SHOW YOUR WORK. NO WORK, NO CREDIT
INCLUDE LABELS AND PROPER NUMBER OF SIG FIGS
Up to 75% of the credit for a problem will be given for correctly setting it up, including labels on all numbers.

Table of Constants

\[ N_0 = 6.022 \times 10^{23} \frac{\text{particles}}{\text{mole}} \]

Circle the correct answer.

1. (2 pts) How many protons and electrons are present in one Br⁻ ion?
   A. 35 p, 35 e  B. 80 p, 81 e  C. 35 p, 34 e  D. 35 p, 36 e  E. 80 p, 34 e

2. (2 pts) Which of the following is a metalloid?
   A. carbon, C, Z = 6  B. sulfur, S, Z = 16  C. germanium, Ge, Z = 32
   D. iridium, Z = 77  E. bromine, Br, Z = 35

3. (2 pts) Which of these elements is chemically similar to oxygen?
   A. sulfur  B. calcium  C. iron  D. nickel  E. potassium

4. (2 pts) Do the arithmetic and give the answer to the correct number of significant figures.
   \[ 0.871 \times 0.23 / 5.871 \]
   A. 0.0341219  B. 0.0340  C. 0.03412  D. 0.0341  E. 0.034

5. (2 pts) Which of the following represents the smallest volume?
   A. \(10^6\) nL  B. \(10^3\) pL  C. \(10^{-4}\) cL  D. \(10^{-3}\) mL  E. \(10^{-5}\) kL

6. (2 pts) If the ruler below is used to measure the length of an object, how many decimal places should there be in the measurement?

\[ \begin{array}{cccccccc}
0 & 0.1 & 0.2 & 0.3 & 0.4 & 0.5 & 0.6 \\
\end{array} \]
7. (3 pts each) Name the following compounds:

A. SO₂
   _________________________________

B. Fe(ClO₃)₃
   _________________________________

8. (3 pts each) Write the formula for the following compounds:

A. sulfurous acid
   _________________________________

B. tin (IV) sulfide
   _________________________________

12. An unknown compound is composed of 65.4% carbon, 5.5% hydrogen, and 29.1% oxygen.

A. (10 pts) What is the empirical formula for the compound?

B. (5 pts) The molecular mass of this compound determined from freezing point depression was found to be 110.108 g/mole. What is the molecular formula for the compound?
9. (5 pts) You have come to lab a bit early and are visiting with your classmates before lab begins. No one is working in the lab. Why is it still hazardous to eat something like a granola bar or drink a bottle of pop in the lab while you wait?

11. (10 pts) Silicon has three naturally-occurring isotopes with isotopic masses of 27.97693 amu, 28.97649 amu, and 29.97376 amu. The abundance of the lightest isotope is 92.21% and of the heaviest isotope is 3.08%. What is the atomic mass of silicon?

13. Hydrochloric acid can be prepared by the following reaction:

\[ \text{NaCl(s)} + \text{H}_2\text{SO}_4(aq) \rightarrow \text{HCl(g)} + \text{Na}_2\text{SO}_4(s) \]

A. (6 pts) Balance the reaction

B. (10 pts) If 20 mL of 10.0 M H₂SO₄ is mixed with 1.50 g NaCl, which will be the limiting reagent? Show your work.
10. (10 pts) What is the mass in grams of one molecule of ethylene glycol (C₂H₆O₂)?

14. Powdered zinc reacts with chromium (III) oxide according to the unbalanced reaction below.

\[ \text{Zn} + \text{Cr}_2\text{O}_3 \rightarrow \text{ZnO} + \text{Cr} \]

A. (10 pts) If 0.0348 mole of Zn is mixed with an excess of Cr₂O₃, what is the theoretical yield of chromium for that reaction?

B. (10 pts) If 0.491 g of Cr metal is actually recovered from the reaction, what is the percent yield?
HONOR PLEDGE: Sign and date.
On my honor, I pledge that I have upheld the honor code. And that the work I have done on this test has been honest, and that the work of others in this class has, to the best of my knowledge, been honest as well.

