1-6 選擇題，7-20 簡答題，每題10分，總分200分

1. Silica exhibits ionic and covalent bonding. What fraction of the bonding is covalent? (The electronegativity of silicon is 1.8 and that of oxygen is 3.5) (a) 0.256 (b) 0.375 (c) 0.486 (d) 0.642

2. Diamond can be classified as a (a) metal (b) ceramic (c) polymer material.

3. A phosphor material with a bandgap of 3.5 eV with appropriate doping will be used to produce blue (475 nm) colors. Determine the energy level of the donor trap with respect to the conduction band. (a) 0.44 (b) 0.88 (c) 2.62 (d) 3.62 eV

4. Determine the degree of freedom in a Cu-40% Ni alloy at 1250 °C. (a) F=1 (b) F=2 (c) F=3 (d) F=4
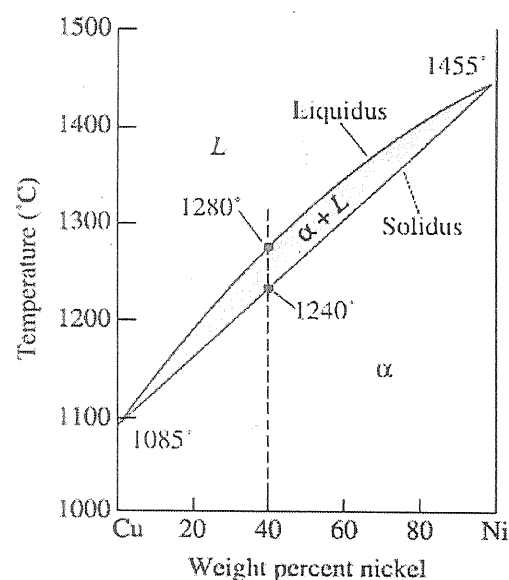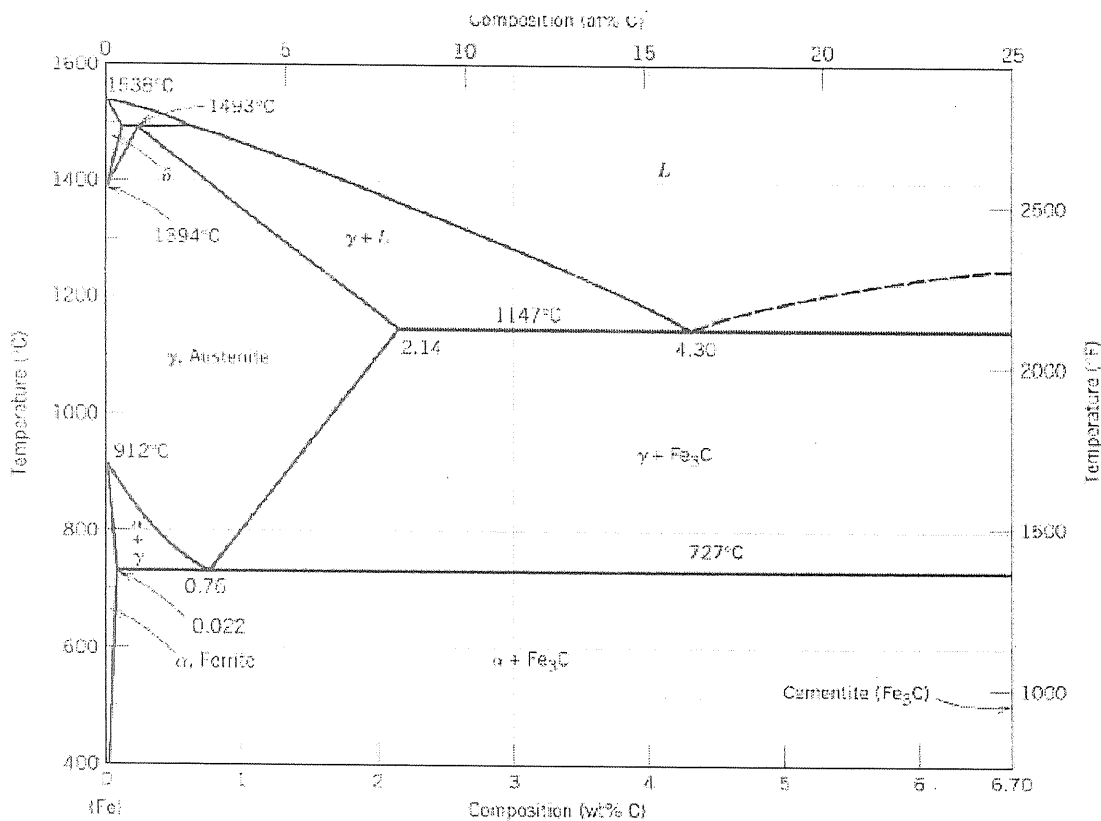
5. The reaction of $\gamma \rightarrow \alpha+\beta$ is called (a) eutectic (b) peritectic (c) monotectic (d) eutectoid reaction.
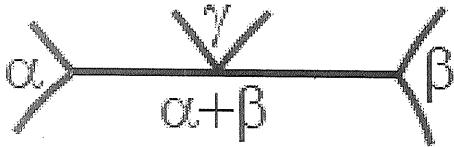
6. Austenite and Fe_3C are in equilibrium at 1000°C and 3 wt% C. What is the weight percent of iron carbide in the two-phase alloy?

(a) 27.6% (b) 72.4% (c) 50% (d) 66%

7. As shown in the above phase diagram, please calculate the amounts (ratio) of ferrite and cementite present in pearlite.

8. Calculate the packing factor for the BCC unit cell.

9. The lattice constant of GaAs is 5.65 Å. Calculate the theoretical density of

GaAs. (The molar mass of Ga is 69.72 g and that of As is 74.92g).

10. Draw the perovskite crystal structure of $CaTiO_3$.

11. The lattice constant of Si is 5.4307 Å. Calculate the radius of a silicon atom and the theoretical density of silicon. The atomic mass of Si is 28.09 g/mol.

12. Calculate the concentration of vacancies in copper at 25 °C. The lattice parameter of FCC copper is 0.36151 nm, and 83680 J are required to produce a mole of vacancies in copper.

13. Write the appropriate defect reactions for the incorporation of CaO in ZrO_2 using the Kröger-Vink notation.

14. Calculate the length of the Burgers vector in copper. (The lattice parameter of copper is 0.36151 nm)

15. Show the Hall-Petch equation.

16. What's the driving force for grain growth?

17. How to evaluate the tensile properties of ductile and brittle materials?

18. What's the difference between tensile toughness and impact toughness?

19. Fracture mechanics is the discipline concerned with the behavior of materials containing cracks or other small flaws. What are the factors that affect the growth of a crack in materials?

20. Show the conditions for unlimited solid solubility (Hume-Rothery rule).