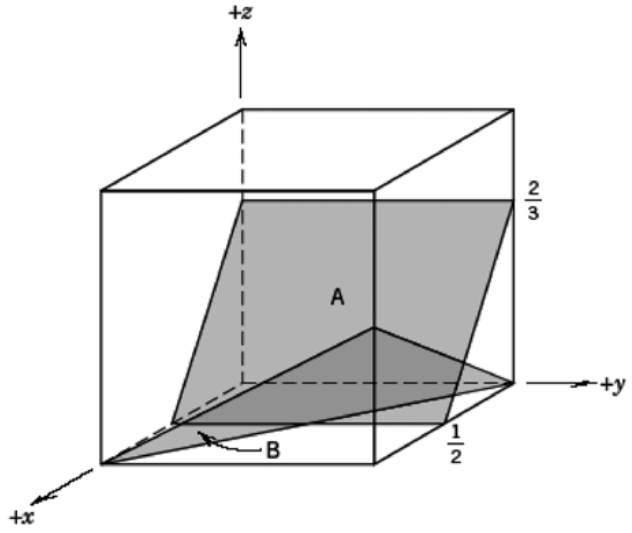
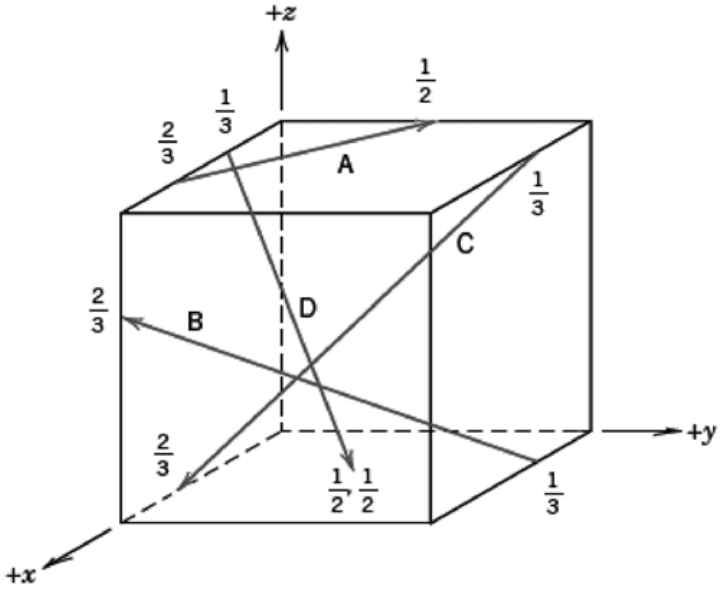
Name:

Student ID:

Question 1

From the figures given below, determine the indices of the two planes and any two directions of your choice.





Solution

Planes: *A*: (4 0 3) *B*: ($\bar{1}$ $\bar{1}$ 2)

Directions: A: [$\bar{4}$ 3 0] B: [2 $\bar{3}$ 2] C: [1 $\bar{3}$ $\bar{3}$] D: [1 3 $\bar{6}$]

Question 2

a) Calculate the planar atomic density in atoms per square millimeter for (110) crystal plane in FCC gold, which has the atomic radius of 0.1442 nm.

b) Calculate the atomic packing factor for a metal that has a cubic unit cell with a lattice parameter of 0.288 nm, density of 7.20 g/cm^3, and an atomic weight of 52.0g/mole. Justify your answer.

Solution

a)

Equation (3.10), planar density: $\rho_p = \frac{number\ of\ atoms\ centered\ on\ a\ plane}{area\ of\ plane}$

For FCC unit cell, $a_o=4r/\sqrt{2}$

$4\times0.1442=\sqrt{2}a \rightarrow$ a= 0.4078 nm

No of atoms in the plane: 4 corners ×1/4 atom per corner + ½ atoms×2 (in mid position) = 2 atoms

The area of the plane is $(\sqrt{2}\ a)(a) = \sqrt{2}\ a^2$

$$\rho_p = \frac{2}{\sqrt{2}\ (0.40788 \times 10^{-9})^2} = 8.5 \times 10^{12}\ atom/mm^2$$

b)

We know: $r = \frac{nA}{V_C N_A}$ 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:

$$\text{Number of atoms} = \frac{7.2\acute{}\ (0.288\acute{}\ 10^{-9})\acute{}\ (6.02\acute{}\ 10^{23})}{52} = 1.99\ @2$$

[1 point]

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