

UNIVERSITI TEKNIKAL MALAYSIA MELAKA  
FAKULTI KEJURUTERAAN MEKANIKAL

BMCB 2423 – MATERIALS SCIENCE

TUTORIAL 3

1. Calculate the number of vacancies per cubic meter in gold at 900°C. The energy for vacancy formation is 0.98 eV/atom. Furthermore, the density and atomic weight for Au are 18.63 g/cm<sup>3</sup> (at 900°C) and 196.9 g/mol, respectively.
2. Calculate the energy for vacancy formation in silver, given that the equilibrium number of vacancies at 800°C (1073 K) is  $3.56 \times 10^{23} \text{ m}^{-3}$ . The atomic weight and density at 800°C for silver are 107.9 g/mol and 9.5 g/cm<sup>3</sup>.
3. Below are listed the atomic radius, crystal structure, electronegativity and the most common valence for several elements. For those that are nonmetals, only atomic radii are indicated.

Element	Atomic radius (nm)	Crystal structure	Electro-negativity	valence
Ni	0.1246	FCC	1.8	+2
C	0.071			
H	0.046			
O	0.060			
Ag	0.1445	FCC	1.9	+1
Al	0.1431	FCC	1.5	+3
Co	0.1253	HCP	1.8	+2
Cr	0.1249	BCC	1.6	+3
Fe	0.1241	BCC	1.8	+2
Pt	0.1387	FCC	2.2	+2
Zn	0.1332	HCP	1.6	+2

Which of these elements would you predict to form the following with nickel, Ni:

- (a) A substitutional solid solution having complete solubility.
- (b) A substitutional solid solution of incomplete solubility.
- (c) An interstitial solid solution.

Justify your answer.

4. Calculate the composition, in weight percent, of an alloy that contains 105 kg of iron, 0.2 kg of carbon and 1.0 kg of chromium.
5. What is the composition, in atom percent, of an alloy that contains 20.19 kg of silver, 37.97 kg of gold and 2.4 kg of copper?
6. What is the composition, in atom percent, of an alloy that contains 33 g copper and 47 g zinc?
7. Calculate the number of atoms per cubic meter in lead.
8. Determine the ASTM grain size number if 30 grains per square inch are measured at a magnification of 250.