

**EXAM FOUR**  
**CHM 203 (Dr. Mattson)**  
**29 OCTOBER 2008**

**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 how 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 and then attach the periodic table. **BOX YOUR ANSWERS!** Write legibly.

1. The visible region of the electromagnetic spectrum extends from about  $4 \times 10^{-7}$  m to  $8 \times 10^{-7}$  m.

1(a) (3 pts) Convert the wavelength  $4 \times 10^{-7}$  m into nm.

1(b) (3 pts) Convert the wavelength  $4 \times 10^{-7}$  m into frequency.

1(c) (2 pts) Which wavelength has the highest energy?

Circle:  $4 \times 10^{-7}$  m to  $8 \times 10^{-7}$  m

1(d) (2 pts) Is the wavelength  $3 \times 10^{-7}$  m in the infrared or ultraviolet region? Circle: infrared or ultraviolet

1(e) (4 pts) Convert the wavelength  $4 \times 10^{-7}$  m into units of kJ/mol.

2. (8 pts) Recall the demo in which we viewed the hydrogen discharge tube using the special glasses and observed "spectral lines." These were shown and discussed in the book as well. The lines we saw were attributed to a photon \_\_\_\_\_. (More than one.)

- in  $n = 2$
- undergoing  $n = 1 \rightarrow n = 2$
- undergoing  $n = 3 \rightarrow n = 2$
- undergoing  $n = 2 \rightarrow n = 3$
- undergoing  $n = 5 \rightarrow n = 2$
- undergoing  $n = 2 \rightarrow n = \infty$

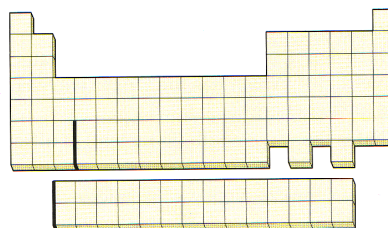
3. (4 pts) Evaluate each of these as an absorption of energy or discharge (release) of energy:

- (a)  $n = 6 \rightarrow n = 1$       Absorption or Discharge
- (b)  $n = 1 \rightarrow n = 2$       Absorption or Discharge
- (c)  $n = 4 \rightarrow n = 5$       Absorption or Discharge
- (d)  $n = 7 \rightarrow n = \infty$       Absorption or Discharge

4. (4 pts) Which transition is associated with the smallest change in energy within each pair of choices?

- (a)  $n = 6 \rightarrow n = 2$     or     $n = 5 \rightarrow n = 2$
- (b)  $n = 6 \rightarrow n = 2$     or     $n = 5 \rightarrow n = 1$
- (c)  $n = 3 \rightarrow n = \infty$    or     $n = 4 \rightarrow n = \infty$
- (d)  $n = 1 \rightarrow n = 2$     or     $n = 1 \rightarrow n = 3$

5. (4 pts) On the periodic table below, shade in the elements associated with these orbital groups: 6s, 3d, 5p and 5f.



6. (8 pts) Supply one allowed quantum number for each empty box in the table. There are many possible answers. Do not list all that are possible as that will be counted wrong.

n	l	m <sub>l</sub>
4		
	2	
		-1
		+3

7. (8 pts) Give the expected ground state electron configuration for each of the following species. Use "core" notation for elements past neon.

Se
B
Br
Z = 51

8. (4 pts) Give the atomic symbol for each of these elements:

(a) [Ar] 4s <sup>2</sup> 3d <sup>2</sup>
(b) 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>6</sup> 3s <sup>2</sup> 3p <sup>6</sup> 4s <sup>2</sup> 3d <sup>10</sup> 4p <sup>6</sup> 5s <sup>2</sup> 4d <sup>10</sup> 5p <sup>5</sup>
(c) [Kr] 5s <sup>2</sup> 4d <sup>8</sup>
(d) 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>6</sup> 3s <sup>2</sup> 3p <sup>6</sup> 4s <sup>1</sup>

9 (4 pts) How many unpaired electrons are in the ground state of each of these elements?

(a) F
(b) Mg
(c) Fe
(d) Mn

10. The “h” orbitals refer to orbitals for which  $l = 5$ .

10(a) (3 pts) What is the minimum value of  $n$  when  $l = 5$ ?

