# Chemistry 121: Structural Chemistry, with Application to Chemistry of the Elements

**Midterm 1** **October 6, 2006**

Okanagan

**/50 Total Marks**

**Name:** _____

**1)** $H_2S$ was reacted with oxygen according to the following unbalanced reaction:

$$\mathbf{H_2S + O_2 \rightarrow SO_2 + H_2O}$$

**/10**

**a)** What mass of $H_2O$ will be produced from 20.0 g of $H_2S$ and 20.0 g of $O_2$? Indicate which of the two reagents is limiting.
**b)** Calculate the amount of excess reagent remaining at completion.
**c)** The yield of $SO_2$ for this reaction is 86.4%. What mass of $O_2$ would be required to produce 50.0 g of $SO_2$? Be careful of your significant figures

**2)** A 58.3 mg sample of a compound, which contains only carbon, hydrogen and oxygen, is burned completely in oxygen. The products of combustion are 105 mg of $CO_2$ and 36.0 mg of $H_2O$. The molecular mass as determined by mass spectrometry is 146.1 g mol-1. Calculate the molecular formula of the compound. **/10**

**3A)** Calculate the wavelength of light required to remove an electron from a ground state hydrogen atom. **B)** How would this compare to the wavelength required to remove an electron from a ground state helium atom. **/5**

**4)** Sketch all of the orbitals with a principal quantum number of equal to 2. **/4**

**3)** Phosgene, a poisonous gas used during the WW1, is composed of 12.1 % C, 16.2% O and 71.1 % Cl. What is the empirical formula of phosgene? **/6**

**4)** What is the name of the following compounds? **/2**

FeO_____ $PbCl_4$ _____

$N_2O_4$_____ $K_2Cr_2O_7$_____

**5)** Give the molecular formula for the following; **/2**

Hydrogen Cyanide _____ Dihydrogen Oxide _____

Sodium Sulphate _____ Chromium (VI) Oxide _____

**Multiple Choice (circle best answer)** **/10 (1 point each)**

**6)** Which of the following transitions would produce the lowest wavelength?
**(A)** Hydrogen 3s → 1s **(B)** Hydrogen 3p → 1s
**(C)** Hydrogen 3d → 1s **(D)** All would be equal

**7)** What is the wavelength in nm of radiation with a frequency of $5.75 \times 10^{14}$ Hz?
**(A)** 522 **(B)** 425 **(C)** 575 **(D)** 325

**8)** Which atom would be paramagetic?
**(A)**Be **(B)** He **(C)** Cl **(D)** Mg

**9)** Which of the following atoms has the most valance electrons?
**(A)**Cs **(B)** Ca **(C)** Cl **(D)** C

**10)** Which of the following atoms has the greatest atomic radius?
**(A)**Na **(B)** Mg **(C)** Si **(D)** S

**11)** What is the chemical formula of the salt produced by neutralization of nitric acid with Calcium Hydroxide?
**(A)** $CaNO_3$ **(B)** $Ca_2(NO_3)_3$ **(C)** $Ca_3(NO_3)_2$
**(D)** $Ca_2NO_3$ **(E)** $Ca(NO_3)_2$

**12)** Which of the following sets of quantum numbers in the form $(n,l,m_l,m_s)$ are not possible?
**(A)** (5,2,3,-½) **(B)** (4,3,-2,+½) **(C)** (6,1,0,+½) **(D)** (2,0,0,-½)

**13)** From the list below, select the quantum numbers that would represent the electron removed from Boron (B) when determining the first ionization energy.
**(A)** (1,0,0,+½) **(B)** (2,0,0,-½) **(C)** (2,0,0,+½) **(D)** (2,1,1,+½)

**14)** Which of the following is not an Alkali metal?

**(A)** Li **(B)** Na **(C)** Ca **(D)** Rb **(E)** K

**15)** In a single atom, the maximum number of electrons with a principle quantum number of 3 is?
**(A)** 8 **(B)** 18 **(C)** 6 **(D)** 10 **(E)** None of these

- $u = \lambda\nu$ (7.1)
- $E = h\nu$ (7.2)
- $E_n = -R_H\left(\frac{1}{n^2}\right)$ (7.4)
- $\Delta E = h\nu = R_H\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right)$
- $\lambda = \frac{h}{mu}$ (7.7)
- $\Delta x \Delta p \geq \frac{h}{4\pi}$ (7.8)

$h$ = 6.63 x $10^{-34}$ J s

$R_H$ = 2.18 x $10^{-18}$ J

c = 3.00 x $10^8$ m/s

# THE PERIODIC TABLE OF THE ELEMENTS

| IA | | | | | | | | | | | | IIIA | IVA | VA | VIA | VIIA | VIII |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 H 1.008 | IIA | | | VIIIA | Group Number | | | | | | | | | | | | 2 He 4.003 |
| 3 Li 6.941 | 4 Be 9.012 | | | 26 Fe 55.85 | Atomic Number<br>Symbol*<br>Atomic Weight | *Synthetic elements are hollow faced. The most stable isotope is shown. | | | | | | 5 B 10.81 | 6 C 12.01 | 7 N 14.01 | 8 O 16.00 | 9 F 19.00 | 10 Ne 20.18 |
| 11 Na 22.99 | 12 Mg 24.31 | IIIB | IVB | VB | VIB | VIIB | \|← | VIIIB | →\| | IB | IIB | 13 Al 26.98 | 14 Si 28.09 | 15 P 30.97 | 16 S 32.06 | 17 Cl 35.45 | 18 Ar 39.95 |
| 19 K 39.10 | 20 Ca 40.08 | 21 Sc 44.96 | 22 Ti 47.88 | 23 V 50.94 | 24 Cr 52.00 | 25 Mn 54.94 | 26 Fe 55.85 | 27 Co 58.93 | 28 Ni 58.69 | 29 Cu 63.55 | 30 Zn 65.38 | 31 Ga 69.72 | 32 Ge 72.59 | 33 As 74.92 | 34 Se 78.96 | 35 Br 79.90 | 36 Kr 83.80 |
| 37 Rb 85.47 | 38 Sr 87.62 | 39 Y 88.91 | 40 Zr 91.22 | 41 Nb 92.91 | 42 Mo 95.94 | 43 Tc (97.91) | 44 Ru 101.1 | 45 Rh 102.9 | 46 Pd 106.4 | 47 Ag 107.9 | 48 Cd 112.4 | 49 In 114.8 | 50 Sn 118.7 | 51 Sb 121.8 | 52 Te 127.6 | 53 I 126.9 | 54 Xe 131.3 |
| 55 Cs 132.9 | 56 Ba 137.3 | 57-71 See Lanth-anides | 72 Hf 178.5 | 73 Ta 180.9 | 74 W 183.9 | 75 Re 186.2 | 76 Os 190.2 | 77 Ir 192.2 | 78 Pt 195.1 | 79 Au 197.0 | 80 Hg 200.6 | 81 Tl 204.4 | 82 Pb 207.2 | 83 Bi 209.0 | 84 Po (209) | 85 At (210) | 86 Rn (222) |
| 87 Fr (223) | 88 Ra 226.0 | 89-103 See Actin-ides | 104 Rf (261.1) | 105 Db (262.1) | 106 Sg (263.1) | 107 Bh (262.1) | 108 Hs (265) | 109 Mt (266) | 110 Uun (269) | 111 Uuu (272) | 112 Uub (265) | 113 Uut ( ) | 114 Uuq (289) | 115 Uup ( ) | 116 Uuh (289) | 117 Uus ( ) | 118 Uuo (293) |