CHEMISTRY 101
Hour Exam III
December 1, 2016
Adams/ Huynh

Name _____

Signature _____

Section _____

"Success means having the courage, the determination, and the will to become the person you believe you were meant to be."
George Sheehan

This exam contains 17 questions on 7 numbered pages. **Check now** to make sure you have a complete exam. You have one hour and fifteen 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	(12 pts.)	_____
17	(18 pts.)	_____
Total	(60 pts)	_____

1. How many of the following are **true** concerning endothermic processes?

   I. The product(s) are more stable than the reactant(s).
   II. More energy goes into the system overall.
   III. The product(s) are in a lower energy state than the reactant(s).
   IV. The system is always at a lower temperature (gets colder) in its final state.

   a) 0 b) 1 c) 2 d) 3 e) 4

2. Which of the following is **not** an exothermic process? (The system is underlined.)

   a) freezing of water
   b) using a hot pack
   c) burning a match
   d) freezing a racquetball with liquid nitrogen
   e) boiling of water

3. Which of the following electron configurations is **not** possible for the neutral atom chlorine (could be excited or in its ground state)?

   a) $[Ne]3s^2 3p^5$
   b) $[Ne]3s^2 3p^6$
   c) $[Ne]3s^2 3p^4 4s^1$
   d) $1s^2 2s^2 2p^6 3s^2 3p^5$
   e) At least two of the above are not possible.

4. Of the species listed below, which has at least one bond angle that is 90° around the central atom?

   a) BH_3
   b) N_2
   c) ICl_5
   d) CCl_4
   e) SeO_2

5. Consider the general diagram showing the succession of theories behind atomic structure.

   atom →→ electrons →→ nucleus →→ quantized energy levels →→ "wave-like" and "particle-like" behavior of electrons

   Which of the following is/are **true** regarding these theories?

   a) All of the theories are backed up by experimental support.
   b) The models become more accurate, but also more complex.
   c) Our current model allows us to predict an electron's exact location, whereas before that was not possible.
   d) Both (a) and (b) are true.
   e) All of the above (a-c) are true.

Consider the following species to answer questions 6 – 9. The central atom is listed first except for HCN. The central atom for HCN is carbon.

CCl_2H_2 BeF_2 NO_3^- SF_4 HCN

6. How many of the compounds above have a linear shape?

a) 0 b) 1 c) 2 d) 3 e) 4

7. How many of the compounds above are polar overall?

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

8. How many of the compounds above exhibit hydrogen bonding interactions?

a) 0 b) 1 c) 2 d) 3 e) 4

9. Which compound exhibits resonance?

a) HCN
b) NO_3^-
c) BeF_2
d) SF_4
e) At least two of the above compounds exhibit resonance.

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10. How is a bond between Na and F different from a bond between S and O? Choose the best answer.

a) Na and F will form an ionic bond whereas S and O will form a covalent bond.
b) The bond between Na and F involves an electron transfer whereas the bond between and S and O involves electron sharing.
c) When Na and F bond, both achieve noble gas electron configurations whereas with S and O, this is not possible.
d) Both (a) and (b) are correct.
e) All of the above (a-c) are correct.

11. The element with a ground state electron configuration of $[Kr]5s^2 4d^{10} 5p^3$ has _____ valence electrons and _____ unpaired electron(s).

a) 5 ; 3
b) 5 ; 1
c) 15 ; 3
d) 13 ; 3
e) 3 ; 1

12. Arrange the following substances in order of **increasing** solubility in carbon tetrachloride, CCl_4.

$CH_3CH_2CH_2OH$, CH_3CH_3, H_2O

Least soluble → Most soluble

a) H_2O, CH_3CH_3, $CH_3CH_2CH_2OH$
b) $CH_3CH_2CH_2OH$, CH_3CH_3, H_2O
c) CH_3CH_3, $CH_3CH_2CH_2OH$, H_2O
d) H_2O, $CH_3CH_2CH_2OH$, CH_3CH_3
e) $CH_3CH_2CH_2OH$, H_2O, CH_3CH_3

13. Recall from lab when you looked through a spectroscope to determine the colors of the photons in the visible region that were emitted by excited hydrogen atoms. What color of light should **not** have been observed?

a) purple
b) blue
c) green
d) reddish-orange
e) white

Consider the following atoms to answer questions 14 – 15.

Te, Cs, F, Sn, Se

14. Arrange the atoms in order of **increasing** ionization energy.

a) Cs < Te < Sn < Se < F
b) F < Se < Te < Sn < Cs
c) F < Se < Sn < Te < Cs
d) Sn < Te < Se < F < Cs
e) Cs < Sn < Te < Se < F

15. Which atom has the **smallest** 1*s* orbital?

a) Cs b) Sn c) Te d) Se e) F

16. The following are true/false statements that require explanation. State whether each are "true" or "false" and then provide the requested explanation or support. **Please limit your answers to the space provided.**

True or False? (Recall the "pop" bottle demonstration from lecture.) *The reaction between hydrogen gas and oxygen gas to form water is exothermic.*
Whether true or false, justify your answer. Include an energy diagram with the following components: reactant(s), product(s), and activation energy (if needed).

True or False? *Electrons move in elliptical orbits around the nucleus of an atom*. If true, explain what atomic theory supports this statement. If false, explain what our current theory is in terms of electron movement and location.

True or False? *If an element (abbreviated X) has a general ground state valence electron configuration of ns^2np^4, then the formula of the compound that X forms with calcium is Ca_2X.* If true, justify your answer. If false, justify your answer along with the corrected formula of the compound.

True or False? *The following is considered an isoelectronic series:*

$$O^{2-}, F^{-}, Na^{+}, Mg^{2+}$$

Whether true or false, justify your answer and rank the given series according to **increasing size** (along with a justification for your ranking).

17. Examine the following pairs of compounds for (a) – (d). Determine which compound will have the **stronger** intermolecular forces. In your explanation for (a) – (d), include:
    - the Lewis structures (where applicable)
    - whether or not each molecule is polar overall
    - all intermolecular forces (where applicable)
    - the strongest intermolecular force (and *how* you determined this).

    Only complete and coherent explanations will receive full credit. **Please limit your answers to the space provided.**

    a) NH_3 and AsH_3

    b) SiF_4 and XeF_4

c) CO_2 and COS (Carbon is the central atom for both molecules.)

d) NaF and HF

e) Of all the compounds listed above: NH_3, AsH_3, SiF_4, XeF_4, CO_2, COS, NaF, and HF; which would you predict to have the **highest** boiling point? Explain your answer.