NAME:____________________________ Student Number:______________________

Fall 2012 **Chemistry 1000 Practice Midterm #1A** ____/ 69 marks

INSTRUCTIONS:
1) Please read over the test carefully before beginning. You should have 8 pages of questions and a formula/periodic table sheet.
2) If your work is not legible, it will be given a mark of zero.
3) Marks will be deducted for incorrect information added to an otherwise correct answer.
4) Marks will be deducted for improper use of significant figures and for missing or incorrect units.
5) Show your work for all calculations. Answers without supporting calculations will not be given full credit.
6) You may use a calculator.
7) You have 90 minutes to complete this test.

Confidentiality Agreement:
I agree not to discuss (or in any other way divulge) the contents of this exam until after 8:30pm Mountain Time on Monday, October 15th, 2012. I understand that breaking this agreement would constitute academic misconduct, a serious offense with serious consequences. The minimum punishment would be a mark of 0/69 on this exam and removal of the "overwrite midterm mark with final exam mark" option for my grade in this course; the maximum punishment would include expulsion from this university.

Signature: ____________________________ Date: ______________________________
Course: CHEM 1000 (General Chemistry I)
Semester: Fall 2012
The University of Lethbridge

Spelling matters!

Fluorine = F Fluorene = $C_{13}H_{10}$

Flourine =

Question Breakdown

Q1	/ 2
Q2	/ 6
Q3	/ 4
Q4	/ 8
Q5	/ 7
Q6	/ 6
Q7	/ 6
Q8	/ 2
Q9	/ 6
Q10	/ 4
Q11	/ 3
Q12	/ 5
Q13	/ 10

Total	/ 69

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1. What is the difference between a Sievert and a Gray? **[2 marks]**

2. Sketch each of the following atomic orbitals. Clearly draw and label axes. Underneath each sketch, indicate how many planar nodes the orbital has.
Do not show radial nodes. **[6 marks]**

(a) $4p_x$

(b) $4d_{x^2-y^2}$

(c) $4d_{yz}$

3. Complete the following table.
Make sure your symbol is formatted in the same way as the example. **[4 marks]**

Symbol	Atomic Number	Mass Number	Number of Protons	Number of Neutrons	Number of Electrons
$^{209}_{83}Bi^{3+}$					
			49	66	46

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4. Carbon-14 decays to nitrogen-14. **[8 marks]**

(a) What kind of nuclear reaction is this? *[1 mark]*

(b) Calculate the energy change when a single atom of carbon-14 decays. *[5 marks]*

(c) Calculate the energy change when 1 mole of carbon-14 decays. *[2 marks]*

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5. A graph of the band of stability appears on the data sheet. **[7 marks]**

(a) Define the term "half-life". *[1 mark]*

(b) What is the significance of the Z=N line? *[1 mark]*

(c) Why does the band of stability diverge from the Z=N line? *[2 marks]*

(d) What kind of decay would you expect $^{242}_{99}\mathrm{Es}$ to undergo? Briefly, justify your answer. *[3 marks]*

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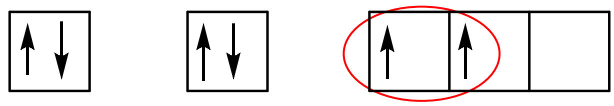
6. Consider the following orbital occupancy diagram, drawn in haste by a student who was running late. It was intended to show all core and valence electrons for a neutral atom. **[6 marks]**



(a) Label the boxes to indicate which subshell each box (or set of boxes) represents. *[1 mark]*

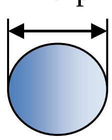
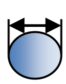
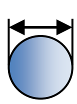
(b) Identify the neutral element represented by this diagram. *[1 mark]*

(c) In the space below, write a valid set of four quantum numbers for each of the two circled electrons. *[4 marks]*

electron on left:

electron on right:

7. Three kinds of particles were found when analyzing a piece of rusting iron. They are suspected to be Fe, Fe^{2+} and Fe^{3+}. Their sizes were measured and listed in the table below. Complete the table with the appropriate symbol and electron configuration *(in line notation)* for each particle. Also, circle the corresponding magnetic behavior expected for that particle. **[6 marks]**

Size of the particle	Symbol	Electron Configuration (Noble Gas Abbreviation)	Magnetic Property
248 pm 			Paramagnetic Diamagnetic
130 pm 			Paramagnetic Diamagnetic
154 pm 			Paramagnetic Diamagnetic

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8. Heisenberg’s Uncertainty Principle states that the more precisely we know one property of certain particles, the less precisely we know a different property (and vice versa). What are the two properties referred to by Heisenberg’s Uncertainty Principle?

