**Exam 1 Organic Chemistry 3514**

**Alfred State College 29 Sept 201**

Your name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 pt \_\_\_\_\_\_/100 pts

* 1. **Lewis Model Bonding Part 1 ( 9 pts total/3 pts each)**

Sketch the most stable Lewis structures that **strictly** obey the octet rule for the compounds below:

***(include formal charges , lone pairs & indicate if symmetric resonances are present when necessary by writing `RES’)***







SO2 (RES) CO2 COCl2

* 1. **Lewis Model Bonding Part 2 (9 pts total/ 3 pts each)**

1. Draw the best structure for neutral POF3  that **strictly** obeys the octet rule and indicate where the formal charges are likely to be. *(P is central atom. Include all formal charges , lone pairs*)



Best structure for

POF3 that strictly obeys

Octet rule

1. If we relax the octet rule but insist on minimizing formal charge, what is the best structure for POF3?

*(Include all formal charges , lone pairs*)



1. With the help of appropriate Lewis models, explain why CO is over 200 times more likely to react with the iron in your blood than O2?

*(-):C*≡*O: (+) has formal charge such that the (-)C end is strongly attracted to the Fe3+ of the blood’s heme. In contrast, :O=O: has not formal charge and is much less effective at binding Fe3+*

\_\_\_\_/19 includes name

* 1. **Lewis Model Bonding Part 3 ( 15 pts total)**

1. Consider the 4 compounds below:

.. .. .. .. .. .. .. .. .. ..

:O=C-S=O: :O-C=S=O: H-O-C≡S-O: :O-C-S-O:

| .. | .. .. .. .. | .. ..

H H H

**A B C D**

Which compound(s) (if any) contains a neutral S ? \_\_\_\_\_\_D\_\_\_\_

2 pts/line

Which compound(s) (if any) contains O with a formal charge of -1 ? \_\_\_B,C,D\_\_\_\_\_\_\_\_\_\_

Which compounds(s) (if any) contains S with a formal charge of +2 ? \_\_\_\_\_\_B,C\_\_\_\_\_\_\_\_

Which compound(s) (if any) have an overall net charge of +1 ? \_\_\_\_\_\_\_\_A,B,C\_\_\_\_\_\_\_\_\_\_

Which compound(s) (if any) are anions (possess net negative charges) ? \_\_\_\_\_D\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Which compound: **A B C D** has the minimum formal charge of the group ? (circle your answer)

1. For each pair below, circle the compound that is most stable using the rough Lewis model reactivity rules : (1 pt each/3 pts total)
2. CH3F vs.  **CH3CH3**  ii) NO vs.  **NO3-** iii) CO vs. CO2
3. Draw both structures with the empiric formula C2H2O2 that satisfies the octet rule and results in zero formal charge on all the atoms. Show all lone pairs .(2 pts)





Others possible.

formic acid dioxirane

* 1. **Pauling’s Localized Hybrid Bonding Model (6 pts total/1 pt each)**

1. Identify the hybridization on the **bolded** elements in the compounds below:

.. .. .. ..

:S=**C**=O: H3C- **P**-H HO-**C**H= CH2 O=**N**-H

|

H

\_\_sp\_ \_sp3\_\_\_ \_sp2\_\_\_ \_sp2\_\_

1. Name two things the Pauling hybrid model explains that the Lewis model doesn’t:
2. \_\_\_\_\_\_explains reactivity order of ethane < ethylene <acetylene\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. \_\_\_\_\_\_explains how multiple bonds can arrange themselves between atoms\_\_\_\_\_\_\_\_\_\_\_

Others possible (rearrangement of AO🡪MO; reactivity of ethylene on Pt; pi electron character)

\_\_\_/17

* 1. **Nomenclature of Alkanes (24 pts total)**

1. Using just IUPAC rules, name the compounds below: (2 pts each)







CH3CH(CH3)C(CH3)2(CH2)2CH3

1

1

1

4-(1-methylethyl)-2,5-dimethylheptane 4-(1-methylethyl)-2,3-dimethylheptane 4-ethyl-3,3-dimethylhexane

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_





1

Hexylcyclohexane 2,3,3-trimethylhexane

2-bromo-8-chloro-5-(1-methylpropylnonane)

1. Provide common names for the compounds below: (4 pts total/1 pt each)









\_tertbutyl bromide neopentyl bromide\_ isobutyl bromide sec-butyl bromide

\_\_\_\_/20

* 1. **Functional groups (8 pts)**

Supply the name or chemical equivalent for the functional group designations below:

R-CHO= \_\_\_\_aldehyde\_\_\_\_\_\_\_\_\_\_\_\_\_ R-COOH = \_\_\_carboxylic acid\_\_\_\_\_\_\_\_\_\_\_\_\_\_

esters\_\_RCOOR’\_\_\_\_\_\_\_\_\_\_\_ ketones =\_\_\_\_\_RR’C=O\_\_\_\_\_or RCOR’\_\_\_

