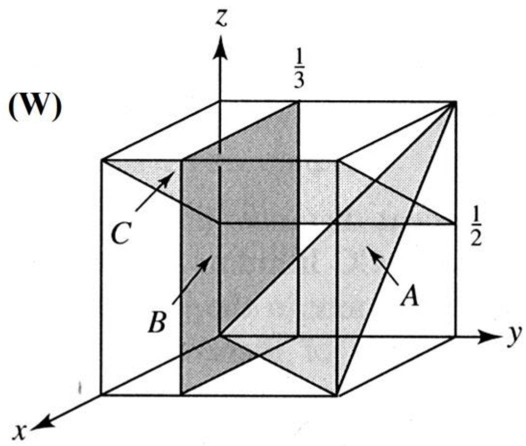
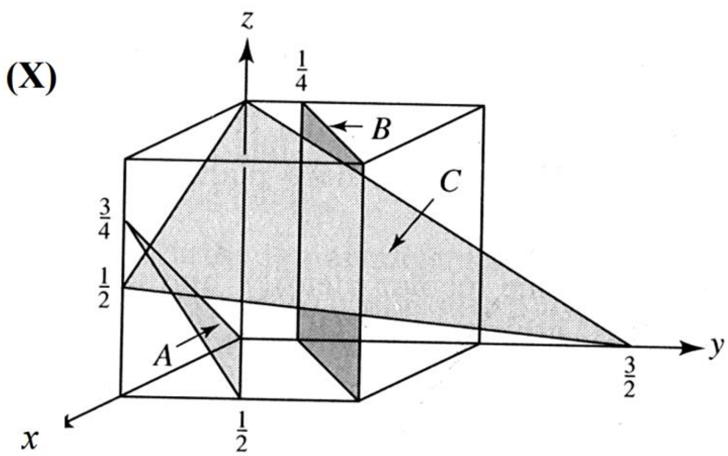
Name :

Student ID :

Question 1) Determine the plane indices for the planes shown below. [3 points]





<u>Solution</u>

(W) $(A)(1\bar{1}1)$ $(B)(030)$ or $(0\bar{3}0)$ $(C)(10\bar{2})$ or $(\bar{1}02)$

(X) $(A)(\bar{3}64)$ or $(3\overline{64})$ $(B)(3\bar{4}0)$ or $(\bar{3}40)$ $(C)(346)$

[0.5 points each]

Question 2:

A common metal is known to have a cubic unit cell with an edge length of 0.288 nm. If this metal has a density of 7.20 g/cm^3 and an atomic weight of 52.0 g/mole, what is its atomic packing factor? Why?

[3 points]

Solution

We know: $\rho = \frac{nA}{V_C N_A}$ which n,A,V_C and N_A are number of atoms in each unit cell, atomic weight, volume of unite cell and Avogadro's number, respectively. So:

$$\text{Number of atoms} = \frac{7.2\times(0.288\times10^{-9})\times(6.02\times10^{23})}{52} = 1.99 \cong 2$$

[1 point]

So, it is BCC structure[1 point] and atomic packing factor is 0.68[1 point]

Question 3

(a) Compare interstitial and vacancy atomic mechanisms for diffusion.
[2 points]

(b) Cite two reasons why interstitial diffusion is normally more rapid than vacancy diffusion.
[2 points]

Solution

(a) With vacancy diffusion, atomic motion is from one lattice site to an adjacent vacancy. Self-diffusion and the diffusion of substitutional impurities proceed via this mechanism. On the other hand, atomic motion is from interstitial site to adjacent interstitial site for the interstitial diffusion mechanism.

(b) Interstitial diffusion is normally more rapid than vacancy diffusion because: (1) interstitial atoms, being smaller, are more mobile; and (2) the probability of an empty adjacent interstitial site is greater than for a vacancy adjacent to a host (or substitutional impurity) atom.