Exam 2 Chm 203 (Dr Mattson) 27 September 2019

Name:

Academic Integrity Pledge: *In keeping with Creighton University's ideals and with the Academic Integrity Code, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.*

Signature:

Chemistry Student Number: _____

Instructions: **Show all work whenever a calculation box is provided!** Write legibly. Include units whenever appropriate. You will receive credit for **how** you worked each problem as well as for the correct answer. If you need more space, you may use the back of the periodic table provided — Write: "See PT" in the answer box. Write your name on the periodic table if it contains work to be graded. On your desk you may have pencils (but no pencil pouch), an eraser, and a non-programmable calculator without a slipcover. Backpacks, bags, and similar items must be stored on the tables in the back of the room. Cell phones must be silent and placed in your backpack/bag – not in your pocket.

1a. (12 pts) Balance these chemical reactions with the smallest whole number coefficients. No partial credit.

__ $TiCl_4$ + __ H_2O → __ TiO_2 + __ HCl

__ $KClO_3$ + __ P_4 → __ P_4O_{10} + __ KCl

__ $HClO_4$ + __ P_4O_{10} → __ H_3PO_4 + __ Cl_2O_7

1b. (4 pts) Balance the reaction for the combustion of methane, CH_4.

2. Consider the following balance chemical reaction to answer all parts of Question 2. Molar masses are provided above each chemical.

17.03 32.00 30.01 18.02

$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

2a. (4 pts) How many moles of O_2(g) are required to react with 77.0 g NH_3?

Show all work for credit.

Answer with units: _____

2b. (4 pts) Suppose excess NH_3 is reacted with 44.2 g O_2. What is the theoretical yield of NO in grams?

Show all work for credit.

Answer with units: _____

2c. (4 pts) What is the limiting reagent if 0.913 mol of NH_3 and 1.105 mol of O_2 are reacted?

$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

Answer with units: _____

2d. (5 pts) Based on your answer above, how much of the excess reagent is left over? Give your answer in grams.

Show all work for credit.

Answer with units: _____

2e. (4 pts) Suppose 8.00 mol NH_3 is reacted with 9.00 mol O_2 and 157 g NO was obtained. What is the % yield?

Show all work for credit.

Answer with units: _____

3. (5 pts) Iocane powder, the poison mentioned in the 1987 timeless classic movie The Princess Bride[1], is not a real substance but probably inspired by coniine, a poison obtained from hemlock. Coniine contains only C, H and N and analysis reveals that it is 75.519% C and 13.469% H. What is the simplest formula for coniine?

Show all work for credit.

Answer: _____

[1] https://princessbride.fandom.com/wiki/Iocane

4. (4 pts) What is the percent phosphorus in tetraphosphorus hexasulfide?

Show all work for credit.

Answer: _____

5a. (4 pts) Suppose 7.118 g $Fe(NO_3)_2$(s), MM = 179.855 g/mol) is dissolved in enough water to make 250.00 mL solution. What is the molarity of the solution?

Show all work for credit.

Answer with units / correct sig figures: _____

5b. (2 pts) What is the molarity of the nitrate ion, $[NO_3^-]$?

Answer with units: _____

5c. (4 pts) What volume of the previous solution is needed to deliver 3.50 mmol $Fe(NO_3)_2$? Give answer in mL.

Show all work for credit.

Answer (in mL): _____

5d. (4 pts) What volume of the solution in 5a, in mL, would be required to make 500.0 mL of a 2.5 x 10^{-3} M solution?

Answer (in mL): _____

6. (9 pts) Which of the following form strong electrolytic solutions when dissolved in water? Check all that do.

☐ $AgNO_3$	☐ C_2H_5OH	☐ K_2SO_4
☐ $FePO_4$	☐ $C_{12}H_{22}O_{11}$	☐ NH_4Br
☐ H_2SO_4	☐ $RbClO_4$	☐ KOH

7. (6 pts) Which of the following are soluble in water? Check all that are.