Signature ____________________________ Date ____________________________

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Table of Constants:

\[ N_0 = 6.022 \times 10^{23} \frac{\text{particles}}{\text{mole}} \quad c = 2.998 \times 10^8 \frac{m}{s} \]

\[ h = 6.626 \times 10^{-34} \frac{J \cdot s}{\text{photon}} \quad R_H = 2.18 \times 10^{-18} J \]
Chem 120A – Test 2
I. Multiple Choice: (Circle the correct answer.) (2 pt each)

1. Consider the Argon atom. How many electrons in an Argon atom have \( m_l = 1 \) and \( m_s = +1/2 \).
   
   (a) 6  (b) 0  (c) 1  (d) 2  (e) 4

2. Which of the following sets of quantum numbers are not allowed for an electron in an atom?

<table>
<thead>
<tr>
<th></th>
<th>( n )</th>
<th>( l )</th>
<th>( m_l )</th>
<th>( m_s )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>2</td>
<td>0</td>
<td>+2</td>
<td>+1/2</td>
</tr>
<tr>
<td>(ii)</td>
<td>4</td>
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<td>(iv)</td>
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<td>-1/2</td>
</tr>
<tr>
<td>(v)</td>
<td>3</td>
<td>3</td>
<td>-1</td>
<td>+1/2</td>
</tr>
</tbody>
</table>

   (a) (iii), (v)  (b) (ii), (iii), (v)  (c) (i), (iv), (v)  (d) (ii), (iii), (iv)  (e) (i), (v)

3. Which of the following has the highest first ionization energy?

   (a) Na  (b) Cl  (c) K  (d) Cs  (e) I

4. The spheres in the figure represent atoms of Li, Be, B, and F (not necessarily in that order). Which one of these spheres represents an atom of F?

   ![Sphere Diagram]

   A) sphere (a)  B) sphere (b)  C) sphere (c)  D) sphere (d)

5. Using the VSEPR model, predict the geometry of the \( \text{H}_2\text{O} \) molecule and determine which of the following statements is true about this molecule.

   (a) electron-domain geometry is tetrahedral, actual geometry is tetrahedral and the molecule has a permanent dipole moment
   
   (b) electron-domain geometry is linear, molecule is linear with no permanent dipole moment
   
   (c) electron-domain geometry is square planar, actual geometry is linear with no permanent dipole moment
   
   (d) electron-domain geometry is tetrahedral, actual geometry is bent and the molecule has a permanent dipole moment.
Chem 120A Test 2

6. Which choice indicates the correct number and type of hybrid orbitals on Carbons for the following molecule?

- \( \text{H} - \text{C} - \text{O} - \text{C} - \text{C} - \text{H} \)

(a) 12 sp\(^3\) and 3 sp\(^2\)
(b) 12 sp\(^3\) and 1 sp\(^2\)
(c) 10 sp\(^3\) and 3 sp\(^2\)
(d) 11 sp\(^3\) and 3 sp\(^2\) and 1 sp

7. The number of sigma and pi bonds in the molecule to the right is:

- \( \text{H} - \text{C} = \text{C} - \text{C} = \text{N} \)

(a) 5\(\sigma\), 2\(\pi\)
(b) 5\(\sigma\), 3\(\pi\)
(c) 6\(\sigma\), 3\(\pi\)
(d) 6\(\sigma\), 2\(\pi\)
(e) 9\(\sigma\), 1\(\pi\)

8. Use formal charges to determine the correct Lewis structure of formamide, CH\(_3\)NO.

(a) \( \text{H} - \overset{\cdot}{\text{O}} - \text{H} \)

(b) \( \text{H} - \overset{\cdot}{\text{C}} - \overset{\cdot}{\text{N}} - \text{H} \)

