

# 國立臺北科技大學九十八學年度碩士班招生考試

系所組別：3301 材料科學與工程研究所不分組

## 第二節 工程材料 (選考) 試題

第一頁 共一頁

### 注意事項：

1. 本試題共八題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

一、Please explain or define the following terms: (每小題 5%，計 25%)

- (1) Hardenability
- (2) Tempered Martensite
- (3) Plane strain fracture toughness  $K_{IC}$
- (4) MMC (Metal-Matrix Composites)
- (5) Carbon Nanotubes

二、Please cite the three different strengthening mechanism in metals, and explain them in detail? (15%)

三、What is the Creep? Please draw the picture and explain the three steps of creep? (10%)

四、Briefly describe the phenomenon of passivity. Name two common types of alloy that passivate. (10%)

五、A cylindrical specimen of steel having an original diameter of 12.8 mm (0.505 in) is tensile tested to fracture and found to have an engineering fracture  $\sigma_f$  of 460 MPa (67,000 psi). If its cross-sectional diameter at fracture is 10.7 mm (0.422 in), determine: (每小題 5%，計 10%)

- (a) The ductility in terms of percent reduction in area;
- (b) The true stress at fracture?

*Handwritten notes:*  
 $\ln \frac{A_0}{A_f} = \ln \frac{12.8^2}{10.7^2} = \ln \frac{163.84}{114.49} = \ln 1.431 = 0.358$   
 $\epsilon = 0.358 \times 100 = 35.8\%$   
 $\sigma_t = \sigma_f \left( \frac{A_0}{A_f} \right) = 460 \times 1.431 = 658.36 \text{ MPa}$

六、The activation energy for diffusion of copper in silver is 193,000 J/mol. Calculate the diffusion coefficient at 927 °C, given that D at 727 °C is  $1.0 \times 10^{-14} \text{ m}^2/\text{s}$ . (10%)

七、For the following pairs of alloys (Table 1) that are coupled in seawater, predict the possibility of corrosion; if corrosion is possible, note which metal/alloy will corrode? (每小題 2%，計 10%)

- (a) Aluminum and Magnesium
- (b) Zinc and Low-carbon steel
- (c) Brass (60Cu-40Zn) and Monel couple (70Ni-30Cu)
- (d) Titanium and 304 Stainless steel
- (e) Cast iron and 316 Stainless steel

Table 1 The Galvanic Series

	Platinum
	Gold
	Graphite
	Titanium
	Silver
	316 Stainless steel (passive)
	304 Stainless steel (passive)
	Inconel (80Ni-13Cr-7Fe) (passive)
	Nickel (passive)
	Monel (70Ni-30Cu)
	Copper-nickel alloys
	Bronzes (Cu-Sn alloys)
	Copper
	Brasses (Cu-Zn alloys)
	Inconel (active)
	Nickel (active)
	Tin
	Lead
	316 Stainless steel (active)
	304 Stainless steel (active)
	Cast iron
	Iron and steel
	Aluminum alloys
	Cadmium
	Commercially pure aluminum
	Zinc
	Magnesium and magnesium alloys

Sources: M. G. Fontana, *Corrosion Engineering*, 3rd edition. Copyright 1986 by McGraw-Hill Book Company. Reprinted with permission.

八、Would you expect any correlation between the successive jump vectors of a tracer in a pure metal if diffusion occurs by

- (a) A vacancy mechanism
- (b) An interstitial mechanism

Please briefly explain your answer. (每小題 5%，計 10%)