Group Member Names \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Properties of Crystals and Defects**

**Pre Activity**

1. Material A has a smaller average atomic separation than Material B, i.e. the atoms in Material A are on

average closer together. Which of the following statements is true?

a) Material A has greater mass density.

b) Material B has greater mass density.

c) Material A or Material B could have the greater mass density.

**Activity I: Crystals & Atomic Packing Factor**

1. Give an explanation of the atomic packing factor which another student who has never had materials

science would understand.

1. Draw a body-centered cubic (BCC) unit cell.
2. Determine the relation between the length of a side of the unit cell, **a**, and the radius of the atoms, **r**.
3. Using your relation between **a** and **r** find the atomic packing factor for a bcc unit cell.

Hints: atomic packing factor = Volume of atoms in a unit cell **/** Volume of a unit cell.

Volume of atoms = Number of atoms\*4/3 π r3

1. Imagine that you fill this room with close-packed basketballs. Then you fill the room with close-packed marbles. How does the amount of empty space in the room when it is filled with basketballs compare to that when it is filled with marbles?

**Activity II: Point Defects.**

1. “Sketch” each defect and then briefly describe each defect and where it could occur in the unit cell.

|  |  |
| --- | --- |
| **Sketch of each defect at an atomic level** | **Written description for each defect & where it can occur** |
| Vacancy:  Figure_3_2ab | Description:  Occurs: |

|  |  |
| --- | --- |
| **Sketch of each defect at an atomic level** | **Written description for each defect & where it can occur** |
| Self Interstitial:  Figure_3_2ab | Description:  Occurs: |
| Interstitial Impurity:  Figure_3_2ab | Description:  Occurs: |

**Activity III: Looking Forward/Challenge Questions**

1. A crystal structure looks different from different angles, and behaves differently depending on its orientation. (Try to picture this mentally or draw a BCC structure to help you visualize it.) If a metal is polycrystalline, how can the metal’s properties be non-directional? Can a polycrystalline metal be directional in its properties?

**Post Activity**

9. Material A has a greater mass density than Material B. Which of the following statements is true?

a) Material A has smaller average atomic separation.

b) Material B has smaller average atomic separation.

c) Material A or Material B could have smaller average atomic separation.

Explain your reasoning: