EXAM THREE **CHM 203 (Dr. Mattson)** **15 OCTOBER 2009**	***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. (8 pts) In each case, circle the wave with the largest energy.

   (a) λ = 470 nm or λ = 850 nm

   (b) υ = 150,000 s^{-1} or υ = 220,000 s^{-1}

   (c) ultraviolet or infrared

   (d) λ = 470 nm or υ = 220,000 s^{-1} (You must show work for Part (d).)

2. (4 pts) A wave has $\lambda = 2.70 \times 10^{-9}$ cm. Convert this wavelength into pm.

3. (5 pts) Suppose an electronic emission line has a λ = 470 nm. What is the corresponding energy in kJ/mol?

4. (8 pts) What are the n and l values for the highest energy ground state electron in:

	n	***l***
Ga		
Cs		
Re		
U		

5. (4 pts) What is the maximum value of m_l for these n and l values?

	m_l
$n = 2$	
$l = 3$	
$n = 4$ and $l = 1$	
$n = 5$	

6. (4 pts) What is the atomic number ***and*** electron configuration (use core notation) for the yet undiscovered element located directly under radium, Ra?

7. (5 pts) Select from the following list of electron transitions to complete the matching that follows. (Some may be used more than once and others not at all.)

   A. $n = 2 \rightarrow n = 1$ B. $n = 2 \rightarrow n = 6$

   C. $n = 3 \rightarrow n = 6$ D. $n = 6 \rightarrow n = 5$

   E. $n = 4 \rightarrow n = 1$ F. $n = 1 \rightarrow n = \infty$

	The emission with the most energy.
	The absorbance that takes the most energy
	The emission with the longest wavelength
	The emission with the highest frequency.
	The absorbance that requires energy of the longest wavelength.

8. (5 pts) Which of the following sets of quantum numbers are not allowed?

   (a) $n = 3$ $l = 2$ $m_l = 1$ $m_s = 0$

   (b) $n = 4$ $l = 2$ $m_l = -1$ $m_s = -½$

   (c) $n = 2$ $l = 2$ $m_l = 1$ $m_s = -½$

   (d) $n = 6$ $l = 0$ $m_l = 0$ $m_s = ½$

   (e) $n = 5$ $l = -3$ $m_l = 2$ $m_s = ½$

9. (8 pts) How many <u>orbitals</u> in an atom can have the following quantum numbers?

(a) $n = 3$, $l = 2$, $m_l = 1$	
(b) $n = 3$	
(c) $n = 5$, $l = 3$	
(d) $n = 4$, $m_l = 0$	

9. (5 pts) Identify the following atoms from their electron configuration.

(a) $1s^2\ 2s^2\ 2p^6$
(b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^7$
(c) [Ar] $4s^1\ 3d^{10}$
(d) [Kr] $5s^2\ 4d^{10}\ 5p^3$
(e) [Xe] $6s^2\ 4f^{14}\ 5d^{10}\ 6p^4$

10. (3 pts) How many unpaired electrons are there in a nickel atom in the ground state?

11. (4 pts) Classify each of these electron configurations for a neutral atom as ground state (GS), excited state (ES) or not-allowed configuration (NA).

(a) $1s^2\ 2s^2\ 2p^3$	GS	ES	NA
(b) $1s^2\ 2s^2\ 2p^6\ 3s^0\ 3p^1$	GS	ES	NA
(c) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^7$	GS	ES	NA
(d) [Ar] $4s^2\ 3d^7$	GS	ES	NA

12 (3 pts) Give a set of allowed quantum numbers for highest energy ground state electron of yttrium, element 39.

$n =$	$l =$	$m_l =$	$m_s =$

13. (6 pts) Circle the atom with the largest radius in each series.

(a) S Se Te (b) Br K Ni

(c) Ba F Si (d) Be Na Rb

(e) Fe O P (f) Ne Se Sr

14. (6 pts) Circle the atom with the largest first ionization energy in each series.

(a) S Se Te (b) Br K Ni

(c) Ba F Si (d) Be Na Rb

(e) Fe O P (f) Ne Se Sr

15. (4 pts) Circle the atom with the largest effective nuclear charge in each series.

(a) Te I In (b) K Fe Br

(c) Mn Fe Ge (d) Li B Ne

16. (4 pts) Circle the atom with the <u>smallest</u> electron affinity in each series.

(a) Se Br Kr (b) Li Be B

(c) Cl Br I (d) Co Ni Cu

17. (8 pts) Write the ground state electron configuration for these ions. Do <u>not</u> use core notation.

Ca^{+2}
Na^{+}
S^{-2}
Mn^{+2}

18. (4 pts) Circle the smallest ion in each series

a. Na^+ Mg^{+2} Al^{+3} b. Na^+ Mg^{+2} F^-

c. F^- O^{-2} N^{-3} d. V^{+2} V^{+4} V^{+5}

19. (2 pts) What row three element would have the following sequence of sequential ionization energies: 787, 1817, 2745, 11575, 14830, and 18376 kJ/mol? Circle your choice:

Na Mg Al Si P S Cl Ar

<u>Print</u> your name here and <u>sign</u> Academic Integrity Statement on other side.

$c = \lambda\upsilon$

$\Delta E_{per\ photon} = hc/\lambda$

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

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

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

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

$h = 6.626 \times 10^{-34}\ J\ s$

$c = 3 \times 10^8\ m/s$

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

Answers

1. (a) $\lambda = 470$ nm; (b) $\upsilon = 220{,}000\ s^{-1}$; (c) ultraviolet ; (d) $\lambda = 470$ nm (You must convert wavelength to frequency or frequency to wavelength so they can be compared. A frequency of $\upsilon = 220{,}000\ s^{-1}$ corresponds to a $\lambda = 1.36 \times 10^{12}$ nm, so $\lambda = 470$ nm has a larger energy.)

2. $\lambda = 27$ pm.

3. 255 kJ/mol

4.

	n	***l***
Ga	4	1
Cs	6	0
Re	5	2
U	5	3

5.

	m_l
$n = 2$	1
$l = 3$	3
$n = 4$ and $l = 1$	1
$n = 5$	4

6. The atomic number is 120 and the electron configuration is [Uuo] $8s^2$

7. E, F, D, E, C

8. a, c, and e

9.

(a) $n = 3$, $l = 2$, $m_l = 1$	1
(b) $n = 3$	9
(c) $n = 5$, $l = 3$	7
(d) $n = 4$, $m_l = 0$	4

9. Ne, Co, Cu, Sb, and Po

10. two

11. GS, ES, NA, and GS

12

$n = 4$	$l = 2$	m_l = any value between -2 and 2	$m_s = +\frac{1}{2}$ or $-\frac{1}{2}$

13. (a) Te; (b) K; (c) Ba; (d) Rb; (e) Fe (f) Sr

14. (a) S; (b) Br; (c) F; (d) Be; (e) O; (f) Ne

15. (a) I; (b) Br; (c) Ge; (d) Ne

16. (a) Kr; (b) Be; (c) I; (d) Co

17.

$Ca^{+2}\ 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$
$Na^{+}\ 1s^2\ 2s^2\ 2p^6\ 3s^0$
$S^{-2}\ 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
$Mn^{+2}\ 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0\ 3d^5$

18. a. Al^{+3}; b. Mg^{+2}; c. F^{-}; d. V^{+5}

19. Al