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Key

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Chem 1101A Mid-Term Test 20 October 2010
Name: **St. Number:**

(Use INK pens only except RED. 5 pts will be deducted if ABOVE information is not provided.)

Part I: General Knowledge

1. Give the chemical names or the corresponding chemical formula of the following: (20pts)

4 a) tin (II) fluoride

SnF_2

4 b) perchloric acid

$HClO_4$

4 c) $K_2Cr_2O_7$

potassium dichromate

4 d) ammonia

NH_3

4 e) Pu

plutonium

2. **Fill in the Blanks** (10pts)

2 In the year 1869, Prof Mendeleev discovered the periodic table. 4
This discovery allowed him to predict the atomic mass of an element which he named Eka-aluminum with a atomic mass of **68 g/mol**.

Scientists were amazed when this element was discovered a few years later because the low **percent error** (2.5%) of Mendeleev's prediction. 4

$$\%\,\text{error} = \frac{|69.72 - 68|}{69.72} \times 100 = 2.5\%$$

Hints : Atomic Mass: O(16.00), C(12.01), N(14.01), H(1.008) , S(32.07), Cl(35.45), Na(22.99), F(19.00), Si(28.09), Al(26.98), K(39.10), Ca(40.08), Ga (69.72), Ge (72.59)

Rydberg Constant=2.18 x 10^{-18} J; **Avogadro Constant**=6.022 x 10^{23} mol^{-1}
Planck constant= 6.6256x10^{-34} J s **Speed of Light**= 2.998 x 10^{8} m/s

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Part II: Problems. Support your answers with calculations/arguments. Encircle final answers and check for *significant figures*. Show all steps.

1. **Analysis of a metal chloride XCl_3 shows that it contains 67.2 percent Cl by mass. Calculate the molar mass of X and identify the element.** (20pts)

Given 100 g of XCl_3 then there are 67.2 g Cl and 32.8 g X.

$$\text{mol Cl} = \frac{67.2\ \text{g}}{35.45\ \text{g/mol}} = 1.8956\ \text{mol Cl}$$ 10

From molecular formula, 3 moles Cl : 1 mole X

$$\therefore \text{mol X} = \frac{1.8956\ \text{mol}}{3} = \frac{32.8\ \text{g}}{?\ \text{g/mol}}$$

$$?\ \text{g/mol} = \frac{32.8\ \text{g}}{(1.8956/3)\ \text{mol}} = \boxed{51.9\ \text{g/mol} \Downarrow \text{Cr atom}}$$ 10

2. **Write the Lewis structures for the following molecule and ion: (a) N_2F_2 and (b) $CH_3NH_4^+$.** (20pts) → (3)

typo here! everybody gets full credit for 2b.

(a) N_2F_2

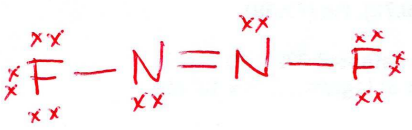
$S = [4*8] - [2*5 + 2*7]$

$S = 8 \Rightarrow$ 4 bonds

(b) $CH_3NH_3^+$

$S = [2*8 + 6*2] - [4+5+6-1]$ (28, 14)

$S = 14 \Rightarrow$ 7 bonds



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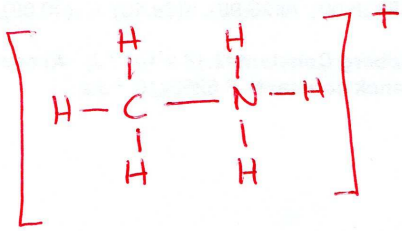

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3. Write the ground state electron configuration for vanadium (atomic number = 23). **Use the arrow notation and illustrate all electrons.** (20 pts)

Aufbau Principle

1s
2s 2p
3s 3p 3d
4s 4p 4d 4f
5s

Hund's Rule: "Distribute before pairing."

Energy

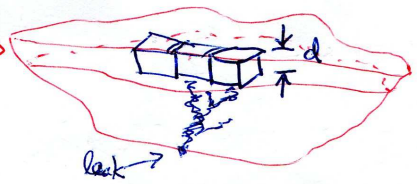
1↿ 4s
1↿ 3s
1↿ 2s
1↿ 1s
1↿ 1↿ 1↿ 3p
1↿ 1↿ 1↿ 2p
1 1 1 3d

4. **Dimensional Analysis.** The *Deepwater Horizon* well was sealed on July 15, 2010 after leaking oil from the bottom of the Gulf of Mexico for **84 days**. Officials estimate the average leak rate at **6.2×10^4 barrels/day**. If 26 % of the total oil released manage to make it to the ocean surface and form a *single layer* of oil molecules, **calculate the total area (in km^2) of the oil slick** formed on the ocean surface. Assume oil molecule is a cube and has a volume of 15.0 nm^3(15 pts) **Hint:** 1 barrel (oil) = 159 Liter; **Ref:** Crone & Tolstoy, Science Online, Sept 23, 2010.

(a) Solve for oil thickness (d) 5

$d = (15.0\ nm^3)^{1/3} = 2.466\ nm$

oil monolayer



(b) Solve for oil slick area (A): 5

$$A = \frac{\text{total oil volume}}{d} = \frac{6.2 \times 10^4 \frac{\text{barrel}}{\text{day}} (84\ \text{day})(0.26)\left(\frac{159\ L}{\text{barrel}}\right)\left(\frac{10^3\ mL}{L}\right)\frac{cm^3}{mL}}{2.466\ nm\left(\frac{10^{-9}\ m}{nm}\right)\left(\frac{10^2\ cm}{m}\right)}$$

$A = 0.8730 \times 10^{18}\ cm^2$ 5

(c) Convert to km^2

$$\_\_\_ km^2 = 0.8730 \times 10^{18}\ cm^2 \left(\frac{10^{-2}\ m}{cm}\right)^2 \left(\frac{km}{10^3\ m}\right)^2 = \boxed{8.7 \times 10^{7}\ km^2}$$