

MC: (_____ - _____ / 4)(3 pts each) = _____	FR: _____	Overall: _____
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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. Electrons in the *1s* subshell are much closer to the nucleus in Ar than in Cl due to the greater _____ of Ar.
 - a. Electron affinity
 - b. Ionization energy
 - c. Nuclear charge
 - d. Paramagnetism
 - e. Not enough information given or none of the aboveAns: _____

2. In which of the molecules below is the carbon-carbon distance the shortest?
 - a. C₂H₆
 - b. C₂H₄
 - c. C₂H₂
 - d. C₃H₈
 - e. Not enough information given or none of the aboveAns: _____

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 aboveAns: _____

4. Of the following, which gives the correct order for the magnitude of electron affinity for Si, P, and S?
 - a. Si < P < S
 - b. S < P < Si
 - c. P < S < Si
 - d. P < Si < S
 - e. Not enough information given or none of the aboveAns: _____

5. Of the molecules below, the bond in _____ is most polar.
 - a. H₄C
 - b. HCl
 - c. HI
 - d. H₂S
 - e. Not enough information given or none of the aboveAns: _____

6. Of the following, which gives the correct order for bond order in CO₃²⁻, NO₃¹⁻, SO₄²⁻?
 - a. CO₃²⁻ > NO₃¹⁻ > SO₄²⁻
 - b. SO₄²⁻ > NO₃¹⁻ > CO₃²⁻
 - c. SO₄²⁻ > NO₃¹⁻ = CO₃²⁻
 - d. NO₃¹⁻ = CO₃²⁻ > SO₄²⁻
 - e. Not enough information given or none of the aboveAns: _____

7. Compared to the screening by valence electrons, screening by core electrons in atoms is:
- Essentially identical.
 - Impossible to measure.
 - Less efficient.
 - More efficient.
 - Not enough information given or none of the above
- Ans: _____
8. For resonance forms of a molecule or ion,
- All the resonance structures are observed in nature in various proportions.
 - One resonance form corresponds to the observed structure.
 - The observed structure is an average of the resonance forms.
 - The same atoms need not be bonded to each other in all resonance forms.
 - Not enough information given or none of the above
- Ans: _____
9. According to valence bond theory, which orbitals overlap in the formation of the bond in HBr?
- $1s$ on H and $3p$ on Br
 - $1s$ on H and $4p$ on Br
 - $1s$ on H and $4s$ on Br
 - $1s$ on H and sp on Br
 - Not enough information given or none of the above
- Ans: _____
10. Which equation correctly represents the measurement of the electron affinity of calcium?
- $\text{Ca (g)} + e^{-} \rightarrow \text{Ca}^{1-} \text{(g)}$
 - $\text{Ca (g)} \rightarrow \text{Ca}^{1+} \text{(g)} + e^{-}$
 - $\text{Ca (g)} \rightarrow \text{Ca}^{1-} \text{(g)} + e^{-}$
 - $\text{Ca}^{1+} \text{(g)} + e^{-} \rightarrow \text{Ca (g)}$
 - Not enough information given or none of the above
- Ans: _____
11. A valid Lewis structure of _____ cannot be drawn without violating the octet rule.
- PO_4^{3-}
 - SiF_4
 - CF_4
 - SeF_4
 - Not enough information given or none of the above
- Ans: _____
12. Of the following molecules, determine which are polar: PCl_3 , CCl_4 , TeCl_4 , XeF_4
- Only PCl_3 and CCl_4
 - Only PCl_3 and TeCl_4
 - Only CCl_4 and XeF_4
 - Only TeCl_4 and XeF_4
 - Not enough information given or none of the above
- Ans: _____
13. A metal oxide reacts with water to produce a/an:
- Acid
 - Base
 - Isomer
 - Salt
 - Not enough information given or none of the above
- Ans: _____
14. Bond enthalpy is:
- Always negative.
 - Always positive.
 - Equal to zero.
 - Sometimes positive, sometimes negative.
 - Not enough information given or none of the above
- Ans: _____

SECTION II: Free Response

15. (20 pts) Consider the molecule ArCl_3F .

