ME1205 MATERIALS SCIENCE
TUTORIAL 1

1. Calculate the number of atoms contained in a cylinder 1μm in diameter by 1μm deep of (a) magnesium and (b) lead.
2. One mole of solid MgO occupies a cube 22.37 mm on a side. Calculate the density of MgO (in g/cm^3). Calculate the mass of an MgO refractory brick with dimensions: 50 mm × 100 mm × 200 mm.
3. Calculate the dimensions of (a) cube containing 1 mol of copper and (b) a cube containing 1 mol of lead.

2.6 Allowed values for the quantum numbers of electrons are as follows:

$$n = 1, 2, 3, \ldots$$
$$l = 0, 1, 2, 3, \ldots, n-1$$
$$m_l = 0, \pm 1, \pm 2, \pm 3, \ldots, \pm l$$
$$m_s = \pm \tfrac{1}{2}$$

The relationships between n and the shell designations are noted in Table 2.1. Relative to the subshells,

$l = 0$ corresponds to an s subshell
$l = 1$ corresponds to a p subshell
$l = 2$ corresponds to a d subshell
$l = 3$ corresponds to an f subshell

For the K shell, the four quantum numbers for each of the two electrons in the 1s state, in the order of nlm_lm_s, are $100(\frac{1}{2})$ and $100(-\frac{1}{2})$.

Write the four quantum numbers for all of the electrons in the L and M shells, and note which correspond to the s, p, and d subshells.

2.7 Give the electron configurations for the following ions: Fe^{2+}, Fe^{3+}, Cu^{+}, Ba^{2+}, Br^{-}, and S^{2-}.

2.8 Cesium bromide (CsBr) exhibits predominantly ionic bonding. The Cs^{+} and Br^{-} ions have electron structures that are identical to which two inert gases?

2.9 With regard to electron configuration, what do all the elements in Group VIIA of the periodic table have in common?

2.10 Without consulting Figure 2.6 or Table 2.2, determine whether each of the electron configurations given below is an inert gas, a halogen, an alkali metal, an alkaline earth metal, or a transition metal. Justify your choices.

(a) $1s^22s^22p^63s^23p^63d^74s^2$.
(b) $1s^22s^22p^63s^23p^6$.
(c) $1s^22s^22p^5$.
(d) $1s^22s^22p^63s^2$.
(e) $1s^22s^22p^63s^23p^63d^24s^2$.
(f) $1s^22s^22p^63s^23p^64s^1$.

2.13 The net potential energy between two adjacent ions, E_N, may be represented by the sum of Equations 2.8 and 2.9, that is,

$$E_N = -\frac{A}{r} + \frac{B}{r^n}$$

Calculate the bonding energy E_0 in terms of the parameters A, B, and n using the following procedure:

1. Differentiate E_N with respect to r, and then set the resulting expression equal to zero, since the curve of E_N versus r is a minimum at E_0.

2. Solve for r in terms of A, B, and n, which yields r_0, the equilibrium interionic spacing.

3. Determine the expression for E_0 by substitution of r_0 into Equation 2.11.

2.17 **(a)** Briefly cite the main differences between ionic, covalent, and metallic bonding.

(b) State the Pauli exclusion principle.