[2 marks]

9. What observations regarding the photoelectric effect are impossible to explain using classical physics? Briefly explain the difficulties from the perspective of classical physics. **[6 marks]**

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10. Which of the following sets of quantum numbers could belong to an electron in a ground state atom of manganese (Mn)? **[4 marks]**

- For each set of quantum numbers describing one of the electrons in ground state manganese, name the orbital that electron is in.
- For each set of quantum numbers *not* describing one of the electrons in ground state manganese, **briefly** indicate why not.

(a) $n = 1$, $l = 1$, $m_l = 0$, $m_s = +½$

(b) $n = 3$, $l = 0$, $m_l = 0$, $m_s = +½$

(c) $n = 3$, $l = 2$, $m_l = -1$, $m_s = +½$

(d) $n = 4$, $l = 1$, $m_l = 1$, $m_s = +½$

11. **[3 marks]**

(a) Give the complete electron configuration for arsenic (As).
Do not use the noble gas abbreviation. *[1 mark]*

(b) What monoatomic ion would you expect arsenic to form? **Briefly**, justify your answer. *[2 marks]*

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12. Potassium (K) exists as a mixture of three isotopes:

Percent Abundance	Mass of Isotope
93.258%	38.96371 u
0.0012%	39.96400 u

Complete the table by calculating the percent abundance and mass of the third isotope of potassium. *Show your work in the space below.* **[5 marks]**

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13. An ultraviolet lamp produces electromagnetic radiation with a wavelength of 150. nm. **[10 marks]**

(a) Calculate the energy of one photon from this ultraviolet lamp. *[3 marks]*

(b) Would the radiation from this ultraviolet lamp be capable of ionizing the last electron out of a ground state Li^{2+} ion?
Your answer must be backed up by calculations. No credit will be given for answers that are strictly 'yes' or 'no'. *[7 marks]*

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Some Useful Constants and Formulae

Fundamental Constants and Conversion Factors

Atomic mass unit (u)	$1.660\ 539 \times 10^{-27}$ kg	Planck's constant	$6.626\ 070 \times 10^{-34}$ J·Hz^{-1}
Avogadro's number	$6.022\ 141 \times 10^{23}$ mol^{-1}	Proton mass	1.007 277 u
Bohr radius (a_0)	$5.291\ 772 \times 10^{-11}$ m	Neutron mass	1.008 665 u
Electron charge (e)	$1.602\ 177 \times 10^{-19}$ C	Rydberg Constant (R_H)	$2.179\ 872$ x 10^{-18} J
Electron mass	$5.485\ 799 \times 10^{-4}$ u	Speed of light in vacuum	$2.997\ 925$ x 10^{8} m·s^{-1}

Formulae

$$c = \nu\lambda \qquad E = h\nu \qquad p = mv \qquad \lambda = \frac{h}{p} \qquad \Delta x \cdot \Delta p > \frac{h}{4\pi}$$

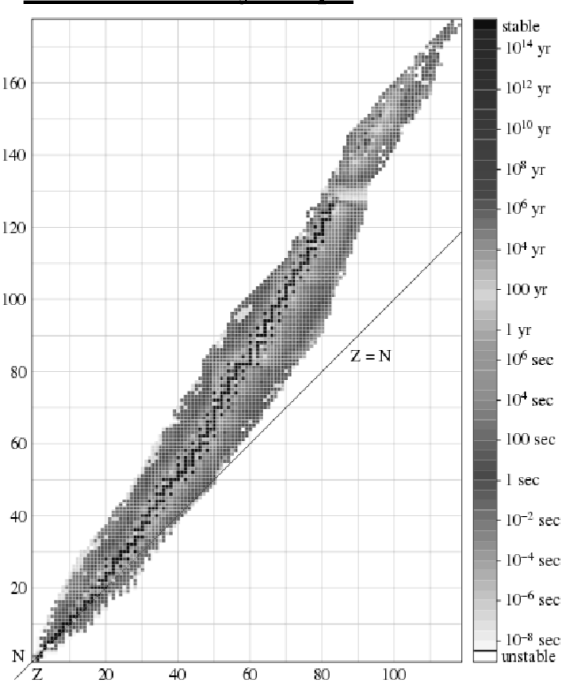
$$r_n = a_0 \frac{n^2}{Z} \qquad E_n = -R_H \frac{Z^2}{n^2} \qquad E_k = \frac{1}{2}mv^2$$

$$\Delta E = \Delta mc^2 \qquad A = -\frac{\Delta N}{\Delta t} \qquad A = kN \qquad \ln\left(\frac{N_2}{N_1}\right) = -k(t_2 - t_1) \qquad \ln(2) = k \cdot t_{1/2}$$

