



Quiz Question Prompts

Fundamentals of Phase Diagrams with Ansys Granta EduPack Software

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Ansys Software Used

This resource uses Ansys Granta EduPack™ teaching software for materials education.

Instructions

Below is a bank of multiple choice, True/False, and fill in the blank questions related to Phase Diagrams for use in courses. Solution keys and different formats are available to instructors- see ReadMe file for details.

Reading points from phase diagrams

1. What is the upper limit of solubility of tin in solid lead (Pb), at any temperature?
 - a. 18.3at%
 - b. 18.3 wt%
 - c. 2.2 at%
 - d. 2.2 wt%
2. The solubility of tin in solid (Pb) has a maximum at a temperature of ____ degrees Celsius
3. According to the Al-Cu phase diagram, the limit of copper solubility in solid aluminum is:
 - a. 33 wt%
 - b. 54 wt%
 - c. 6wt%
 - d. 0wt%
4. The maximum solubility of carbon in austenite is:
 - a. 2.14 wt%
 - b. 0.76wt%
 - c. 0.02 wt%
 - d. 4.30 wt%
5. The silica-alumina phase diagram has a eutectic reaction at a composition of ____ wt% alumina
6. The Fe-C phase diagram has a eutectic reaction at which composition?
 - a. 0.76 wt%
 - b. 2.14 wt%
 - c. 4.30 wt%
7. True/False: The copper-nickel phase diagram forms a complete solid solution across all compositions.

Identifying phases in given conditions

8. Which phases are present in the alloy Al-10wt%Cu at 600C?
 - a. 50wt% Al solid solution, 50wt% Liquid
 - b. 100% Theta phase
 - c. 100% copper Solid Solution

9. Which phases are present in equilibrium for a mixture of 80 wt% silica, 20 wt% Alumina at 1500 C?
- Liquid, Mullite
 - Cristobalite, Mullite
 - Alumina, Mullite
 - Mullite
10. Which phases are present in equilibrium for a Cu-65wt% Zn at 600 C?
- Gamma
 - Alpha
 - Alpha, Beta
 - Beta, Gamma
11. True/False: The eutectic temperature of the silica-alumina system is 1587 C
12. The melting point of pure aluminum is ____ C
13. True/False: The eutectic temperature of the Fe-C system is 727 C
14. On cooling, at what temperature does 50 wt% Cu-50 wt% Ni begin to solidify?
15. At what temperature does iron with 3wt% Carbon begin to melt?
16. What is the lowest melting temperature of any binary Pb-Sn alloy?

The Lever Rule, calculating weight fractions and compositions

17. In equilibrium, what weight percentage of the theta phase is present in Al-10 wt% Cu at 200 C?
18. In steel, when pearlite forms from austenite at the eutectoid temperature, what weight percentage of cementite is present?
19. A sample of silica-alumina contains 75 wt% mullite and 25 wt% alumina. What is its overall composition?
20. A hypoeutectoid steel is held at the eutectoid temperature. In total, it contains 90 wt% ferrite and 10 wt% cementite. If it was cooled slowly from liquid in equilibrium, what weight percentage of the steel is pearlite?

Reactions

21. Which of these best describes a peritectic reaction, where L is a liquid and A, B, C are solids?
- $A+L \rightarrow B$
 - $L \rightarrow A+B$
 - $A \rightarrow B+C$
 - $A+B \rightarrow C$

22. Which of these best describes a eutectic reaction, where L is a liquid and A, B, C are solids?

- a. $A+L \rightarrow B$
- b. $L \rightarrow A+B$
- c. $A \rightarrow B+C$
- d. $A+B \rightarrow C$

23. Which of these best describes a eutectoid reaction, where L is a liquid and A, B, C are solids?

- a. $A+L \rightarrow B$
- b. $L \rightarrow A+B$
- c. $A \rightarrow B+C$
- d. $A+B \rightarrow C$

Miscellaneous

The following questions are based on exam questions kindly shared by Andy Horsewell of DTU Denmark

24. How many single phase regions are shown in the Pb-Sn phase diagram?

25. From the Al-Mg phase diagram—what is the composition of maximum solid solubility of Mg in Al?

- a. 17 wt% Mg
- b. 36 wt% Mg
- c. 66 wt% Mg
- d. 100 wt% Mg

26. How many two-phase regions are there on the Pb-Sn diagram?

- a. 1
- b. 2
- c. 3
- d. 6

27. Which of these compositions of Pb-Sn alloy is best suited for soldering electronic components?

- a. 4 wt% Pb
- b. 40 wt% Pb
- c. 60 wt% Pb
- d. 95 wt% Pb

28. The Al-Cu system is used for precipitation hardening alloys. What is the composition of maximum solid solubility of Cu in Al?

- a. 6 wt% Cu
- b. 33 wt% Cu
- c. 54 wt% Cu
- d. 100 wt% Cu

29. What is the composition of the precipitates that can be formed by precipitation hardening (i.e. solution treating, quenching, and hardening) of an alloy containing 10 wt% Cu in Al?

- a. 6 wt% Cu
- b. 10 wt% Cu
- c. 54 wt% Cu
- d. 100 wt Cu

30. The Cu-Zn system is commonly known as brass. Which brass alloy is used to make musical instruments like trumpets and trombones, and gun cartridges? These components require a large amount of deformation during manufacture, such as rolling and deep-drawing, to make them.

- a. 30 wt% Zn
- b. 40 wt% Zn
- c. 65 wt% Zn
- d. Any of the above

31. Very slow cooling of mixtures of lead and tin produces an equilibrium phase diagram of the type known as a binary eutectic phase diagram. How many regions on the phase diagram show 2 phases in equilibrium?

- a. 1
- b. 2
- c. 3
- d. 4

32. Consider a molten alloy of Pb-Sn containing 80 wt% Sn at a temperature of 300C. We assume that Pb and Sn are homogeneously mixed in the liquid phase. Next, consider what happens as the melt is slowly cooled to room temperature. What is the composition of the last liquid just before solidification is complete?

- a. 18.3wt% Sn
- b. 61.9 wt%Sn
- c. 80 wt% Sn
- d. 100 wt% sn

33. The annealing at constant temperature of super-saturated alloy solid solutions of Al-Cu results in the following sequence of precipitation: GP zones—theta'' precipitates – theta' precipitates – theta precipitates. What is the equilibrium phases?

- a. GP zones
- b. Theta'' precipitates
- c. Theta' precipitates
- d. Theta precipitates

34. How many peritectic points are there in the Cu-Zn phase diagram?

35. What is the initial composition of the austenite that forms when 3 wt% carbon-steel is slow-cooled from the liquid phase?

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