First Name _____ Last Name _____ 44.

Student ID _____ Signature _____

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

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.

$c = \lambda\nu$ $E_{photon} = h\nu$ $E = mc^2$ $p = \frac{h}{\lambda c}$ hydrogenic atoms: $\Delta E = -2.18 \times 10^{-18}\ J\ Z^2\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$

EMR spectrum: γ rays X rays Ultraviolet Visible Infrared Microwaves Radio waves

400 700 nm

Page	Maximum	Score		
1	9	5	4	
2	16	8	8	
3	9	3	6	
4	10	5	5	
5	8	4	4	
6	8	3	5	
Total	60			

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

potassium hydrogen phosphate K_2HPO_4 $AuCl_3$ gold (III) chloride

hydrogen peroxide H_2O_2 XeF_2 xenon difluoride

sodium bromite $NaBrO_2$

/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? F

b. Indicate the mass number 19 and number of neutrons 10 of the element you have chosen under a.

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

$\frac{1}{12}$ of the mass of C-12

/8 3. a. Write a balanced equation for the combustion (reaction with oxygen) of acetone (C_3H_6O) to form water and carbon dioxide.

$$C_3H_6O + 4\,O_2 \longrightarrow 3\,CO_2 + 3\,H_2O$$

b. A particular sodium/oxygen compound contains 59% sodium by mass.
What is the empirical formula of this compound. Show the work.

	mass (g)		moles	ratio	
Na	59	÷23	2.56	1	(NaO)
O	41	÷16	2.56	1	

c. The C/H molar ratio in a particular hydrocarbon is 1 : 1. (CH) → 13 g/mol
Its molar mass is approximately 90 g/mol.
What is the molecular formula for this hydrocarbon? Show the work.

$$\frac{90}{13} = 6.92 \approx \quad \therefore C_7H_7$$

/8 4. a. Indicate the electron configuration for tungsten, element # 74
(shorthand notation acceptable):

$$[Xe]\ 6s^2\,4f^{14}\,5d^4$$

b. How many unpaired electrons are present in Fe^{2+}. Show the work.
(Remember 4s & 3d electrons are close in energy)

$[Ar]\ 3d^6$; ↑↓ ↑ ↑ ↑ ↑ 4 unpaired

c. Compare the (first) ionization energies for the following elements. In each case, circle the element with the larger ionization energy.

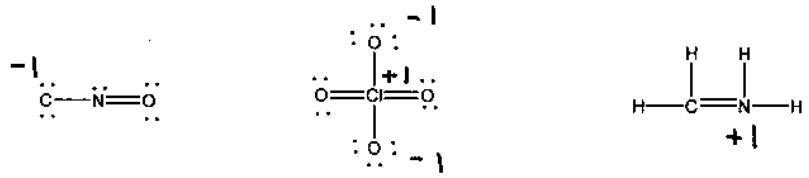
i. (Be), B

ii. B, (C)

iii. C, (N)

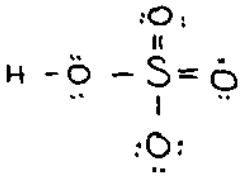
iv. (N), O

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

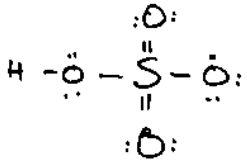


-1 -1 +1

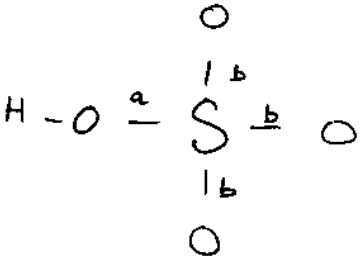
b. i. Write a reasonable Lewis structure for the hydrogen sulfate anion, HSO_4^- .



ii. Write one acceptable resonance structure for the above.



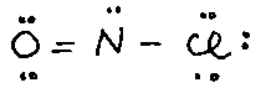
iii. How many types of S,O bonds are present? *Question relates to resonance!*
Re-write the skeletal structure and identify the types with letters.



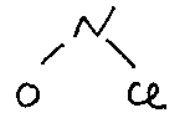
/10 6. For the following show: i. Lewis structure
ii geometric arrangements of electron groups; ***in words***
iii. atom arrangement & molecular shape; ***in words and sketch***
iv. hybridization of the central atom acc. to V.B. theory

a. NOCl (N central)

i.



iii.



; bent

ii.

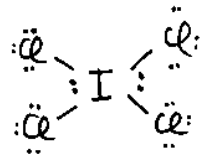
trigonal planar

iv.

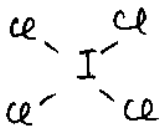
sp^2

b. ICl_4^- anion

i.



iii.



square planar

ii.

octahedral

iv.

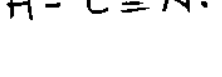
sp^3d^2

/8 7. Are the following molecules polar?

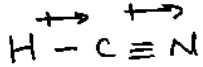
Show the work by giving i. *Lewis structure*, ii. *molecular shape* and iii. *bond dipoles*.

a. HCN

i.

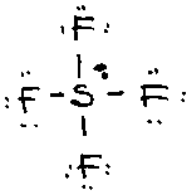


ii. & iii



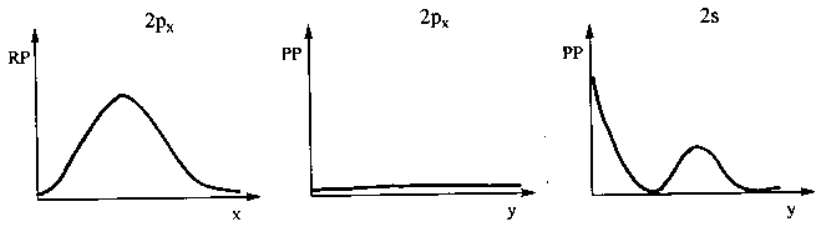
ans. Yes

b. SF_4

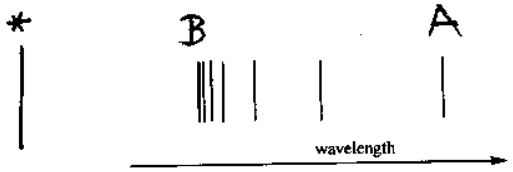


Yes

/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.



i. Place the letter A on top of the line that relates to the transition from n = 3.

ii. Place the letter B on top of the line that relates to the photon with the highest energy in this series.

iii. Place a line (marking it with a *) that relates to the first ionization energy of the hydrogen atom. *Relative position only.*