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**Include file name:** Chemistry\_Worksheet\_0043

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### **Exam**

#### **Instructions for writing chemical equations:**

1. Write reactants and products in the order specified in the question.
2. Use -> (hyphen + greater than) for yields.
3. Write subscripts as numbers with no special character, but use a carot (^) before each superscript. Always write the number before the sign and always include '1'. Thus,  $\text{HCO}_3^{1-}$  would be  $\text{HCO}3^1-$ .
4. Do not include the state of the substance, i.e., no (s), (l), (g), or (aq).
5. Answers are case sensitive. Spaces are ignored, but are required after the charge on an ion.
6. Click on the "eye" symbol to see your formatted response.

1) Answer the following for a **Bi** atom.

- **Use carots to indicate exponents and leave spaces between sublevels in the electron configurations. Include the sign of the charge of the ion even if it is positive. For example,  $6s^2 5d^9$  and  $+3$ .**

The valence electron configuration is	
The number of unpaired electrons is	
The number of occupied p orbitals in the atom is	
The charge on its most common ion is	

2) Write out the Bronsted acid-base reaction and determine the equilibrium constant for the reactions that occur when the following solutions are mixed. Use ^ to indicate superscripts but nothing for subscripts. **Express all equilibrium constants to three significant digits.** [Acid-Base Table](#)

- Use carots to indicate superscripts and -> for yields.
- Express all equilibrium constants to three significant figures.
- Write the substances in the order given at the top of the column.

Mixed Solutions	Acid(1) + Base(2) -> Base(1) + Acid(2)	K
HClO + KCN		
KOH + H <sub>2</sub> SO <sub>3</sub>		
HF + NH <sub>3</sub>		
K <sub>2</sub> S + HCl		

3) **You get only one submission of this question!** A galvanic cell is constructed by connecting a Ag<sup>1+</sup>/Ag couple and a Cu<sup>2+</sup>/Cu couple. Use a [Standard Reduction table](#) to answer the following:

The anode couple is	Ag <sup>1+</sup> /Ag Cu <sup>2+</sup> /Cu
The couple that electrons flow into	Ag <sup>1+</sup> /Ag Cu <sup>2+</sup> /Cu
The couple that cations flow into from the salt bridge	Ag <sup>1+</sup> /Ag Cu <sup>2+</sup> /Cu
The Ag electrode would	dissolve grow
The species with the lowest unfilled orbitals is	Cu <sup>2+</sup> Cu Ag <sup>1+</sup> Ag
The standard cell potential is	_____ V

4) **No marks** Give the following for an atom of Br. For the most common ion, enter only the charge and put the sign first. For example, enter +3 not 3+.

the number of unpaired electrons	
the number of valence electrons	
the number of occupied p orbitals	
the charge of its most common ion	

5) **You get only one submission of this question!** Indicate solution (A or B) with the higher pH. [Acid-Base Table](#)

<b>Solution A</b>	<b>Solution B</b>	<b>pH</b>
0.10 M KClO	0.10 M KCN	A / B
0.20 M KF	0.30 M KF	A / B
0.10 M HClO	0.10 M HCN	A / B
0.20 M HCl	0.30 M HCl	A / B

6) Construct the Lewis structure for S<sub>2</sub>N<sub>2</sub> that minimizes formal charge. Note there are two resonance forms, but only one minimizes the formal charge.

- Select the atom symbol to change the number of lone pairs.
- Select the area between atoms to change the bond order.
- Use the list box to set the formal charge for each atom.

0	▼	0	▼	0	▼	0	▼
---	---	---	---	---	---	---	---

7) Assume the reaction of 36.44 g of F<sub>2</sub> in the following reaction to determine the other quantities.

<b>5F<sub>2</sub> + 2Sb -&gt; 2SbF<sub>5</sub></b>	
moles of F <sub>2</sub> reacting =	_____mol
moles of Sb required =	_____mol
moles of SbF <sub>5</sub> formed =	_____mol
mass of SbF <sub>5</sub> formed =	_____g

8) **No marks** What is the oxidation state of the red atom (also underlined) in each of the following. Place the charge before the number, i.e., +2 not 2+.

<u>C</u> <sub>2</sub> O <sub>4</sub> <sup>2-</sup>	
<u>Co</u> <sub>2</sub> S <sub>3</sub>	
<u>N</u> H <sub>3</sub>	

9) No marks

Select the atom with an unfilled orbital at lowest energy.

C  
O  
As  
Ga  
Se

Select the atom with the highest energy electron.

C  
O  
As  
Ga  
Se

10) No marks One compound in the list below is a gas at room conditions, while all of the others are liquids or solids. For each indicate that it is the gas or the force most responsible for it being in a condensed state (liquid or solid).

CH <sub>3</sub> OH	<input type="text" value="---Select---"/>
C <sub>2</sub> H <sub>2</sub>	<input type="text" value="---Select---"/>
CCl <sub>4</sub>	<input type="text" value="---Select---"/>
KCl	<input type="text" value="---Select---"/>
Pb	<input type="text" value="---Select---"/>

11) Write the chemical equations (even for those that not extensive) that describe the following redox processes and indicate whether each is extensive. Note there are no marks for the extent. [Standard Reduction table](#)

- See instructions for writing chemical equations at the top of the exam
- Be sure to write all substances in the order given at the top of the column.

