1. For the tensile stress-strain diagram given below for an aluminum alloy, determine the following. (a) The modulus of elasticity, (b) the yield strength, (c) the tensile strength, and the ductility as determined by the percent elongation at fracture. (e) Draw a rectangle around elastic region and circle the plastic region of behavior.

![Stress-Strain Diagram](image)

2. How is the ductility of a metal normally affected by cold working? Why? What other mechanical properties are affected by cold working?
6. For the iron-carbon diagram shown below, (a) circle and number all three-phase invariant reactions. Then list by number the type of the reaction, the specific reaction, and the temperature at which it occurs. (b) Is the microstructure shown below associated with a hyper- or hypoeutectoid composition? Explain.
7. A portion of the Ti-Al phase diagram is shown below. An originally molten Ti-Al alloy with an overall composition of 50 wt% Ti is cooled to 1100 °C. Determine (a) the phases present, (b) the composition of each phase, and (c) the relative amount of each phase present.
1. For the tensile stress-strain diagram given below for an aluminum alloy, determine the following. (a) The modulus of elasticity, (b) the yield strength, (c) the tensile strength, and (d) the ductility as determined by the percent elongation at fracture. (e) Draw a rectangle around the elastic region and circle the plastic region of behavior.

\[ E = \frac{\Delta \sigma}{\Delta \varepsilon} = \frac{200 \text{MPa}}{0.0032} = 62,500 \text{MPa} = 62.5 \text{GPa} \]

(b) \( \sigma_{YS} = 295 \text{MPa} \)

(c) \( \sigma_{TS} = \text{maximum} = 370 \text{MPa} \)

(d) \( \% \text{EL} = 100\% \times 0.16 = 16\% \)

Note: The yield strength is calculated by the 0.002 offset line on the inset figure.

2. How is the ductility of a metal normally affected by cold working? Why? What other mechanical properties are affected by cold working?

The ductility is reduced by cold working due to an increase in the number of dislocations. The greater concentration of dislocations prevents slip from occurring and increases the yield strength of the metal.
6. For the iron-carbon diagram shown below, (a) circle all peritectic reactions, draw squares around all eutectic reactions, and triangles around all eutectoid reactions. For each, list the reaction involved, and the temperature it occurs at. (b) Is the microstructure shown below associated with a hyper- or hypo composition? Explain.

![Iron-Carbon Diagram](image)

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peritectic reactions</td>
<td>1495°C</td>
</tr>
<tr>
<td>( L + S \rightarrow \gamma )</td>
<td>1495°C</td>
</tr>
<tr>
<td>Eutectoid reactions</td>
<td>727°C</td>
</tr>
<tr>
<td>( \gamma \rightarrow \alpha + Fe_3C )</td>
<td>727°C</td>
</tr>
<tr>
<td>Peritectoid reactions</td>
<td>1148°C</td>
</tr>
<tr>
<td>( L \rightarrow \gamma + Fe_3C )</td>
<td>1148°C</td>
</tr>
</tbody>
</table>

(b) The microstructure is a hypo eutectic composition. We can tell this because it contains pro-eutectoid \( \alpha \) which will only form with compositions less than the eutectoid composition.
7. A portion of the Ti-Al phase diagram is shown below. An originally molten Ti-Al alloy with an overall composition of 50 wt\% Ti is cooled to 1100 °C. Determine (a) the phases present, (b) the composition of each phase, and (c) the relative amount of each phase present.

\[(a) \text{ Phases: } \gamma + L\]

\[(b) \text{ Compositions: } \frac{46 \text{ wt}\% \text{ Ti}}{58 - 46} \rightarrow 58 \text{ wt}\% \text{ Ti}\]

\[(c) \text{ Fraction } \gamma: \frac{58 - 50}{58 - 46} \times 100\% = 66.7\%\]

\[\text{Fraction Liquid: } \frac{50 - 46}{58 - 46} \times 100\% = 33.3\%\]