(c) \( \text{H} - \overset{\cdot}{\text{C}} = \overset{\cdot}{\text{N}} - \text{H} \)

(d) \( \text{H} - \overset{\cdot}{\text{C}} = \overset{\cdot}{\text{O}} - \text{N} - \text{H} \)

9. Which of the following is a weak base?

(a) NH\(_3\)  (b) Ca(OH)\(_2\)  (c) Ba(OH)\(_2\)  (d) NaOH  (e) HC\(_2\)H\(_3\)O\(_2\)
Chem 120A Test 2

10. Which of these chemical equations describes an acid-base neutralization reaction?

(a) \( 2\text{Al}(s) + 3\text{H}_2\text{SO}_4(aq) \rightarrow \text{Al}_2(\text{SO}_4)_3(aq) + 3\text{H}_2(g) \)

(b) \( \text{SO}_2(g) + \text{H}_2\text{O}(l) \rightarrow \text{H}_2\text{SO}_3(g) \)

(c) \( \text{LiOH}(aq) + \text{HNO}_3(aq) \rightarrow \text{LiNO}_3(aq) + \text{H}_2\text{O}(l) \)

(d) \( 2\text{KBr}(aq) + \text{Cl}_2(g) \rightarrow 2\text{KCl}(aq) + \text{Br}_2(l) \)

(e) \( \text{CaBr}_2(aq) + \text{H}_2\text{SO}_4(aq) \rightarrow \text{CaSO}_4(s) + 2\text{HBr}(g) \)

II. Nomenclature:

1. Name the following compounds: (2 pt each)

\[
\begin{align*}
\text{Ag}_2\text{SO}_3 & \quad \text{HClO}_4 \\
\end{align*}
\]

2. Write formulas for the following compounds: (2 pt each)

\[
\begin{align*}
\text{Copper (I) sulfide} & \quad \text{manganese dioxide} \\
\end{align*}
\]

III. Descriptive and Problem:

1. What are the differences and similarities between an orbit and orbital? (5 pt)
Chem 120A Test 2

2. The Simplified version of valence bond theory (no hybridization) is unable to predict the structure of $\text{H}_2\text{O}$. Explain why? Discuss how the concept of hybridization can be used to rectify this problem. (9 pt)

3. (a) Calculate the energy of the photon emitted when a hydrogen atom undergoes a transition from $n=6$ to $n=3$. (5 pt)

(b) What is the wavelength (in nm) of the photon emitted? (5 pt)
Chem 120A Test 2

4. Using valence bond theory determine the change in the geometry for the following reaction:

\[ \text{C}_2\text{H}_4 + 2\text{H}_2 \rightarrow 2 \text{CH}_4 \]  

(9 pt)

5. In the trigonal bipyramidal arrangement, identify the axial and equatorial positions. Why does a lone pair occupy an equatorial position rather than an axial position?  

(9 pt)

6. (a) Draw the molecular orbital diagram for the \( \text{N}_2 \) molecule.  

(b) Write down the molecular electronic configuration for the \( \text{N}_2 \) molecule.  

(c) Calculate the bond order of the molecule.
7. Write and balance the net ionic equation. (7 pt)

\[ \text{H}_3\text{PO}_4 + 3 \text{NaOH} \rightarrow \text{Na}_3\text{PO}_4 + 3 \text{H}_2\text{O} \]

8. Draw the Lewis structures, including any resonance structures, for \( \text{NO}_3^- \) (9 pt)
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Signed ________________________________________________

If you feel you can’t sign this, contact the instructor (email, or in person)

Table of Constants

\[ N_0 = 6.022 \times 10^{23} \text{ particles/mole} \]
\[ c = 2.998 \times 10^8 \text{ m/s} \]
\[ h = 6.626 \times 10^{-34} \text{ J s} \]
\[ R_H = 2.18 \times 10^{-18} \text{ J} \]
\[ S(H_2O) = 4.184 \text{ J/(g \cdot ^\circ C)} \]
\[ 1.0 \text{ L \cdot atm} = 101.3 \text{ J} \]

(2 pts each) Multiple Choice: Circle the correct answer.

