Exam 3 Chm 203 (Dr Mattson) 24 October 2018

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:

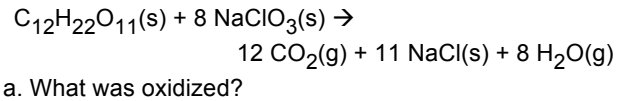
Name:

Chemistry Student Number: _____

(1 point bonus for completing 1. signature, 2. printed name and 3. your correct 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 data sheet provided — Write: "See data sheet" in the answer box – then write your name on the data sheet. On your desk you are allowed only pencils (but no pencil pouch), an eraser, and a non-programmable calculator without a slipcover. Backpacks, bags, and purse-like items must be stored on the tables in the back of the room. Cell phones must be silent and placed in your backpack/bag/purse – not in your pocket.

1. (4 pts) Consider the reaction between sugar and sodium chlorate (that we saw on the plaza):



$$C_{12}H_{22}O_{11}(s) + 8\ NaClO_3(s) \rightarrow 12\ CO_2(g) + 11\ NaCl(s) + 8\ H_2O(g)$$

1a. What was oxidized?

$C_{12}H_{22}O_{11}$ $NaClO_3$ $CO_2(g)$ $NaCl(s)$ H_2O

1b. What was reduced?

$C_{12}H_{22}O_{11}$ $NaClO_3$ $CO_2(g)$ $NaCl(s)$ H_2O

1c. What was the oxidizing agent?

$C_{12}H_{22}O_{11}$ $NaClO_3$ $CO_2(g)$ $NaCl(s)$ H_2O

1d. What was reducing agent?

$C_{12}H_{22}O_{11}$ $NaClO_3$ $CO_2(g)$ $NaCl(s)$ H_2O

2. (7 pts) Consider these seven equations and match them with the descriptions that follow:

A. $Ag^+(aq) + Br^-(aq) \rightarrow AgBr(s)$

B. $HClO_4(aq) + LiOH(aq) \rightarrow H_2O(l) + LiClO_4(aq)$

C. $Br_2(aq) + Zn(s) \rightarrow ZnBr_2(aq)$

D. $H_3O^+(aq) + OH^-(aq) \rightarrow 2\ H_2O(l)$

E. $Ag(aq)^+ + C_2H_3O_2^-(aq) + Na^+(aq) + Br^-(aq) \rightarrow AgBr(s) + Na^+(aq) + C_2H_3O_2^-(aq)$

F. $HF(aq) + OH^-(aq) \rightarrow H_2O(l) + F^-(aq)$

G. $AgC_2H_3O_2(aq) + NaBr(aq) \rightarrow AgBr(s) + NaC_2H_3O_2(aq)$

2a A net ionic reaction between a strong acid and a strong base. **Circle:** **A B C D E F G**

2b. A net ionic precipitation reaction. **A B C D E F G**

2c. An oxidation-reduction reaction. **A B C D E F G**

2d. An overall precipitation reaction. **A B C D E F G**

2e. A net ionic neutralization reaction of a weak acid with a strong base. **A B C D E F G**

2f. A neutralization reaction between a strong acid and strong base. **A B C D E F G**

2g. An ionic reaction for a precipitation. **A B C D E F G**

3. (6 pts) Identify the oxidation state of the element selenium in each of these selenium compounds.

SeH_2	SeO_2	Na_2SeO_3
H_2SeO_4	Se_2H_2	Se

4. (5 pts) Consider this oxidation-reduction reaction that takes place in aqueous solution:

$$5\ H_2C_2O_4(aq) + 2\ KMnO_4(aq) + 3\ H_2SO_4(aq) \rightarrow 10\ CO_2(g) + 2\ MnSO_4(aq) + K_2SO_4(aq) + 8\ H_2O(l)$$

What is the $[KMnO_4]$ if 22.35 mL reacts with 0.5170 g $H_2C_2O_4(s)$ (MM = 90.02 g/mol) dissolved in water?

Show your work for full credit.

Answer with units: _____

5a. (4 pts) Neon has an intense emission line at 585.2 nm. Convert this to frequency in units of s^{-1}. (Equations provided at the end of the exam)

Show your work for full credit.

