Problem Set # 1 Grading Criteria

CHAPTERS 2 & 3

Graded: **2.17(a)**, **3.8**, **3.27**

2.17 (a) The main differences between the various forms of **primary** bonding are:

Ionic--there is electrostatic attraction between oppositely charged ions.

Covalent--there is electron sharing between two adjacent atoms such that each atom assumes a stable electron configuration.

Metallic--the positively charged ion cores are shielded from one another, and also "glued" together by the sea of valence electrons.

1 point each for identification of the three primary bonding types (3 points)

1 point each for appropriate keywords or phrases (3 points):

Ionic: electrostatic, ions, or electron transfer

Covalent: electron sharing

Metallic: free electrons, sea of electrons, or de-localized electrons

Maximum possible: 6

3.8 This problem calls for a computation of the density of **iron**. According to Equation (3.5)

$$\rho = \frac{nA_{Fe}}{V_C N_A}$$

Correct equation: 2 points

For BCC, **n** = 2 atoms/unit cell, and

Recognize that Fe is a BCC metal with 2 atoms/unit cell
2 points

$$V_C = \left(\frac{4R}{\sqrt{3}}\right)^3$$

Thus,

$$\rho = \frac{(2 \text{ atoms/unit cell})(55.9 \text{ g/mol})}{\left[(4)(0.124 \times 10^{-7} \text{ cm})^3/\sqrt{3}\right]^3/(\text{unit cell})(6.023 \times 10^{23} \text{ atoms/mol})}$$

$$= 7.90 \text{ g/cm}^3$$

(The value given inside the front cover is 7.87 g/cm^3.)

Correct substitution in equation and final answer:
2 points

Maximum possible: 6

3.27 (a) We are asked for the indices of the two directions sketched in the figure. For direction **1**, the projection on the **x**-axis is zero (since it lies in the **y**-**z** plane), while projections on the **y**- and **z**-axes are **b**/2 and **c**, respectively. This is an [012] direction as indicated in the summary below

	x	y	z
Projections	0a	b/2	c
Projections in terms of **a**, **b**, and **c**	0	1/2	1
Reduction to integers	0	1	2
Enclosure		[012]	

Correct components: 1

Reduction to integers and enclosure: 1

Total possible: 2 points each (part a)

Direction **2** is $[11\overline{2}]$ as summarized below.

	x	y	z
Projections	a/2	b/2	-c
Projections in terms of **a**, **b**, and **c**	1/2	1/2	-1
Reduction to integers	1	1	-2
Enclosure		$[11\overline{2}]$	

(b) This part of the problem calls for the indices of the two planes which are drawn in the sketch. Plane **1** is an (020) plane. The determination of its indices is summarized below.

	x	y	z
Intercepts	∞ a	b/2	∞ c
Intercepts in terms of **a**, **b**, and **c**	∞	1/2	∞
Reciprocals of intercepts	0	2	0
Enclosure		(020)	

Correct intercepts: 1

Reciprocals and reduction to integers: 1

Total possible: 2 points each (part b)

Plane **2** is a $(2\overline{2}1)$ plane, as summarized below.

	x	y	z
Intercepts	a/2	-b/2	c
Intercepts in terms of **a**, **b**, and **c**	1/2	-1/2	1
Reciprocals of intercepts	2	-2	1
Enclosure		$(2\bar{2}1)$	

Maximum possible: 8

Grand total: 20 points