1. Which is the most polar bond?

2. Which of the following is not paired correctly with its molecular geometry?
   A. CO₂; linear  B. H₂O; linear  C. Cl₂; linear  D. SiF₄; tetrahedral  E. all are correct

3. Which type of hybridization is usually associated with trigonal bipyramidal geometry?
   A. sp⁴  B. sp³  C. sp³d  D. sp³d²  E. sp

4. Identify the major ions present in an aqueous H₂SO₄ solution.
   A. H⁺, S^{6+}, O^{2-}  B. OH⁻, SO₃^{2-}  C. H₂O⁺, SO₄^{2-}  D. H⁺, SO₄^{2-}  E. H⁺, SO₂⁻

5. What is the reducing agent in the following reaction?
   \( \text{Mg} + \text{NiO}_2 + 2\text{H}_2\text{O} \rightarrow \text{Mg(OH)}_2 + \text{Ni(OH)}_2 \).
   A. Mg  B. NiO₂  C. H₂O  D. Mg(OH)₂  E. Ni(OH)₂

6. When heat is absorbed by the system and work is done by the system on the surroundings then
   A. q is negative and w is positive.  B. both q and w are positive.
   C. both q and w are negative.  D. q is positive and w is negative.
   E. q is positive for endothermic processes and w is positive for endothermic processes.
7. Predict which of the following reactions has a negative entropy change.

A. \(2 \text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2 \text{SO}_3(\text{g})\)  
B. \(\text{MgCO}_3(\text{s}) \rightarrow \text{MgO}(\text{s}) + \text{CO}_2(\text{g})\)  
C. \(\text{PCl}_5(\text{s}) \rightarrow \text{PCl}_3(\text{l}) + \text{Cl}_2(\text{g})\)  
D. \(\text{Mn(OH)}_2(\text{s}) + \text{HCl}(\text{aq}) \rightarrow \text{MnCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l})\)  
E. \(\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{g})\)

8. Which of the following equations represents a reaction that provides the heat of formation of ethanol \((\text{CH}_3\text{CH}_2\text{OH})\)?

A. \(2 \text{CO}_2(\text{g}) + 6 \text{H}_2(\text{g}) \rightarrow \text{CH}_3\text{CH}_2\text{OH}(\text{l}) + 3 \text{H}_2\text{O}(\text{l})\)  
B. \(2 \text{C}(\text{s}) + 3 \text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{CH}_3\text{CH}_2\text{OH}(\text{l})\)  
C. \(2 \text{CO}(\text{g}) + 3 \text{H}_2(\text{g}) \rightarrow \text{CH}_3\text{CH}_2\text{OH}(\text{l}) + \frac{1}{2} \text{O}_2(\text{g})\)  
D. \(\text{CH}_2 = \text{CH}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{CH}_3\text{CH}_2\text{OH}(\text{l})\)  
E. \(2 \text{C}(\text{s}) + 6 \text{H}(\text{g}) + \text{O}(\text{g}) \rightarrow \text{CH}_3\text{CH}_2\text{OH}(\text{l})\)

9. Which of the following equations is correct at constant pressure?

A. \(\Delta H = q + w\)  
B. \(\Delta H = -P\Delta V\)  
C. \(\Delta H = \Delta U + P\Delta V\)  
D. \(\Delta H = \Delta U - P\Delta V\)

10. The vaporization of a liquid to form a gas is

A. an exothermic process  
B. an endothermic process  
C. a constant entropy process  
D. all of them

11. All of the reactions below take place in aqueous solution. Some reactions may fit more than one category, and some may not fit any category. Some categories may have no reactions. Which of the reactions are:

A. (2 pts) redox reactions? ____________________  
B. (2 pts) acid-base reactions? ____________________  
C. (2 pts) precipitation reactions? ____________________

