

1. Sketch a general phase diagram between two solids A and B which form a peritectically melting compound A_2B and an eutectic somewhere between A_2B and B. Assume a homogeneity range for the solution of A_2B in A and for B in A_2B .
2. What do you know about the solubility of carbon in the different modifications of iron? How to describe the difference between an alloy and a conventional molecular compound with respect to the chemical composition?
3. How can we rationalize the chemical composition and the structure of the Zintl phase NaTl. Make a suggestion for the general structure of the Zintl phase NaSi.
4. Explain the basic structural concepts for the rationalization of Frank-Kasper and Laves phases.
5. Name defects in solids and explain their importance for the properties of materials. Sketch an "edge dislocation".
6. Defects in solids are inevitable also at low temperatures and in very pure and perfect materials. Give a thermodynamic justification.
7. Describe the essential characteristics of "Zintl-phases" and "Laves-phases". Give at least two examples for each group and describe them.
8. Write down the Curie law for paramagnetic materials and propose a suitable graphical representation that is mostly used in magneto chemistry. Explain the term "ferrimagnetism".
9. Describe the difference between the (magnetic) "orbital momentum" and the "spin momentum". What is the importance of the quantities "susceptibility" and "magnetization" for a given material?
10. What is the difference between "soft" and "hard" magnetic materials and which importance do they have for energy consumption considerations.
11. Name dielectric materials and describe their special properties. Explain the terms "ferroelectricity" and "piezoelectricity".
12. Superconductivity is close to a "physical miracle". What do you know about this physical property including historical aspects? Which class of materials is (among others) of high importance with respect to superconductivity. Sketch the basic structural properties of this materials class.
13. Describe and sketch the basic principles of a pn-junction, an LED and a solar cell. Which materials are of importance in this field of semiconductor devices?
14. ZrO_2 is a versatile material for different applications. Describe some of its properties by using suitable examples.