

ChE 231 - Spring 2009 - Closed Book Question List

Chapter 1

- 1 Compare and contrast the typical physical properties of metals, ceramics, and polymers. (Generalization is expected; there will be specific exceptions to any statement you make.)

Chapter 2

- 6 Describe the different kinds of primary atomic bonds and how each type of primary atomic bond acts to fill the valence electron shells of individual atoms.
- 8 Describe how the electronegativity difference affects the ionic/covalent character of a bond.
- 10 Explain why some covalently-bonded molecules have low boiling points and others have high boiling points.

Chapter 3

- 12 Compare the BCC, FCC, and HCP crystal structures. Consider the arrangement of atoms, coordination, and packing density.
- 14 Describe the factors which determine the crystal structure of crystalline ceramic materials.

Chapter 4

- 22 Describe the crystalline structure of polymers and the factors which can affect the extent of crystallinity.

Chapter 5

- 24 Define the term solution. Describe the two kinds of solid solutions and the kinds of atoms that are involved in each.

Chapter 7

- 32 Explain the difference between strength and toughness and how they are measured on a stress-strain diagram. When is strength important and when is toughness important?
- 34 Explain the significance of a decrease in engineering stress as strain increases.
- 36 Describe three different typical stress-strain behaviors of polymers and relate this to temperature, crystallinity, and crosslinking.
- 37 Describe the possibilities for the strain response of a polymer subjected to a constant stress for a finite period of time, after which the stress is removed.

Chapter 8

- 41 Why is slip easier in FCC than in either HCP or BCC crystal structures?
- 45 Describe what happens to the grain structure of a cold-worked metal as it is held at an elevated temperature.

Chapter 9

- 50 Describe and explain the relationship between temperature, toughness, and brittle vs. ductile failure modes in metals. Need to connect ideas of slip, ductility, and toughness.

Chapter 10

- 55 Describe the possibilities for the solid atomic structure present when two dissimilar metals are mixed. Consider binary eutectic diagrams only.

- 56 Describe what happens (in terms of atomic and microscopic scale structure) to a liquid mixture of 20 wt% Ag in Cu as it is cooled to below 779 C. The phase diagram will be provided. Other materials and compositions could be substituted.
- 59 Describe the origin and equilibrium microstructure of hypereutectoid and hypoeutectoid steel.

Chapter 11

- 60 Explain the shape of the isothermal phase transformation diagram for plain-carbon steel. Include both nucleation and diffusion concepts in your answer.
- 61 Describe the microstructure and cooling process followed to form the various two-phase mixtures which can be formed by cooling austenite.
- 65 Explain how alloy steels can be used to make larger parts made of martensite.

ChE 231 - Spring 2009 - Open Book Question List

Chapter 3

- 1 Be able to calculate the coordination number, lattice constant, and atomic packing factor for FCC and BCC structures.
- 2 Be able to determine the crystal structure for ceramics, and calculate the packing factor the cubic ionic crystal structures given in the text (NaCl structure, CsCl structure, zinc blende structure, perovskite structure).
- 4 Be able to determine the atomic positions, directions and Miller indices in cubic unit cells.

Chapter 5

- 6 Be able to convert atomic percent to weight percent and vice-versa

Chapter 6

- 8 Be able to apply the solution to Fick's second law for a semi-infinite solid fixed a fixed concentration at the surface (The solution given by Equation 5.5)
- 9 Be able to apply the concept of activation energy and the effect of temperature on diffusion

Chapter 7

- 10 Be able to calculate engineering stress and strain, both tensile and shear.
- 11 Be able to apply the definitions of elastic modulus and shear modulus.

Chapter 8

- 14 Be able to calculate the amount of cold work in a material
- 15 Be able to develop a cold work / heat treatment process to meet a specified set of properties

Chapter 10

- 19 Be able to determine the phases present, the compositions and amounts of each phase present at a given temperature and overall composition (application of the lever rule)
- 20 Be able to calculate the amount of proeutectic and eutectic material for a given phase
- 22 Be able to identify the phases present on the Fe-C phase diagram and their structure
- 23 Be able to apply the lever rule on the Fe-C phase diagram
- 24 Be able to calculate the amount of proeutectoid versus eutectoid material for both hypoeutectoid and hypereutectoid steels

Chapter 11

- 26 Be able to describe how an isothermal transformation diagram is developed, and identify the phases present given a path or heat treatment