Chemistry 1301A Practice Final Exam

- Questions -

Introduction

Dear Student,

Thank you for opening the Chemistry 1301A practice final exam questions for Chemistry 1301A. This resource has been created by the Education Team at WebStraw. The Education Team consists of students that have previously taken and/or students that are currently taking Chemistry 1301A.

Purpose

This resource focuses on key concepts that are important for students to understand to succeed within this course. This resource was created by students for other students. Our goal is to help students (1) further develop their understanding of course content and (2) achieve greater academic success. (3) Our resource is also open access meaning there are no financial or legal barriers to students who wish to access and use our resource.

Instructions

Treat these practice questions like an actual exam: give yourself a set time to complete the questions and only refer to the hints when necessary. Upon completion of the Practice Questions, compare your thought-process and answers to the solutions provided.

Disclaimer

This resource is supplementary to your course content and is not meant to (1) replace any of the resources provided to you by your instructor nor is it meant to (2) be used as a tool to learn the course material from scratch. We assume that students who use this resource will have a basic understanding of the course content. As such, many of the solutions expect you to have the basic knowledge of understanding (e.g, knowing the formula for equilibrium). This resource does not contain everything you need to know for your evaluations. Please refer to the course material provided by your instructors if there are any discrepancies between our resource and your course content.

We wish you the best of luck on your exams!
The WebStraw Team

Note to Instructors: If this resource has been created for your course and you would like to collaborate with us, please email us at team@webstraw.ca

1. Fundamental Concepts

Question Type: "Stoichiometry and Gas Laws"

How many litres of hydrogen gas will be formed from the following unbalanced reaction if 400 mL of a 0.75 M solution of K_2MnO_4 reacts with excess water under standard conditions? What happens if the temperature (K) of the reaction environment is increased by 30%?

$$K_2MnO_4 + H_2O \rightarrow KMnO_4 + KOH + H_2$$

A) 3.67 L. The volume increases by 30%
B) 6.72 L. The volume increases by 30%
C) 3.67 L. The volume decreases by 30%
D) 6.72 L. The volume decreases by 30%

Space to Work

Hint: We must find the number of moles of hydrogen gas; at that point we can use the molar volume of gas in standard conditions to find the volume

1. Fundamental Concepts

Question Type: "Solubility of Elements"

When dissolved in solution, which of the following will most likely form a complex ion at ease?

A) Mg^{2+}
B) K^{+}
C) Cr^{3+}
D) F^{-}

Space to Work

1. Fundamental Concepts

Question Type: “pH Calculations using Concentration”

What is the concentration of hydrogen in an aqueous solution that has a pOH of 8.30? What would be the new pOH if a solution of pH = 5, with the double of the volume of the first solution, is added?

Space to Work

Hint: Remember that when calculating for the final pOH, the final volume is the initial volume and the volume of the added solution combined.

1. Fundamental Concepts

Question Type: "Identity of an Element"

A novel element, Webstranium (Wb), has an average atomic mass of 119.49. If the three stable isotopes are ^{120}Wb, ^{119}Wb and ^{124}Wb, propose a set of isotopic abundances that would be expected of the new element?

Space to Work

Hint:
What relationship exists between:
a) each isotopic abundance?
b) the isotopic abundances and the average atomic mass?

1. Fundamental Concepts

Question Type: "Resulting Mixture Calculation"

Two aqueous solutions of HCl have molar concentrations of 1.50M and 2.00M. When 2.00 liters of the first solution are mixed with 4.00 litres of the second solution, what is the concentration of HCl in the resulting mixture?

Space to Work

Hint: How do we find the new number of moles of HCl and the new volume? How are these related to the new concentration?

2. Atomic Theory

Question Type: "Quantum Numbers I"

Which set of quantum numbers is possible for a p electron in a Ni atom (assume electrons are in their ground state)?

