招生學年度	101	招生類別	碩士班
系所班別	材料科學與工程學系碩士班		
科目	材料科學與工程		
注意事項	本考科可使用掌上型計算機		

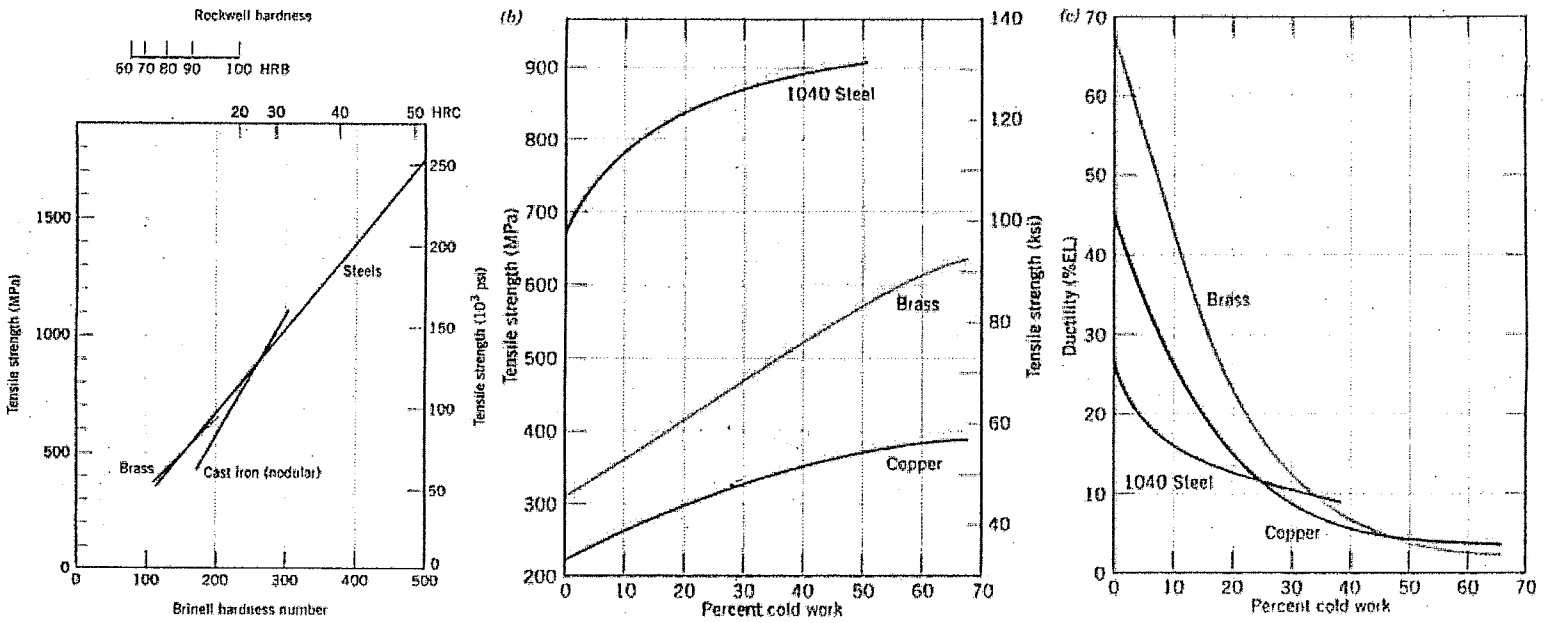
1. Define or explain the following terms in some sentence(s). You need to explain the names of the parameters you use. (42%)
(1) polymorphism, (2) twin boundary, (3) self-diffusion, (4) Hooke's law, (5) yield strength, (6) ductility, (7) toughness, (8) strain hardening, (9) fatigue limit, (10) creep, (11) eutectoid reaction, (12) Gibbs phase rule, (13) precipitation hardening, (14) homopolymers.

2. For a K^+-Cl^- ion pair, attractive and repulsive energies E_A and E_R, respectively, depend on the distance between the ions r, according to

$$E_A = -\frac{1.436}{r} \qquad E_R = \frac{5.86\times10^{-6}}{r^9}$$

For these expressions, energies are expressed in electron volts per K^+-Cl^- pair, and r is the distance in nanometers. The net energy E_N is just the sum of the two expressions above. Determine the minimum bonding energy, E_0. (5%)

3. Using the figures shown below, determine whether or not it is possible to cold work brass so as to give a minimum Brinell hardness of 130, and at the same time have a ductility of at least 32%EL. (5%)



4. Write structural formulas for the mers of the following polymers: (a) polyvinyl chloride, (b) polystyrene, and (c) polyacrylonitrile. (6%)

5. (a) Point out which materials have considerable plastic deformation under compressive stress at room temperature: covalent crystals, covalently bonded ceramics, single crystals of ionically bonded ceramics, or polycrystalline inoically bonded ceramics. (3%) (b) Explain why? (5%)

6. A galvanic cell consists of an electrode of zinc in a 0.01 M solution of $ZnSO_4$ and an electrode of copper in a solution of 0.05 M $CuSO_4$ at 25°C. What is the emf of the cell? (5%) ($Zn \rightarrow Zn^{2+} + 2e^-$, $E^0 = -0.763$ V; $Cu \rightarrow Cu^{2+} + 2e^-$, $E^0 = +0.337$ V)

7. Briefly illustrate three main mechanisms that reinforcing fibers can inhibit crack propagation in ceramic-matrix materials. (6%)

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8. Describe n-type and p-type extrinsic silicon semiconductors. (4%) And plot lnσ versus 1/T for an n-type extrinsic semiconductor and explain this curve in detail, where σ and T are conductivity of this semiconductor and absolute temperature, respectively. (4%)

9. Calculate a theoretical value for the saturation induction for iron, assuming all unpaired 3d electrons contribute to the magnetization. (Fe is BCC and a = 0.287 nm; each Fe atom has 4 Bohr magnetrons; atomic number of Fe: 26, μ_0: $4\pi\times10^{-7}$ T·m/A, μ_B: 9.27×10^{-24} A·m^2) (5%)

10. Illustrate the final microstructures produced after the phase transformation at different cooling rates. (10%)