Exam Four **CHM 203 (Dr. Mattson)** **24 OCTOBER 2007**	***Academic Integrity Pledge:*** *In keeping with Creighton University's ideals and with the Academic Integrity Code adopted by the College of Arts and Sciences, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.* *Signature:*

Instructions: Show all work whenever a calculation is required! You will receive credit for <u>how</u> you worked each problem as well as for the correct answer. If you need more space, you may use the back of your periodic table — Write: "See PT" in box. BOX YOUR ANSWERS! Write legibly.

Chapter 4. Reactions in Aqueous Solution

1. (5 pts) Iodine, I_2, reacts with aqueous thiosulfate ion in neutral solution according to the balanced equation.

$$I_2(aq) + 2\ S_2O_3^{-2}(aq) \rightarrow S_4O_6^{-2}(aq) + 2\ I^-(aq)$$

What mass of I_2 is present in a solution if 32.44 mL of 0.222 M $Na_2S_2O_3$ solution is needed to titrate the I_2 solution?

2. (6 pts) The metal content of iron in ores can be determined by the redox procedure in which the sample is first oxidized with Br_2 to convert all of the iron to $Fe^{+3}(aq)$ and then titrated with $Sn^{+2}(aq)$ to reduce the $Fe^{+3}(aq)$ to $Fe^{+2}(aq)$. The balanced equation is:

$$2\ Fe^{+3}(aq) + Sn^{+2}(aq) \rightarrow 2\ Fe^{+2}(aq) + Sn^{+4}(aq)$$

What is the mass percent Fe in a 0.3951 g sample if 14.44 mL of a 0.1111 M Sn^{+2} solution is needed to titrate the Fe^{+3}?

Chapter 5. Periodicity and Atomic Structure

3(a) (2 pts) Which wave has the largest λ?

Circle: (a) or (b)

(b) (2 pts) Which wave has the largest energy?

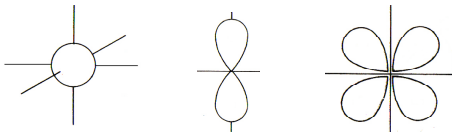
Circle: (a) or (b)

(c) (5 pts) Suppose the wave on the left has a wavelength of 400 nm. What is this energy in kJ/mol?

(d) (2 pts) Given the Wave "a" (left) has a wavelength of 400 nm, in what region of the electromagnetic spectrum will Wave "b" occur?

Circle: Ultraviolet Visible Infrared

4. Consider the following orbitals labeled A, B and C:



(a). (6 pts) What is the value for the shape quantum number, ***l*** for each?

Orbital A
Orbital B
Orbital C

(b). (6 pts) What is the minimum value for ***n*** for each?

Orbital A
Orbital B
Orbital C

(c). (6 pts) Each orbital pictured is from a set of one or more orbitals that are equivalent in terms of energy. How many orbitals are <u>in each set</u> of orbitals equivalent to (and including)

Orbital A?
Orbital B?
Orbital C?

(d). (6 pts) Give the atomic symbol of the first element to have a ground state electron in each of the following orbital types.

Orbital A
Orbital B
Orbital C

5. (12 pts) Give the allowable combinations of quantum numbers for each of the following electrons. In some cases more than one value is possible: include them all.

	n	l	m_l	m_s
4s				
5f				
3d				

6. (8 pts) The Aufbau principle gives us the order in which orbitals are filled in their ground state electron configurations. List the orbital(s) that are filled before and after the one listed in each case.

Filled before:		Filled after:
	2p	
	4s	
	5d	
	4f	

7. (8 pts) Give the ground state electron configuration for each of the following elements using "core" notation:

V
Ge
Pd
Ca

8. (4 pts) How many unpaired electrons does each of the above elements have in the ground state?

V
Ge
Pd
Ca

9. (2 pts each) Periodic trends.

(a) How does the effective nuclear charge change as one moves across the periodic table from left to right?

Circle: Increases or decreases

(b) How does the atomic radius change as one moves across the periodic table from left to right?

Circle: Increases or decreases

(c) How does the atomic radius change as one moves down the periodic table from top to bottom?

Circle: Increases or decreases

(d) How does the first ionization energy change as one moves across the periodic table from left to right?

Circle: Increases or decreases

(e) How does the first ionization energy change as one moves down the periodic table from top to bottom?

Circle: Increases or decreases

(f) How does the electron affinity change as one moves across the periodic table from left to right?

Circle: Increases or decreases

10. (6 pts) Write the electron configuration for the following ions. Do not use core notation.

S^{-2}
Mg^{+2}
Fe^{+3}

11. (3 pts) Ionization energies increase with each additional electron removed. The increase "jumps" considerably under certain circumstances that we can predict. Between what two ionization energies will the jump be expected for each of the following? Use the book's notation of E_{i1} and E_{i2}, etc. to designate first and second ionization energies, and so on.

Ca	E_i jumps between	and	.
K	E_i jumps between	and	.
B	E_i jumps between	and	.

(1 pt) Sign the Academic Integrity pledge *and* print your name here:

Your exam score (100 possible): _____

Determine your grade:

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

Useful Formulas:

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

$c = 3.00 \times 10^{8}$ m s^{-1} $\qquad$ $N = 6.023 \times 10^{23}$

Answers

1. 0.913 g

2. 45.5%

3 (a) (a); (b) (b); (c) 300 kJ/mol; (d) ultraviolet

4 (a) 0, 1, 2

(b) 1, 2, 3

(c) 1, 3, 5

(d) H, B, Sc

5.

	n	l	m_l	m_s
4s	4	0	0	½ or -½
5f	5	3	+3…-3	½ or -½
3d	3	2	+2…-2	½ or -½

6.

Filled before:		Filled after:
2s	**2p**	3s
3p	**4s**	3d
4f (or 6s)	**5d**	6p
	4f	5d

7.

V [Ar] $4s^2\ 3d^3$

Ge [Ar] $4s^2\ 3d^{10}\ 4p^2$

Pd [Ar] $5s^2\ 4d^8$

Ca [Ar] $4s^2$

8. 3, 2, 2, 0

9. (a) increases; (b) decreases; (c) increases; (d) increases; (e) decreases; (f) increases

10. S^{-2}: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$; Mg^{+2}: $1s^2\ 2s^2\ 2p^6$; Fe^{+3}: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0\ 3d^5$

11.

Ca: E_i jumps between 2nd and 3rd; K: E_i jumps between 1st and 2nd; B: E_i jumps between 3rd and 4th.