

所別： 材料工程研究所 組別： _____ 科目： 材料導論

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 2 頁，第 1 頁

- What is the coordination number of the BCC and FCC crystal structure?
Please draw a picture to explain your answer. (10%)
- Please explain the edge, screw and mixed dislocation. (15%)
- Please explain the strengthening mechanisms in metal. (15%)
- At room temperature the electrical conductivity and the electron mobility for copper are $6.0 \times 10^7 (\Omega \cdot m)^{-1}$ and $0.0030 m^2/V \cdot s$, respectively. Please compute the number of free electrons per cubic meter for copper at room temperature. (20%)
- A coil of wire 0.30 m long and having 200 turns carries a current of 15 A.
 - What is the magnitude of the magnetic field strength H ? (5%)
 - Compute the flux density B if the coil is in a vacuum. (5%)
(Note: μ_0 is the permeability of a vacuum, $1.257 \times 10^{-6} H/m$)
 - Compute the flux density inside a bar of titanium that is positioned within the coil. (5%)
(Note: The susceptibility shown in below Table.)
 - Compute the magnitude of the magnetization M . (5%)

Room-Temperature Magnetic Susceptibilities for Diamagnetic and Paramagnetic Materials

<i>Diamagnetics</i>		<i>Paramagnetics</i>	
<i>Material</i>	<i>Susceptibility χ_m (volume) (SI units)</i>	<i>Material</i>	<i>Susceptibility χ_m (volume) (SI units)</i>
Aluminum oxide	-1.81×10^{-5}	Aluminum	2.07×10^{-5}
Copper	-0.96×10^{-5}	Chromium	3.13×10^{-4}
Gold	-3.44×10^{-5}	Chromium chloride	1.51×10^{-3}
Mercury	-2.85×10^{-5}	Manganese sulfate	3.70×10^{-3}
Silicon	-0.41×10^{-5}	Molybdenum	1.19×10^{-4}
Silver	-2.38×10^{-5}	Sodium	8.48×10^{-6}
Sodium chloride	-1.41×10^{-5}	Titanium	1.81×10^{-4}
Zinc	-1.56×10^{-5}	Zirconium	1.09×10^{-4}

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6. Nitrogen from a gaseous phase is to be diffused into pure iron at 700°C. If the surface concentration is maintained at 0.1 wt% N, what will be the concentration 1 mm from the surface after 10 h? The diffusion coefficient for nitrogen in iron at 700°C is $2.5 \times 10^{-11} \text{ m}^2/\text{s}$, please utilize the below table of error function to provide your answer. (20%)

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