

CHEM 1215
Exam III
John III. Gelder
April 5, 2000

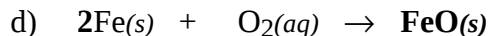
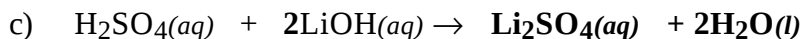
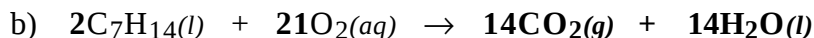
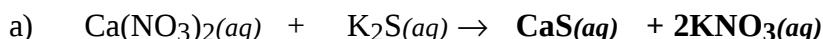
Name _____
TA's Name _____
Lab Section _____

INSTRUCTIONS:

1. This examination consists of a total of 6 different pages. The last page includes a periodic table and a solubility table. All work should be done in this booklet.
2. PRINT your name, TA's name and your lab section number now in the space at the top of this sheet. **DO NOT SEPARATE THESE PAGES.**
3. Answer all questions that you can and whenever called for show your work clearly. Your method of solving problems should pattern the approach used in lecture. You do not have to show your work for the multiple choice (if any) or short answer questions.
4. No credit will be awarded if your work is not shown in problems 4 - 8.
5. Point values are shown next to the problem number.
6. Budget your time for each of the questions. Some problems may have a low point value yet be very challenging. If you do not recognize the solution to a question quickly, skip it, and return to the question after completing the easier problems.
7. Look through the exam before beginning; plan your work; then begin.
8. ~~Relax~~ and do well.

	Page 2	Page 3	Page 4	Page 5	TOTAL
SCORES	_____	_____	_____	_____	_____
	(42)	(22)	(26)	(10)	(100)

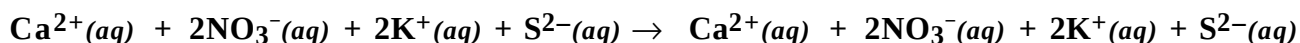
(12) 1. Write the chemical formula(s) of the product(s) and balance the following reactions. Identify all products phases as either (g)as, (l)iquid, (s)olid or (aq)ueous.



(8) 2. Write the balanced ionic and balanced net ionic chemical equations for the reactions a) and c) in Problem 1. (Remember to include the correct charges on all ions and the phase of each species.)

1a)

Ionic equation:

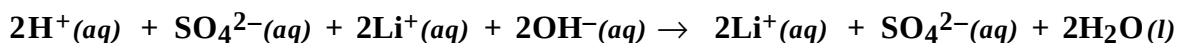


Net Ionic equation:

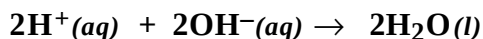
No net ionic equation

1c)

Ionic equation:



Net Ionic equation:



(22) 3. Complete the following table

Formula	M , Molar Mass $\left(\frac{\text{g}}{\text{mol}}\right)$	m , Mass of sample (g)	n , Moles of sample (mol)	N , Number of atoms, molecules, or formula units
CF_2Cl_2	121	42.3	0.350	2.11×10^{23} molecules
$\text{C}_4\text{H}_8\text{O}_2$	88	1.75×10^{-21}	1.99×10^{-23}	12 molecules
unknown	55.8	1.05	0.0188	1.13×10^{22} atoms
$\text{C}_{10}\text{H}_{19}\text{O}_6\text{PS}_2$	330	38.5	0.117	7.03×10^{22}

If the unknown is an element, indicate the symbol.....**Fe**

(12)4. Short answer

a) Calculate the mass, in grams, of a single molecule of glucose, $\text{C}_6\text{H}_{12}\text{O}_6$.

$$\left(\frac{180 \text{ g } \text{C}_6\text{H}_{12}\text{O}_6}{1 \text{ mol } \text{C}_6\text{H}_{12}\text{O}_6} \right) \left(\frac{1 \text{ mol } \text{C}_6\text{H}_{12}\text{O}_6}{6.02 \times 10^{23} \text{ molecules } \text{C}_6\text{H}_{12}\text{O}_6} \right) = 2.99 \times 10^{-22} \text{ g} \cdot \text{molecules}^{-1}$$

b) Calculate the number of atoms of nitrogen in 3.45 g $\text{CoC}_4\text{H}_{19}\text{N}_5\text{Cl}$.

