

MATRL 100A: Structure and Properties I, assignment 4

This is a practice midterm exam. In the exam, you would be allowed a simple periodic table (not with the configurations) and a calculator.

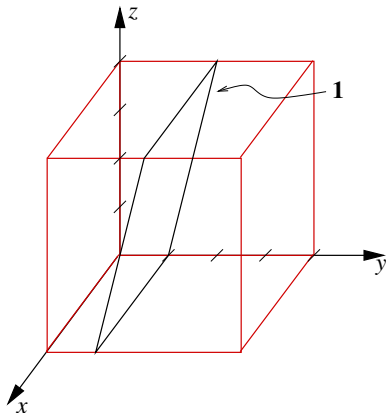
Each question carries ten points. Please read the questions carefully.

1. Iridium (Ir) is one of the heaviest elements, with a density $\rho = 22.55 \text{ g cm}^{-3}$. The cubic unit cell parameter of Ir is $a = 3.84 \text{ \AA}$.

- (a) Use the data to determine the number of Ir atoms in the unit cell. [7]
 (b) Is the cell simple (*P*) cubic, body-centered (*I*) cubic, or face-centered (*F*) cubic? [3]

(You need the atomic weight of Ir, which is 192.22 and the Avogadro number is $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$.)

2. In the following object:



- (a) Identify the Miller plane 1. [4]
 (b) Using the same coordinate system, sketch the $(1 \bar{1} 0)$ and $(2 \ 2 \ 2)$ Miller planes. [6]
3. The *I*-cubic (bcc) structure:
- (a) Sketch this structure [3]
 (b) How many neighbors does each atom have, and what is the distance between an atom and its nearest neighbor in terms of the cell parameter a ? [3]
 (c) How many next-near neighbors does an atom in this structure have? What is the distance from an atom to its next-nearest neighbor in terms of a ? [4]

4. Bonding:

- (a) What kind of bond would you find in the hydrogen molecule (H_2) ? How is the noble gas configuration achieved and which is the noble gas ? [2]
- (b) What kind of bond is found in LiH (lithium hydride). How is the noble gas configuration achieved ? Which is the noble gas or gases ? [2]
- (c) What kind of bonding would you find between the atoms in (i) solid Ar (ii) HCl (iii) NaCl [3]
- (d) Write the electronic configuration of the following species: (i) nitrogen in Na_3N (ii) phosphorous in PF_3 (iii) S in Na_2S [3]

Table of electronegativities:

H	Li	N	F	Na	P	S	Cl	Ar
2.1	1.0	3.0	4.0	0.9	2.1	2.5	3.0	-