Name____

Exam #1
14 September 2022

Instructions:

1. **Read** every problem CAREFULLY!
2. Make sure your answer addresses **each part** of the problems.
3. Make sure your answer is clearly marked by a circle or **box around the answer**.
4. Be sure to include the **proper units** with your answer and use 3 significant figures.
5. You may use a calculator for basic calculations.

Potentially Useful Information (continues on next page)

Constants

k = 8.617×10^{-5} eV/K
= 1.381×10^{-23} J/K

h = 6.626×10^{-34} J·s

$m_e = 9.11\times 10^{-31}$ kg

$N_A = 6.022 \times 10^{23}$ atoms/mole

R = 8.3145 J/(K·mol)

c = 3.00×10^{8} m/s

e = 1.60×10^{-19} C

1 eV = 1.60×10^{-19} J

Basics

$$n_i = \frac{w_i / M_i}{\frac{w_1}{M_1} + \frac{w_2}{M_2} + \ldots + \frac{w_N}{M_N}}$$

$$w_B = \frac{n_B M_B}{n_A M_A + n_B M_B + n_C M_C + \ldots}$$

$$\rho = \frac{\sum(\text{Number of atoms of given type in unit cell} \times \text{Atomic mass of this type})}{\text{Volume of unit cell}}$$

$$PV = \left(\frac{N}{N_A}\right)RT$$

$$L = L_0[1+\lambda(T - T_0)]$$

$$n_v = N \exp\left(-\frac{E_v}{kT}\right)$$

$$D = D_o \exp\left(-\frac{E_A}{kT}\right)$$

$$L_{rms} = \sqrt{2Dt}$$

Drude Model/Metals

$\sigma = en\mu$

$\lambda = u\tau$

$\tau = \frac{\mu m_e}{e}$

$R_H = -\frac{1}{en}$

$\rho = \rho_0[1 + \alpha_0 \Delta T]$

$\rho_{alloy}\alpha_{alloy} = \rho_{pure}\alpha_{pure}$

$\rho_{alloy} = \rho_{pure} + CX(1\text{-}X)$

$$\frac{\sigma - \sigma_c}{\sigma + 2\sigma_c} = \chi \frac{\sigma_d - \sigma_c}{\sigma_d + 2\sigma_c}$$

Surface scattering: $\frac{\rho_{\text{film}}}{\rho_{\text{crystal}}} = 1 + (3/8)\frac{\lambda}{D}(1-p)$

Grain boundaries: $\rho_{\text{film}} = \frac{\rho_{\text{crystal}}}{1-(3/2)\beta + 3\beta^2 - 3\beta^3 \ln(1+\beta^{-1})}$; $\beta = \frac{\lambda}{d}\left(\frac{R}{1-R}\right)$

Power = IV = I^2R = V^2/R