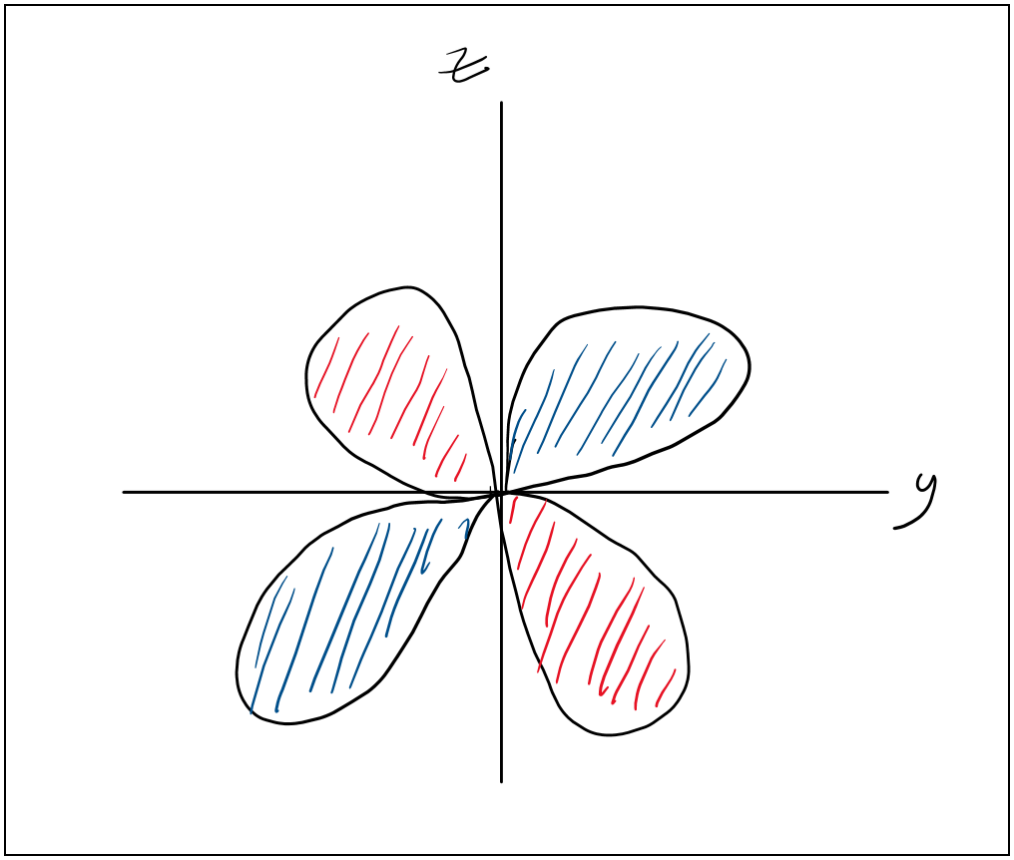
	n	l	m_l	m_s
a)	3	2	0	+½
b)	3	1	-1	-1
c)	4	2	-2	-½
d)	2	0	1	+½
e)	3	1	-1	-½

Space to Work

2. Atomic Theory

Question Type: "Orbitals and Bonding"

Which orbital shape does the following diagram represent?



a) $3d_{xy}$
b) $3d_{xz}$
c) $3d_{yz}$
d) $2p_z^2$
e) 2py

2. Atomic Theory

Question Type: “Quantum Numbers II”

Describe the quantum numbers for the last electron of the highest orbital of a calcium atom in its ground configuration?

Hint: Make use of the periodic table to identify the element's position and how that relates to orbitals and configuration.

2. Atomic Theory

Question Type: "Ionization Energy and Reactivity"

According to trends in the first ionization energy, which of the following alkali metals is the MOST reactive?

a) Li
b) Na
c) K
d) Cs

Space to Work

2. Atomic Theory

Question Type: "Diamagnetism"

Which of the following alkali species are diamagnetic?

I. Na
II. Ca^{+}
III. Ca^{+2}

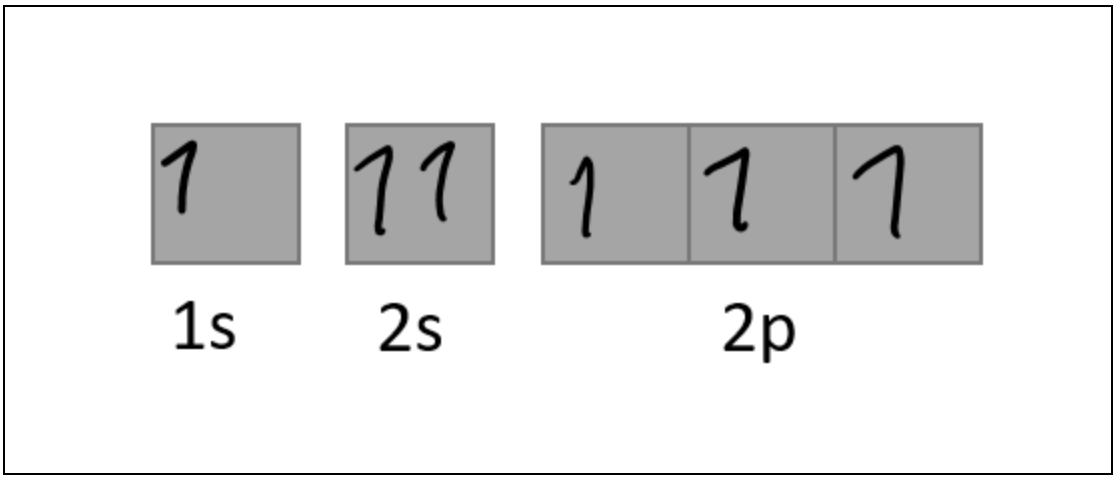
a. I and II
b. I
c. III
d. None of the above

