In-Class Test 1
CHM 1301
September 23, 2008

Name: ___________________________ Student No. __________________

Givens: Avogadro's Number: $N_A = 6.022 \times 10^{23}$ units/mol

1. A solution of 34.5% sulfuric acid by mass in water has a density of 1.26 g/mL. What mass of sulfuric acid is needed to make 3.22 L of this solution?

A) 1.20×10^5 g
B) 882 g
C) 135 g
D) 1.4×10^3 g
E) 1.40×10^5 g

$m = v \cdot d$
$= 3.22 \times 10^3 \text{ mL} \times 1.26 \frac{g}{mL}$
$= 4.06 \times 10^3$ g

34.5 g in 100 g
x in 4.06×10^3 g

$x = \frac{(34.5)(4.06 \times 10^3 g)}{100} = \boxed{1.4 \times 10^3 g}$

2. A 15.0 g sample of hydrated copper sulfate was heated to dryness and the new mass measured to be 9.59 g. Calculate the percentage of water in the hydrated crystal. Express your answer to the correct number of significant digits.

A) 36.1%
B) 36%
C) 63.3%
D) 63%
E) 45%

$m_{H_2O} = (15.0 - 9.5)$ g
$= 5.4$ g

$\therefore$ Mass % $H_2O = \frac{5.4 g}{15.0 g} \times 100\%$

$= \boxed{36\%}$

3. If the density of lead is 11.34 g/cm^3, how many atoms are in a piece of lead that is 2.00 cm wide, 1.00 m long, and 2.00 mm thick?

A) 1.32×10^{24}
B) 1.16×10^{23}
C) 1.32×10^{23}
D) 1.16×10^{22}
E) 6.60×10^{23}

$V = L \cdot w \cdot h$
$= (2.00\,cm)(1.00\times10^{2}\,cm)(2.00\times10^{-1}\,cm)$
$= 40.0\,cm^3$

$m = d \cdot V = \left(11.34 \frac{g}{cm^3}\right)(40.0\,cm^3)$
$= 4.54\times10^{2}\,g$

$n = \frac{m}{MM} = \frac{4.54\times10^{2}\,g}{207.2\,g/mol} = 2.19\,mol$

$\#\,atoms = 2.19\,mol \times 6.022\times10^{23}\frac{atoms}{mol} = 1.32\times10^{24}\,atoms$

4. A 1.500 g sample of compound containing only C, H, and O was burned completely. The only combustion products were 1.738 g CO_2 and 0.711 g H_2O. What is the empirical formula of the compound?

A) CH_2O_2
B) CH_2O
C) $C_2H_4O_3$
D) CHO
E) CH_4O

$n_{CO_2} = \frac{1.738\,g}{44\,g/mol} = 3.95\times10^{-2}\,mol$
$n_C = 3.95\times10^{-2}\,mol$
$m_C = 0.474\,g$

$n_{H_2O} = \frac{0.711\,g}{18\,g/mol} = 3.95\times10^{-2}\,mol$
$n_H = 2(3.95\times10^{-2}\,mol) = 7.90\times10^{-2}\,mol = m_H$
$m_O = m_{comp} - m_C - m_H = (1.500 - 0.474 - 7.90\times10^{-2})\,g$
$= 0.947\,g$
$n_O = \frac{0.947\,g}{16\,g/mol} = 5.92\times10^{-2}\,mol$

$C_{\frac{3.95\times10^{-2}}{3.95\times10^{-2}}} H_{\frac{7.90\times10^{-2}}{3.95\times10^{-2}}} O_{\frac{5.92\times10^{-2}}{3.95\times10^{-6}}}$

$C\,H_2\,O_{1.5}$ ⇒ double the formula to get $C_2H_4O_3$

5. Choose the INCORRECT name formula combination.

A) HNO_2 ; nitrous acid
B) $Fe_2(SO_4)_3$; iron(III) sulfite
C) LiCN ; lithium cyanide
D) Na_2CO_3 ; sodium carbonate
E) $Ba(OH)_2$; barium hydroxide

should be Iron(III) sulfate

6. What thickness (in cm) is the silicon block (density = 2.33 g/cm^3) that is 2.87 cm wide and long necessary to react with 91.3 g of Cr_2O_3 by the reaction: $3\ Si\ (s) + 2\ Cr_2O_3\ (s) \rightarrow 3\ SiO_2\ (s) + 4\ Cr\ (l)$?

