

## Materials Science - Examination questions

Questions set by dr Janusz Ćwiek

1. Present major groups/classes of engineering materials.
2. What does influence on material properties?
3. Crystalline structures of metals.
4. Defects of crystalline structure.
5. Atomic mechanisms of diffusion.
6. Solid solutions.
7. Intermediate phases and intermetallic compounds.
8. Draw and describe a binary thermal equilibrium diagram with complete solubility in solid state.
9. Draw and describe a binary thermal equilibrium diagram with complete insolubility in solid state.
10. Draw and describe a binary thermal equilibrium diagram with partial (limited) solubility in solid state.
11. Terms of eutectic and eutectoid mixture.
12. Phase and structural components of the Fe-Fe<sub>3</sub>C equilibrium system.
13. Draw and describe the Fe-Fe<sub>3</sub>C equilibrium diagram with phase or structural description.
14. Rate of a crystal nucleation and growth.
15. Homogenous and heterogenous nucleation of crystals.
16. Zone segregation in a cast ingot.
17. Pearlitic transformation; correlation between austenite and pearlite grains size.
18. Bainite and bainitic transformation.
19. Martensite and martensitic transformation.
20. Mechanisms of strengthening in metals.
21. Mechanisms of plastic deformation of metals.
22. Influence of strain (cold work) hardening on properties of metals.
23. Recovery after strain hardening.
24. Recrystallization after strain hardening.
25. Kinds of annealing operations with allotropic transformation.
26. Kinds of annealing operations without allotropic transformation.
27. Kinds of bulk quenching.

28. Surface quenching.
29. Kinds of tempering.
30. Time-Temperature-Transformation diagrams; draw an example for steel.
31. Hardenability of steel.
32. Draw and describe a stress-strain curve for the tensile test of steel.
33. Methods of hardness testing for metals.
34. Impact Charpy test.
35. Fatigue of materials; draw and describe a Wohler curve.
36. Heat-resistance and creep-resistance of metals.
37. Definition and general classification of steel.
38. Describe unalloyed steels.
39. Describe alloyed steels for case-hardening (carburising and nitriding), and toughening.
40. Describe alloyed tool steels.
41. Describe alloyed heat and creep resistance steels.
42. Describe alloyed stainless steels.
43. Describe cast steels.
44. Describe cast irons.
45. Describe aluminium alloys.
46. Describe copper alloys.
47. Principles of powder metallurgy.
48. Generation (constitution) methods of coatings and surface layers.
49. Base rules of materials selection.
50. Base principles of materials design.