Last Name: [redacted] Student Number: [redacted]

First Name: [redacted] Print all information clearly

Fill out as much of the Laboratory information as you can

Laboratory section? [redacted] Teaching assistant? [redacted]
(if not in lab write PLC)

General Chemistry I Midterm 2 November 13, 2018

[redacted] (CHEM 1100)

The time limit for this test is 50 minutes.

Numerical answers must be given with appropriate units and significant figures. Please place all answers in the space provided for the question. IF more space is required write on the back of the question sheet and indicate this in the answer space.

*There are six questions worth **a total of marks**. If more than one answer is given only the first answer will be graded unless you indicate otherwise.*
Data tables are supplied separately. DO NOT WRITE ON THESE. Hand them in with your exam.

This examination should be written in non-erasable INK
Exams that have been altered by erasures or white out may be ineligible for appeal of grades at the discretion of the professors.

Question 1	5 /5
Question 2	5 /6
Question 3	4 /6
Question 4	4.5 /6
Question 5	5 /6
Question 6	4 /5
TOTAL	27.5 /34

5

1. The work function of Rb is 218.15 kJ mol^{-1}. [5 marks]

a) How much energy does it take to remove a single electron from an atom on the surface of solid rubidium?

E=?

$\emptyset = 3.62\times10^{-19}$ J

$E = h\nu$

→ (3.62×10^{-19} J or larger)

It would take equal to or greater the amount of energy in Joules of Rb which is 218.15 kJ/mol = (3.62×10^{-19} J)

b) What is the wavelength (in nm) and frequency (in Hz) of light capable of doing this? You can calculate these in any order you wish.

$\lambda = ?$

$\nu = ?$

$h\nu = \emptyset$

$(6.626\times10^{-34}\ J\cdot s)(\nu) = 3.62\times10^{-19}$ J

$\nu = 5.46\times10^{14}\ s^{-1} = 5.46\times10^{14}$ Hz

$E = \frac{hc}{\lambda}$ $3.62\times10^{-19}\ J = \frac{1.98\times10^{-25}\ J/m}{\lambda}$

$\lambda = \frac{(6.626\times10^{-34}\ J\cdot s)(3\times10^{8}\ m/s)}{3.62\times10^{-19}\ J}$ $\lambda = 549$ nm

c) What is the maximum kinetic energy of the electrons emitted when light of 7.3×10^{14} Hz is used?

$\nu = 7.3\times10^{14}$ Hz $= 7.3\times10^{14}\ s^{-1}$

$E_k = ?$

$\emptyset = 3.62\times10^{-19}$ J

$E = h\nu$

$E_{photon} = (6.626\times10^{-34}\ J\cdot s)(7.3\times10^{14}\ s^{-1})$

$= 4.83\times10^{-19}$ J

$E_k = E_{photon} - \emptyset$

$= 4.83\times10^{-19}\ J - 3.62\times10^{-19}\ J$

$= 1.21\times10^{-19}$ J

∴ kinetic energy would be 1.21×10^{-19} J

2. Write the electron configurations of the following elements or ions in both the complete form and noble gas (outer electron) notations: [6 marks]

a) C $1s^2 2s^2 2p^2$ (1)

$[He]\ 2s^2 2p^2$ (1)

5

b) Cr $[Ar]\ 4s^2 3d^4 = [Ar]\ 4s^1 3d^5$ (1)

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4$ x

→ $4s^1 3d^5$ instead!

c) Co^{2+}

$Co \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^7$ (1)

$Co^{2+} \rightarrow [Ar]3d^7$ (1)

3. Arrange the following elements in order from smallest to largest for the following properties: [6 marks]

a) Atomic Size Te S Se

S, Se, Te (2)

