科目：材料科學導論
考試時間：100 分鐘

系所：化學工程及材料工程學系
(無組別)
本科原始成績：100 分

是否使用計算機：是

1. Multiple choice questions (only **one correct answer** for each question below): (30%)

(1) Which one of the following types of stress–strain relationship best describes the behavior of brittle materials such as ceramics and thermosetting plastics: (A) elastic and perfectly plastic, (B) elastic and strain hardening, (C) perfectly elastic, (D) none of the above.

(2) The treatment in which the brittleness of martensite is reduced is called which one of the following? (A) aging, (B) annealing, (C) normalizing, (D) tempering.

(3) The Jominy end-quench test is designed to indicate which one of the following? (A) cooling rate, (B) ductility, (C) hardenability, (D) hardness.

(4) Which of the following properties is generally exhibited by amorphous solids? (A) anisotropy, (B) glass-transition, (C) equal strength of all bonds, (D) all of the mentioned.

(5) The Miller indices h, k, and l of parallel planes in a BCC lattice should satisfy which of the following X-ray diffraction reflection rules? (A) h + k + l should be even, (B) h, k, and l should all be either even or odd, (C) h, k, and l should form Pythagoras triplet, (D) all planes allow reflections.

(6) Burger vectors are relevant to which of the following crystalline defects? (A) point defects, (B) line defects, (C) interfacial defects, (D) bulk defects.

(7) The solubility of solute in a solvent in a solid solution is governed by Hume-Rothery rules. The solubility is more if: (A) radii of solute are much smaller than that of solvent, (B) solute and solvent have a similar crystal structure, (C) solute has low valence, (D) all of the mentioned.

(8) Interstitial diffusion is generally faster than diffusion by vacancy mode. This is because: (A) number of interstitial sites is greater than vacancies, (B) vacancy diffusion requires more energy than interstitial diffusion, (C) interstitial species are smaller than substitution species, (D) all of the mentioned.

(9) If a material is repelled in an external magnetic field then it is (A) ferromagnetic (B) diamagnetic (C) paramagnetic (D) antiferromagnetic.

(10) Which statement is **incorrect** regarding polymers/elastomers?

(A) Thermosets are highly cross-linked polymer chains that form a three-dimensional network structure.

(B) In thermosets, cross linking is not reversible; once formed, the thermosets cannot be refused or conveniently recycled.

(C) Vulcanization is a process which uses nitrogen atoms to link polymer chains in rubber.

(D) Thermoplastics such as polyethylene has a flexible linear chain structure (straight or branched)

國立高雄大學 109 學年度研究所碩士班招生考試試題

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2. Please draw the HCP crystal structure, and show that the ideal c/a ratio is 1.633. (10%)

3. Use the silver-copper phase diagram shown in Fig. 1. For a Cu-Ag alloy of 50 wt.% Ag, answer the following: (20%)

(a) Determine the phases present, compositions of the phases, and relative amounts (weight fractions) of the phases at a temperature **just above** the eutectic temperature.

(b) Determine the phases present, compositions of the phases, and relative amounts (weight fractions) of the phases when solidification is just complete (at a temperature **just below** the eutectic temperature).

(c) Sketch the 50 wt.% silver alloy at a temperature **just below** the eutectic temperature. Label both the phases and the microconstituents.

