1. Provide the correct name or formula for each of the following compounds:
   a. K₂CrO₄ _______ potassium chromate _______
   b. N₂O₅ _______ dinitrogen pentoxide _______
   c. Pb(CO₃)₂ _______ lead(IV) carbonate _______
   d. HgS _______ mercury(II) sulfide _______
   e. carbon tetrachloride _______ CCl₄ _______
   f. silver nitrate _______ AgNO₃ _______
   g. sodium phosphide _______ Na₃P _______
   h. sulfuric acid _______ H₂SO₄(aq) _______

2. For each of the following,
   i. Identify the type of reaction using the letters designated below:
      – Combination (C)   – Double Replacement/Precipitation (P)
      – Decomposition (D)  – Acid-Base Neutralization (N)
      – Single Replacement (SR)  – Combustion (B)
   TYPE ii. Balance the equation
   S   a. 2 Al(s) + 3 Cu(NO₃)₂(aq) → 3 Cu(s) + 2 Al(NO₃)₃(aq)
   N   b. 3 NaOH(aq) + H₃PO₄(aq) → 3 H₂O(l) + Na₃PO₄(aq)
   P   c. K₂CrO₄(aq) + Mg(NO₃)₂(aq) → MgCrO₄(s) + 2 KNO₃(aq)
   D   d. LiHCO₃(s) Δ→ Li₂CO₃(s) + H₂O(g) + CO₂(g)

3. For each of the following sets of reactants, write “NR” for “no reaction” OR write the formulas for the products (including physical states) and balance the equation if a reaction occurs.

   a. Zn(s) + 2 HCl(aq) → H₂(g) + ZnCl₂(aq)
   b. 2 LiOH(aq) + H₂SO₄(aq) → 2 H₂O(l) + Li₂SO₄(aq)
   c. C₅H₁₂(l) + 8 O₂(g) Δ→ 5 CO₂(g) + 6 H₂O(g)
   d. HNO₃(aq) + KHCO₃(aq) → H₂O(l) + CO₂(g) + KNO₃(aq)
   e. Mg(s) + H₂O(l) → NR (Mg is not an active metal.)
Nuclear Chemistry Practice Problems:

1. The inhalation of radon-222 and its decay to form other isotopes poses a health hazard. Write balanced nuclear equations for the decay of radon-222 to lead-206 in eight steps.

   a. Step 1: Radon-222 decays by alpha emission. (Radon has the element symbol Rn.)
   \[ ^{222}_{86}\text{Rn} \rightarrow ^{4}_{2}\alpha + ^{218}_{84}\text{Po} \]

   b. Step 2: The daughter product in part a decays by alpha emission.
   \[ ^{218}_{84}\text{Po} \rightarrow ^{4}_{2}\alpha + ^{214}_{82}\text{Pb} \]

   c. Step 3: The daughter product in part b decays by beta and gamma emissions.
   \[ ^{214}_{82}\text{Pb} \rightarrow ^{0}_{0}\beta + ^{0}_{0}\gamma + ^{214}_{83}\text{Bi} \]

   d. Step 4: The daughter product in part c decays by beta and gamma emissions.
   \[ ^{214}_{83}\text{Bi} \rightarrow ^{0}_{0}\beta + ^{0}_{0}\gamma + ^{214}_{84}\text{Po} \]

   e. Step 5: The daughter product in part d decays by beta emission.
   \[ ^{214}_{84}\text{Po} \rightarrow ^{0}_{0}\beta + ^{214}_{85}\text{At} \]

   f. Step 6: The daughter product in part e decays by alpha emission.
   \[ ^{214}_{85}\text{At} \rightarrow ^{4}_{2}\alpha + ^{210}_{83}\text{Bi} \]

   g. Step 7: The daughter product in part f decays by beta and gamma emissions.
   \[ ^{210}_{83}\text{Bi} \rightarrow ^{0}_{0}\beta + ^{0}_{0}\gamma + ^{210}_{84}\text{Po} \]

   h. Step 8: The daughter product in part g decays by alpha and gamma emissions.
   \[ ^{210}_{84}\text{Po} \rightarrow ^{4}_{2}\alpha + ^{0}_{0}\gamma + ^{206}_{82}\text{Pb} \]

   The final stable isotope is lead-206.

General Practice Problems

2. Indicate the number of protons, neutrons, and electrons in the following isotopes: phosphorus-32, iodine-131, oxygen-18, Rn-222, chromium-51, fluorine-21, potassium-40, copper-64

