Exam 3 Chm 203 (Dr Mattson) 25 October 2013

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:

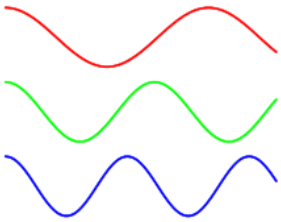
Name:

Circle your Folder group:

H He Li Be B C N O F Ne Na Mg Al Si

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 and then hand the periodic table in with your exam. On your desk you are allowed only pencils (but no pencil pouch), an eraser, and a non-programmable calculator without a slipcover. Backpacks and purses must be closed and stored on the floor under the table. Cell phones must be OFF and placed in your backpack/purse – not in your pocket.

1 – 3. Consider these three electromagnetic waves to answer Questions 1 - 3. The top line is shown in red, the middle one in green and the bottom one in blue.



1. (5 pts) True and False

T F There are over two full wavelengths displayed for the green wave.

T F The red wave has the longest wavelength.

T F The blue wave has the lowest frequency.

T F The red wave has the smallest energy.

T F If the red line represented red light, green light and blue light would have wavelengths as shown by the green and blue lines, respectively.

2. (3 pts) Suppose red light had λ = 680 nm. Convert this to frequency, ν.

3. (4 pts) Suppose red light had λ = 680 nm. Convert this to energy in kJ/mol.

4. (3 pts) We saw the hydrogen discharge tube in class (we wore the funny glasses). These were transitions in which the electrons ended in the energy level of n = 2. Compare two electrons, one starting at n = 3 and another starting at n = 4, and both ending at n = 2.

Which one represents more energy? n = 3 or n = 4

Which one represents shorter λ? n = 3 or n = 4

Are these emissions or absorptions? Circle answer

5. (1 pt) What is the value of n for the ground state for atomic hydrogen?

A. n = 1 B. n = 2 C. n = 3 D. n = ∞ E. other

6. (1 pt) For n = 4, what are the possible values for quantum number l?

A. 0 – 4 B. 1 – 3 C. 0 – 3 D. -4 to +4 E. other

7. (1 pt) For l = 4, what are the possible values for quantum number m_l?

A. 0 – 4 B. 1 – 3 C. 0 – 3 D. -4 to +4 E. other

8. (1 pt) For l = 4, what are the possible values for quantum number n?

A. 0 to 4 B. 1 to 5 C. 5 D. -4 to +4 E. 5 to ∞

9. (1 pt) What are the quantum numbers n and l for the 4d orbitals?

A. n = 4 and l = 1 B. n = 5 and l = 1

C. n = 3 and l = 2 D. n = 4 and l = 2

10. (1 pt) How many atomic orbitals are possible if n = 6 and l = 2?

A. 5 B. 6 C. 10 D. 12 E. other

11. (1 pt) How many electrons on an atom could have n = 3, l = 2 and m_l = 0?

A. 1 B. 2 C. 10 D. 18 E. other

12. (1 pt) Which of these combination of n and l is possible?

A. n = 1 and l = 1 B. n = 3 and l = -2

C. n = 7 and l = 0 D. n = 2 and l = +½

13. (1 pt) What transition occurs when an electron is removed from a ground state lithium atom?

A. n = 2 to n = 1 B. n = 1 to n = 2

C. n = 2 and n = 0 D. n = 2 and n = ∞

14. (8 pts) Write the electron configuration for each of these elements and indicate the number of unpaired electrons (# upe). Use "core notation" (e.g. [Ne])

Write electron configuration	#upe
A. As	
B. Co	
C. K^+	
D. Te^{-2}	

15. (1 pt) How many total d-electrons does technetium, atomic number 43, have?

A. 0 B. 5 C. 10 D. 15 E. 43 F. other

16. (3 pts) Match the examples A, B, and C for:

___ Pauli Exclusion Principle

___ Hund's Rule

___ Aufbau Principle

A. The 3p orbitals of sulfur have one pair and two unpaired electrons.

B. The electron configuration for carbon builds upon the electron configuration of boron, which builds upon the atoms before it.

C. The 15 electrons on phosphorus each have a unique set of quantum numbers.

17. (4 pts) T F The effective nuclear charge…

T F can never exceed the atomic number.

T F increases from left to right across the periodic table.

T F explains why atomic radius decreases across the periodic table.

T F explains why it is easier to ionize K than Na.

18. (4 pts) Circle the atom with the smallest atomic radius in each series. (4 circled answers)

A. C N O B. C Si Ge

C. Fe Co Ni D. Ga Si N

19. (4 pts) Circle the atom with the largest first ionization energy in each series. (4 circled answers)

A. Li Na K B. B C N

C. Sc Ti V D. Ga Si N

20. (4 pts) Circle the atom with the largest electron affinity in each series. (4 circled answers)

A. Li Na K B. B N F

C. Sc Ti V D. Ga P O

21. (2 pts) Circle the electron configuration associated with the smaller first ionization energy. (2 circled answers)

A. [core] $ns^2\ np^1$ or [core] $ns^2\ np^5$

B. [core] $ns^2\ np^5$ or [core] $ns^2\ np^6$

22. (4 pts) Circle the ion with the larger radius. (4 circled answers)

A. Na^+ Mg^{2+} B. Na^+ K^+

C. S^{2-} Cl^- D. Fe^{+2} Fe^{+3}

23. (2 pts) Circle the ion with the larger ionization energy. (2 circled answers)

A. Mg^+ Mg^{2+} B. Fe^{+2} Fe^{+3}

24. (1 pt) Which equation represents the third ionization energy for an element, E?