10(b) (3 pts) How many “h” orbitals are there in any allowed value of  $n$  (like there are three p-orbitals)?

11. (6 pts) Which orbital group is filled immediately before and immediately after each orbital listed below.

Immediately before		Immediately after
	3p	
	4d	
	6s	

12. (3 pts) The element under bismuth ( $Z = 83$ ) has never been reported and likely has never existed. Nevertheless, we can predict what sort of orbital is being filled with its last electron. What is your prediction? (Format of answer: “3s”)

13. (4 pts) Circle the member of each series with the largest effective nuclear charge

- (a) boron carbon nitrogen
- (b) lithium fluorine neon
- (c) potassium calcium scandium
- (d) iron nickel zinc

14. (4 pts) Circle the member of each series with the largest atomic radius

- (a) boron carbon nitrogen

- (b) fluorine neon sodium
- (c) argon potassium calcium
- (d) iron nickel zinc

15. (4 pts) Circle the member of each series with the largest first ionization energy

- (a) boron carbon nitrogen
- (b) fluorine neon sodium
- (c) argon potassium calcium
- (d) iron nickel zinc

16. (4 pts) Circle the member of each series with the largest electron affinity

- (a) boron carbon nitrogen
- (b) oxygen fluorine neon
- (c) argon potassium calcium
- (d) iron nickel zinc

17. (3 pts) Regarding atoms vs. ions, circle the member of each pair with the largest radius.

- (a) S S<sup>-2</sup>
- (b) Mg Mg<sup>+2</sup>
- (c) Mg<sup>+2</sup> S<sup>-2</sup>

18. (5 pts) True/False

- T F Ionization energies are always positive, that is, they always require energy.
- T F Ionization energy decreases as we move down a column in the periodic table.
- T F All elements have electron affinities greater than zero.
- T F The effective nuclear charge is used to explain changes in the atomic radius and first ionization energy as one moves left to right across the periodic table.
- T F The effective nuclear charge is zero for some elements.

19. (2 pts) Give the electron configuration for the fluoride ion. Do not use core notation.

(1 pt) Print your name here and sign Academic Integrity Statement on other side.

**Your exam score (100 possible):** \_\_\_\_\_

Determine your grade:

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

## Answers:

1(a) 400 nm

1(b)  $7.5 \times 10^{14} \text{ s}^{-1}$

1(c)  $4 \times 10^{-7} \text{ m}$

1(d) ultraviolet

1(e) 299 kJ/mol

2.

undergoing  $n = 3 \rightarrow n = 2$

undergoing  $n = 5 \rightarrow n = 2$

3.

(a) Discharge

(b) Absorption

(c) Absorption

(d) Absorption

4.

(a)  $n = 5 \rightarrow n = 2$

(b)  $n = 6 \rightarrow n = 2$

(c)  $n = 4 \rightarrow n = \infty$

(d)  $n = 1 \rightarrow n = 2$

5.



6.

$n$	$l$	$m_l$
4	Any value < 4	Any value between +4 and -4
Any value > 2	2	Any value between +2 and -2
Any value > $l$	Any value $\geq 1$	-1
Any value > $l$	Any value $\geq 1$	+3

7.

Se  $[\text{Ar}]4s^23d^{10}4p^4$

B  $1s^22s^22p^1$

Br  $[\text{Ar}]4s^23d^{10}4p^5$

Z = 51  $[\text{Kr}]5s^24d^{10}5p^3$

8. (a) Ti (b) I (c) Pd (d) K

9 (a) 1 (b) 0 (c) 4 (d) 5

10.

10(a) 6

10(b) eleven

11.

Immediately before		Immediately after
3s	3p	4s
5s	4d	5p
5p	6s	4f

12. 7p

13.

(a) nitrogen

(b) neon

(c) scandium

(d) zinc

14. (a) boron

(b) sodium

(c) potassium

(d) iron

15.

(a) nitrogen

(b) neon

(c) argon

(d) zinc

16.

(a) carbon

(b) fluorine

(c) potassium

(d) nickel

17.

(a)  $\text{S}^{-2}$

(b) Mg

(c)  $\text{S}^{-2}$

18. T, T, F, T, F

19.  $1s^22s^22p^6$