A) 2.05
B) 1.32
C) 3.08
D) 8.98
E) 3.79

$$n_{Cr_2O_3} = \frac{91.3g}{151.9904\ g/mol} = 0.601\ mol$$

$$3\ Si : 2\ Cr_2O_3$$

$$x : 0.601$$

$$x(2) = 3(0.601)$$

$$x = \frac{3}{2}(0.601) = 0.901$$

$$m_{Si} = n \cdot MM = (0.901\ mol)(28.0855\ \frac{g}{mol}) = 25.3\ g$$

$$V = \frac{m}{d} = \frac{25.3\ g}{2.33\ g/cm^3} = 10.9\ cm^3 = L \times W \times h$$

$$h = \frac{V}{L \times W} = \frac{10.9\ cm^3}{(2.87\ cm)^2} = \boxed{1.32\ cm}$$

7. If the percent yield is 82.0%, what mass in grams of silicon is needed to make 105 g of chromium by the reaction:

$$3\ Si\ (s) + 2\ Cr_2O_3\ (s) \rightarrow 3\ SiO_2\ (s) + 4\ Cr\ (l)?$$

A) 51.9 g
B) 92.2 g
C) 42.5 g
D) 34.9 g
E) 13.0 g

$n_{Cr} = \frac{m}{MM} = \frac{105 g}{51.9961 \frac{g}{mol}} = 2.02\ mol$

$\%\ yield = \frac{actual}{theoretical} \times 100\%$

$0.82 = \frac{2.02}{x} \Rightarrow x = \frac{2.02}{0.82} = 2.46\ mol$

3 Si : 4 Cr
x : 2.46 mol

$x = \frac{3(2.46\ mol)}{4} = 1.85\ mol$

$m_{Si} = n \cdot MM = (1.85\ mol)(28.0855 \frac{g}{mol}) = \boxed{51.9\ g}$

8. If gas volume is doubled but the temperature remains constant:

A) the pressure stays the same
B) the molecules move faster
C) the kinetic energy increases
D) the molecules move slower
E) none of these

Please see chapter

9. The statement, "For a fixed mass of gas at constant temperature, gas volume is inversely proportional to gas pressure." is known as:

A) Avogadro's Law
B) Boyle's Law
C) Charles' Law
D) Graham's Law
E) Kelvin's Law

Please see chapter

10. The relationship between the "absolute temperature" on the Kelvin scale and the Celsius temperature is given by:

A) T(K) = T(°C) + 273.15
B) T(°C) = T(K) + 273.15
C) T(K) = 5/8[T(°C)] - 32
D) T(K) = 8/5[T(°C)] + 32
E) T(°C) = 98.6 + T(K)

The temperature in Kelvin must always be ≥ 0

BONUS: (can only answer if you have made an attempt at ALL other questions!)

A lead cube that is 3.00 cm on each side contains 8.91 x 10^{23} atoms. What is the density of this cube in g/cm^3?

A) 34.1
B) 11.4
C) 0.0550
D) 0.990
E) 26.7

$$V = (3.00\text{ cm})^3 = 27.0\text{ cm}^3$$

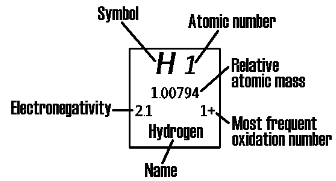
$$n_{Pb} = \frac{8.91\times10^{23}\text{ atoms}}{6.022\times10^{23}\ \frac{\text{atoms}}{\text{mol}}} = 1.48\text{ mol}$$

$$m = n \cdot MM = (1.48\text{ mol})\left(207.2\ \frac{\text{g}}{\text{mol}}\right)$$

$$= 3.07\times10^{2}\text{ g}$$

$$d = \frac{m}{V} = \frac{3.07\times10^{2}\text{ g}}{27.0\text{ cm}^3} = 11.4\ \frac{\text{g}}{\text{cm}^3}$$

