

系所組別： 奈米科技暨微系統工程研究所

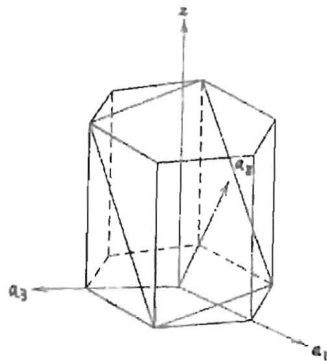
考試科目： 材料科學

考試日期： 0219，節次： 3

※ 考生請注意：本試題 可 不可 使用計算機

1. Please determine the percent ionic character of the interatomic bond for  $\text{TiO}_2$ .  
The electronegativities of Ti and O are 1.5 and 3.5, respectively. (15%)

2. Determine the index for the plane shown in the hexagonal unit cell given below.  
(10%)



3. Molybdenum forms a substitutional solid solution with tungsten. What is the weight percent of molybdenum that must be added to tungsten to yield an alloy that contains  $1 \times 10^{22}$  Mo atoms per cubic centimeter. The densities of pure Mo and W are 10.22 and 19.30 g/cc, respectively. The molecular weights of Mo and W are 95.94 and 183.85 g/mol, respectively. (15%)

4. When  $\alpha$ -iron is subjected to an atmosphere of hydrogen gas, the concentration of hydrogen in the iron,  $C_H$  (in weight percent), is a function of hydrogen pressure,  $p_{H_2}$  (in MPa), and absolute temperature ( $T$ ) according to

$$C_H = 1.34 \times 10^{-2} \sqrt{p_{H_2}} \exp\left(-\frac{27.2 \text{ kJ/mol}}{RT}\right)$$
 Furthermore, the values of  $D_0$  and  $Q_d$  for this diffusion system are  $1.4 \times 10^{-7} \text{ m}^2/\text{s}$  and 13,400 J/mol, respectively. Consider a thin iron membrane 1 mm thick that is at 250 °C. What is the diffusion flux

through this membrane if the hydrogen pressure on one side of the membrane is 0.15 MPa (1.48 atm), and on the other side 7.5 MPa (74 atm). The density of iron is 7.87 g/cc. (15%)

(背面仍有題目,請繼續作答)

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5. For a bronze alloy, the stress at which plastic deformation begins is 275 MPa (40,000 psi), and the modulus of elasticity is 115 GPa ( $16.7 \times 10^6$  psi). What is the maximum load that may be applied to a specimen with a cross-sectional area of 325 mm<sup>2</sup> (0.5 in<sup>2</sup>) without plastic deformation? (15%)
6. A single crystal of aluminum is oriented for a tensile test such that its slip plane normal makes an angle of 28.1° with the tensile axis. Which of the following slip directions is most favored? (15%)
7. A fatigue test was conducted in which the mean stress was 50 MPa (7250 psi) and the stress amplitude was 225 MPa (32,625 psi). What is the magnitude of the stress range? (15%)