4

b) First Ionization Energy K Br Ni

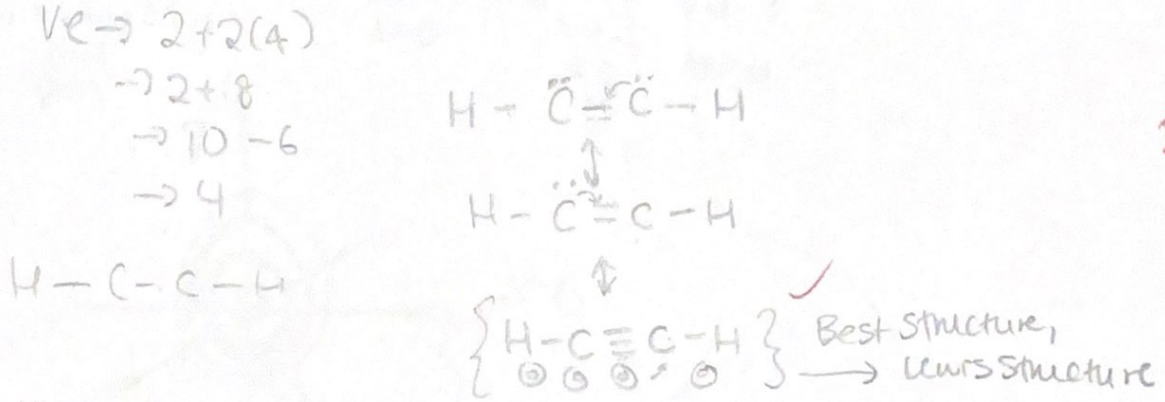
K, Ni, Br Ni, K, Br x

c) Electron Affinity Ba Si F

Ba, Si, F (2)

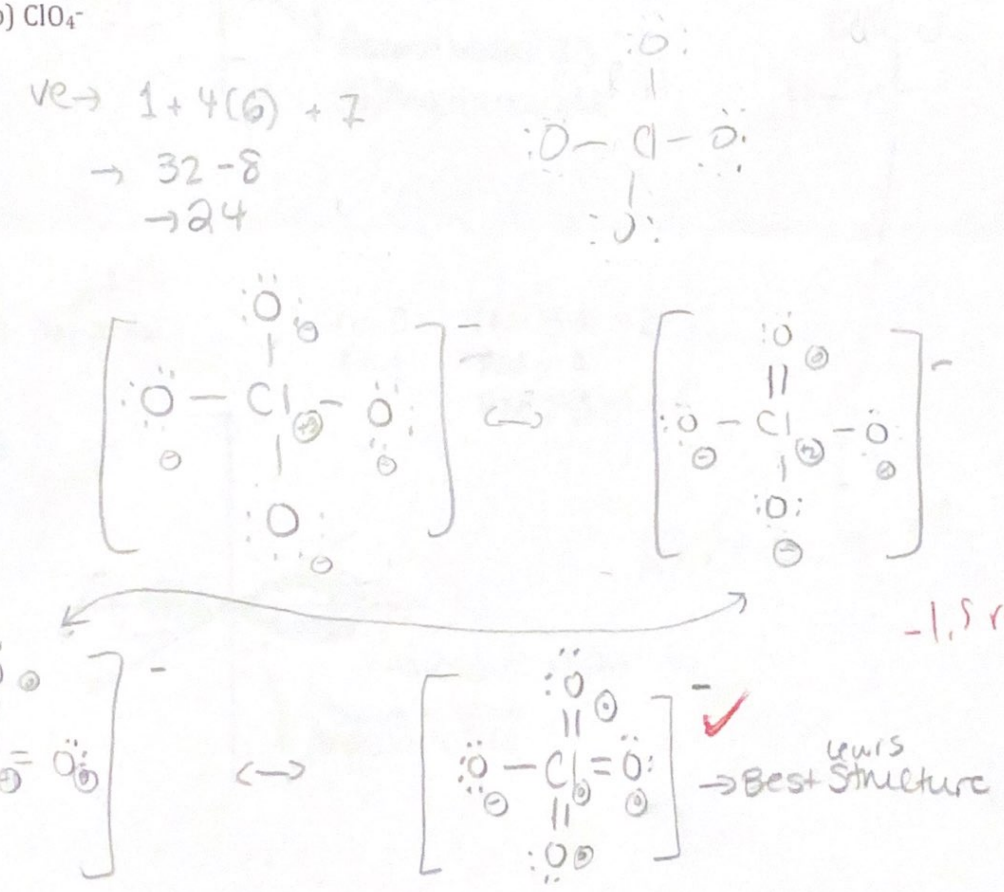
4. Write Lewis structures for the following species and identify any resonance structures. If an atom can expand its octet, do so to minimize the charge separation in the structure(s). Include formal charges on all structures of your final answer. [6 marks]

