Multiple Choice: (1 point each) Clearly mark answers on both the scantron and circle correct answer on exam.

You must show work for credit!

1. In an exothermic reaction:
   
   A) Heat flows out of the system.
   
   B) Heat flows into the system.
   
   C) The surroundings lose energy.
   
   D) The Earth begins to spin backwards.
   
   E) You can’t find your shoes.

2. How much heat is required to raise the temperature of a 6.21-g sample of iron (specific heat = 0.450 J/(g · °C)) from 25.0°C to 79.8°C?
   
   A) 70.0 J
   
   B) 101 J
   
   C) 386 J
   
   D) 756 J
   
   E) 153 J
3. At 25°C, the following heats of reaction are known:

<table>
<thead>
<tr>
<th>Reaction</th>
<th>$\Delta H$ (kJ/mol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2\text{ClF} + \text{O}_2 \rightarrow \text{Cl}_2\text{O} + \text{F}_2\text{O}$</td>
<td>167.4</td>
</tr>
<tr>
<td>$2\text{ClF}_3 + 2\text{O}_2 \rightarrow \text{Cl}_2\text{O} + 3\text{F}_2\text{O}$</td>
<td>341.4</td>
</tr>
<tr>
<td>$2\text{F}_2 + \text{O}_2 \rightarrow 2\text{F}_2\text{O}$</td>
<td>-43.4</td>
</tr>
</tbody>
</table>

At the same temperature, calculate $\Delta H$ for the reaction:

$\text{ClF} + \text{F}_2 \rightarrow \text{ClF}_3$

A) -217.5 kJ/mol  
B) -130.2 kJ/mol  
C) +217.5 kJ/mol  
D) -108.7 kJ/mol  
E) none of these

4. What is the wavelength of a photon of red light (in nm) whose frequency is $4.60 \times 10^{14}$ Hz?

A) 652 nm  
B) $153 \times 10^6$ nm  
C) 153 nm  
D) 460 nm  
E) none of these

5. When a hydrogen electron makes a transition from $n = 3$ to $n = 1$, which of the following statements is true?

I. Energy is emitted.  
II. Energy is absorbed.  
III. The electron loses energy.  
IV. The electron gains energy.  
V. The electron cannot make this transition.

A) I, IV  
B) I, III  
C) II, III  
D) II, IV  
E) V

6. Which of the following is not determined by the principal quantum number, $n$, of the electron in a hydrogen atom?

A) the energy of the electron  
B) the minimum wavelength of the light needed to remove the electron from the atom.  
C) the size of the corresponding atomic orbital(s)  
D) the shape of the corresponding atomic orbital(s)  
E) All of these are determined by $n$.  

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7. How many electrons in an atom can have the quantum numbers \( n = 4, l = 2? \)
   A) 14
   B) 12
   C) 5
   D) 10
   E) 6

8. An element has the electron configuration \([\text{Kr}]4d^{10}5s^25p^2\). The element is a(n)
   A) nonmetal.
   B) transition element.
   C) metal.
   D) lanthanide.
   E) actinide.

9. How many unpaired electrons are there in an atom of sulfur in its ground state?
   A) 0
   B) 1
   C) 2
   D) 3
   E) 4

10. \(1s^22s^22p^63s^23p^64s^23d^2\) is the correct electron configuration for which of the following atoms?
    A) Ca
    B) Ti
    C) Ge
    D) Zr
    E) none of these

11. List the following atoms in order of increasing ionization energy: Li, Na, C, O, F.
    A) Li < Na < C < O < F
    B) Na < Li < C < O < F
    C) F < O < C < Li < Na
    D) Na < Li < F < O < C
    E) Na < Li < C < F < O
Short Answer (Must show all work for full credit!)

Write the electron configuration for the following (2 points each):

12. I

13. Fe$^{3+}$

Calculate:

14. (5 points) When a 3.88 g sample of solid ammonium nitrate dissolves in 60.0 g of water in a coffee-cup calorimeter, the temperature drops from 23.0 °C to 18.4 °C. Calculate the enthalpy (ΔH) for the solution process (in kJ/mole NH$_4$NO$_3$). The specific heat of the solution is 4.184 J °C$^{-1}$ g$^{-1}$.

NH$_4$NO$_3$(s) → NH$_4^+$ (aq) + NO$_3^-$ (aq)
Answer Key -- Chem 212 Fall 03 Exam II

1. A
2. E
3. D
4. A
5. B
6. D
7. D
8. C
9. C
10. B
11. B
12. 1s^22s^22p^63s^23p^64s^23d^{10}4p^65s^24d^{10}5p^5 or [Kr]5s^25p^5
13. 1s^22s^22p^63s^23p^64s^23d^3 or [Ar]4s^23d^3
14. 25.4 kJ/mol