1) \(3 \text{Zn} + 2 \text{H}_3\text{PO}_4 \rightarrow \text{Zn}_3(\text{PO}_4)_2 + 3 \text{H}_2\)  
2) \(\text{H}_2\text{CO}_3 \rightarrow \text{H}_2\text{O} + \text{CO}_2\)  
3) \(\text{Pb(NO}_3)_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{PbSO}_4 + 2 \text{NaNO}_3\)  
4) \(\text{CaSO}_3 + 2 \text{HI} \rightarrow \text{CaI}_2 + \text{H}_2\text{SO}_3\)

12. (2 pts each) Name the following compounds.

\(\text{Cl}_2\text{O}_7\) ______________________________  \(\text{Ni} (\text{NO}_2)_2\) ______________________________

13. (2 pts each) Write formulas for the following compounds.

ammonium chlorate ______________________________  arsenic (V) hydride ______________________________
14. (8 pts) Draw the Lewis structure including any resonance structures for SeS₂.

15. (1 pt each) Fill in the blanks for each Lewis structure.

<table>
<thead>
<tr>
<th>Lewis Structure</th>
<th>Molecular geometry</th>
<th>Polar (yes/no)</th>
<th>Hybrid</th>
</tr>
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</table>

Polar (yes/no) ________________________

Hybrid ______________________________

16. (8 pts) Write and balance the net ionic reaction:

\[
\text{HI} + \text{Ba}_3(\text{PO}_4)_2 \rightarrow \text{H}_3\text{PO}_4 + \text{BaI}_2
\]

17. (8 pts) Balance the following redox reaction that takes place in acidic solution:

\[
\text{MnO}_4^{-1} + \text{Cl}^{-1} \rightarrow \text{Mn}^{2+} + \text{Cl}_2
\]
18. The enthalpy and entropy change of a reaction are -32.3 kJ/mole and -34.0 J/mole·K respectively at 25°C.

A. (7 pts) What is the free energy change in kJ/mole?

B. (3 pts) Is this reaction spontaneous? Explain your reasoning.

19. (8 pts) Using the following reactions and their ΔH° values:

\[ \text{2 P(s) + 3 Cl}_2(g) \rightarrow 2 \text{PCl}_3(g) \quad \Delta H^\circ/\text{kJ} = -542 \]
\[ \text{2 P(s) + 5 Cl}_2(g) \rightarrow 2 \text{PCl}_5(g) \quad \Delta H^\circ/\text{kJ} = -764 \]

Determine the ΔH° (kJ) for this reaction: \[ \text{PCl}_3(g) + \text{Cl}_2(g) \rightarrow \text{PCl}_5(g) \]

20. (8 pts) It takes 78.2 J to raise the temperature of 45.6 g of lead by 13.3°C. What is the molar specific heat (J/mol·°C) of lead?
21. At 25°C, a 0.010 mole sample of a gas is compressed in volume from 5.0 L to 3.0 L at constant temperature.

A. (7 pts) What is the work (w) in joules for this process if the external pressure is 3.0 atm?

B. (3 pts) Is work done on the system or by the system? Explain your reasoning.
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Table of Constants:

\[
N_0 = 6.022 \times 10^{23} \frac{\text{particles}}{\text{mole}} \quad K_w = 1.00 \times 10^{-14}
\]

\[
R = 0.08206 \frac{L \cdot \text{atm}}{K \cdot \text{mole}} = 62.36 \frac{L \cdot \text{torr}}{K \cdot \text{mole}} = 8.314 \frac{J}{K \cdot \text{mole}}
\]

1 atm = 760 mm Hg = 101.3 kPa
Chem 120A – Test 4
1. Multiple Choice: (Circle the correct answer.) (2 pt each)

1. What is the value of \( K_b \) for the formate anion, \( \text{HCOO}^- \)? \( K_a(\text{HCOOH}) = 2.1 \times 10^{-4} \)
   
   (a) \(-2.1 \times 10^{-4}\)  
   (b) \(2.1 \times 10^{-4}\)  
   (c) \(6.9 \times 10^{-6}\)  
   (d) \(4.8 \times 10^{-11}\)  
   (e) \(2.1 \times 10^{-18}\)

2. Acid strength decreases in the series \( \text{HI} > \text{HSO}_4^- > \text{HF} > \text{HCN} \). Which of these anions is the weakest base?
   
