Exam: Ch 7 – 9 & 25
AP Chem (80 pts)
Version M

Name: KEY
I have not given, received, nor will give any aid on this exam.
Period: 1 2 3 4 **November 18, 2005**

MC: (_____ - _____ / 4)(3 pts each) = ____	FR:____	Overall: ____

SECTION I: Multiple Choice (3 pts each): Choose the option that is the best answer or completes each question or statement. Write your answers in the blanks provided and erase mistakes completely. In this section, as a correction for haphazard guessing, one-fourth of the number of questions you answer incorrectly will be subtracted from the number of questions you answer correctly.

1. Electrons in the *1s* subshell are much closer to the nucleus in Ar than in Cl due to the greater _____ ~~in~~ of Ar.
   a. Electron affinity
   b. Ionization energy
   c. Nuclear charge
   d. Paramagnetism
   e. Not enough information given or none of the above

   Ans: C

2. In which of the molecules below is the carbon-carbon distance the shortest?
   a. C_2H_6
   b. C_2H_4
   c. C_2H_2
   d. C_3H_8
   e. Not enough information given or none of the above

   Ans: C

3. The electron-domain geometry and molecular geometry of iodine trichloride are _____ and _____, respectively.
   a. Trigonal planar, trigonal planar
   b. Tetrahedral, trigonal pyramidal
   c. Trigonal bipyramidal, T-shaped
   d. Octahedral, T-shaped
   e. Not enough information given or none of the above

   Ans: C

4. Of the following, which gives the correct order for ~~atomic radius~~ for ~~Mg, Na, P, Si, and Ar~~?
   a. ~~Mg > Na > P > Si > Ar~~
   b. ~~Ar > Si > P > Na > Mg~~
   c. ~~Si > P > Ar > Na > Mg~~
   d. ~~Na > Mg > Si > P > Ar~~
   e. Not enough information given or none of the above

   Ans: d

5. Of the molecules below, the bond in _____ is most polar.
   a. H_4C
   b. HCl
   c. HI
   d. H_2S
   e. Not enough information given or none of the above

   Ans: b

6. Of the following, which gives the correct order for bond order in CO_3^{2-}, NO_3^{1-}, SO_4^{2-}?
   a. $CO_3^{2-} > NO_3^{1-} > SO_4^{2-}$
   b. $SO_4^{2-} > NO_3^{1-} > CO_3^{2-}$
   c. $SO_4^{2-} > NO_3^{1-} = CO_3^{2-}$
   d. $NO_3^{1-} = CO_3^{2-} > SO_4^{2-}$
   e. Not enough information given or none of the above

   Ans: d or c

7. Compared to that of valence electrons, screening by core electrons in atoms is:
   a. Essentially identical.
   b. Impossible to measure.
   c. Less efficient.
   d. More efficient.
   e. Not enough information given or none of the above

Ans: d

8. For resonance forms of a molecule or ion,
   a. All the resonance structures are observed in nature in various proportions.
   b. One resonance form corresponds to the observed structure.
   c. The observed structure is an average of the resonance forms.
   d. The same atoms need not be bonded to each other in all resonance forms.
   e. Not enough information given or none of the above

Ans: c

9. According to valence bond theory, which orbitals overlap in the formation of the bond in HBr?
   a. *1s* on H and *3p* on Br
   b. *1s* on H and *4p* on Br
   c. *1s* on H and *4s* on Br
   d. *1s* on H and *sp* on Br
   e. Not enough information given or none of the above

Ans: b

10. Which equation correctly represents the measurement of the electron affinity of calcium?
   a. $Ca\,(g) + e^{1-} \rightarrow Ca^{1-}\,(g)$
   b. $Ca\,(g) \rightarrow Ca^{1+}\,(g) + e^{1-}$
   c. $Ca\,(g) \rightarrow Ca^{1-}\,(g) + e^{1-}$
   d. $Ca^{1+}\,(g) + e^{1-} \rightarrow Ca\,(g)$
   e. Not enough information given or none of the above

Ans: a

11. A valid Lewis structure of _____ cannot be drawn without violating the octet rule.
   a. PO_4^{3-}
   b. SiF_4
   c. CF_4
   d. SeF_4
   e. Not enough information given or none of the above

Ans: d

12. Of the following molecules, determine which are polar: PCl_3, CCl_4, $TeCl_4$, XeF_4
   a. Only PCl_3 and CCl_4
   b. Only PCl_3 and $TeCl_4$
   c. Only CCl_4 and XeF_4
   d. Only $TeCl_4$ and XeF_4
   e. Not enough information given or none of the above

