國立雲林科技大學
99學年度碩士班暨碩士在職專班招生考試試題

系所：材料所
科目：材料科學導論(2)

1. The diffusion coefficients for copper in aluminum at 500 and 600 °C are 4.8×10^{-14} and 5.3×10^{-13} m^2/s, respectively. Determine the approximate time at 500 °C that will produce the same diffusion result (in terms of concentration of Cu at some specific point in Al) as a 10-h heat treatment at 600°C. (10%)
2. Consider a single crystal of BCC iron oriented such that a tensile stress is applied along a [010] direction. Compute the resolved shear stress along a (110) plane and in a [-111] direction when a tensile stress of 52 MPa (7500 psi) is applied. (10%)
3. Using the isothermal transformation diagram for an iron–carbon alloy of eutectoid composition (Figure 1), specify the nature of the final microstructure (in terms of microconstituents present and approximate percentages) of a small specimen that has been subjected to the following time–temperature treatments. In each case assume that the specimen begins at 760 °C and that it has been held at this temperature long enough to have achieved a complete and homogeneous austenitic structure. (a) Rapidly cool to 350 °C, hold for 10^4 s, and quench to room temperature. (b) Rapidly cool to 650 °C, hold for 20 s, rapidly cool to 400 °C hold for 10^3 s, and quench to room temperature. (10%)

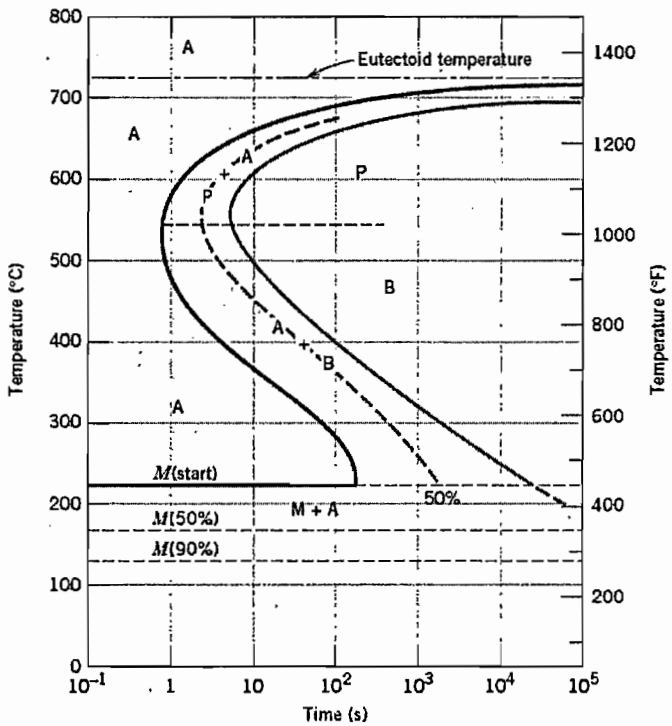

Figure 1 The complete isothermal transformation diagram for an iron–carbon alloy of eutectoid composition: A, austenite; B, bainite; M, martensite; P, pearlite.

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4. On the basis of crystal structure, compute the theoretical density for sodium chloride. The sodium and chlorine ionic radii are 0.102 and 0.181 nm, respectively. A_{Na} = 22.99 g/mol, A_{Cl} =35.45 g/mol. (10%)
5. Calculate the number of Schottky defects per cubic meter in potassium chloride at 500 °C. The energy required to form each Schottky defect is 2.6 eV, while the density for KCl (at 500 °C) is 1.955 g/cm^3. A_K = 39.10 g/mol, A_{Cl} =35.45 g/mol, Boltzmann's constant is $1.3806504 \times 10^{-23}$ J/K. (10%).
6. A high-molecular-weight polyethylene has an average molecular weight of 410,000 g/mol. What is its average degree of polymerization? (10%).
7. Define the following phases that exist in the Fe-Fe_3C phase diagram: (*a*) austenite, (*b*) α ferrite, (*c*) cementite, (*d*) δ ferrite. (10%).
8. In the solidification of a pure metal, what are the two energies involved in the transformation? Write the equation for the total free-energy change involved in the transformation of liquid to produce a strain-free solid nucleus by homogeneous nucleation. Find the critical size to form a stable nucleus. (10%).
9. According to electron energy band structure, explain electrical conductivities of metals, semiconductors, and insulators. (10%).
10. A plain-carbon steel contains 93 wt % ferrite and 7 wt % Fe_3C. What is its average carbon content in weight percent? (10%).

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科目：微積分(4)

注意:每題答案10分，共10題。

1) IF $f(x)=x^3-26, x\in[2,3]$, SHOW THAT THE FUNCTION f HAS ONLY ONE ZERO (零位) IN THE INTERVAL $[2,3]$.

2) APPROXIMATE $\sqrt[3]{26}$ BY
   a) DIFFERENTIAL METHOD,
   b) NEWTON METHOD: FIND THE NEXT SOLUTION IF THE INITIAL SOLUTION 3 IS GIVEN.

3) SOLVE $\frac{dW}{dt}=kW(t)$, WITH $W(0)=M$ AND $k<0.$; THEN FIND THE HALF-LIFE (半衰期).

4) a) G IVE THE DEFINITION OF THE DIRECTIONAL DERIVATIVE (方向導數) OF $Z=F(X,Y)$ AT THE POINT (a,b) WITH THE DIRECTION VECTOR $U=(\alpha,\beta)$.
   b) FIND THE DIRECTION OF MAXIMUM INCREASE OF F.

5) IF $E=\{(x,y)|\frac{x^2}{9}+\frac{y^2}{16}\le 1\}$, FIND THE AREA OF E.

6. *If* $\lim_{x\to 0}\left(\frac{\sin 2x}{x}+\frac{1-\cos x}{x}+\frac{1-\cos x}{x^2}\right)=a$, *find* a.

7. *Find* $\int_0^{\pi/2}\sin 2\theta\ d\theta$.

8. *Is* $\sum_{n=8}^{\infty}\frac{1}{n\ln n}$ *convergent?*

9. *Find the Maclaurin series for* $\ln(1+x)$.

10. *Find the relative extrema of* $f(x)=x^3+y^3+3xy+3$.