$$3.45 \text{ g } \text{CoC}_4\text{H}_{19}\text{N}_5\text{Cl} \left(\frac{1 \text{ mol}}{231.4 \text{ g}} \right) \left(\frac{6.023 \times 10^{23} \text{ molecule}}{1 \text{ mol}} \right) \left(\frac{5 \text{ N atoms}}{1 \text{ molecule}} \right) = 4.49 \times 10^{22} \text{ N atoms}$$

c) Calculate the number of formula units and the number of grams in 1.75×10^{-21} mol of $\text{Na}_2\text{Cr}_2\text{O}_7$.

$$1.75 \times 10^{-21} \text{ mol } \text{Na}_2\text{Cr}_2\text{O}_7 \left(\frac{6.023 \times 10^{23} \text{ formula units}}{1 \text{ mol}} \right) = 1054 \text{ formula units}$$

$$1.75 \times 10^{-21} \text{ mol } \text{Na}_2\text{Cr}_2\text{O}_7 \left(\frac{262 \text{ g}}{1 \text{ mol}} \right) = 4.59 \times 10^{-19} \text{ grams } \text{Na}_2\text{Cr}_2\text{O}_7$$

(10) 5. Urea, a common component in fertilizer, has the formula $\text{CH}_4\text{N}_2\text{O}$. Calculate the percentage composition by mass of the elements in urea.

$$\text{C} : \left(\frac{12.0 \text{ g C}}{60.0 \text{ g } \text{CH}_4\text{N}_2\text{O}} \right) \cdot 100 = 20.0 \% \text{ C}$$

$$\text{H} : \left(\frac{1.008 \text{ g H}}{60.0 \text{ g } \text{CH}_4\text{N}_2\text{O}} \right) \cdot 100 = 6.73 \% \text{ H}$$

$$\text{N} : \left(\frac{14.0 \text{ g N}}{60.0 \text{ g } \text{CH}_4\text{N}_2\text{O}} \right) \cdot 100 = 46.7 \% \text{ N}$$

$$\text{O} : \left(\frac{16.0 \text{ g O}}{60.0 \text{ g } \text{CH}_4\text{N}_2\text{O}} \right) \cdot 100 = 26.7 \% \text{ O}$$

- (10) 6. Ibuprofen is a headache remedy. Ibuprofen is 75.69% C, 8.80% H and 15.51% O. Calculate the empirical formula for Ibuprofen.

$$75.69 \text{ g C} \left(\frac{1 \text{ mol C}}{12.0 \text{ g C}} \right) = 6.308 \text{ mol C}$$

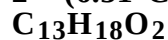
$$8.80 \text{ g H} \left(\frac{1 \text{ mol H}}{1.01 \text{ g H}} \right) = 8.713 \text{ mol H}$$

$$15.51 \text{ g O} \left(\frac{1 \text{ mol O}}{16.00 \text{ g}} \right) = 0.9694 \text{ mol O}$$

$$\left(\frac{6.308 \text{ mol C}}{0.9694} \right) : \left(\frac{8.713 \text{ mol H}}{0.9694} \right) : \left(\frac{0.9694 \text{ mol O}}{0.9694} \right)$$

$$6.51 \text{ C} : 8.99 \text{ H} : 1.0 \text{ O} = 1 \text{ C} : 1 \text{ H} : 1 \text{ O}$$

$$2 \cdot (6.51 \text{ C} : 8.99 \text{ H} : 1.0 \text{ O}) = 13 \text{ C} : 18 \text{ H} : 2 \text{ O}$$



- (16) 7a. In laboratory last week everyone reacted copper with nitric acid, according to the equation

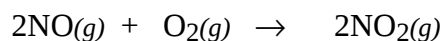


Calculate the number of moles and the number of grams of NO formed when 1.17 grams of copper metal reacted with excess nitric acid.