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Atomic Symbol</th>
<th># of protons</th>
<th># of neutrons</th>
<th># of electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>phosphorus-32</td>
<td>(^{32}_{15}\text{P})</td>
<td>15</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>iodine-131</td>
<td>(^{131}_{53}\text{I})</td>
<td>53</td>
<td>78</td>
<td>53</td>
</tr>
<tr>
<td>oxygen-18</td>
<td>(^{18}_{8}\text{O})</td>
<td>8</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Rn-222</td>
<td>(^{222}_{86}\text{Rn})</td>
<td>86</td>
<td>136</td>
<td>86</td>
</tr>
<tr>
<td>chromium-51</td>
<td>(^{51}_{24}\text{Cr})</td>
<td>24</td>
<td>27</td>
<td>24</td>
</tr>
<tr>
<td>fluorine-21</td>
<td>(^{21}_{9}\text{F})</td>
<td>9</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>potassium-40</td>
<td>(^{40}_{19}\text{K})</td>
<td>19</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>copper-64</td>
<td>(^{64}_{29}\text{Cu})</td>
<td>29</td>
<td>35</td>
<td>29</td>
</tr>
</tbody>
</table>
3. For each of the following molecules: $\text{H}_2\text{O}$, $\text{NH}_3$, $\text{PCl}_3$, $\text{OF}_2$, $\text{CH}_4$, $\text{CCl}_4$, $\text{CHF}_3$, $\text{O}_3$, $\text{CH}_2\text{O}$
   i. Draw the Lewis structure, and indicate the molecular geometry (3D shape) and bond angle(s).
   ii. Sketch the three-dimensional shape of the molecule, showing the dipole for each polar bond.
   iii. Indicate if each molecule is polar or nonpolar.
   iv. Indicate the intermolecular forces between molecules.

<table>
<thead>
<tr>
<th>Molecule</th>
<th>Lewis Structure</th>
<th>Molecular Geometry</th>
<th>Bond Angle(s)</th>
<th>Polar/Nonpolar</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{H}_2\text{O}$</td>
<td><img src="image" alt="H2O Lewis structure" /></td>
<td>bent</td>
<td>$&lt;109.5^\circ$</td>
<td>polar</td>
</tr>
<tr>
<td>$\text{NH}_3$</td>
<td><img src="image" alt="NH3 Lewis structure" /></td>
<td>trigonal pyramid</td>
<td>$&lt;109.5^\circ$</td>
<td>polar</td>
</tr>
<tr>
<td>$\text{PCl}_3$</td>
<td><img src="image" alt="PCl3 Lewis structure" /></td>
<td>trigonal pyramid</td>
<td>$&lt;109.5^\circ$</td>
<td>polar</td>
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<tr>
<td>$\text{OF}_2$</td>
<td><img src="image" alt="OF2 Lewis structure" /></td>
<td>bent</td>
<td>$&lt;109.5^\circ$</td>
<td>polar</td>
</tr>
<tr>
<td>$\text{CH}_4$</td>
<td><img src="image" alt="CH4 Lewis structure" /></td>
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<td>$109.5^\circ$</td>
<td>nonpolar</td>
</tr>
<tr>
<td>$\text{CCl}_4$</td>
<td><img src="image" alt="CCl4 Lewis structure" /></td>
<td>tetrahedral</td>
<td>$109.5^\circ$</td>
<td>nonpolar</td>
</tr>
<tr>
<td>$\text{CHF}_3$</td>
<td><img src="image" alt="CHF3 Lewis structure" /></td>
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<td>$109.5^\circ$</td>
<td>polar</td>
</tr>
<tr>
<td>$\text{O}_3$</td>
<td><img src="image" alt="O3 Lewis structure" /></td>
<td>bent</td>
<td>$&lt;120^\circ$</td>
<td>nonpolar</td>
</tr>
<tr>
<td>$\text{CH}_2\text{O}$</td>
<td><img src="image" alt="CH2O Lewis structure" /></td>
<td>trigonal planar</td>
<td>$120^\circ$</td>
<td>polar</td>
</tr>
</tbody>
</table>

4. Which of the following changes is exothermic?

- melting
- condensing
- sublimation
- freezing
- vaporizing
- deposition

**Release of heat:****

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5. Calculate the molarity of a solution prepared by dissolving 4.488 g of potassium hydroxide in 150.0 mL of solution.

\[
4.488 \text{ g KOH} \times \frac{\text{mol KOH}}{56.11 \text{ g KOH}} = 0.07999 \text{ mol KOH}
\]

\[\rightarrow [\text{KOH}] = \frac{0.07999 \text{ mol KOH}}{0.1500 \text{ L}} = 0.5333 \text{ M}\]

6. Calculate the mass of solute present in 150.0 g of a 2.50% by mass AgNO₃ solution.

\[2.50 \text{% AgNO}_3 \quad \frac{100 \text{ g soln}}{2.50 \text{ g AgNO}_3} \quad \frac{150.0 \text{ g soln}}{100 \text{ g soln}} = 3.75 \text{ g AgNO}_3\]

7. Calculate the concentration of solution prepared by diluting 5.00 mL of a 1.25% (w/v) KCl solution to make 100.0 mL of solution.

\[V_1 \quad m_1 \quad V_2 \quad m_2 \quad \frac{m_1 V_1}{V_2} = \frac{V_1}{V_2} \times \frac{(1.25 \text{% (w/v)})(5.00 \text{mL})}{100.0 \text{ mL}} = 0.0625 \text{ %o}\]

8. Calculate the concentration of solution prepared by diluting 8.00 mL of a 2.00M nitric acid solution with 100.0 mL of DI water.

\[V_2 = 8.00 + 100.0 \text{ mL} = 108.0 \text{ mL}\]

\[m_2 = \frac{m_1 V_1}{V_2} = \frac{(2.00 \text{M})(8.00 \text{mL})}{108.0 \text{ mL}} = 0.148 \text{ M}\]