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.

1. **Solidus** \( S = \alpha + \beta \)

2. **Solidus** \( S = \alpha + L \)

3. **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.

4. \( \alpha + \beta \) \( \alpha = 80\% \text{ Ni} \); \( \beta = 81\% \text{ Ni} \)

5. \( L \) \( 4\% \text{ Ni} \)

6. \( \alpha + L \) \( \alpha = 70\% \text{ Ni} \); \( L = 44\% \text{ Ni} \)
The phase diagram of the binary system, neodymium-scandium (Nd-Sc), is given 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.

\[ \varnothing = 2 \Rightarrow \text{phase} \delta \Rightarrow \text{LEVER RULE} \]

\[ \% \text{Nd-rich phase} = \frac{92-40}{92-13} \times 100 = 66 \% \]

\[ \% \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 \( T > 1200 \)ºC to melt
- Cool to 1180ºC \& hold — take the solid which is \( \sim 70\% \) Sc
- Melt that by heating to \( T > 1300 \)ºC
- Cool to 1290ºC \& hold — the solid that forms will contain \( > 80\% \) Sc.