   (a) \(\text{I}^-\)  
   (b) \(\text{SO}_4^{2-}\)  
   (c) \(\text{F}^-\)  
   (d) \(\text{CN}^-\)

3. Which of the following compounds should be soluble in \( \text{CCl}_4 \)?
   
   (a) \(\text{NaCl}\)  
   (b) \(\text{H}_2\text{O}\)  
   (c) \(\text{NaOH}\)  
   (d) \(\text{PF}_3\)  
   (e) None of these choices is correct.

4. For the following reaction at equilibrium, which choice gives a change that will shift the position of equilibrium to favor formation of more products?
   \[ 2\text{NOBr}(g) \rightleftharpoons 2\text{NO}(g) + \text{Br}_2(g), \Delta H^\circ_{\text{rxn}} = 30 \text{ kJ/mol} \]
   
   (a) Increase the total pressure by decreasing the volume.  
   (b) Add more \(\text{NO}\).  
   (c) Remove \(\text{Br}_2\).  
   (d) Lower the temperature.  
   (e) Remove \(\text{NOBr}\) selectively.

5. For the reaction \( \text{H}_2(g) + \text{Br}_2(g) \rightleftharpoons 2\text{HBr}(g), K_c = 81.4 \text{ at } 385^\circ \text{C} \). If \([\text{H}_2] = [\text{Br}_2] = [\text{HBr}] = 2.4 \times 10^{-4} \text{ M at } 385^\circ \text{C}\), which one of the following is correct?
   
   (a) \([\text{H}_2]\) and \([\text{HBr}]\) decreases as the system moves toward equilibrium.  
   (b) The system is at equilibrium.  
   (c) \([\text{H}_2]\) and \([\text{Br}_2]\) increases as the system approaches equilibrium.  
   (d) \([\text{HBr}]\) increases as the system approaches equilibrium.  
   (e) \([\text{HBr}]\) and \([\text{Br}_2]\) increases as the system approaches equilibrium.

6. Which one of the following substances should exhibit hydrogen bonding in the liquid state?
   
   (a) \(\text{PH}_3\)  
   (b) \(\text{He}\)  
   (c) \(\text{H}_2\text{S}\)  
   (d) \(\text{CH}_4\)  
   (e) \(\text{CH}_3\text{OH}\)

7. Which of the following substances should have the highest boiling point?
   
   (a) \(\text{CH}_4\)  
   (b) \(\text{Cl}_2\)  
   (c) \(\text{Kr}\)  
   (d) \(\text{CH}_3\text{Cl}\)  
   (e) \(\text{N}_2\)
8. At 298 K which of the following gases has the lowest rms velocity?

(a) C₂H₆ at 0.5 atm  
(b) CO at 0.8 atm  
(c) CH₄ at 0.2 atm  
(d) H₂O at 0.6 atm  
(e) CO₂ at 0.4 atm

9. Which one of the following relationships when graphed does not give a straight line for helium gas?

I. \( V \) versus \( n \) at constant pressure and temperature  
II. \( P \) versus \( 1/V \) at constant temperature for a constant mass  
III. \( P \) versus \( 1/T \) at constant volume for a constant mass

(a) I  
(b) II  
(c) II and III  
(d) III  
(e) I and II

10. How many liters of \( \text{H}_2 \) are needed to make 8.00 L of \( \text{NH}_3 \) according to the reaction below? Both gases are measured at the same temperature and pressure.