Mokeur's Periodic table of the elements



	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIII	9 VIII	10 VIII	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	*H* 1 1.00794 2.1 1+ Hydrogen																	*He* 2 4.002602 - - Helium
2	**Li** 3 6.941 1.0 1+ Lithium	**Be** 4 9.012182 1.5 2+ Beryllium											**B** 5 10.811 2.0 3+ Boron	**C** 6 12.011 2.5 4+,4- Carbon	*N* 7 14.00674 3.0 3+,3- Nitrogen	*O* 8 15.9994 3.5 2- Oxygen	*F* 9 18.9984032 4.0 1- Fluorine	*Ne* 10 20.1797 - - Neon
3	**Na** 11 22.989768 0.9 1+ Sodium	**Mg** 12 24.3050 1.2 2+ Magnesium											**Al** 13 26.981539 1.5 3+ Aluminum	**Si** 14 28.0855 1.8 4+ Silicon	**P** 15 30.973762 2.1 5+ Phosphorus	**S** 16 32.066 1.8 4+ Sulfur	*Cl* 17 35.4527 3.0 1- Chlorine	*Ar* 18 39.948 - - Argon
4	**K** 19 39.0983 0.8 1+ Potassium	**Ca** 20 40.078 1.0 2+ Calcium	**Sc** 21 44.955910 1.3 3+ Scandium	**Ti** 22 47.88 1.5 4+ Titanium	**V** 23 50.9415 1.6 5+ Vanadium	**Cr** 24 51.9961 1.6 3+ Chromium	**Mn** 25 54.93805 1.5 2+ Manganese	**Fe** 26 55.847 1.8 3+ Iron	**Co** 27 58.9332 1.8 2+ Cobalt	**Ni** 28 58.6934 1.8 2+ Nickel	**Cu** 29 63.546 1.9 2+ Copper	**Zn** 30 65.39 1.6 2+ Zinc	***Ga*** 31 69.723 1.6 3+ Gallium	**Ge** 32 72.61 1.6 4+ Germanium	**As** 33 74.92159 2.0 3+,3- Arsenic	**Se** 34 78.96 2.4 4+ Selenium	***Br*** 35 79.904 2.8 1- Bromine	*Kr* 36 83.80 - - Krypton
5	**Rb** 37 85.4678 0.8 1+ Rubidium	**Sr** 38 87.62 1.0 2+ Strontium	**Y** 39 88.90585 1.3 3+ Yttrium	**Zr** 40 91.224 1.4 4+ Zirconium	**Nb** 41 92.90638 1.6 5+ Niobium	**Mo** 42 95.94 1.8 6+ Molybdenum	Tc 43 98.9063 1.9 7+ Technetium	**Ru** 44 101.57 2.2 3+,4+ Ruthenium	**Rh** 45 102.9055 2.2 3+ Rhodium	**Pd** 46 106.42 2.2 2+ Palladium	**Ag** 47 107.8682 1.9 1+ Silver	**Cd** 48 112.411 1.7 2+ Cadmium	**In** 49 114.82 1.7 3+ Indium	**Sn** 50 118.71 1.8 4+ Tin	**Sb** 51 121.757 1.9 3+,3- Antimony	**Te** 52 127.60 2.1 4+ Tellurium	**I** 53 126.90447 2.5 1- Iodine	*Xe* 54 131.29 - - Xenon
6	***Cs*** 55 132.90543 0.7 1+ Cesium	**Ba** 56 137.327 0.9 2+ Barium	**La** 57 138.9055 1.1 3+ Lanthanum	**Hf** 72 178.49 1.3 4+ Hafnium	**Ta** 73 180.9479 1.5 5+ Tantalum	**W** 74 183.85 1.7 6+ Tungsten	**Re** 75 186.207 1.9 7+ Rhenium	**Os** 76 190.2 2.2 4+ Osmium	**Ir** 77 192.22 2.2 4+ Iridium	**Pt** 78 195.08 2.2 4+ Platinum	**Au** 79 196.96654 2.4 3+ Gold	***Hg*** 80 200.59 1.9 2+ Mercury	**Tl** 81 204.3833 1.8 1+ Thallium	**Pb** 82 207.2 1.8 2+ Lead	**Bi** 83 208.98037 1.9 3+ Bismuth	**Po** 84 208.9824 2.0 2+ Polonium	**At** 85 209.9871 2.2 1- Astatine	*Rn* 86 222.0176 - - Radon
7	***Fr*** 87 223.0197 0.7 1+ Francium	**Ra** 88 226.0254 0.9 2+ Radium	**Ac** 89 227.0278 1.1 3+ Actinium	Rf 104 261.11 - - Rutherfordium	Db 105 262.11 - - Dubnium	Sg 106 263.12 - - Seaborgium	Bh 107 262.12 - - Bohrium	Hs 108 264 - - Hassium	Mt 109 266.1378 - - Meitnerium	Uun 110 269 - - Ununnilium	Uuu 111 272 - - Unununium	Uu 112 277 - - Ununbium		Uuq 114 289 - - Ununquadium		Uuh 116 289 - - Ununhexium		Uuo 118 293 - - Ununoctium

6	**Ce** 58 140.115 1.1 3+ Cerium	**Pr** 59 140.90765 1.1 3+ Praseodymium	**Nd** 60 144.24 1.1 3+ Neodymium	Pm 61 144.9127 1.1 3+ Promethium	**Sm** 62 150.36 1.2 3+ Samarium	**Eu** 63 151.965 1.2 3+ Europium	**Gd** 64 157.25 1.2 3+ Gadolinium	**Tb** 65 168.92534 1.2 3+ Terbium	**Dy** 66 162.50 1.2 3+ Dysposium	**Ho** 67 164.93032 1.2 3+ Holmium	**Er** 68 167.26 1.2 3+ Erbium	**Tm** 69 168.93421 1.2 3+ Thulium	**Yb** 70 173.04 1.1 3+ Ytterbium	**Lu** 71 174.967 1.2 3+ Lutetium
7	**Th** 90 232.0381 1.3 4+ Thorium	**Pa** 91 231.03588 1.5 5+ Protactinium	**U** 92 238.0289 1.4 6+ Uranium	Np 93 237.082 1.3 5+ Neptunium	Pu 94 244.0642 1.3 4+ Plutonium	Am 95 243.0614 1.3 3+ Americium	Cm 96 247 1.3 3+ Curium	Bk 97 247.0703 1.3 3+ Berkelium	Cf 98 251.0796 1.3 3+ Californium	Es 99 252.03 1.3 - Einsteinium	Fm 100 257.0951 1.3 - Fermium	Md 101 258.01 1.3 - Mendelevium	No 102 259.1009 1.3 - Nobelium	Lr 103 260.1053 - - Lawrencium

Under normal conditions, bold symbols correspond to solid state, bold italic correspond to liquid state, italic correspond to gaseous state and normal correspond to synthetic elements.