a) C_2H_2



2

b) ClO_4^-



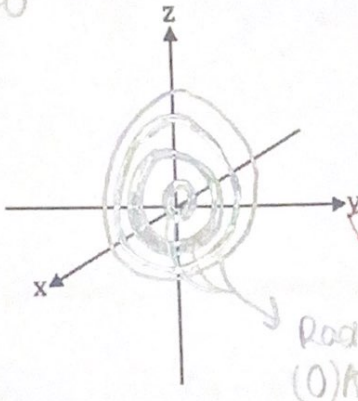
2.5

4.5

5. Identify the orbital or suggest quantum numbers that could apply to the orbital given. Sketch a diagram of the orbital. In addition to a sketch of the orbital, on the sketch, identify any nodes (angular or radial) in the orbitals.

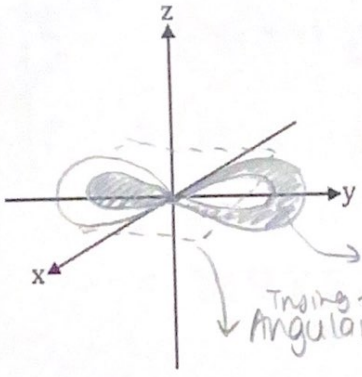
[6 marks]

a) $n = 4, l = 0, m_l = 0$



Radial Nodes (3)
(0) Angular Nodes

b) $3p_y$ orbital



Radial Node
Trying to show Angular Node (1)

$m_l = 0$

6. Methane (CH_4) reacts with chlorine and fluorine in the gas phase to give gaseous Feon-12 (CF_2Cl_2). Side products of the reaction are hydrochloric and hydrofluoric acids. [5 marks]

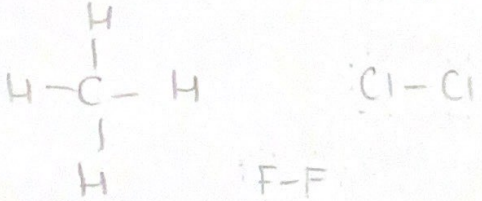
4/5

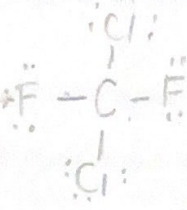
a) Write a balanced chemical equation for the reaction.

$$CH_4(g) + 2Cl_2(g) + 2F_2(g) \rightarrow CF_2Cl_2(g) + 2HF(aq) + 2HCl(aq)$$

2/

b) Using bond energies (table provided in the Data Sheets) estimate $\Delta_r H$ for the reaction.





↳ 4(C-H) ✓
↳ 2(F-F) ✓
↳ 2(Cl-Cl)] R

↳ 2(C-Cl)
↳ 2(C-F)] P

$\Delta_r H$ = ΣΔH(reactants) − ΣΔH(Products)

= (4(414) + 2(159) + 2(243)) − (2(339) + 2(485))

= (1656 + 318 + 486) − (678 + 970)

= 2460 − 1648

= 812 kJ/mol

-2(477)
-2(485)

2/

End of Examination