

CHEMISTRY 101
Hour Exam III
December 4, 2014
Adams/Esbenshade

Name _____

Signature _____

Section _____

"Let me tell you the secret that has led me to my goal. My strength lies solely in my tenacity."

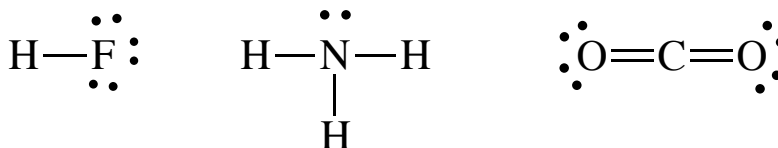
-Louis Pasteur-

This exam contains 17 questions on 7 numbered pages. **Check now** to make sure you have a complete exam. You have one hour and thirty minutes to complete the exam. Determine the best answer to the first 15 questions and enter these on the special answer sheet. Also, circle your responses in this exam booklet. Show all of your work and provide complete answers to questions 16 and 17.

1-15	(30 pts.)	_____
16	(11 pts.)	_____
17	(19 pts.)	_____
Total	(60 pts)	_____

1. What is the expected ground state electron configuration for Te^{2-} ?
 - a) $[\text{Kr}]5s^25d^{10}5p^4$
 - b) $[\text{Kr}]5s^24d^{10}5p^4$
 - c) $[\text{Kr}]5s^24d^{10}4f^{14}5p^6$
 - d) $[\text{Kr}]5s^24d^{10}5p^6$
 - e) $[\text{Kr}]5s^24d^{10}5p^2$
2. Which of the following is ranked in order of ***smallest to largest*** atomic radius?
 - a) F, Ge, S, Mn, Rb
 - b) Rb, Mn, Ge, S, F
 - c) Ge, S, F, Rb, Mn
 - d) S, F, Mn, Ge, Rb
 - e) F, S, Ge, Mn, Rb

3. Consider the following drawings below:



Which of the following statements are ***true***?

- I. The electrons in each molecule tend to be attracted to the most electronegative element.
 - II. Each molecular drawing follows the localized electron model.
 - III. Both HF and CO_2 are linear molecules and therefore nonpolar.
 - IV. The bond angles of NH_3 are slightly less than 109.5° because the lone pair compresses the angles between the bonding pairs.
- a) I, III, IV
 - b) I, II, IV
 - c) I, II, III
 - d) II, IV
 - e) All of the above statements (I – IV) are true.
4. Which of the following has the ***smallest*** ionization energy?
 - a) Se^{2-}
 - b) Br^-
 - c) Sr^{2+}
 - d) Zr^{4+}
 - e) Rb^+

5. Arrange the following bonds from the *least polar* to the *most polar* bond.

C-F, Na-F, Ga-F, Si-F

- C-F, Ga-F, Si-F, Na-F
 - C-F, Si-F, Ga-F, Na-F
 - Si-F, C-F, Ga-F, Na-F
 - Na-F, Ga-F, Si-F, C-F
 - Na-F, C-F, Si-F, Ga-F
6. Which of the following statements about the periodic table is *false*?
- Elements in the same column have similar reactivities because their valence electrons tend to be located in the same types of orbitals.
 - A series of ions that are isoelectronic in their ground states must have the same electron configuration.
 - The atomic size of the elements increase going across a period from left to right because the number of electrons increase, so they are located further from the nucleus.
 - It takes more energy to remove an electron from lithium than from cesium because the valence electrons in lithium are located closer to the nucleus.
 - Fluorine is the most electronegative element due to its size and nuclear charge.
7. Liquid water turns to ice. Is this process endothermic or exothermic? Choose the *best* answer.
- endothermic*; The water absorbed heat and got colder, therefore forming ice.
 - endothermic*; Energy in the form of heat was given off by the water to become colder and form ice.
 - exothermic*; The water released energy, slowing the water molecules down to form ice.
 - exothermic*; Heat was absorbed by the water, moving its molecules faster to condense on an object and form ice.
 - neither endothermic nor exothermic*; There was no energy transfer in or out of the water to form ice.
8. In ionic bonding,
- the electrons are shared between the atoms.
 - the process of forming an ionic bond is highly endothermic overall.
 - the bonding that occurs is usually between two nonmetal atoms.
 - a noble gas configuration is formed for each element or ion.
 - At least two of the above statements are correct.