Substances	RED(1) + OX(2) → OX(1) + RED(2)	Extensive?
bromide ions + zinc ions		yes/no
copper(II) ions + tin metal		yes/no
chlorine + lead metal		yes/no
aluminum metal + chromium(III) ions		yes/no

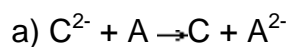
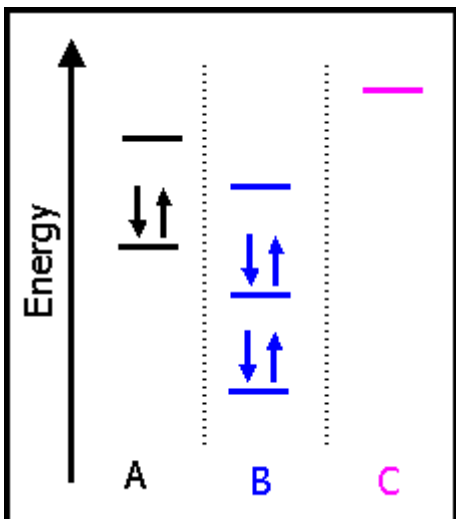
12) Name the following compounds.

Mg <sub>3</sub> N <sub>2</sub>	
Cl <sub>2</sub> O	
CuCl <sub>2</sub>	
CrPO <sub>4</sub>	

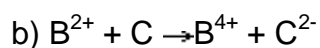
13) **No marks** What are the *n* and *l* quantum numbers for the highest energy electron in **Tl**?

<b>n</b>	<b>l</b>

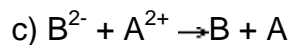
14) You get only one submission of this question! Shown below are the energy level diagrams for the valence electrons of elements A, B, and C. Indicate if the reactions below would be spontaneous or non-spontaneous. Also indicate the best oxidizing and reducing agent.



spontaneous/  
non-spontaneous



spontaneous/  
non-spontaneous



d) Select the best oxidizing agent.

- $A^{2-}$
- A
- $A^{2+}$
- $B^{4+}$
- $B^{2+}$
- B
- $B^{2-}$
- C
- $C^{2-}$

e) Select the best reducing agent.

- $A^{2-}$
- A
- $A^{2+}$
- $B^{4+}$
- $B^{2+}$
- B
- $B^{2-}$
- C
- $C^{2-}$

15) Use the [Solubility Rules](#) to write **net ionic equations** for the reactions that occur when solutions of the following are mixed or write **none** (all lower case) if no reaction is expected. The instructions are identical to the homework and can be viewed in the exam heading.

Required order:	<b>Cation + Anion -&gt; Precipitate</b> or <b>none</b> if no reaction occurs
a) $\text{KCl} + \text{K}_2\text{CrO}_4$	
b) $\text{Ag}_2\text{SO}_4 + \text{Cu}(\text{NO}_3)_2$	
c) $\text{CsOH} + \text{Cr}(\text{NO}_3)_3$	
d) $\text{CuSO}_4 + \text{Ba}(\text{ClO}_4)_2$	

16) **No marks** Select all of the strong electrolytes:

- $\text{CH}_3\text{OH}$
- $\text{KNO}_3$
- $\text{NaOH}$
- $\text{CH}_3\text{Cl}$
- $\text{NH}_4\text{Cl}$
- $\text{HF}$
- $\text{HClO}$
- $\text{SO}_2$
- $\text{KClO}$
- $\text{HCl}$



17) **No marks** Consider the following gas phase reaction:



and the following bond energies:

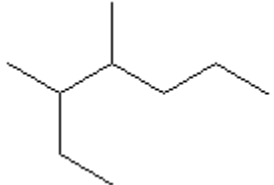
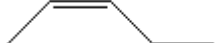

A≡A: 510 kJ/mol	A=A: 440 kJ/mol	A-B: 110 kJ/mol
A-D: 580 kJ/mol	B-B: 350 kJ/mol	D-D: 290 kJ/mol

The enthalpy of reaction is \_\_\_\_\_ kJ/mol.

The entropy of reaction is nearly zero / positive / negative

The reaction is

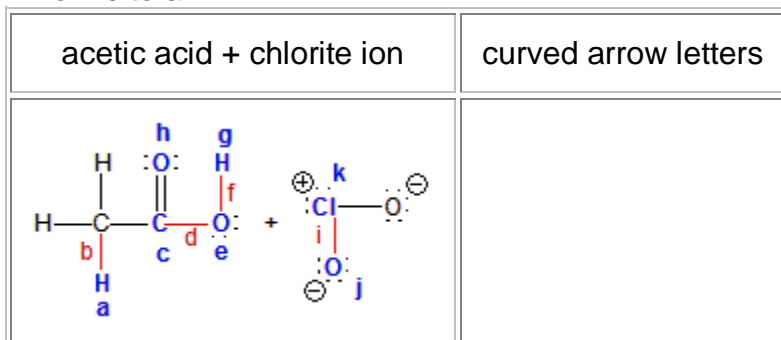
18) Name the following organic compounds. If a compound can exist in more than one isomer, identify the isomer that is drawn:

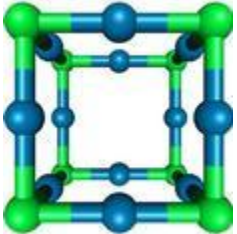
19) You get only one submission of this question! Indicate whether each of the following has only ionic, only covalent, or both ionic and covalent bonds.

