Multiple Choice: (4 points each. Put answers in left margin as capital letters.)

1. Which pair of elements should have similar properties?
   A) C/Sn        B) Ca/Li        C) Cl/Na        D) Ga/Ge        E) K/Li

2. Ti(SO₃)₂ is
   A) titanium(II) sulfate          B) titanium sulfur oxide
   C) titanium (IV) sulfite         D) titanium sulfur trioxide
   E) titanium(IV) sulfate

3. Which of the following generic salts is least likely to be soluble?
   A) M⁺X⁻        B) M²⁺X⁻        C) M⁺X²⁻        D) M³⁺X⁻        E) M²⁺X²⁻

4. Which of the following is an oxidation-reduction (redox) reaction?
   A) Cu(OH)₂(aq) + 2 HNO₃(aq) → Cu(NO₃)₂(aq) + 2 H₂O(l)
   B) Fe₂O₃(s) + 3 CO(g) → Fe(s) + 3 CO₂(g)
   C) 2 SrS(s) + 2 HCl(aq) → SrCl₂(aq) + H₂S(g)
   D) H₂SO₄(aq) + 2 NH₃(aq) → (NH₄)₂SO₄(aq)
   E) None are oxidation-reduction reactions.

5. What is the oxidation number of the phosphorus atom in H₃PO₃?
   A) -1        B) +1        C) +3        D) +5        E) +7

6. Which of the following is an isolated system?
   A) a bonfire        B) the Earth        C) the human body        D) a pressure cooker        E) a Thermos® bottle

7. Which of the following sets of conditions possesses the greatest amount of kinetic energy?
   (FYI: All speeds are approximately correct for the sport.)
   A) a 2 kg bowling ball traveling at 10³ m/hr        B) a 10 kg shot put traveling at 10⁴ m/hr
   C) a 150 g baseball traveling at 10⁵ m/hr        D) a 400 g football traveling at 10⁵ m/hr
   E) a 500 g basketball traveling at 10³ m/hr

8. What is ΔH for the net reaction below?
   \[ 2 \text{Al}(s) + 1.5 \text{O}_2(g) \rightarrow \text{Al}_2\text{O}_3(s) \quad \Delta H = -1601 \text{ kJ} \]
   \[ 2 \text{Na}(s) + \text{O}_2(g) \rightarrow \text{Na}_2\text{O}_2(s) \quad \Delta H = -505 \text{ kJ} \]
   \[ 6 \text{Na}(s) + 2 \text{Al}_2\text{O}_3(s) \rightarrow 4 \text{Al}(s) + 3 \text{Na}_2\text{O}_2(s) \quad \Delta H = ? \]
   A) -2106 kJ        B) -86 kJ        C) +86 kJ        D) 1687 kJ        E) 2106 kJ
Discussion Questions: (Show your work to receive credit.)

1. Isopropyl alcohol (C₃H₈O) is mixed with water to produce a solution that is 35.0% alcohol by volume. How many milliliters of each component are present in 805 mL of this solution? What is its molar concentration? (density C₃H₈O = 0.7863 g/mL) What would its molar concentration be if 75.0 mL of water was added to the original solution? (10 points)

2. Aluminum reacts with chlorine gas according to the reaction:
   \[ 2 \text{Al(s)} + 3 \text{Cl}_2(g) \rightarrow 2 \text{AlCl}_3(s) \]
   What is the limiting reactant when 34.0 g of aluminum is combined with 39.0 g of chlorine gas? What is the maximum mass of aluminum chloride that can be produced? What is the percent yield if 45.0 g of AlCl₃ is made? (15 points)

3. Complete the following: (10 points)
   \[ ____ \text{MnO}_2(s) + ____ \text{HCl(aq)} \rightarrow ____ \text{MnCl}_2(\text{aq}) + ____ \text{Cl}_2(\text{g}) + ____ \text{H}_2\text{O}(\text{l}) \]
   Ammonium nitrate decomposes to produce gaseous dinitrogen oxide and water.

4. Write out the net ionic equation for the reaction of Ba(NO₃)₂ (aq) with Na₂CO₃ (aq): (4 points)
5. The molar heat capacity of ethanol, C\textsubscript{2}H\textsubscript{5}OH, is 110.4 J/mol\(\cdot\)K. When 1567 J of heat energy is added to a sample of ethanol, C\textsubscript{2}H\textsubscript{5}OH, the temperature increases by 9.61 °C. What mass of ethanol was in the sample? (8 points)

6. Circle the ENDOthermic processes. (10 points) Homework problem 5.2
   a) car using gasoline    b) baking a cake   c) ice melting
   d) the chemical reaction inside a cold pack   e) water condensing on a surface

7. For the following reaction, (11 points)
   a) What is the heat of reaction? and
   b) What is the energy change associated with the consumption or production of 5.25 g NH\textsubscript{3}?

   \[4 \text{NH}_3(g) + 5 \text{O}_2(g) \rightarrow 4 \text{NO}(g) + 6 \text{H}_2\text{O}(g)\]

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<tr>
<th>Substance</th>
<th>$\Delta H^\circ$ kJ/mol</th>
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<tr>
<td>H\textsubscript{2}O(g)</td>
<td>$-$241.8</td>
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<td>H\textsubscript{2}O(l)</td>
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