GRANTA EduPack Quiz Questions with Solutions: Phase Diagrams

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Mike Ashby[1], Kaitlin Tyler[2], and Andy Horsewell[3]

[1]Department of Engineering, University of Cambridge
[2]Ansys
[3]DTU Denmark

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The goal of this resource is to provide a bank of choice, fill in the blank, and True/False questions related to Phase Diagrams for use in courses. Many questions are similar, allowing for rotation between classes and course years. These questions can also be found in a format compatible with Moodle and Blackboard within this teaching package. Some of these questions can also be found in this Granta Resource. Many thanks to Andy Horsewell of DTU Denmark for sharing some questions (#24-35).

This copy of the quiz questions contain answers written and/or highlighted in **bold**. Questions without answers can be found in another file within this teaching package.

This resource is part of the Ansys Granta Phase Diagram teaching package. The goal of this package is to provide a set of resources around introducing phase diagrams in the classroom. These resources were designed to be used separately or together, depending on the needs of the class and/or curriculum. Currently, the package contains the following resources:

- PowerPoint Lecture
- Student Note Sheet
- Exercise bank
- Quiz Question bank in Word, GIFT, and Blackboard LMS format
- Three MicroProjects
- Three concept map prompts

Note: the exercises, quiz questions, MicroProjects, and concept maps all contain a "student-friendly" version for use in the classroom and a solution manual.

These resources easily integrate with the MS&E database from GRANTA EduPack and use many figures and definitions from said software. Our hope is this package, combined with GRANTA EduPack, supports teaching phase diagrams across a wide range of courses.

Phase Diagram Quiz Questions

Topic: 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
    183
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

    7-9

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. The copper-nickel phase diagram forms a complete solid solution across all compositions.
    a. True
    b. False

Topic: 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% solica, 20 wt% Alumina at 1500 C?
    a. Liquid, Mullite
    b. Cristobalite, Mullite
    c. Alumina, Mullite
    d. Mullite

10. Which phases are present in equilibrium for a Cu-65wt% Zn at 600 C?
    a. **Gamma**
    b. Alpha
    c. Alpha, Beta
    d. Beta, Gamma
11. The eutectic temperature of the silica-alumina system is 1587 C
    a. **True**
    b. False
12. The melting point of pure aluminum is ____C

    660

13. The eutectic temperature of the Fe-C system is 727 C
    a. True
    b. **False**
14. On cooling, at what temperature does 50 wt% Cu-50 wt% Ni begin to solidify?
    1310-1340 C
15. At what temperature does iron with 3wt% Carbon being to melt?
    1147 C
16. What is the lowest melting temperature of any binary Pb-Sn alloy?
    183 C

Topic: 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?
    19±1
18. In steel, when pearlite forms from austenite at the eutectoid temperature, what weight percentage of cementite is present?
    10-12
19. A sample of silica-alumina contains 75 wt% mullite and 25 wt% alumina. What is its overall composition?
    79-82 wt% alumina
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?
    89-91 wt% pearlite

Topic: Reactions

21. Which of these bests describes a peritectic reaction, where L is a liquid and A, B, C are solids?
    a. **A+L→B**
    b. L→A+B
    c. A→B+C
    d. A+B→C

22. Which of these bests describes a eutectic reaction, where L is a liquid and A, B, C are solids?
    a. A+L→B
    b. L→A+B
    c. A→B+C
    d. A+B→C
23. Which of these bests describes a eutectoid reaction, where L is a liquid and A, B, C are solids?
    a. A+L→B
    b. L→A+B
    c. A→B+C
    d. A+B→C

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?]
    3
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?
    5
35. What is the initial composition of the austenite that forms when 3 wt% carbon-steel is slow-cooled from the liquid phase?
    1.2-1.5wt% Carbon

Document Information

This exercise unit is part of a set of teaching resources to help introduce students to materials, processes and rational selections.

Accuracy

The author(s) try hard to make sure that these resources are of a high quality. If you have any suggestions for improvements, please contact the author(s) by email. You may also write to the Ansys Granta Education Team with your suggestions at granta-education-team@ansys.com.

Ansys Granta Education Hub

For more information on Ansys GRANTA EduPack software and related teaching resources, please visit https://www.ansys.com/products/materials/granta-edupack/

Teaching Resources Website

The Teaching Resources website aims to support teaching of materials-related courses in design, engineering and science. Resources come in various formats and are aimed primarily at undergraduate education. Visit grantadesign.com/education/teachingresources/ to learn more.

There are 350+ resources on the Ansys Granta Education Hub. The resources include:

- Lecture presentations with notes
- Case studies
- Exercises with worked solutions
- Microprojects
- Recorded webinars
- White papers
- Solution manuals
- Interactive exercises

Some of the resources are open access and students can access them. Others are only available to educators using GRANTA EduPack.

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