Ans: b

13. A metal oxide reacts with water to produce a/an:
   a. Acid
   b. Base
   c. Isomer
   d. Salt
   e. Not enough information given or none of the above

Ans: b

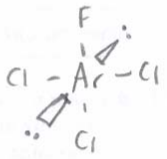
14. Bond enthalpy is:
   a. Always negative.
   b. Always positive.
   c. Equal to zero.
   d. Sometimes positive, sometimes negative.
   e. Not enough information given or none of the above

Ans: b

CTION II: Free Response 36

15. (20 pts) Consider the molecule $ArCl_3F$.

a. (7 pts) Draw a three-dimensional representation this molecule.



b. (3 pts) What is the electron-domain geometry of this molecule? octahedral

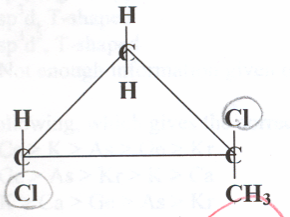
c. (3 pts) What is the molecular geometry of this molecule? sq. planar

d. (3 pts) What hybridization is present in the central atom? sp^3d^2

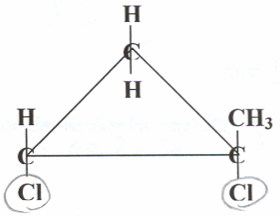
e. (4 pts) Assuming that Ar has negligible electronegativity, is this molecule POLAR or NONPOLAR? Explain how you know with words and/or drawings in the space below.

POLAR

16. (8 pts) Geometric isomers are not restricted to compounds containing the C=C bond. Using your knowledge of *cis-* and *trans-* nomenclature, give the complete systematic name of the following molecules, which have the formula $C_4H_6Cl_2$.



Name: trans-1,2-dichloro-1-methyl cyclopropane



Name: cis-1,2-dichloro-1-methylcyclopropane

17. (10 pts) Consider atoms of chlorine, fluorine, and sulfur. Circle the element that correctly fits the description, than provide a brief explanation (in 1 to 2 sentences) for your choice in terms of atomic structure.

a. (5 pts) (Chlorine / Fluorine / Sulfur) has the ~~smallest~~ largest atomic radius because…

b. (5 pts) (Chlorine / Fluorine / Sulfur) has the largest ionization energy because…

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SECTION I: Multiple Choice (3 pts each): Choose the option that is the best answer or completes each question or statement. Write your answers in the blanks provided and erase mistakes completely. In this section, as a correction for haphazard guessing, one-fourth of the number of questions you answer incorrectly will be subtracted from the number of questions you answer correctly.

1. Going left-to-right on the periodic table, the nuclear charge of atoms inc, and the calculated effective nuclear charge inc, respectively.
   a. Decreases, decreases
   b. Increases, decreases
   c. Increases, remains constant
   d. Increases, increases
   e. Not enough information given or none of the above

   Ans: d

2. In which of the molecules below is the carbon-carbon bond order the greatest?
   a. C_2H_6
   b. C_2H_4
   c. C_2H_2
   d. C_3H_8
   e. Not enough information given or none of the above

   Ans: C

3. The hybridization and molecular geometry of iodine trichloride are _____ and _____, respectively.
   a. sp^2, trigonal planar
   b. sp^3, trigonal pyramidal
   c. sp^3d, T-shaped
   d. sp^3d^2, T-shaped
   e. Not enough information given or none of the above

   Ans: C

4. Of the following, which gives the correct order for ~~atomic radius~~ for ~~Ca, K, As, Ge, and Kr~~?
   a. Ca > K > As > Ge > Kr
   b. Ge > As > Kr > K > Ca
   c. K > Ca > Ge > As > Kr
   d. Kr > Ge > As > K > Ca
   e. Not enough information given or none of the above

   Ans: a

5. Of the molecules below, the bond in _____ is least polar.
   a. H_4C
   b. H_3N
   c. H_2O
   d. HF
   e. Not enough information given or none of the above

   Ans: a

6. Of the following, which gives the correct order for bond angle in CO_3^{2-}, NO_3^{1-}, SO_4^{2-}?
   a. $CO_3^{2-} > NO_3^{1-} > SO_4^{2-}$
   b. $SO_4^{2-} > NO_3^{1-} > CO_3^{2-}$
   c. $SO_4^{2-} > NO_3^{1-} = CO_3^{2-}$
   d. $NO_3^{1-} = CO_3^{2-} > SO_4^{2-}$
   e. Not enough information given or none of the above