(d) Determine the fractional amounts (weight fractions) of microconstituents at a temperature **just below** the eutectic temperature.
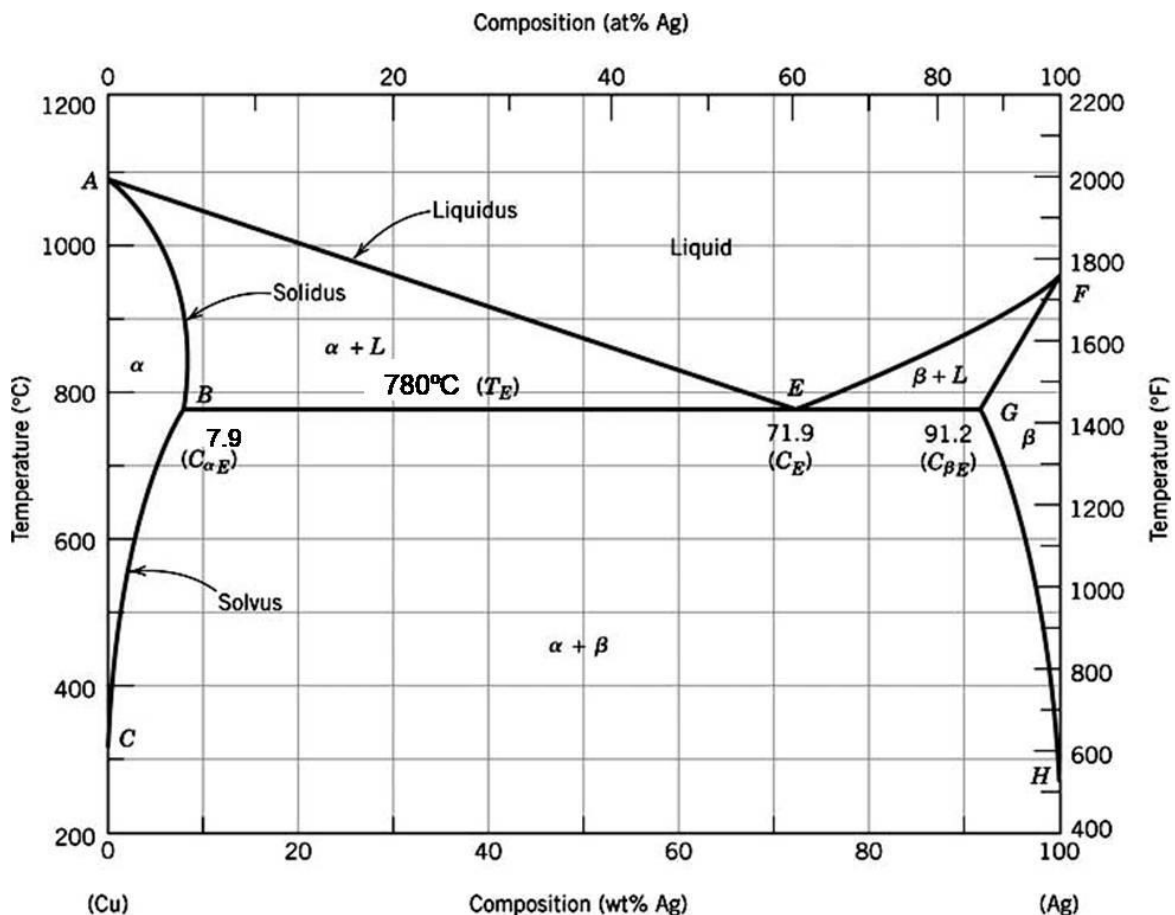

Fig. 1

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4. The microstructures of two precipitation hardenable aluminum alloy specimens of the same composition are shown below (Fig. 2). The magnification for both A and B micrographs is about 500x. Which specimen would have higher hardness? Briefly explain your answer. (10%)
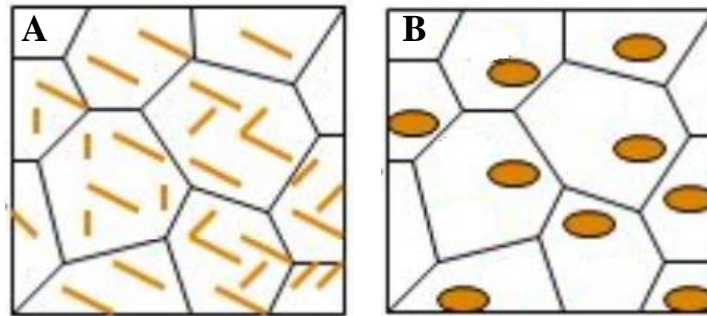

Fig. 2

5. Briefly describe the microstructure and characteristics of pearlite and spheroidite? Which is more stable, the pearlitic or the spheroiditic microstructure? Why? (10%)

6. The electrical conductivity and electron mobility for aluminum are 3.8×10^7 $(\Omega \cdot m)^{-1}$ and 0.0012 $m^2/V \cdot s$, respectively. Calculate the Hall voltage for an aluminum specimen that is 15 mm thick for a current of 25 A and a magnetic field of 0.6 tesla (imposed in a direction perpendicular to the current). (10%)

7. What three kinds of structural metals or alloys does "light metals" usually mainly include? Please write down the structure, properties and applications of these three metals. (10%)