Question Number II /25

Two metallic elements (A and B) are completely miscible in the liquid state, but are partially soluble in each other In the solid state. There is a eutectic at 185 °C with 60 mass % A in B. The maximum solubility of A in B is 20 mass% and occurs at the eutectic temperature. The maximum solubility of B in A is 5 mass%, also at the eutectic temperature. At 150 °C, the solubilities are 10% A in B and 0.1% B in A. Pure A melts at 230 °C and pure B melts at 325 °C.

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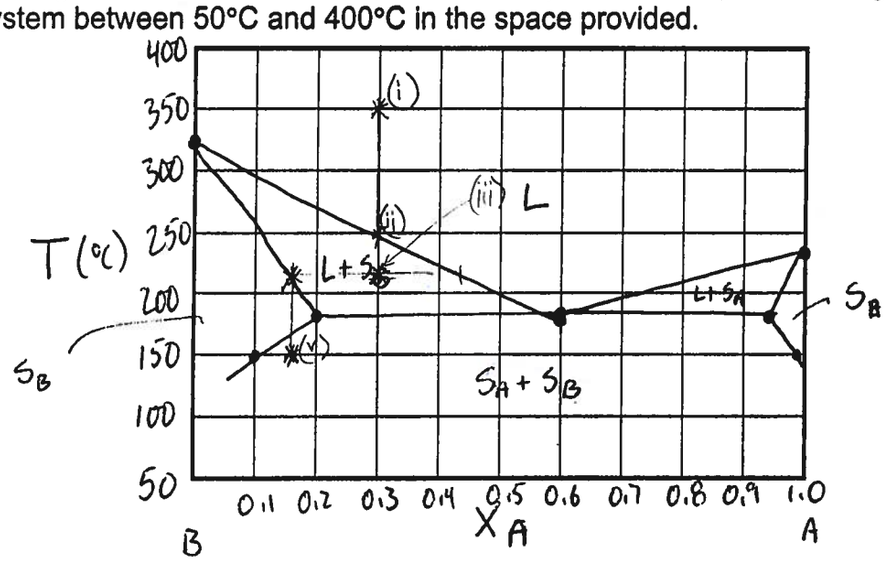
(a) Using the above information, draw a temperature-composition diagram for the A-B system between 50°C and 400°C in the space provided.



(b) A sample containing 14 kg of B and 6 kg of A is initially at 350°C. Answer the following questions:

(i) What is the mass fraction of A in the sample?

1

$$\frac{6\ kg}{14\ kg + 6\ kg} = 0.30 \text{ mass fraction A}$$

0.30 or 30%

(ii) The sample is then cooled. At which temperature will the first solid appear?

1.5

250 °C

(iii) The cooling of the sample continues until the sample is half liquid and half solid. At what temperature does this occur?

1.5

~215 °C

(iv) Identify the compositions (mass fraction A) of each phase at the temperature in part (iii).

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Liquid	Solid B
0.44 mass A	0.16 mass A

(v) The liquid phase In part (iv) is separated from the solid, and the liquid is discarded. The solid is then cooled to 150°C. Identify the phases present and their compositions.

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Phase 1		Phase 2	
Solid A	99.9% A	Solid B	10% A

(vi) What are the masses (in kilograms) of the two phases in part (v)?

4

20 kg total ~~total~~ 10kg total

$$\frac{M_A}{M_T} = \frac{0.16 - 0.10}{0.999 - 0.10} = 0.0667$$

$0.0667 \times 20\ kg = 1.33$ (10)

Solid A — Phase 1: 0.667 kg

$10 - 0.667 = 9.333$ kg

Solid B — Phase 2: 9.333 kg