NAME:______________________________ Student Number:________________________

Fall 2012 **Chemistry 1000 Practice Midterm #2B** ____/ 60 marks

INSTRUCTIONS:

1) Please read over the test carefully before beginning. You should have 6 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, November 19th, 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 0/60 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	/ 8
Q2	/ 8
Q3	/ 3
Q4	/ 2
Q5	/ 4
Q6	/ 4
Q7	/ 4
Q8	/ 6
Q9	/ 6
Q10	/ 10
Q11	/ 5

Total	/ 60

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1. Complete the following table, giving the name and symbol for an element meeting each description. **[8 marks]**

Description	**Symbol**	**Name**
The alkali metal in the 4th period		
The noble gas in the 2nd period		
An element in Group 17 that is a gas under standard laboratory conditions		
The only element in Group 13 which is not a metal		
The element in the 4th period whose most common ion is a dianion (-2 charge)		
A transition metal that, when neutral, has six valence electrons		
The element in the 1st period with the larger atomic radius		
The element in Group 2 with the smallest atomic radius		

2. Write balanced chemical equations for each of the following reactions. **[8 marks]**
Include states of matter.

(a) Magnesium metal reacts with liquid bromine.

(b) Potassium metal reacts with water.

(c) Lithium metal reacts with nitrogen.

(d) Aluminium oxide reacts with aqueous acid.

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3. **[3 marks]**

(a) What is a diagonal relationship?

(b) Give an example of a reaction that can be rationalized by a diagonal relationship and explain briefly.

4. **[2 marks]**

(a) What is passivation?

(b) Give an example of a passivated metal.

5. In the first step of the industrial process for refining aluminium, the ore is treated with base. Explain what this step accomplishes and give a balanced chemical equation for the reaction. **[4 marks]**

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6. Consider the following set of elements: **[4 marks]**

Na, Mg, Al, and F

Which of these elements has the highest second ionization energy? Why?
Your explanation must include the definition of a second ionization energy.

7. The general trend for electron affinity is for the values to increase as you go from left to right across a period. **[4 marks]**

(a) Draw a valence orbital occupancy diagram (aka "orbital box diagram") for phosphorus. *[1 mark]*

(b) Draw a valence orbital occupancy diagram (aka "orbital box diagram") for silicon. *[1 mark]*

(c) Explain why the electron affinity for phosphorus is smaller than that for silicon. *[2 marks]*

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8. It is possible to make octet-rule-obeying species with the general formula AF_4^z where z is the charge (possibly zero) and A = boron, carbon or nitrogen. **[6 marks]**

For each species:

- draw a Lewis diagram (including any non-zero formal charges), and
- clearly indicate what the overall charge must be

(a) BF_4^z (b) CF_4^z (c) NF_4^z

9. **[6 marks]**

(a) Draw all formal-charge-minimized resonance structures for the sulfite ion (SO_3^{2-}). *Include non-zero formal charges on the appropriate atoms.* *[4 marks]*

(b) What is the average S-O bond order for the sulfite ion? *[1 mark]*

(c) Draw a valid Lewis diagram for sulfurous acid (H_2SO_3). *[1 mark]*

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10. Experimental evidence shows that PF_3Cl_2 has a dipole moment whereas PCl_3F_2 does not. Answer the following questions regarding these two molecules and this experimental observation. **[10 marks]**

(a) Draw a Lewis diagram for each of these compounds. *[2 marks]*

(b) Draw each of these two compounds showing the correct VSEPR geometry, and give the name for the molecular geometry of each compound. *[4 marks]*

(c) Explain why the F and Cl atoms occupy the positions shown in your VSEPR structures. *[2 marks]*

(d) Explain why PF_3Cl_2 has a dipole moment whereas PCl_3F_2 does not. *[2 marks]*

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11. **[5 marks]**

(a) Write a balanced chemical equation for the electrolysis of molten sodium chloride. *Include states of matter.* *[1 mark]*

(b) If we want to make 0.600 kg of sodium metal, what mass of sodium chloride must be electrolyzed? Report your answer in kg. *[4 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}
Ideal gas constant (R)	8.314 462 J·mol^{-1}·K^{-1} 8.314 462 m^{3}·Pa·mol^{-1}·K^{-1}	Standard atmospheric pressure	1 bar = 100 kPa

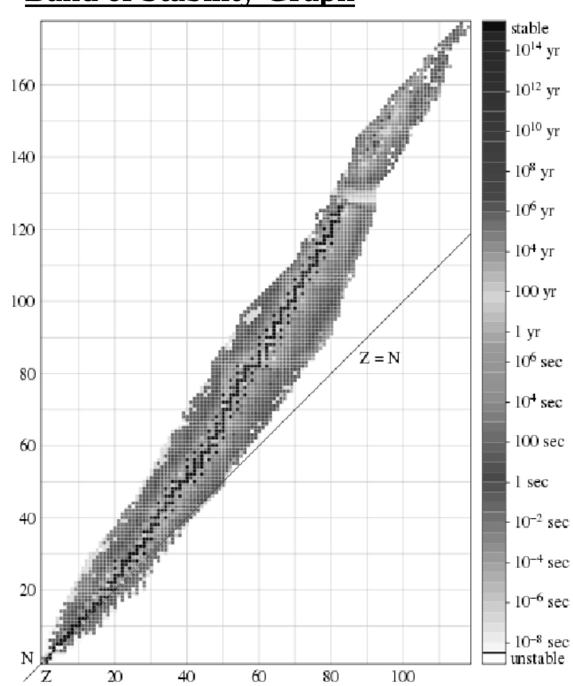
Formulae

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

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

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

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																	2
6.941 **Li** 3	4											10.811 **B** 5	12.011 **C** 6	14.0067 **N** 7	15.9994 **O** 8	18.9984 **F** 9	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	18
19	20	44.9559 **Sc** 21	47.88 **Ti** 22	23	24	25	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	33	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