**Instructions**

1. Do not open the exam until you are told to start.

2. This exam is closed note and closed book. You are not allowed to use any outside material while taking this exam.

3. Use the spaces provided to write down your answers. To receive full credit, you must show all work. Do not write answers on any other pieces of paper. If you need more room, write on the back of the exam and be sure to include a note describing where the work is located.

4. When solving numerical problems, make sure you include the proper units in your final answer.

5. If a question asks for a response in sentence or paragraph form, make sure you respond in that format.

6. Useful data for the exam and a periodic table are provided on the last page of the exam. Carefully tear out these sheets if you wish.

<table>
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<tr>
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<th>Points awarded</th>
</tr>
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</tbody>
</table>
Multiple Choice
Unless otherwise directed, choose the single best answer for each question. When balancing chemical equations use smallest whole number coefficients. (3 points each)

1. Which of the following compounds is/are ionic compounds?
   I. H₂SO₄   IV. NCl₃
   II. NH₄Cl   V. MgBr₂
   III. PtCl₃
   b. I, II, III, V  e. II, III, V
   c. II, III, IV, V

2. While in lab over the weekend, I placed a chemical in deionized water. I then took a very powerful magnifying glass given to me by some Martian friends and observed the solution. Shown below is a diagram of what I observed through the magnifying glass. What term would best describe the chemical when it is in water?
   a. non-electrolyte
   b. weak electrolyte
   c. strong electrolyte
   d. super electrolyte
   e. None of the above

3. In the balanced chemical equation shown below, which element is oxidized?

   \[ \text{I}_2\text{O}_5(s) + 5\text{CO}(g) \rightarrow \text{I}_2(g) + 5\text{CO}_2(g) \]

   a. I
   b. O
   c. C
   d. None of the elements are oxidized; it is not an oxidation-reduction reaction.

4. When Al(OH)₃(s) and H₂SO₄(aq) are mixed, a reaction occurs. What is the sum of all the coefficients for the balanced chemical equation for this reaction? Hint: If the balanced chemical equation was 2A + B → 3C, the sum of the coefficients would be 6.

   a. 4
   b. 6
   c. 11
   d. 12
   e. None of the above.
5. What is the oxidation state of bromine in H$_5$BrO$_6$?

   a. -1  
   b. +1  
   c. +2  
   d. +7  
   e. None of the above.

6. What is the formula for titanium(IV) sulfide?

   a. Ti$_4$S   
   b. TiS$_4$   
   c. Ti$_2$S$_4$   
   d. Ti$_4$S$_2$   
   e. None of the above.

7. When the following chemical equation is balanced, what is the sum of all of the coefficients? 
   Hint: If the balanced chemical equation was 2A + B $\rightarrow$ 3C, the sum of the coefficients would be 6.

   $\text{CS}_2(g) + \text{Cl}_2(g) \rightarrow \text{CCl}_4(g) + \text{S}_2\text{Cl}_2(g)$

   a. 7  
   b. 6  
   c. 5  
   d. 4  
   e. None of the above.

8. Which of the following contains the greatest number of atoms?

   a. 1 molecule of S$_8$  
   b. 2 molecules of P$_4$  
   c. 4 molecules of Cl$_2$  
   d. 8 H atoms  
   e. All of these contain the same number of atoms.

9. When C$_7$H$_6$O$_2$ is combusted, what is the sum of all of the coefficients in the balanced chemical equation? 
   Hint: If the balanced chemical equation was 2A + B $\rightarrow$ 3C, the sum of the coefficients would be 6.

   a. 37  
   b. 26  
   c. 18  
   d. 4  
   e. None of the above.
10. How many atoms are there in a 72.5 g sample of nickel (Ni)?

a. 1.24 atoms  
b. $7.44 \times 10^{23}$ atoms  
c. $2.05 \times 10^{-24}$ atoms  
d. $2.56 \times 10^{27}$ atoms  
e. None of the above.

11. When aqueous zinc sulfate is mixed with aqueous sodium hydroxide, what is the coefficient in front of the sodium hydroxide in the balanced chemical equation?

a. 4  
b. 3  
c. 2  
d. 1  
e. None of the above.

