4 • Bonding

4.3 Problems - Solids

1. For each substance, determine
   - what type of solid it forms [molecular, network, ionic, metallic]
   - (2) the type of inter-particle forces involved [London Dispersion Forces, Dipole-Dipole Interactions, Hydrogen Bonding, Covalent Bonds, Ionic Bonds, Metallic Bonds]

<table>
<thead>
<tr>
<th>Substance</th>
<th>Type of Solid</th>
<th>Inter-Particle Forces</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Chlorine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) MgCl₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) Iron</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e) HCl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f) Graphite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(g) NH₃ (ammonia)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(h) CaO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Silica</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(j) CH₄ (methane)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(k) Cobalt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(l) CO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. The following picture represents a sample of solid benzene, C₆H₆.

   These molecules form a(n) _______________________ solid.

   What forces are between the molecules?

   What forces are within a molecule?

   What forces are broken when benzene vaporizes?  C₆H₆ (ℓ) → C₆H₆ (g)

   This molecule is [ polar | non-polar ] and [ will | will not ] dissolve in water.
3. The following picture represents a sample of diamond. Each sphere represents a carbon atom.

   ![Diamond structure]

   This is a(n) _______ solid.

   What forces are between carbon atoms in diamond?
   ____________________________

   Diamond is expected to have a [lower | higher] boiling point than benzene (C₆H₆).

4. The following picture represents a sample of solid zinc sulfide, ZnS. The smaller sphere represents Zn²⁺ ions, while the larger sphere represents S²⁻ ions.

   ![Zinc sulfide structure]

   This is a(n) _______ solid.

   What forces are between the atoms in this solid?
   ____________________________

   ZnS is expected to have a [lower | higher] boiling point than benzene (C₆H₆).

   Draw the Lewis Structure for this compound.

5. The following picture represents a sample of solid gold, Au.

   ![Gold structure]

   This is a(n) _______ solid.

   What forces are between the atoms in this solid?
   ____________________________

   List three properties of this solid.
   ____________________________

6. Predict which substance in each of the following pairs would have the stronger IMFs. Explain briefly.

   (a) CO₂ or OCS
   (b) NH₃ or PH₃
   (c) HF or HCl
   (d) SO₂ or SO₃

7. In each of the following groups of substances, select the one that has the given property and briefly explain.

   Highest boiling point HCl or Ar or F₂
   Highest freezing point H₂O₂, NaCl or HF
   Lowest freezing point N₂, CO or CO₂