Some Useful Masses

$^{14}_{6}C$	14.003 241 988 u
$^{14}_{7}N$	14.003 074 005 u
$^{4}_{2}\alpha$	4.001 506 179 u
$^{1}_{1}p$	1.007 276 467 u
$^{1}_{0}n$	1.008 664 916 u

Band of Stability Graph



The graph at the right shows the band of stability. Stable isotopes are in black. Isotopes that exist but are not stable are shown in varying shades of gray with the shades of gray corresponding to different half-lives.

The original version of the graph used a rainbow colour scale.
http://commons.wikimedia.org/wiki/File:Isotopes_and_half-life_eo.svg

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CHEM 1000 Periodic Table

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.0079 **H** 1																	4.0026 **He** 2
6.941 **Li** 3	9.0122 **Be** 4											10.811 **B** 5	12.011 **C** 6	14.0067 **N** 7	15.9994 **O** 8	18.9984 **F** 9	20.1797 **Ne** 10
22.9898 **Na** 11	24.3050 **Mg** 12											26.9815 **Al** 13	28.0855 **Si** 14	30.9738 **P** 15	32.066 **S** 16	35.4527 **Cl** 17	39.948 **Ar** 18
39.0983 **K** 19	40.078 **Ca** 20	44.9559 **Sc** 21	47.88 **Ti** 22	50.9415 **V** 23	51.9961 **Cr** 24	54.9380 **Mn** 25	55.847 **Fe** 26	58.9332 **Co** 27	58.693 **Ni** 28	63.546 **Cu** 29	65.39 **Zn** 30	69.723 **Ga** 31	72.61 **Ge** 32	74.9216 **As** 33	78.96 **Se** 34	79.904 **Br** 35	83.80 **Kr** 36
85.4678 **Rb** 37	87.62 **Sr** 38	88.9059 **Y** 39	91.224 **Zr** 40	92.9064 **Nb** 41	95.94 **Mo** 42	(98) **Tc** 43	101.07 **Ru** 44	102.906 **Rh** 45	106.42 **Pd** 46	107.868 **Ag** 47	112.411 **Cd** 48	114.82 **In** 49	118.710 **Sn** 50	121.757 **Sb** 51	127.60 **Te** 52	126.905 **I** 53	131.29 **Xe** 54
132.905 **Cs** 55	137.327 **Ba** 56	**La-Lu**	178.49 **Hf** 72	180.948 **Ta** 73	183.85 **W** 74	186.207 **Re** 75	190.2 **Os** 76	192.22 **Ir** 77	195.08 **Pt** 78	196.967 **Au** 79	200.59 **Hg** 80	204.383 **Tl** 81	207.19 **Pb** 82	208.980 **Bi** 83	(210) **Po** 84	(210) **At** 85	(222) **Rn** 86
(223) **Fr** 87	226.025 **Ra** 88	**Ac-Lr**	(261) **Rf** 104	(262) **Db** 105	(263) **Sg** 106	(262) **Bh** 107	(265) **Hs** 108	(266) **Mt** 109	(281) **Dt** 110	(283) **Rg** 111							

138.906 **La** 57	140.115 **Ce** 58	140.908 **Pr** 59	144.24 **Nd** 60	(145) **Pm** 61	150.36 **Sm** 62	151.965 **Eu** 63	157.25 **Gd** 64	158.925 **Tb** 65	162.50 **Dy** 66	164.930 **Ho** 67	167.26 **Er** 68	168.934 **Tm** 69	173.04 **Yb** 70	174.967 **Lu** 71
227.028 **Ac** 89	232.038 **Th** 90	231.036 **Pa** 91	238.029 **U** 92	237.048 **Np** 93	(240) **Pu** 94	(243) **Am** 95	(247) **Cm** 96	(247) **Bk** 97	(251) **Cf** 98	(252) **Es** 99	(257) **Fm** 100	(258) **Md** 101	(259) **No** 102	(260) **Lr** 103

Developed by Prof. R. T. Boeré