9. Which of the following statements is/are **true** regarding the atom?
- I. Negatively charged particles are *embedded* in a positively charged cloud throughout the atom.
 - II. As verified by Rutherford, *only* positively charged particles called protons are found inside the nucleus.
 - III. Electrons located *further* from the nucleus have more predictable behavior because they contain less energy.
 - IV. Electrons display *both* particle-like behavior (they have mass) and wave-like behavior (they are associated with probability).
 - V. Neils Bohr showed that quantized energy is a *continuous* spectrum, like a ramp or the slope of a hill.
- a) IV only
 - b) II, IV
 - c) II, IV, V
 - d) I, II
 - e) III, IV, V
10. Which of the following statements is correct **and** provides the best explanation when removing the first two electrons from calcium?
- a) Energy is released when either electron comes off since calcium is a metal and not very electronegative.
 - b) It takes less energy to remove the second electron from calcium as compared to the first because calcium wants to have eight electrons in its outer shell (and thus have a noble gas configuration).
 - c) It takes less energy to remove the first electron as compared to the second because it is in a higher energy level than the second electron.
 - d) Electrons cannot be removed from calcium since it is a metal and only wants to gain electrons to become more stable.
 - e) It takes more energy to remove the second electron as compared to the first because the nucleus binds the electrons more tightly as each electron is removed.
11. Which of the following statements about energy is **false**?
- a) Energy can be defined as whatever is required to oppose a natural tendency.
 - b) A system is the most stable when it is at its lowest energy state.
 - c) A reaction is endothermic overall if activation energy is required.
 - d) Energy transferred into a system can also be transferred out of the system.
 - e) An atom in an excited state can return to its ground state by releasing visible light.

12. Which of the following statements is *false* concerning orbitals?

- a) An orbital is a region of space where an electron might be found with 90% probability.
- b) As an electron absorbs more energy, the orbital in which it might be found becomes larger and/or more complex.
- c) For each successive energy level, a new type of orbital is added.
- d) The *f* orbitals begin at the fourth principal energy level and can hold a maximum of 14 electrons for a given energy level.
- e) For each orbital, an electron orbits the nucleus around the outer edge according to the shape of that orbital.

Draw the Lewis structures for the following compounds below to assist you in answering questions 13 – 15.



13. How many of the compounds above are nonpolar?

- a) 1 b) 2 c) 3 d) 4 e) 5

14. Which compound has bond angles of 109.5° around the central atom?

- a) CBr₂H₂ b) BH₃ c) XeCl₄ d) SF₄ e) HCl

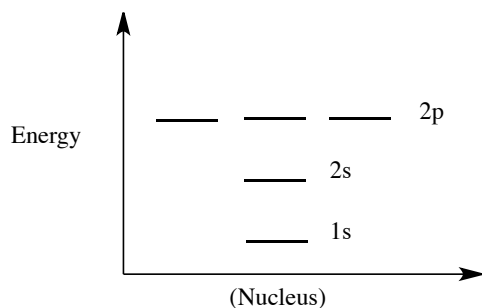
15. Which compound has a see-saw shape?

- a) CBr₂H₂ b) BH₃ c) XeCl₄ d) SF₄ e) HCl

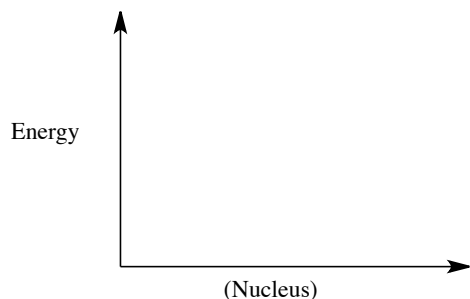
16. Answer each of the following questions below. Be thorough in your answers and provide complete support. *Please limit your answers to the space provided.*

a) Write the ground-state electron configuration for oxygen.

b) Fill in the energy level diagram for the ground state of oxygen. Justify your placement of electrons in the energy level diagram.



c) Write an electron configuration for oxygen in an excited state. Explain your answer *and* show how the energy level diagram would be modified from the one above.



d) When oxygen returns from an excited state to its ground state, explain why we do not see white light.

17. Use the following molecules below to answer the next set of questions.



- a) Draw the Lewis structures for each molecule in the boxes below and indicate whether or not they are polar.

	CH₃OH	CH₄	H₂O	C₂H₆
Lewis Structure				
Polar? (Write yes or no.)				

- b) At room temperature, two of these compounds exist as a liquid and two of these compounds exist as a gas.

State which two compounds are liquids at room temperature and which two are gases. Be sure to justify your answer completely. Include discussions of intermolecular forces in your response.

- c) Consider the molecule CH₄. According to the VSEPR model, the actual bond angles around the central atom are 109.5° (meaning CH₄ is tetrahedral in shape). Why isn't CH₄ square planar in shape?

- d) Rank the compounds from ***lowest to highest*** boiling point. Be sure to thoroughly justify your answer. You do not need to repeat all of the statements that you used in part b.

Lowest Boiling Point < < < Highest Boiling Point

- e) Consider the molecules CH_4 , C_2H_6 , and CH_3OH . Which molecule is most likely soluble in water? Justify your answer.