Answer with units: _____

5b. (5 pts) Convert this to kJ/mol.

Show your work for full credit.

Answer with units: _____

6. (8 pts) Circle your choice.

6a. The emission with the shortest λ:

Circle one: **n = 3 → n = 2** or **n = 4 → n = 2**

6b. An example of an absorption of energy:

Circle one: **n = 1 → n = 4** or **n = 4 → n = 2**

6c. The ionization of hydrogen from the ground state:

Circle one: **n = 1 → n = ∞** or **n = 1 → n = 2**

6d. The smallest change in energy:

Circle one: **n = 4 → n = 3** or **n = 2 → n = 1**

7. (6 pts) Circle **all** possible values are for…

7a. l if n = 4? **-5 -4 -3 -2 -1 0 1 2 3 4 5+**

7b. n if l = 2? **-5 -4 -3 -2 -1 0 1 2 3 4 5+**

7c. m_l if l = 3? **-5 -4 -3 -2 -1 0 1 2 3 4 5+**

7d. m_l if n = 2? **-5 -4 -3 -2 -1 0 1 2 3 4 5+**

7e. n if m_l = -3? **-5 -4 -3 -2 -1 0 1 2 3 4 5+**

7f. l if m_l = -2? **-5 -4 -3 -2 -1 0 1 2 3 4 5+**

8. (6 pts) Which set of quantum numbers are possible for an electron in an atom with many electrons?

8a. **Yes No** n = 3, l = 4, m_l = -1; m_s = +½

8b. **Yes No** n = 3, l = 1, m_l = -1; m_s = +½

8c. **Yes No** n = 2, l = 2, m_l = -1; m_s = +½

8d. **Yes No** n = 1, l = 0, m_l = 0; m_s = -½

8e. **Yes No** n = 3, l = 2, m_l = 2; m_s = +½

8f. **Yes No** n = 5, l = 3, m_l = -3; m_s = +½

9. (6 pts) What are the names (1s, 2s, 2p, etc.) of the following subshells and how many orbitals can comprise the subshell in question?

	Name:	**Number of orbitals:**
n = 3, l = 1		
n = 5, l = 0		
n = 5, l = 3		
n = 2, l = 1		
n = 4, l = 2		
n = 1, l = 0		

10a. (6 pts) Give the atomic symbol for the ground state neutral atom represented by each of these.

Electron configuration:	**Atomic symbol:**
(a) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$	
(b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^7$	
(c) [Kr] $5s^2\ 4d^{10}\ 5p^4$	
(d) [Ar] $4s^2\ 3d^6$	
(e) [Xe] $6s^2\ 4f^{10}$	
(f) [Ne] $3s^2\ 3p^6\ 4s^2\ 3d^{10}$	

10b. (6 pts) How many unpaired electrons are in each of these ground state electron configurations?

(a)	(b)	(c)	(d)	(e)	(f)

11. (5 pts) Which of these electron configurations represent ground states (**GS**), excited states (**ES**), or nonsense configurations (those that do not exist) (**NC**)?

(a) **GS ES NC** $1s^2\ 2s^2\ 2p^5\ 3s^1$

(b) **GS ES NC** $1s^2\ 2s^2\ 2p^2$

(c) **GS ES NC** $1s^2\ 2s^2\ 2p^7$

(d) **GS ES NC** $1s^2\ 2s^2\ 2p^6\ 3s^3\ 3p^6\ 4s^2\ 3d^3$

(e) **GS ES NC** $1s^2\ 7s^1$

12. (5 pts) Write the ground state electron configuration for these ions. **Do not use core notation for this problem.**

Ion	**Electron configuration**
(a) S^{2-}	
(b) Ca^{2+}	
(c) Br^-	
(d) Co^{2+}	
(e) V^{3+}	

