3.091 OCW Scholar

# Self-Assessment Exam
# Solid Solutions
# Solution Key

**State your assumptions and show calculations that support your conclusions.**

RESOURCES PERMITTED: PERIODIC TABLE OF THE ELEMENTS, TABLE OF CONSTANTS, AN AID SHEET (ONE PAGE 8½" × 11"), AND A CALCULATOR.

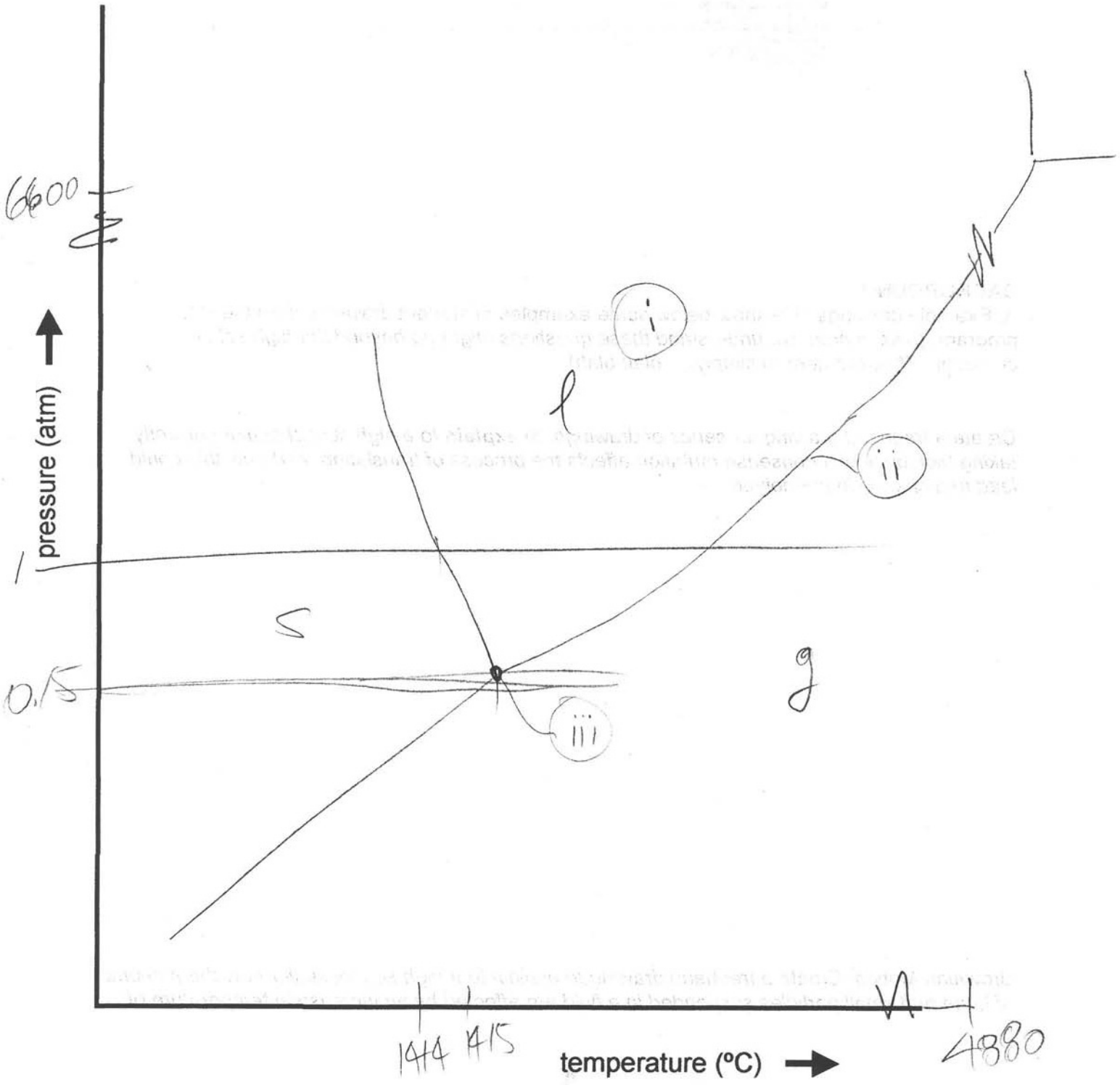
**NO BOOKS OR OTHER NOTES ALLOWED.**

## 2009 Final Exam, Problem #7

Sketch the unary phase diagram (pressure *vs* temperature) of silicon (Si). 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.