☐ $Cu(C_2H_3O_2)_2$	☐ $Sc_2(PO_4)_3$	☐ $NaHSO_4$
☐ $Fe(OH)_3$	☐ $Zn(ClO_4)_2$	☐ $NiCO_3$

8a. (2 pts) When aqueous solutions of lead(II) nitrate and potassium iodide are mixed, a bright yellow precipitate is formed. What is this precipitate?

8b. (3 pts) Write the overall reaction, including states of matter such as (aq) and (s).

8c. (3 pts) Write the net ionic reaction including states of matter, (aq) and (s).

9. (4 pts) Will a precipitate form if the following pairs of solutions are mixed? You do not need to identify it.

Yes **No** NaCl(aq) and $AgC_2H_3O_2$(aq)

Yes **No** NH_4ClO_4(aq) and $BaBr_2$(aq)

Yes **No** Na_2SO_4(aq) and $Ba(NO_3)_2$(aq)

Yes **No** Rb_3PO_4(aq) and $CuSO_4$(aq)

10. (3 pts) Which three of these acids are correctly named? Check all that are. (Everyone does this one.)

☐ H_2SO_4(aq)	sulfurous acid
☐ HNO_3(aq)	nitric acid
☐ $HClO_4$(aq)	chloric acid
☐ $HC_2H_3O_2$(aq)	acetic acid
☐ $HBrO_2$(aq)	bromic acid
☐ H_3PO_4(aq)	phosphorus acid
☐ HI(aq)	hydroiodic acid

11. (10 pts) Nomenclature. Complete the following table. (If you are nomenclature certified, skip this question.)

	SI_4
	$(NH_4)_2SO_4$
	$Co(NO_2)_2$
	As_2O_3
	$KHSO_3$
oxygen difluoride	
nickel(II) chlorate	
barium sulfate	
dinitrogen monoxide	
sodium nitride	

General Chemistry with Dr. Mattson
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1 H 1.0079																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
11 Na 22.990	12 Mg 24.305											13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.065	17 Cl 35.453	18 Ar 39.948
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.867	23 V 50.941	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.409	31 Ga 69.723	32 Ge 72.64	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.06	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	103 Lr (262)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (264)	108 Hs (265)	109 Mt (268)	110 Ds (269)	111 Rg (272)	112 Cn (277)	113 Nh (unknown)	114 Fl (289)	115 Mc (unknown)	116 Lv (289)	117 Ts (unknown)	118 Og (293)

57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	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)

Answers

1a. $1\ TiCl_4 + 2\ H_2O \rightarrow 1\ TiO_2 + 4\ HCl$

$10\ KClO_3 + 3\ P_4 \rightarrow 3\ P_4O_{10} + 10\ KCl$

$12\ HClO_4 + 1\ P_4O_{10} \rightarrow 4\ H_3PO_4 + 6\ Cl_2O_7$

1b. $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$

2a. 5.65 moles of $O_2(g)$

2b. 33.2 g NO

2c. $O_2(g)$ is the limiting reagent

2d. 0.494 g $NH_3(g)$ left over

2e. 72.7 %

3. $C_8H_{17}N_1$

4. 39.17 % P

5a. 0.1583 M $Fe(NO_3)_2(aq)$

5b. 0.3166 M NO_3^-

5c. 22.1 mL

5d. 7.90 mL

6. $AgNO_3$ K_2SO_4 NH_4Br H_2SO_4 $RbClO_4$ KOH

7. $Cu(C_2H_3O_2)_2$ $NaHSO_4$ $Zn(ClO_4)_2$

8a. $PbI_2(s)$

8b. $Ag(NO_3)_2(aq) + 2\ KI(aq) \rightarrow 2\ KNO_3(aq) + PbI_2(s)$

8c. $Pb^{2+}(aq) + 2\ I^-(aq) \rightarrow PbI_2(s)$

9. Yes, No, Yes, Yes

10. $HNO_3(aq)$ = nitric acid, $HC_2H_3O_2(aq)$ = acetic acid, $HI(aq)$ = hydroiodic acid