HC <sub>2</sub> H <sub>3</sub> O <sub>2</sub>	<input type="text" value="---Select---"/>
CaSO <sub>4</sub>	<input type="text" value="---Select---"/>
MgCl <sub>2</sub>	<input type="text" value="---Select---"/>
CHCl <sub>3</sub>	<input type="text" value="---Select---"/>

20) Indicate the direction of curved arrows for the mechanism of the reaction between acetic acid and chlorite ion. Each curved arrow consists of two letters: the letter corresponding to the start of the curved arrow followed by the letter corresponding to end of the arrow. Blue letters and arrows are used for atoms, while red arrows and letters are used for bonding pairs in the figure below. Separate the letter pairs corresponding to the arrows with a comma. For example, the answer eb,ca would mean two arrows: one from e to b and one from c to a.



21) **No marks** Use the structure of an oxide of rhenium shown below to answer the following questions. Green = Re ; Blue = O

	The number of Re atoms in the unit cell is	
	The number of O atoms in the unit cell is	
	The simplest formula (written as $\text{Re}_x\text{O}_y$ ) of the oxide is	

22) **No marks** Use the noble gas configuration shorthand to write the valence electron configuration of each of the following ions. **Use a ^ to indicate a superscript.** For example,  $4s^2 = 4s^2$ . Click the eye symbol to check your entry.

Ion	Electron Configuration
$\text{Ti}^{2+}$	

23) To what temperature in degrees **celcius** must 0.386 mol of He in a 3.10 liter flask be heated to obtain a pressure of 4.50 atm?  
 $t = \text{_____}^\circ\text{C}$

24) **Only one submission of this question.** Answer the following questions pertaining to the Lewis structure below.

1. Lone pairs have been omitted, but all atoms the octet rule.
2. Use no special characters for superscripts, i.e.,  $sp^3 = sp3$ .
3. Include the sign on formal charge and oxidation state, e.g., +2
4. Give only the number for bond angles; do not include the degree mark (o)

hybridization of $C_a$		hybridization of $C_b$	
hybridization of N		oxidation state of $C_a$	
formal charge on $C_b$		formal charge on N	
formal charge on $O_c$		bond angles around $C_a$	
bond angles around N		Is this the Lewis of a stable compound? (y or n)	

25) **No marks** Write formulas for the following compounds. Use no special characters for subscripts. For example,  $Pb(NO_2)_2 = Pb(NO2)2$

aluminum carbonate	
lithium nitride	
cobalt(III) nitrate	
lead(IV) oxide	

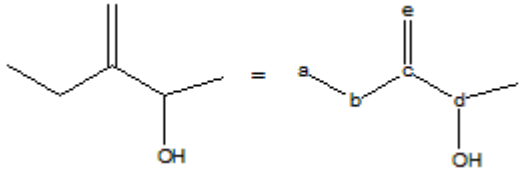
26) Draw the Lewis structure for the formate ion,  $\text{CO}_2^{2-}$ .

- Select the atom symbol to change the number of lone pairs.
- Select the area between atoms to change the bond order.
- Use the list box to set the formal charge for each atom.

0	▼	0	▼	0	▼
---	---	---	---	---	---

27) **No Marks!** Identify the groups in the following skeletal structure.

- The two structures are identical. The second simply shows the labels of the atoms used in the question.

	position	group
	a	---Select---
	b	---Select---
	c	---Select---
	d	---Select---

The hybridization of atoms c and d are

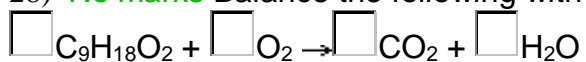
Atom c: ---Select---

Atom d: ---Select---

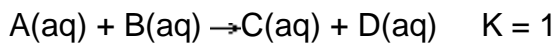
The molecule is a(n) (Select all that apply.)

- alkene
- alcohol
- strong base
- ester
- alkyne
- acid
- amine
- alkane

28) **No marks** Balance the following with smallest integers:



29) **No marks** Consider the following **endothermic** reaction:



A solution is prepared in which the initial concentrations of A and B are each 1.0 M. At equilibrium, the concentrations of B and C would be about

[B]	[C]
<input type="text" value="---Select---"/> M	<input type="text" value="---Select---"/> M

The concentration of **C** could be increased by (select all that apply)

- Adding A
- Adding D
- Increasing temperature
- Removing A
- Removing D