A. $E \rightarrow E^+ + e^-$ B. $E \rightarrow E^{+3} + 3\ e^-$

C. $E^{+3} + 3\ e^- \rightarrow E$ D. $E^{2+} \rightarrow E^{3+} + e^-$

25. (5 pts) True and False

T F The second ionization energy for any atom is always greater than the first ionization energy.

T F Ionization energies always require an absorption of energy (none release energy).

T F Ionization energies are greatest for the noble gases.

T F A large jump in ionization energy is expected after the last valence electron is removed.

T F Calcium's third ionization energy is expected to be larger than aluminum's 3rd ionization energy.

26. (4 pts) Circle the compound in each pair with the largest lattice energy. (4 circled answers)

A. CaO or $CaCl_2$ B. NaCl or K_2O

C. AlP or MgO D. KBr or MgO

Note: If you are Nomenclature Certified you may stop.

27. (5 pts) In this unit, we studied ionic lattices. Name these ionic substances.

$Ca(NO_3)_2$
CrO_3
$NaHCO_3$
$Mg_3(PO_4)_2$
$K_2Cr_2O_7$

28. (5 pts) Write the correct formula for each of these.

barium sulfite
magnesium chlorite
strontium bromate
sodium periodate
potassium peroxide

Subtotal from exam: _____

Folder work: (20 max) _____

Total:

Avogadro's number, N = 6.02×10^{23}

1 H 1.00797																	2 He 4.00260
3 Li 6.941	4 Be 9.012180											5 B 10.81	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.998403	10 Ne 20.1797
11 Na 22.98977	12 Mg 24.305											13 Al 26.98154	14 Si 28.0855	15 P 30.97376	16 S 32.066	17 Cl 35.453	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.224	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.42	47 Ag 107.8682	48C d 112.41	49 In 114.82	50 Sn 118.710	51 Sb 121.757	52 Te 127.60	53 I 126.90454	54 Xe 131.29
55 Cs 132.9054	56 Ba 137.33	57 †La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.85	75 Re 186.207	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.9665	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.9804	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.0254	89 ‡Ac 227.0278	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (269)	109 Mt (268)	110 (271)	111 (272)	112 (277)		114 (289)		116 (289)		118 (293)

	†	58 Ce 140.12	59 Pr 140.9077	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.9254	66 Dy 162.50	67 Ho 164.9304	68 Er 167.26	69 Tm 168.9342	70 Yb 173.04	71 Lu 174.967
†Lanthanides															
‡Actinides	‡	90 Th 232.0381	91 Pa 231.0359	92 U 238.0289	93 Np 237.048	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 (262)

The following useful formulas, equations and constants will be given to you on the exam:

$c = \lambda\upsilon$ $\quad \Delta E_{per\ photon} = hc/\lambda$ $\quad \Delta E_{per\ mol\ photon} = \Delta E_{per\ photon} \times N_A$

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

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

$h = 6.626 \times 10^{-34}\ J\ s$ $\quad c = 3 \times 10^8\ m/s$ $\quad N_A = 6.023 \times 10^{23}\ mol^{-1}$

Answers

1. F T F T T

2. $4.41 \times 10^{14}\ s^{-1}$

3. 176 kJ/mol

4. $n = 4$, $n = 4$, emissions

5. A; 6. C; 7. D; 8. E; 9. D; 10. A; 11. B; 12. C; 13. D

14.

Write electron configuration	#upe
A. As [Ar] $4s^2\ 3d^{10}\ 4p^3$	3
B. Co [Ar] $4s^2\ 3d^7$	3
C. K^+ [Ar]	0
D. Te^{-2} [Xe]	0

15. D

16. C, A, B

17. T T T F

18. A. O B. C C. Ni D. N

19. A. Li B. N C. V D. N

20. A. Li B. F C. V D. O

21. A. [core] $ns^2\ np^1$; B. [core] $ns^2\ np^5$

22. (4 pts) Circle the ion with the larger radius. (4 circled answers)

A. Na^+ B. K^+ C. S^{2-} D. Fe^{+2}

23. A. Mg^{2+} B. Fe^{+3}

24. D

25. T T T T T

26. A. CaO B. K_2O C. AlP D. MgO

27.

calcium nitrate
chromium(VI) oxide
sodium bicarbonate or sodium hydrogen carbonate
magnesium phosphate
potassium dichromate

28.

$BaSO_3$
$Mg(ClO_2)_2$
$Sr(BrO_3)_2$
$NaIO_4$
K_2O_2