Body Centered Cubic (BCC) Structure:

CN:

Atoms touch along:

Number of atoms per unit cell:

Determination of PF:

Face Centered Cubic (FCC) Structure:

CN:

Atoms touch along:

Number of atoms per unit cell:

Determination of PF:

How do you expect the packing factor to vary with coordination number?
BCC Specimen

material: ______________________

a. fully labeled sketch of the microstructure

| eyepiece magnification: ______________ |
| objective magnification: ______________ |
| total magnification = Me \cdot Mo : ______________ |

b. description of the microstructure:

c. grain size by intercept method

<table>
<thead>
<tr>
<th>scan #</th>
<th># of grains</th>
<th>length of scan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1 cm (Me)</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1 cm (Me)</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>1 cm (Me)</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>1 cm (Me)</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>1 cm (Me)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>apparent</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>G =</td>
<td>L = 5 cm (Me)</td>
</tr>
</tbody>
</table>

actual grain intercept distance = \( \frac{L}{G \cdot Me \cdot Mo} \) =

grain size (from ASTM Standard E112) =

d. Assuming equiaxed grains calculate the number of grains in \( \text{lm}^3 \) of this sample:

\( \rho_{iron} = 7.88 \text{ g/cm}^3 \)
FCC Specimen material:___________________

a. fully labeled sketch of the microstructure
   eyepiece magnification:__________________
   objective magnification:__________________
   total magnification = M_e \cdot M_o : ____________

b. description of the microstructure:

c. grain size by use of comparator reticle: ____________

d. Assuming equiaxed grains, calculate the number of grains in 10 grams of this material
   \( \rho_{\text{brass}} = 8.5 \text{ g/cm}^3 \)

The metallographic specimens were described as polycrystalline. What does that mean and specifically how did you identify a single crystal in the metallographic specimens.

How does grain boundary area vary with ASTM grain size?

Which of your single phase specimens had the highest grain boundary area?
Two Phase Specimen (I) material:________________

a. fully labeled sketch total magnification:__________

b. description of the microstructure:

c. diameter of a typical graphite particle: ______________

d. point count of graphite regions in specimen

<table>
<thead>
<tr>
<th>point scan #</th>
<th># points on graphite</th>
<th># points total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>121</td>
<td>121</td>
</tr>
<tr>
<td>2</td>
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</tr>
<tr>
<td>3</td>
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<td>4</td>
<td>121</td>
<td>121</td>
</tr>
<tr>
<td>5</td>
<td>121</td>
<td>121</td>
</tr>
<tr>
<td>totals:</td>
<td></td>
<td>605</td>
</tr>
</tbody>
</table>

\[ P_p = \]

Volume fraction of graphite =

e. Using the volume fraction of graphite and the average graphite particle size in your alloy sample estimate the number of graphite particles in 1 ft\(^3\) of the alloy.
Two Phase Specimen (II)  

a. fully labeled sketch  

b. description of the microstructure:  

c. differences from the other two phase specimens:

Two Phase Specimen (III)  

a. fully labeled sketch  

b. description of the microstructure:  

c. differences from the other two phase specimens:
Imagine planes of atoms slipping over one another in the two systems above. What do you expect the effect of the grain boundaries will be? What might the macroscopic result be? Which would require more input of mechanical energy to cause the atoms to permanently move?

Try to predict the macroscopic behavior of materials by considering the microscopic structure. Take two strips of metal (e.g. polycrystalline copper, which is single phased, and low carbon steel, which has two phases and two constituents). Try bending the metal strips to see which feels stronger. Which would you predict would be stronger? Is that consistent with your observations? Explain.
Questions: (write complete answers)

Briefly describe the features you observed in your metallographic specimens. Explain what they looked like and/or how you identified them.

What is occurring on the atom level that causes grain boundaries, twin boundaries, and phase boundaries to exist?

For a fixed proportion of each phase in a two phase specimen, how does phase boundary area vary with the size of the second phase particles?

For a fixed proportion of each phase in a two phase specimen, how does phase boundary area vary with the shape of the second phase particles?
One way of making a metal bowl is to beat a flat sheet of metal into a bowl shape. What microscopic metallographic properties would you want for the metal used to make the bowl? Explain why each of these properties is desirable.

What was the most important thing you learned from this laboratory exercise?