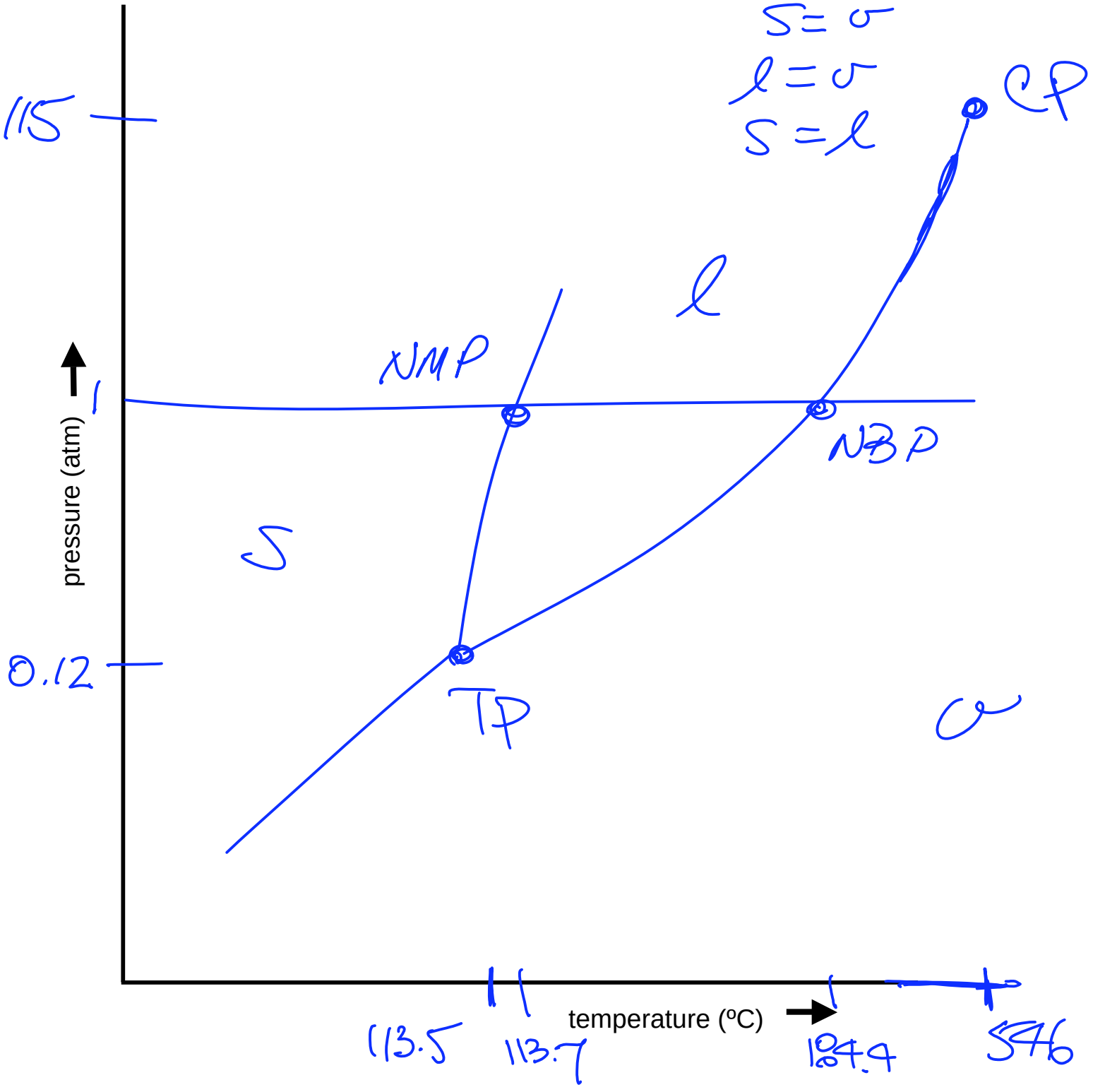
## Solutions Key

**2008 Final Exam, Problem #6**

Sketch the unary phase diagram (pressure *vs* temperature) of iodine (I). Indicate the normal melting point (P = 1 atm), normal boiling point, triple point, and critical point. Label all phase fields. Indicate on the diagram ***one example of each***: (i) one-phase stability; (ii) two-phase coexistence; (iii) three-phase coexistence. For clarity, do not draw to scale.

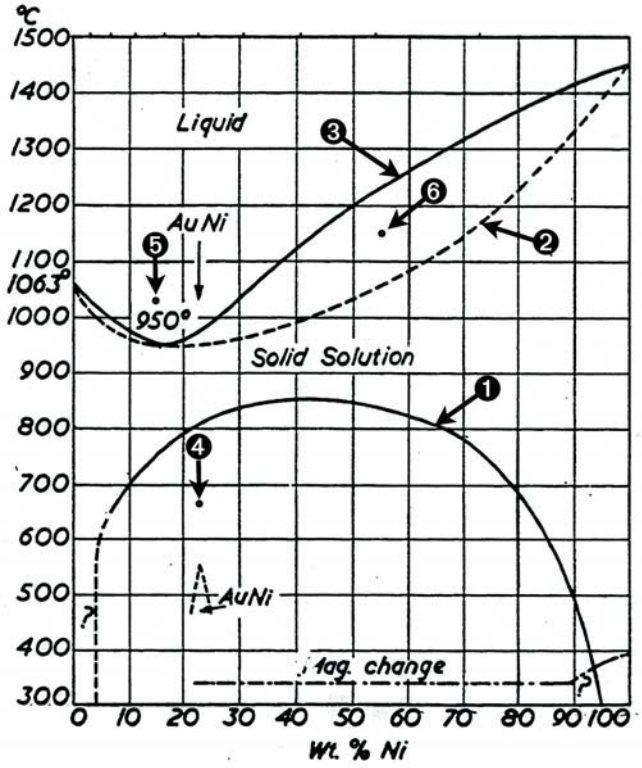
triple point: P = 0.12 atm, T = 113.5ºC

critical point: P = 115 atm, T = 546ºC



## 2008 Final Exam, Problem #8

The phase diagram of the binary system, gold-nickel (Au - Ni), is given below.






(a) (i) Name each of the lines labeled on the diagram above, and, for each, (ii) write the equilibrium it represents.

❶ Solvus $S = \alpha + \beta$

❷ Solidus $S = \alpha + L$

❸ Liquidus $l = \alpha + L$

(b) At each of the temperature-composition pairs labeled on the diagram above, (i) identify all phases present at equilibrium and (ii) give the composition of each phase present, expressed in wt % Ni.

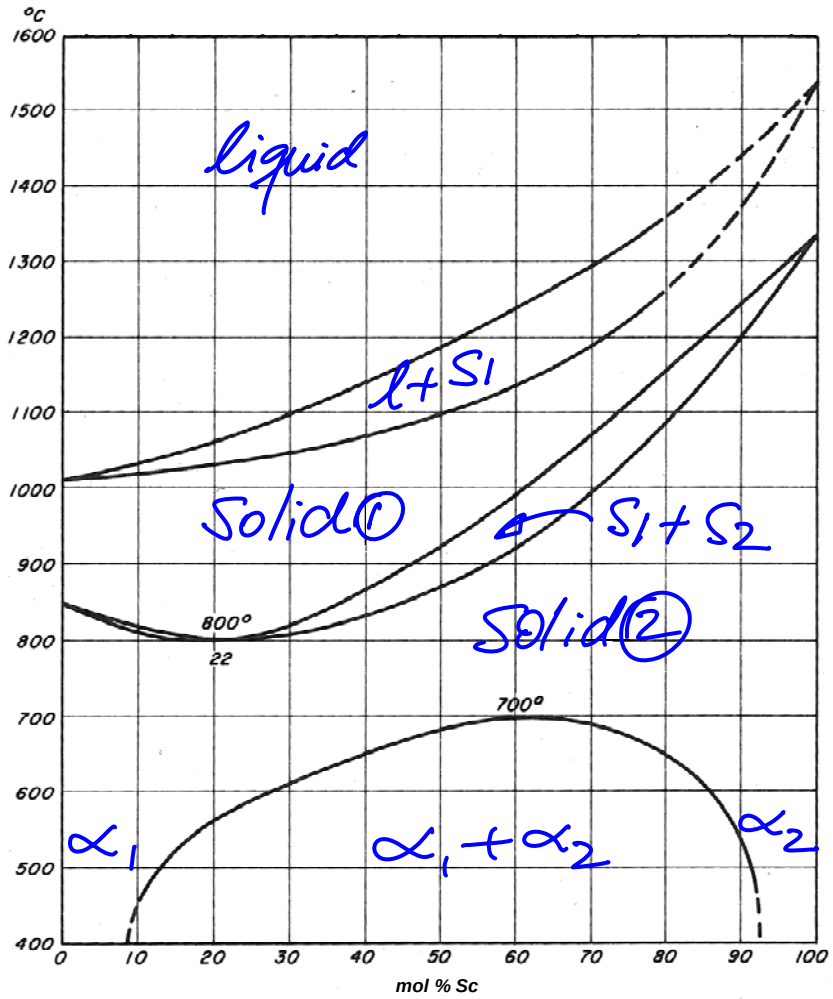
❹ $\alpha + \beta$ $\alpha \equiv 8$ wt % Ni $\beta \equiv 81$ wt % Ni

❺ $L$ 44 wt % Ni

❻ $\alpha + L$ $\alpha \equiv 70$ wt % Ni; $L \equiv 44$ wt % Ni

## 2007 Final Exam, Problem #9

The phase diagram of the binary system, neodymium-scandium (Nd-Sc), is given at right.




(a) On the diagram, label all phase fields identifying the phases present in each.

(b) An alloy with bulk composition 40 mol % Sc is heated to 500ºC and held at temperature for a long enough time to reach equilibrium. Calculate the relative amounts of all phases present.

Ⓟ = 2 ⇒ phase dgm ⇒ LEVER RULE

$$\%\ \text{Nd-rich phase} = \frac{92-40}{92-13}\times 100 = 66 \qquad \%\ \text{Sc-rich phase} = \frac{40-13}{92-13}\times 100 = 34$$

(c) Sc is frightfully expensive. Explain how to use this phase diagram to design a process to raise the Sc content from 50 mol % to something exceeding 80 mol %, starting with a 50:50 Nd-Sc alloy.

- heat alloy to T > 1200°C to melt
- cool to 1180°C & hold — take the solid which is ~70% Sc & melt that by heating to T > 1300°C
- cool to 1290°C & hold — the solid that forms will contain >80% Sc.

3.091SC Introduction to Solid State Chemistry

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