

所別： 材料工程研究所 組別： \_\_\_\_\_ 科目： 材料科學導論

注意： ☐ 不准 ☐ 一般計算器 ☒ 工程用計算器，考試時間總計：100 分鐘。試題共 1 頁，第 1 頁

1. What is the coordination number of the BCC crystal structure?  
Please draw a picture to explain your answer. (10%)
2. Please explain the edge、screw and mixed dislocation. (30%)
3. Please explain the formation of Martensite. (20%)
4. 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  $[\bar{1}11]$  direction when a tensile stress of 52 MPa is applied. (20%)
5. For some applications, it is necessary to harden the surface of steel above that of its interior. One way this may be accomplished is by increasing the surface concentration of carbon in a process termed carburizing; the steel piece is exposed, at an elevated temperature, to an atmosphere rich in a hydrocarbon gas, such as methane ( $\text{CH}_4$ ). Consider one such alloy that initially has a uniform carbon concentration of 0.25 wt% and is to be treated at  $950^\circ\text{C}$ . If the concentration of carbon at the surface is suddenly brought to and maintained at 1.20 wt%, how long will it take to achieve a carbon content of 0.80 wt% at a position 0.5 mm below the surface? The diffusion coefficient for carbon in iron at this temperature is  $1.6 \times 10^{-11} \text{ m}^2/\text{s}$ ; assume that the steel piece is semi-infinite. (20%)

**Table      Tabulation of Error Function Values**

| $z$   | $\text{erf}(z)$ | $z$  | $\text{erf}(z)$ | $z$ | $\text{erf}(z)$ |
|-------|-----------------|------|-----------------|-----|-----------------|
| 0     | 0               | 0.55 | 0.5633          | 1.3 | 0.9340          |
| 0.025 | 0.0282          | 0.60 | 0.6039          | 1.4 | 0.9523          |
| 0.05  | 0.0564          | 0.65 | 0.6420          | 1.5 | 0.9661          |
| 0.10  | 0.1125          | 0.70 | 0.6778          | 1.6 | 0.9763          |
| 0.15  | 0.1680          | 0.75 | 0.7112          | 1.7 | 0.9838          |
| 0.20  | 0.2227          | 0.80 | 0.7421          | 1.8 | 0.9891          |
| 0.25  | 0.2763          | 0.85 | 0.7707          | 1.9 | 0.9928          |
| 0.30  | 0.3286          | 0.90 | 0.7970          | 2.0 | 0.9953          |
| 0.35  | 0.3794          | 0.95 | 0.8209          | 2.2 | 0.9981          |
| 0.40  | 0.4284          | 1.0  | 0.8427          | 2.4 | 0.9993          |
| 0.45  | 0.4755          | 1.1  | 0.8802          | 2.6 | 0.9998          |
| 0.50  | 0.5205          | 1.2  | 0.9103          | 2.8 | 0.9999          |