

Exam Four
CHM 203 (Dr. Mattson)
31 October 2005

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. This exam is worth 50 points. **BOX YOUR ANSWERS!** Questions worth ONE point, unless noted.

1. Arrange the following spectral regions in order of increasing wavelength

- A. microwave < infrared < visible < ultraviolet
- B. ultraviolet < visible < infrared < microwave
- C. microwave < visible < infrared < ultraviolet
- D. ultraviolet < infrared < visible < microwave

2. Which of the following statements is true?

- A. The greater the energy, the greater the wavelength.
- B. The greater the wavelength, the greater the frequency.
- C. The greater the energy, the greater the speed of light.
- D. The greater the energy, the greater the frequency.

3. (3 pts) What is the frequency of a helium-neon laser with a wavelength of 632.8 nm?

4. (4 pts) The energy associated with removing an electron from an atom is called the ionization energy. The ionization energy for hydrogen is associated with the absorption of light with 91.2 nm (or shorter). What energy, in kJ/mol, is associated with the wavelength 91.2 nm?

5. (2 pts) What are the possible values of n and m_l for an electron in a 5d orbital?

- A. $n = 5$ and $m_l = 1$
- B. $n = 5$ and $m_l = -2, -1, 0, +1, \text{ or } +2$
- C. $n = 1, 2, 3, 4, \text{ or } 5$ and $m_l = 1$
- D. $n = 1, 2, 3, 4, \text{ or } 5$ and $m_l = -2, -1, 0, +1, \text{ or } +2$

6. How many subshells are there in the shell $n = 4$?

- A. two
- B. three
- C. four
- D. five

7. (3 pts) How many orbitals are possible in the fifth shell ($n = 5$)?

8. (3 pts) Complete the sequence for increasing orbital energies for neutral atoms:

1s, 2s, 2p, _____, _____, _____, _____, 4p

4p, _____, _____, _____, 6s

6s, _____, _____, _____, 7s

9. Which electronic transition would result in the *emission* of a photon with the highest energy?

- A. $3s \rightarrow 4p$
- B. $5p \rightarrow 3s$
- C. $2p \rightarrow 6d$
- D. $7f \rightarrow 5d$

10. Which of the following have their valence electrons in the same shell?

- A. B, Si, As
- B. K, As, Br
- C. N, As, Bi
- D. He, Ne, F

11. Which of the following have the same number of valence electrons?

- A. Cs, Bi, At
- B. In, Pb, Bi
- C. Xe, Rn, At
- D. N, P, As

12. What is the general valence-electron ground state electron configuration for neutral alkaline earth elements?

- A. $1s^2 2s^1$
- B. $1s^2 2s^2$
- C. ns^1
- D. ns^2

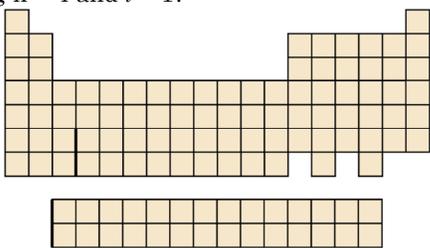
13. How many unpaired electrons does a neutral antimony (Sb) atom have?

- A. zero
- B. one
- C. two
- D. three

14. What orbital is spherical in shape?

- A. 7s
- B. 3p
- C. 9p
- D. 5d

15. Indicate on this blank outline of a periodic table where one finds elements with valence electrons having $n = 4$ and $l = 1$?



16. On the same periodic table, identify the elements with valence electron configurations of $5d$.

17. (2 pts) How many electrons can have $n = 6$ and $l = 2$ on an atom?

18. (2 pts) What is *minimum* value of n for an orbital with (a) $l = 4$?; (b) $m_l = -4$?

| | |
|-----|-----|
| (a) | (b) |
|-----|-----|

19. Which of the following elements is diamagnetic in its ground state?

A. Cd B. K C. Mn D. Cu

20. Which of these atoms has the largest atomic radius?

A. Mg B. Sr C. S D. Te

21. (2 pts) What ion would have the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$?

A. Kr B. Cl^- C. Br^- D. Se^{+2}

22. (2 pts) Which ion does not have a noble gas configuration in its ground state?

A. Ni^{+2} B. Al^{+3} C. Sc^{+3} D. As^{-3}

23. (2 pts) Which of the following sets consists of atoms or ions with the same electron configuration in the ground state?

- I. Al^{+3} , Ne, P^{-3}
 II. O^{-2} , Ne, Mg^{+2}
 III. Ni, Cu^+ , Zn^{+2}

- A. All three groups
 B. Groups I and II, but not III
 C. Groups I and III, but not II
 D. Groups II and III, but not I
 E. Only Group I
 F. Only Group II
 G. Only Group III

24. Which of the following has the largest first ionization energy?

- A. aluminum
 B. chlorine
 C. phosphorus
 D. potassium

25. Which of the following lists does not give the elements in order of increasing ionization energy?

- A. $Sc < Ti < V$
 B. $Ba < Sr < Ca$
 C. $Al < Si < P$
 D. $S < Se < Te$

26. In which pair is the first member listed smaller in terms of radius than the second member?

- A. Na, Na^+
 B. Sb, Te
 C. Se, Se^{-2}
 D. F^- , Na^+

27. (2 pts) In the stepwise ionization of element, a large jump in energy occurs between E_{i4} and E_{i5} .

Which element would exhibit this characteristic?

- A. C B. N C. O D. F

28. Which element has the largest electron affinity?

- A. B B. C C. O D. Ne E. Na F. Mg

29. Which has the highest Z_{eff} for its valence electrons?

- A. Rb B. Ge C. Br D. K

30. (5 pts) Periodic trends: Circle either "increases" or "decreases" for each statement.

- a. *Generally*, the atomic radius [increases/decreases] going from top to bottom on the periodic table.
 b. *Generally*, the atomic radius [increases/decreases] from left to right across the periodic table.
 c. *Generally*, the first ionization energy [increases/decreases] going from top to bottom on the periodic table.
 d. *Generally*, the first ionization energy [increases/decreases] from left to right across the periodic table.
 e. *Generally*, electron affinity [increases/decreases] from left to right across the periodic table.

31. (1 pt bonus) Print your name here.

Useful formulas, equations and constants:

$$c = \lambda\nu = 3 \times 10^8 \text{ m/s}$$

$$\Delta E = h\nu = hc/\lambda$$

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

$$N_A = 6.02 \times 10^{23}$$

Your exam score (50 possible): _____

PrenHall work (0 — 5 max.): _____

Adjusted exam score (50 max.): _____

Determine your grade:

$A \geq 46.5$; $B+ \geq 43.5$; $B \geq 41.0$;

$C+ \geq 37.5$; $C \geq 34.00$; $D \geq 30.00$

Answers:

1. B
2. D
3. $4.74 \text{ A } 10^{14} \text{ s}^{-1}$
4. 1312 kJ/mol
5. B
6. C
7. 25 orbitals
8. (a) 3s, 3p, 4s, 3d; (b) 5s, 4d, 5p; (c) 4f, 5d, 6p
9. B
10. B
11. D
12. D
13. D
14. A
15. 4p group of six elements (Ga through Kr)
16. 5d group of ten elements (La through Hg)
17. 10
18. (a) 5; (b) 5
19. A
20. B
21. C
22. A
23. D
24. B
25. D
26. C
27. A
28. C
29. C
30. inc, dec, dec, inc, inc