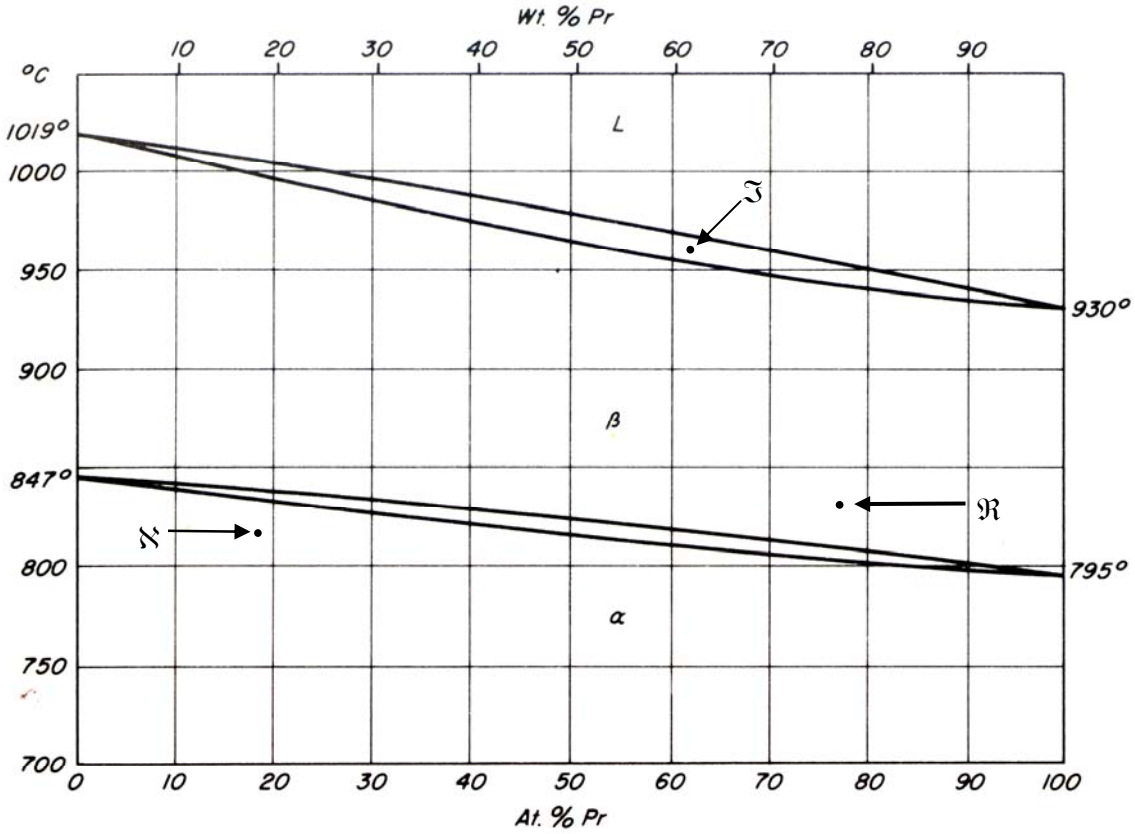
triple point: P = 0.15 atm, T = 1415ºC

critical point: P = 6600 atm, T = 4880ºC



## 2009 Final Exam, Problem #9

The phase diagram of the binary system, neodymium-praseodymium (Nd-Pr) is given below. There are two allotropes: α which is hexagonal close packed (HCP) and β which is body centered cubic (BCC).






(a) Explain why a lenticular phase diagram is to be expected for this binary system.

Hume Rothery rules apply ① Size similar ② Δχ small ③ xtal structure identical

(b) At each point (i) identify all phases present at equilibrium, (ii) state the composition of each phase, and (iii) calculate the relative amounts of all phases present.

① α S.S. 18 at % Pr

② β S.S + liq.

β is 54% Pr

liq is 68% Pr

$\%\,liq. = \frac{62-68}{54-68} \times 100 = 55\%$

$\%\,Solid = 45\%$

③ β SS 77 at % Pr.

3.091SC Introduction to Solid State Chemistry

Fall 2009