Space to Work

2. Atomic Theory

Question Type: "Quantum Mechanical Models of Atoms"

An atom fills its orbital as presented:



Which of the following rules or principles does this configuration violate?

I. Hund's rule
II. Aufbau principle
III. Pauli's Exclusion Principle

A. I and III
B. II and III
C. I and II
D. I only
E. III only

Space to Work

2. Atomic Theory

Question Type: "Electron Configuration"

Which of the following is the correct electron configuration for Cr^{+}?

A) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$
B) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^3$
C) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$
D) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^4$

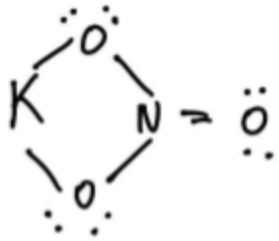
Space to Work

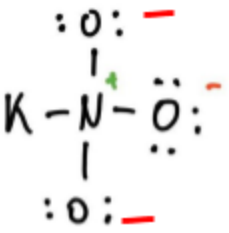
Hint: When writing out the electron configuration for Cr^{+}, make sure to take into account its charge

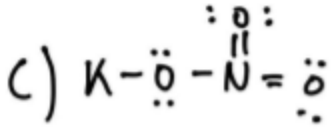
3. Structures and Bonding

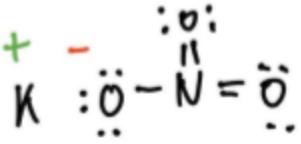
Question Type: "Best Lewis Structure"

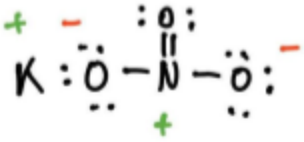
Potassium nitrate (KNO_3) is a common ingredient in many fertilizers. Which one of these 5 lewis structures is the best structure for the compound? Give explanations as to why the other structures are not the best Lewis structure.

A) 

B) 

C) 

D) 

E) 

Space to Work

Hint: What type of compound is potassium nitrate and how does knowing this help to eliminate some of the incorrect responses?

3. Structures and Bonding

Question Type: "MO Diagrams"

Which one of the following compounds/ions is paramagnetic?

A) O_2^{2+}
B) $[Fe(CN)_6]^{4-}$
C) N_2
D) $[Fe(H_2O)_6]^{3+}$

Space to Work

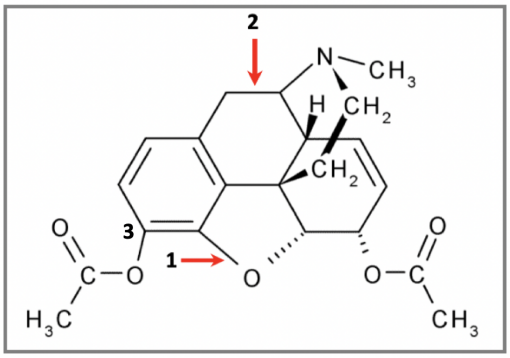
Hint: Construct the MO diagrams for each ion or coordination complex.

3. Structures and Bonding

Question Type: "Hybridization of Complex Structures"

Which statement regarding the structure of heroin is incorrect:

A) The ether group contains oxygen with an sp3 hybridization.
B) The bond at 1 is formed by the overlap of 2 sp3 orbitals
C) The bond at 2 cannot freely rotate about its axis
D) The carbon at 3 has hybrid orbitals arranged in a trigonal planar shape

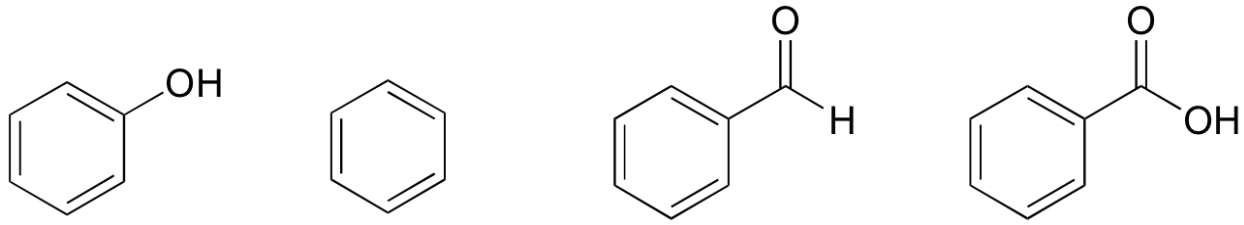


Hint: Think of hybrid orbitals as regions of electron density. In other words, the number of hybrid orbitals is equal to the number of regions of electron density.