13. (11 pts) In each group, select the member with the…

13a. largest atomic radius: **Sc Co As Kr**

13b. largest effective nuclear charge: **Si P S Cl**

13c. smallest atomic radius: **Mg Ca Sr Ba**

13d. smallest atomic radius: **In Ge P O**

13e. largest first ionization energy: **Y Zr Nb Mo**

13f. largest ionic radius: **Na^+ K^+ Mg^{2+} Ca^{2+}**

13g. smallest ionic radius: **Cl^- Br^- S^{2-} Se^{2-}**

13h. largest electron affinity: **Al Si P Cl**

13i. smallest electron affinity: **Mg Si S Cl**

13j. smallest radius: **Ti Fe^{2+} Fe^{3+} Br^-**

13k. largest radius: **Ti Fe^{2+} Fe^{3+} Br^-**

$h = 6.626 \times 10^{-34}$ J s $\quad E = h\upsilon = hc/\lambda$

$c = \lambda\upsilon = 2.998 \times 10^8$ m/s

$\Delta E_{per\ mol\ photon} = \Delta E_{per\ photon} \times N_A$

$N_A = 6.023 \times 10^{23}\ mol^{-1}$

$E = -2.178 \times 10^{-18} J(1/n^2)$

$\Delta E = E_f - E_i = -2.178 \times 10^{-18} J(1/n_f^2 - 1/n_i^2)$

$1/\lambda = 1.097 \times 10^{-2}\ nm^{-1}(1/n_f^2 - 1/n_i^2)$

14. (10 pts) Nomenclature. Complete each of these. Skip this question if you are nomenclature certified.

chloric acid	
sodium bisulfate	
cobalt(II) cyanide	
ammonium chlorite	
dinitrogen dihydride	
	$K_2Cr_2O_7$
	$H_2SO_4(aq)$
	$Fe(OH)_3$
	$LiNO_3$
	P_4O_6

Total score (out of 100): _____

A+ ≥ 95% A ≥ 90% B+ ≥ 85% B ≥ 80% C+ ≥ 75% C ≥ 70% D ≥ 60%

Answers

1a. $C_{12}H_{22}O_{11}$ 1b. $NaClO_3$

1c. $NaClO_3$ 1d. $C_{12}H_{22}O_{11}$

2a **D** 2b. **A** 2c. **C** 2d. **G**

2e. **F** 2f. **B** 2g. **E**

3.

SeH_2 -2	SeO_2 +4	Na_2SeO_3 +4
H_2SeO_4 +6	Se_2H_2 -1	Se 0

4. 0.1028 mol/L

5a. 5.1 x 10^{14} s^{-1} 5b. 204 kJ/mol

6a. **n = 4 → n = 2** 6b. **n = 1 → n = 4**

6c. **n = 1 → n = ∞** 6d. **n = 4 → n = 3**

7a. **0 1 2 3**

7b. **3 4 5+**

7c. **-3 -2 -1 0 1 2 3**

7d. **-1 0 1**

7e. **4 5+**

7f. **2 3 4 5+**

8a. **No** 8b. **Yes** 8c. **No**

8d. **Yes** 8e. **Yes** 8f. **Yes**

9.

	Name:	Number of orbitals:
n = 3, l = 1	3p	3
n = 5, l = 0	5s	1
n = 5, l = 3	5f	7
n = 2, l = 1	2p	3
n = 4, l = 2	4d	5
n = 1, l = 0	1s	1

10a. P Co Te Fe Dy Zn

10b. 3 3 2 4 4 0

11. ES GS NC NC ES

12.

Ion	Electron configuration
(a) S^{2-}	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
(b) Ca^{2+}	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
(c) Br^-	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$
(d) Co^{2+}	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0\ 3d^7$
(e) V^{3+}	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0\ 3d^2$

13a. **Sc** 13b. **Cl** 13c. **Mg** 13d. **O** 13e. **Mo**

13f. **K^+** 13g. **Cl^-** 13h. **Cl** 13i. **Mg** 13j. **Fe^{3+}**

13k. **Br^-**

14.

chloric acid	$HClO_3$
sodium bisulfate	$NaHSO_4$
cobalt(II) cyanide	$Co(CN)_2$
ammonium chlorite	NH_4ClO_2
dinitrogen dihydride	N_2H_2
ammonium dichromate	$K_2Cr_2O_7$
sulfuric acid	$H_2SO_4(aq)$
iron(III) hydroxide	$Fe(OH)_3$
lithium nitrate	$LiNO_3$
tetraphosphorus hexaoxide	P_4O_6