12. A 4.0 mole sample of $\text{H}_2\text{CO}_3$ contains how many moles of hydrogen?

a. 2.0 moles  
b. 4.0 moles  
c. 6.0 moles  
d. 8.0 moles  
e. None of the above.

13. How many grams of oxygen atoms are contained in $1.00 \times 10^2$ g of $\text{K}_2\text{Cr}_2\text{O}_7$?

a. 14.9 g  
b. 38.1 g  
c. 5.44 g  
d. 11.3 g  
e. 78.8 g

14. The smallest unit of hydrogen fluoride gas is an example of a(n) _____________.

a. mole  
b. molecule  
c. ion  
d. atom  
e. formula unit
15. How many SO₂ molecules are there in a 1.80 mole sample of SO₂?
   a. $5.58 \times 10^{23}$ molecules
   b. $3.01 \times 10^{-24}$ molecules
   c. $6.02 \times 10^{23}$ molecules
   d. $1.08 \times 10^{24}$ molecules
   e. None of the above.

16. Which of the following must be an empirical formula?
   a. C₉H₈O₄
   b. C₆H₈O₆
   c. C₈H₁₀N₄O₂
   d. C₁₀H₁₄N₂
   e. None of the above is an empirical formula.

17. In the table below, the name or formula for a chemical compound is given. Fill in the table with the corresponding name or formula of the chemical compound. (16 points)

<table>
<thead>
<tr>
<th>NAME</th>
<th>FORMULA</th>
</tr>
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<tbody>
<tr>
<td>FeO</td>
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<tr>
<td>silver sulfite</td>
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<tr>
<td>SCl₄</td>
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<tr>
<td>hydrobromic acid</td>
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<tr>
<td>calcium periodate</td>
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<tr>
<td>HClO₂</td>
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<tr>
<td>Mg(SCN)₂</td>
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<tr>
<td>potassium phosphide</td>
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</table>
18. For each of the ionic and molecular compounds listed below, show how the compound dissociates or ionizes when placed in water. Put your answer to this part in the space above the formula of the compound. Circle dissociation if the compound dissociates or circle ionization if the compound ionizes. In the corresponding beaker underneath the dissociation or ionization equation, show what the compound exists as in aqueous solution. In the third beaker, show what will be in solution when the beaker containing HNO$_3$ is combined with the beaker containing KOH. (9 points)

a.) HNO$_3$ dissociation or ionization equation  

b.) KOH dissociation or ionization equation

19. What is the molar mass of Ti(NO$_2$)$_2$? (3 points)
20. What are the complete, total ionic, and net ionic equations for the reaction that occurs when an aqueous solution of H$_2$C$_2$O$_4$ reacts with an aqueous solution of NaOH? Assume the reaction takes place in a beaker of deionized water. (5 points)

Complete

Total Ionic

Net-Ionic

21. What are the complete, total ionic, and net ionic equations for the reaction that occurs when an aqueous solution of FeCl$_3$ reacts with an aqueous solution of K$_2$CO$_3$? Assume the reaction takes place in a beaker of deionized water. (5 points)

Complete

Total Ionic

Net-Ionic
22. A sample of hexane (C₆H₁₄) contains 4.235x10²³ molecules of hexane. What is the mass of carbon contained in the sample of hexane? (5 points)

23. Use the balanced oxidation reduction reaction below to answer the following questions. In order to receive full credit, you must show your work. (6 points)

\[ 4\text{Ag}(s) + \text{PtCl}_4(aq) \rightarrow 4\text{AgCl}(s) + \text{Pt}(s) \]

a. Which element is reduced?  

b. Which element is the reducing agent?  

c. Which element is oxidized?  

d. Which element is the oxidizing agent?  

e. How many electrons are transferred?  

f. Which element are the electrons transferred to?
### Conversion Factors, Constants, and Periodic Table

Avogadro’s Number: $6.022 \times 10^{23}$ particles/mole

Mass of Proton: 1.0073 amu

Mass of Neutron: 1.0087 amu

Mass of Electron: $5.486 \times 10^{-4}$ amu

Mass of 1 amu: $1.66 \times 10^{-24}$ g

Temperature conversion: $T [K] = 273.15 + T [^\circ C]$