3. Structures and Bonding

Question type: "Ranking the Melting Points"

From the following compounds that are shown below, which statements are correct? (select all that apply)



1. The melting point of the first compound is greater than the melting point of the second compound.
2. The melting point of the 4th compound is less than the melting point of the third compound.
3. The melting point of the 2nd compound is the highest.
4. The melting point of the 4th compound is the highest.

Space to work

Hint: Think about the type of bonds in each structure and what intermolecular forces they present

3. Structures and Bonding

Question Type: "Hybridization & VSEPR Theory"

Which molecules could have all their atoms on the same plane? (Select all that apply)

A) $CH_2 = CH_2$
B) F_2O
C) NH_3
D) $BeCl_2$
E) $CH_2 = C = CH_2$

Space to Work

4. Transition Metals

Question Type: "Structure and Function of Transition Metals"

Briefly describe the structure and function of hemoglobin.

Hint: Think of how the structure and function of hemoglobin are related.

4. Transition Metals

Question Type: "Bidentate and Chelating Ligands"

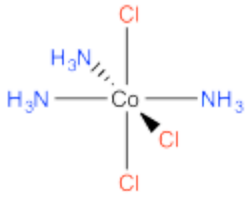
All chelating ligands are bidentate, but not all bidentate ligands are chelating. Explain whether this statement is true or not.

Hint: Think closely about what a chelating ligand is, and what denticity refers to.

4. Transition Metals

Question type: "Understanding Stereochemistry of Chemical Species"

What term would accurately describe the stereochemistry of the complex shown below?



a) cis
b) fac
c) mer
d) trans
e) Z

Space to work

4. Transition Metals

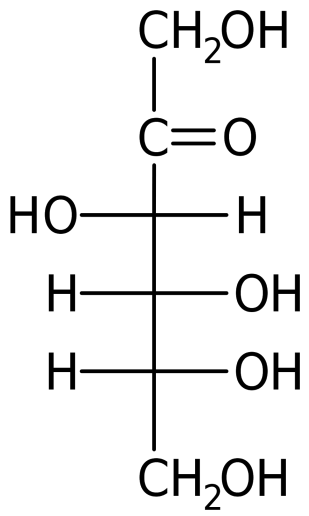
Question type: "Understanding the Mond Process"

In your own words, briefly describe the Mond process and what it is used for?

5. Structure and Shapes of Organic Molecules

Question Type: "Absolute Configurations I"

Fructose is a type of carbohydrate molecule found in fruits and some vegetables. Knowing the chiral centers, determine their absolute configurations (R/S configuration).



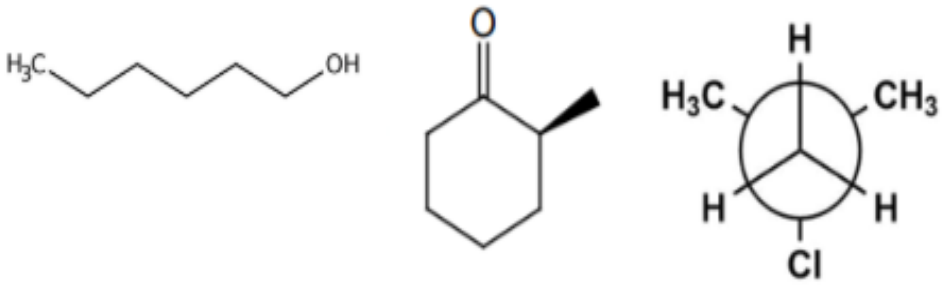
Space to Work

Hint: N-S (vertical) bonds fall below the plane whereas E-W (horizontal) bonds fall above the plane

5. Structure and Shapes of Organic Molecules

Question Type: "Chirality and Light"

Chemical structures that are enantiomers can rotate plane-polarized light, making them optically active. Given the structures above, which one/ones (if any) are optically active?



