

First Name \_\_\_\_\_ Last Name \_\_\_\_\_

Student ID \_\_\_\_\_ Signature \_\_\_\_\_

**Chemistry 101/103, B1**  
**Midterm Examination - 09 March 2007**  
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**Instructions**

Closed book exam; no calculators programmed with chem. info. permitted.

Only answers on the front side of each page will be marked, unless requested otherwise.

Write in pen (to permit potential remarking).

Time allowed: 50 min.

There are **8** questions on **6** pages.

The following data might be useful; for additional information, see the Chemistry Data Sheet.

$$c = \lambda\nu \quad E_{\text{photon}} = h\nu \quad E = mc^2 \quad m = \frac{h}{\lambda c} \quad \text{hydrogenic atoms: } \Delta E = -2.178 \times 10^{-18} \text{ J } Z^2 \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

EMR spectrum:  $\gamma$  rays   X rays   Ultraviolet   Visible   Infrared   Microwaves   Radio waves

/ \

400    700 nm

Page	Maximum	Score	
1	9	<sup>5</sup>	<sup>4</sup>
2	16	<sup>8</sup>	<sup>8</sup>
3	9	<sup>3</sup>	<sup>6</sup>
4	10	<sup>5</sup>	<sup>5</sup>
5	8	<sup>4</sup>	<sup>4</sup>
6	8	<sup>3</sup>	<sup>5</sup>
Total	60		

/5 1. a. Provide names or formulas for the following:

potassium hydrogen phosphate \_\_\_\_\_ AuCl<sub>3</sub> \_\_\_\_\_

hydrogen peroxide \_\_\_\_\_ XeF<sub>2</sub> \_\_\_\_\_

sodium bromite \_\_\_\_\_

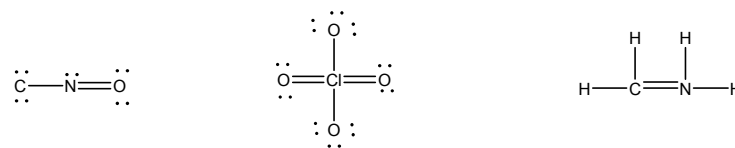
/4 2. a. Consider the elements F, Ne, and Mg. Which one, do you think,  
 has the greatest isotopic purity, i.e., consists mostly of one isotope? \_\_\_\_\_

b. Indicate the mass number \_\_\_\_\_ and number of neutrons \_\_\_\_\_  
 of the element you have chosen under a.

c. Give a precise, current definition of one atomic mass unit (u).

- /8 3. a. Write a balanced equation for the combustion (reaction with oxygen) of acetone (  $C_3H_6O$  ) to form water and carbon dioxide.
- b. A particular sodium/oxygen compound contains 59% sodium by mass. What is the empirical formula of this compound. Show the work.
- c. The C/H molar ratio in a particular hydrocarbon is 1 : 1. Its molar mass is approximately 90 g/mol. What is the molecular formula for this hydrocarbon? Show the work.
- /8 4. a. Indicate the electron configuration for tungsten, element # 74 (shorthand notation acceptable):
- b. How many unpaired electrons are present in  $Fe^{2+}$ . Show the work. (Remember 4s & 3d electrons are close in energy)
- c. Compare the (first) ionization energies for the following elements. In each case, circle the element with the larger ionization energy.
- |           |          |
|-----------|----------|
| i. Be, B  | ii. B, C |
| iii. C, N | iv. N, O |

- /9 5. a. Determine the formal charges for the following species.
- Show the formal charges on the structures directly.
  - Underneath each structure indicate the overall charge.



- b. i. Write a reasonable Lewis structure for the hydrogen sulfate anion,  $HSO_4^-$ .

- ii. Write one acceptable resonance structure for the above.

- iii. How many types of S,O bonds are present? *Question relates to resonance!*  
Re-write the skeletal structure and identify the types with letters.

- /10 6. For the following show:
- Lewis structure
  - geometric arrangements of electron groups; *in words*
  - atom arrangement & molecular shape; *in words and sketch*
  - hybridization of the central atom acc. to V.B. theory

a. NOCl (N central)

i.

iii.

ii.

iv.

b.  $\text{ICl}_4^-$  anion

i.

iii.

ii.

iv.

- /8 7. Are the following molecules polar?

Show the work by giving i. *Lewis structure*, ii. *molecular shape* and iii. *bond dipoles*.

a. HCN

b.  $\text{SF}_4$

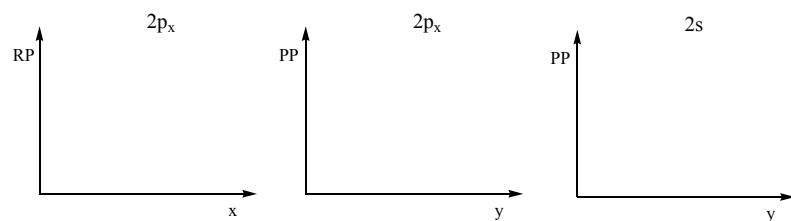
i.

ii. & iii

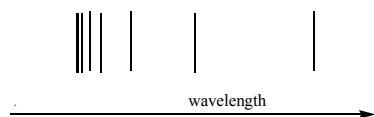
ans. —

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- /8 8. a. Sketch the “point probabilities”, PP, or “radial probabilities”, RP, for the following orbitals. *Pay attention to the labeling of the vertical and horizontal axes!*



- b. The following is a rough sketch of the Balmer series ( $n_f = 2$ ) of the emission spectrum of the hydrogen atom.



- Place the letter A on top of the line that relates to the transition from  $n = 3$ .
- Place the letter B on top of the line that relates to the photon with the highest energy in this series.
- Place a line (marking it with a \*) that relates to the first ionization energy of the hydrogen atom. *Relative position only.*