$$1.17 \text{ g Cu} \left(\frac{1 \text{ mol Cu}}{63.55 \text{ g}} \right) \left(\frac{2 \text{ mol NO}}{3 \text{ mol Cu}} \right) \left(\frac{30.0 \text{ g NO}}{1 \text{ mol NO}} \right) = 0.368 \text{ g NO}$$

$$1.17 \text{ g Cu} \left(\frac{1 \text{ mol Cu}}{63.55 \text{ g}} \right) \left(\frac{2 \text{ mol NO}}{3 \text{ mol Cu}} \right) = 0.0123 \text{ mol NO}$$

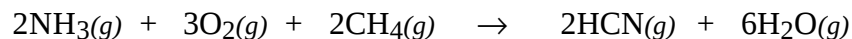
- b) NO is a colorless gas which reacts immediately with O₂ in the atmosphere according to the equation



Calculate the number of grams of NO₂ formed when the 1.17 gram sample of copper in part a) reacts.

$$0.0123 \text{ mol NO} \left(\frac{2 \text{ mol NO}_2}{2 \text{ mol NO}} \right) \left(\frac{46.0 \text{ g NO}_2}{1 \text{ mol NO}_2} \right) = 0.565 \text{ grams NO}_2$$

(10) 8. An interesting reaction which is postulated as occurring in the atmosphere on this planet is,



A sample is prepared by mixing 45.6 g of ammonia with some amounts of oxygen and methane. An electrical arc is used to initiate the reaction. After the reaction occurs 81.3 grams of H_2O is produced. Answer each of the following,

a) the mol of H_2O produced?

$$81.3 \text{ g H}_2\text{O} \left(\frac{1 \text{ mol H}_2\text{O}}{18.0 \text{ g}} \right) = 4.52 \text{ mol H}_2\text{O produced}$$

b) the mass of CH_4 reacted?

$$81.3 \text{ g H}_2\text{O} \left(\frac{1 \text{ mol H}_2\text{O}}{18.0 \text{ g}} \right) \left(\frac{2 \text{ mol CH}_4}{6 \text{ mol H}_2\text{O}} \right) \left(\frac{16.0 \text{ g CH}_4}{1 \text{ mol CH}_4} \right) = 24.1 \text{ g CH}_4 \text{ reacted}$$

c) the mass of ammonia remaining after the reaction occurred?

$$81.3 \text{ g H}_2\text{O} \left(\frac{1 \text{ mol H}_2\text{O}}{18.0 \text{ g}} \right) \left(\frac{2 \text{ mol NH}_3}{6 \text{ mol H}_2\text{O}} \right) \left(\frac{17.0 \text{ g NH}_3}{1 \text{ mol NH}_3} \right) = 25.6 \text{ g NH}_3 \text{ reacted}$$

$$(45.6 \text{ g NH}_3)_{\text{initially}} - (25.6 \text{ g NH}_3)_{\text{reacted}} = 20.0 \text{ g NH}_3 \text{ unreacted}$$

Periodic Table of the Elements																		
IA																VIIIA		
1	1 H 1.008															2 He 4.00		
2	3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.30											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
4	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
5	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 (98)	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
6	55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	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)
7	87 Fr (223)	88 Ra 226.0	89 Ac 227.0	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)									

Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Actinides	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.0	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

Solubility Table

<u>Ion</u>	<u>Solubility</u>	<u>Exceptions</u>
NO_3^-	soluble	none
ClO_4^-	soluble	none
Cl^-	soluble	except Ag^+ , Hg_2^{2+} , Pb^{2+}
SO_4^{2-}	soluble	except Ca^{2+} , Ba^{2+} , Sr^{2+} , Hg^{2+} , Pb^{2+} , Ag^+
CO_3^{2-}	insoluble	except Group IA and NH_4^+
PO_4^{3-}	insoluble	except Group IA and NH_4^+
CrO_4^{2-}	insoluble	except Group IA, IIA and NH_4^+
OH^-	insoluble	except Group IA, Ca^{2+} , Ba^{2+} , Sr^{2+}
S^{2-}	insoluble	except Group IA, IIA and NH_4^+
Na^+	soluble	none
NH_4^+	soluble	none
K^+	soluble	none

*slightly soluble