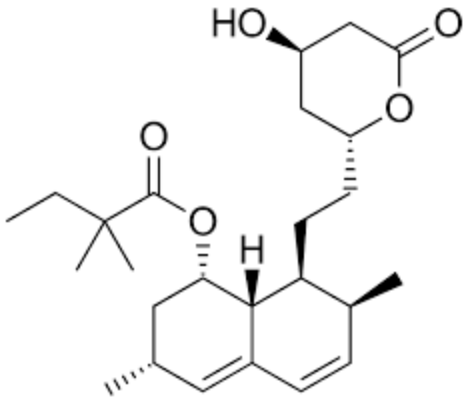
Space to Work

Hint: What property is essential for a chemical structure to be optically active?

5. Structure and Shapes of Organic Molecules

Question Type: "Stereoisomerism"

Below is the molecule for Simvastatin, a medication used to lower lipid levels and protect those who are at risk for cardiovascular diseases. How many stereoisomers can this molecule have?



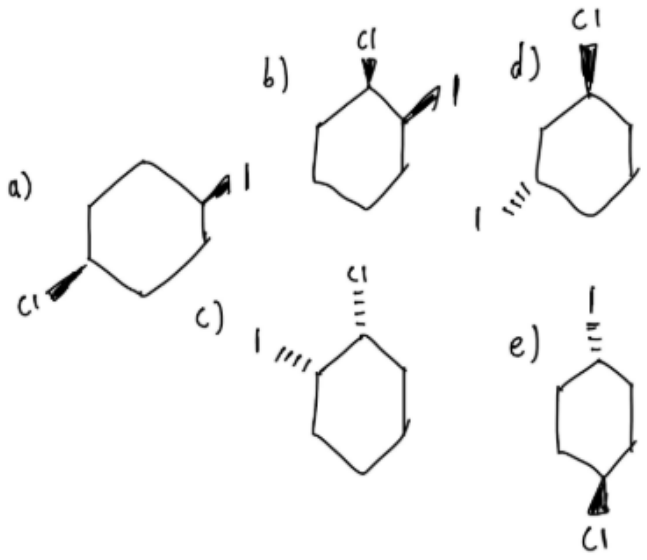
Space to Work

Hint: What forms of stereoisomerism are there?

5. Structure and Shapes of Organic Molecules

Question Type: "Identifying Isomers"

Halogens are common substituents on hydrocarbon rings and can be formed by reacting the two together. Such reactions give rise to many different variations of structures. With the 5 halogen-containing cyclohexane rings below, how many different constitutional/structural isomers are there?



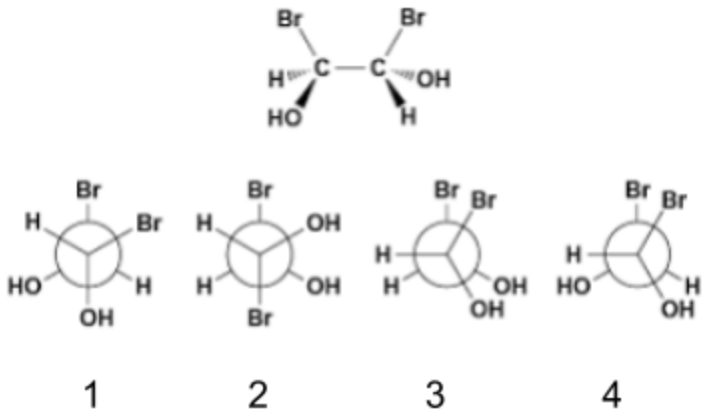
Space to Work

Hint: Think about what makes a constitutional isomer unique from other types of isomers?

5. Structure and Shapes of Organic Molecules

Question Type: "Newman Projections and Energy Favourability"

Which of the following Newman projections is a correct depiction of the dashed-wedge structure below? Which of the 4 Newman projections is the LEAST energetically favourable?



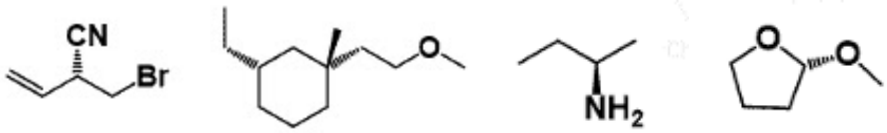
A) 1, 3
B) 4, 4
C) 4, 3
D) 1, 1

Space to Work

5. Structure and Shapes of Organic Molecules

Question Type: "Absolute Configurations II"

Which of the following compounds contain R configurations?



I II III IV

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

Space to work