   Ans: d

7. Screening by core electrons in atoms is:
   a. Directly related to the number of hybrid orbitals present.
   b. Inversely proportional to the electronegativity.
   c. Responsible for a general decrease in atomic radius going down a group.
   d. Responsible for a general decrease in atomic radius going (left-to-right) across a period.
   e. Not enough information given or none of the above

Ans: e or b

8. Resonance structures differ by the _____ within the Lewis structures.
   a. Number and placement of electrons
   b. Number and placement of atoms
   c. Number of electrons only
   d. Placement of electrons only
   e. Not enough information given or none of the above

Ans: d

9. According to valence bond theory, which orbitals overlap in the formation of the bonds in H_2O?
   a. *1s* on H and *1s* on O
   b. *1s* on H and *2p* on O
   c. *1s* on H and *2s* on O
   d. *1s* on H and sp^3 on O
   e. Not enough information given or none of the above

Ans: d

10. Which equation correctly represents the measurement of the ionization energy of sodium?
   a. $Na\ (g) \rightarrow Na^{1+}\ (g) + e^{1-}$
   b. $Na\ (g) \rightarrow Na^{1-}\ (g) + e^{1-}$
   c. $Na\ (g) + e^{1-} \rightarrow Na^{1-}\ (g)$
   d. $Na^{1+}\ (g) + e^{1-} \rightarrow Na\ (g)$
   e. Not enough information given or none of the above

Ans: a

11. A valid Lewis structure of _____ cannot be drawn without violating the octet rule.
   a. CCl_4
   b. PO_4^{3-}
   c. SBr_4
   d. SiH_4
   e. Not enough information given or none of the above

Ans: c

12. Of the following molecules, determine which are nonpolar: PCl_3, CCl_4, $TeCl_4$, XeF_4.
   a. Only CCl_4 and XeF_4
   b. Only PCl_3 and CCl_4
   c. Only PCl_3 and $TeCl_4$
   d. Only $TeCl_4$ and XeF_4
   e. Not enough information given or none of the above

Ans: a

13. A nonmetal oxide reacts with water to produce a/an:
   a. Acid
   b. Allotrope
   c. Base
   d. Salt
   e. Not enough information given or none of the above

Ans: a

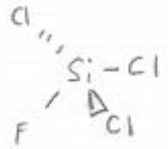
14. Formation of a bond is:
   a. Always endothermic.
   b. Always exothermic.
   c. Equal to zero.
   d. Sometimes endothermic, sometimes exothermic.
   e. Not enough information given or none of the above

Ans: b

ECTION II: Free Response

15. (20 pts) Consider the molecule $SiCl_3F$.

a. (7 pts) Draw a three-dimensional representation this molecule.



-4 wrong

b. (3 pts) What is the electron-domain geometry of this molecule? tet

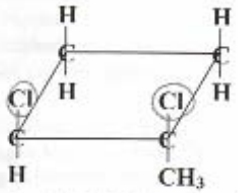
c. (3 pts) What is the molecular geometry of this molecule? tet

d. (3 pts) What hybridization is present in the central atom? sp^3

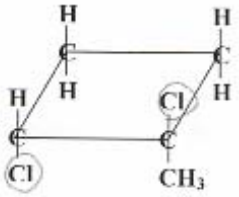
e. (4 pts) Is this molecule POLAR or NONPOLAR? Explain how you know with words and/or drawings in the space below.

POLAR

16. (8 pts) Geometric isomers are not restricted to compounds containing the C=C bond. Using your knowledge of *cis*- and *trans*- nomenclature, give the complete systematic name of the following molecules, which have the formula $C_5H_8Cl_2$.



Name: cis-1,2-dichloro-1-methylcyclobutane



Name: trans-1,2-dichloro-1-methylcyclobutane

17. (10 pts) Consider atoms of bromine, chlorine, and selenium. Circle the element that correctly fits the description, than provide a brief explanation (in 1 to 2 sentences) for your choice in terms of atomic structure.

a. (5 pts) (Bromine / Chlorine / Selenium) has the ~~smallest~~ least ionization energy because…

fewer shielding
closer valence

Cl
Se Br

b. (5 pts) (Bromine / Chlorine / Selenium) has the largest atomic radius because…