\[
\text{N}_2 (g) + 3 \text{H}_2 (g) \rightarrow 2 \text{NH}_3 (g)
\]

(a) 5.33  
(b) 8.0  
(c) 45.3  
(d) 12.0

11. Which of the following solutions has the highest pH?

(a) 1 M HCl  
(b) 0.010 M Ca(OH)₂

(c) 0.010 M NAOH  
(d) 0.10 M HCl

II. Descriptive

1. (a) What are the conjugate bases of \( \text{CH}_3\text{COOH} \), \( \text{HBr} \)?  
(b) What are the conjugate acids of \( \text{N}_2\text{H}_4 \), \( \text{H}_2\text{PO}_4^- \)?
Chem 120A – Test 4

2. Given the following $K_a$ values, determine which species is the strongest acid. Explain your reasoning. (pt. 4)

\[
\begin{align*}
\text{H}_2\text{SO}_3 & \quad 1.2 \times 10^{-2} \\
\text{HNO}_2 & \quad 4.5 \times 10^{-4} \\
\text{HCNO} & \quad 3.5 \times 10^{-4}
\end{align*}
\]

3. Identify the Bronsted-Lowry acid or acids in the following reaction. (pt. 2)

\[
\text{HC}_2\text{H}_3\text{O}_2 + \text{HI} \rightleftharpoons \text{H}_2\text{C}_2\text{H}_3\text{O}_2^+ + \text{I}^-
\]

III. Problems:

1. A 1.00 g sample of unknown gas has a volume of 199 mL at 745 mm Hg and 75 $^\circ$C. What is the molar mass of the gas. (pt. 8)

2. A birthday balloon with a volume of 7.00 L was bought at the Miami airport on a day that the temperature was 32$^\circ$C and the pressure was 763 mmHg. What is the volume of the balloon at the Airport in Calgary if the temperature is -4$^\circ$C and the pressure is 655 mmHg? (pt. 6)
3. A gas mixture contains 4.0 mol O₂, 5.0 mol N₂, and 3.0 mol He. The total pressure of the mixture is 6.0 atm. What is the pressure due to the He? (pt. 6)

4. What mass of Mg is required to produce 5.15 L of H₂ at STP by the following reaction? (STP: P=1 atm, T=25°C)
   \[ \text{Mg(s)} + 2 \text{HCl (aq)} \rightarrow \text{MgCl}_2 \text{ (aq)} + \text{H}_2 \text{ (g)} \] (pt. 8)

5. What are the pH and pOH in a $2.1 \times 10^{-4}$ M Ca(OH)₂ solution? (pt. 8)
Chem 120A – Test 4

6. Butyric acid is responsible for the odor in rancid butter. A solution of 0.25 M butyric acid has a pH of 2.71. What is the $K_a$ for the acid? (pt. 8)

7. What is the percent CsCl by mass in a 0.711 M aqueous CsCl solution that has a density of 1.091 g/mL? (pt. 6)

8. Write the equilibrium constant expression for the following net ionic reaction.

$$2 \text{H}_3\text{PO}_3 + 3 \text{Ba}^{2+} + 6 \text{OH}^- \rightleftharpoons \text{Ba}_3(\text{PO}_3)_2 + \text{H}_2\text{O}$$

(pt. 6)
9. The equilibrium constant for the net ionic reaction below is 0.1216.

\[ \text{C}_2\text{O}_4^{2-} + 2 \text{ HF} \rightleftharpoons 2 \text{ F}^- + \text{H}_2\text{C}_2\text{O}_4 \]  

( pt. 8)

Shortly after mixing a solution of Na₂C₂O₄ with another solution of HF, the solution contained the following concentrations: 0.0035 M C₂O₄²⁻, 0.0016 M H₂C₂O₄, 0.0065 M HF, and 0.0030 M F⁻. Is this mixture at equilibrium? If it is not at equilibrium, will the reaction have to shift toward the reactants or toward the products to get to equilibrium? Show your work or explain your reasoning.