KWANTLEN UNIVERSITY COLLEGE
CHEMISTRY 1110 R11 Spring 2004
Dr. Jennifer Wolf
EXAM No. 2
Wednesday, March 24, 2004

Name: _____

Student Number_____

Instructions: Ensure that this exam contains all **ten** questions. Read the exam carefully and judge your time accordingly. Show your work where space is provided. If you need extra space, use the back of a preceding page and clearly indicate the question number. Rough work and work for short-answer questions may also be done on the back of a preceding page. A periodic chart is supplied with this exam.
Maximum Score: 70 marks

Question	Marks
1	/10
2	/4
3	/8
4	/6
5	/4
6	/8
7	/5
8	/9
9	/7
10	/9
TOTAL	/70

Question 1 (10 marks)
What is the maximum number of electrons that can have the following quantum numbers, and what are the possible orbital designations?

	# of electrons	possible orbital designations: (3p, 2s, etc.)

(a) $n = 2$, $m_\ell = +1/2$ _____ _____

(b) $n = 3$, $\ell = 2$ _____ _____

(c) $n = 2$, $\ell = 2$ _____ _____

(d) $n = 6$, $\ell = 3$ _____ _____

(e) $n = 3$ $m_\ell = 0$ _____ _____

Question 2 (4 marks)
Give the electron configurations of the following (do not use noble gas core abbreviations for this question):

(a) Mo^{2+} _____

(b) Br _____

(c) Pb^{2+} _____

(d) Cu _____

Question 3 (8 marks)
Circle the correct choice(s) (may be more than one or none):

Isoelectronic with O^{2-} S^{2-} O^+ N^{3-}

Isolelectronic with Fe^{3+} Mn^{2+} Cr Ru^{3+}

Has 4 unpaired electrons   O   Ti Cr^{2+}

Is diamagnetic   Ar   Ca   O

Most electronegative   Cl   C   Br

Has no d-electrons   As   P Ti^{4+}

Question 4 (6 marks)
Match the following:

(a) Atomic radius (pm)

117	_____ F
121	_____ As
99	_____ Cl
71	_____ Si

(b) Ionic radius (pm)

99	_____ N^{3-}
171	_____ O^{2-}
59	_____ Na^+
140	_____ Li^+

(c) 2nd ionization energy
(kJ/mol)

4562	_____ Cl
2297	_____ P
1451	_____ Na
2912	_____ Mg

Question 5 (4 marks)   (No need to show work)
(a) Order the following molecules in increasing polarity:

HCN H_2CO CH_3F CH_3Br CF_4

(b) Order the following molecules or ions in order of increasing C-O bond length:

CO CO_2 CO_3^{2-} CH_3OH

Question 6 (8 marks)
In the following pairs of molecules or ionic compounds, one is real and the other does not exist. Circle the **incorrect** one **giving your reasoning**.

(a) K_3N Mg_3N

(b) IF_3 FI_3

(c) PF_5 NF_5

(d) XeO_2 NeO_2
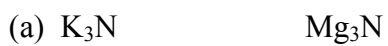
Question 7 (5 marks)

    (a) Sketch a 2s and the three 2p orbitals:

    (b) Describe (with diagrams if necessary) the sp^2-hybridization scheme:

Question 8 (9 marks)
Draw Lewis structures for the following molecules or ions, and indicate the geometry predicted by VSEPR theory:

(a) SF_4

(b) BrF_5

(c) $SOCl_2$

Question 9 (7 marks)
Methyl isocyanate is a toxic chemical used in the production of many pesticides. Methyl isocyanate has the formula CH_3NCO (the methyl group is attached to the nitrogen and the order of the N, C, and O atoms is as shown).

(a) Draw Lewis structures for methyl isocyanate, including all correct resonance forms.

(b) Indicate all non-zero formal charges on your resonance structures above.

(c) Based on your resonance structures above, what would you expect the C-N-C bond angle to be? Explain.

(d) Based on your resonance structures above, which C-N bond would you expect to be longer? Explain and be specific!
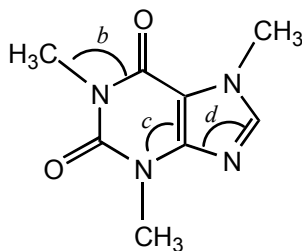
Question 10 (9 marks)
The following is a partial Lewis structure of caffeine:
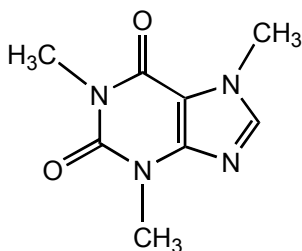
(a) (i) How many lone pairs are there in the complete Lewis structure? ____

   (ii) How many sp^3-hybridized carbons are there? _____

   (iii) How many sp^2-hybridized carbons? _____

   (iv) How many sp-hybridized carbons? _____

   (v) How many sp^3-hybridized nitrogens? _____

   (vi) How many sp^2-hybridized nitrogens?_____

The partial Lewis structure of caffeine is given again below, this time including labels for some bond angles. Give the approximate bond angles indicated below:

(b) _____   (c) _____   (d) _____