CH3 -CH=CH2 is an example of a(n) \_\_alkene\_\_\_\_\_ example of an alcohol=\_\_\_\_\_\_\_any R-OH\_\_\_\_

example of an ether: **any R-O-R’** H2N-C=O is a(n) \_\_\_\_amide\_\_\_\_\_\_\_\_\_\_\_\_\_

**|**

**R**

**\_\_/32**

* 1. **Ring and Rotational Isomer Language (14 pts total)** 

**A B C D**

1. Which structure(s) aboveis/ are gauche \_B\_\_ b)Which structure(s) aboveis/are eclipsed ? \_C,D\_
2. Which structure(s) above is/are anti ?\_\_A\_\_\_\_\_\_ d)What is the most stable rotamer above \_A\_\_

e)order the conformers from highest to lowest in potential energy: \_D\_\_>\_C\_\_>\_B\_\_>\_\_A\_

Consider the dichloro ring compound shown on the right:



1. Provide the most complete name for it : (2 pts)

**Trans (ax,ax)-1,2-dichlorocyclohexane**

1

1. If the above compound is `ring’ flipped, draw the positions

The two chlorines would take on on the `flipped’ ring below:

**trans ( eq,eq)**



**Cl 2**

**1**

1. Sketch (eq, eq) 1,3-dichlorocyclohexane below and indicate Cl

Whether it is cis or trans:



Cl

Cl

**1 3**

(eq, eq) 1,3-dichlorocyclohexane is:

**cis trans (circle your choice)**

1. What ring conformation is drawn below ? **I am a(n) \_\_\_\_boat\_\_\_\_\_\_\_\_\_\_\_\_\_ ring conformer**

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1. **Decide whether the proposed structures can exist (assuming chair form): Circle your choice**
2. **cis (ax,ax) 1,2-dimethylcyclohexane yes no**
3. **trans (eq,ax) 1,3-dichlorocyclohexane yes no**
4. **trans (eq,eq) 1,2-dimethylcyclohexane yes no**
5. **cis (eq,eq) 1,4-dimethylcyclohexane yes no**
   1. **Free Radical Chemistry of Alkanes (11 pts total)**
6. **Key Facts for Methane ( 1 point each/5 points total)**

Write down 5 facts that characterize the reaction behavior of methane under free radical halogenations.

1) reaction will only go at >250oC in dark or with input of ultraviolet (uv) light.

2) uv wavelength required is near that for dissociation wavelength for X2 .

3) in excess X2 , a single photon (hν) event causes thousands of halogenations.

(=> photo yield >>>>1, e.g 1000-5000 halogenated methane molecules/1 photon of hν.

4) O2 causes halogenation reaction to slow or stop.

5) reactivity rate follows the trend : F2 > Cl2 > Br2 > I2 .

1. **Mechanism of Free Radical Methane Chlorination (6 pts)**

Write down the mechanism forwarded to explain the overall reaction. Make sure to label the various steps with their assigned names.

hυ

*xs*  Cl2 + CH4 CH3Cl + HCl,

***step # elementary reaction commentary***

***hv***

1  **Cl2 ------> 2X\*** chain-initiation (rather like making a cancer cell)

2 **Cl\* + CH4 -------> HCl + CH3\*** chain propagation....

3 **Cl2 + CH3\* -------> CH3Cl + Cl\*** (one begets another... ! Note that radicals

**...... etc. etc.** are implicated in aging and cancer)

The process is terminated by radical-radical recombination or quenching by O2.

4a **Cl\* + Cl\*---> Cl2**

4b**CH3\* + CH3\* --->CH3CH3**chain termination

4c **CH3\* + Cl\*---> CH3Cl**

4d **CH3**\* **+ O2-----> CH3OO\*** (final `peroxyl’ radical is rather stable => it sucks peroxyl radical energy from CH3\*)

* 1. **Miscellaneous This and That (7 pts)**

1. Steam distillation relies on the two components being separating having a large

difference in water\_\_\_solubility\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. Re-crystallization assumes that the soluble impurities are \_\_low\_\_\_\_\_\_\_\_in concentration compared to the target species.
2. Linus Pauling’s valence bond model is good at calculating energies of molecules T F
3. A pure substance’s melting point is the maximum value obtainable and has a \_\_narrow\_\_\_\_\_melting point range.
4. You use a Claisen head in which technique ? (CIRCLE CHOICE)

fractional recrystallization Solvent separation simple distillation steam distillation

1. Alkanes are often called paraffins because they are relatively unreactive T F
2. Any day doing Organic Chemistry is a \_\_\_\_great\_\_\_\_\_\_\_\_\_day.
3. \_\_\_/18