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

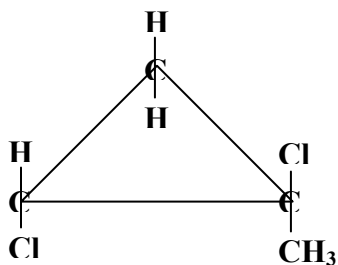
b. (3 pts) What is the electron-domain geometry of this molecule? _____

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

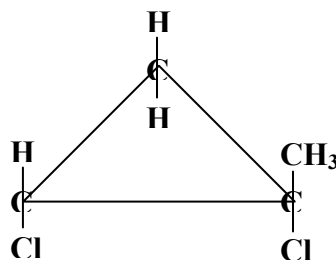
d. (3 pts) What hybridization is present in the central atom? _____

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.

16. (8 pts) Geometric isomers are not restricted to compounds containing the $\text{C}=\text{C}$ bond. Using your knowledge of *cis*- and *trans*- nomenclature, give the complete systematic name of the following molecules, which have the formula $\text{C}_4\text{H}_6\text{Cl}_2$.



Name:



Name:

17. (10 pts) Consider atoms of chlorine, fluorine, and sulfur. Circle the element that correctly fits the description, then 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 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 _____, and the calculated effective nuclear charge _____, respectively.
 - a. Decreases, decreases
 - b. Increases, decreases
 - c. Increases, remains constant
 - d. Increases, increases
 - e. Not enough information given or none of the aboveAns: _____

2. In which of the molecules below is the carbon-carbon bond order the greatest?
 - a. C₂H₆
 - b. C₂H₄
 - c. C₂H₂
 - d. C₃H₈
 - e. Not enough information given or none of the aboveAns: _____

3. The hybridization and molecular geometry of iodine trichloride are _____ and _____, respectively.
 - a. sp², trigonal planar
 - b. sp³, trigonal pyramidal
 - c. sp³d, T-shaped
 - d. sp³d², T-shaped
 - e. Not enough information given or none of the aboveAns: _____

4. Of the following, which gives the correct order for the magnitude of electron affinity for Ge, As, and Se?
 - a. As < Ge < Se
 - b. As < Se < Ge
 - c. Se < Ge < As
 - d. Ge < Se < As
 - e. Not enough information given or none of the aboveAns: _____

5. Of the molecules below, the bond in _____ is least polar.
 - a. H₄C
 - b. H₃N
 - c. H₂O
 - d. HF
 - e. Not enough information given or none of the aboveAns: _____

6. Of the following, which gives the correct order for bond angle in CO₃²⁻, NO₃¹⁻, SO₄²⁻?
 - a. CO₃²⁻ > NO₃¹⁻ > SO₄²⁻
 - b. SO₄²⁻ > NO₃¹⁻ > CO₃²⁻
 - c. SO₄²⁻ > NO₃¹⁻ = CO₃²⁻
 - d. NO₃¹⁻ = CO₃²⁻ > SO₄²⁻
 - e. Not enough information given or none of the aboveAns: _____

7. Screening by core electrons in atoms is:
- Directly related to the number of hybrid orbitals present.
 - Inversely proportional to the electronegativity.
 - Responsible for a general decrease in atomic radius going down a group.
 - Responsible for a general decrease in atomic radius going (left-to-right) across a period.
 - Not enough information given or none of the above
- Ans: _____
8. Resonance structures differ by the _____ within the Lewis structures.
- Number and placement of electrons
 - Number and placement of atoms
 - Number of electrons only
 - Placement of electrons only
 - Not enough information given or none of the above
- Ans: _____
9. According to valence bond theory, which orbitals overlap in the formation of the bonds in H₂O?
- 1s on H and 1s on O
 - 1s on H and 2p on O
 - 1s on H and 2s on O
 - 1s on H and sp³ on O
 - Not enough information given or none of the above
- Ans: _____
10. Which equation correctly represents the measurement of the ionization energy of sodium?
- $\text{Na (g)} \rightarrow \text{Na}^{1+} \text{(g)} + \text{e}^{1-}$
 - $\text{Na (g)} \rightarrow \text{Na}^{1-} \text{(g)} + \text{e}^{1-}$
 - $\text{Na (g)} + \text{e}^{1-} \rightarrow \text{Na}^{1-} \text{(g)}$
 - $\text{Na}^{1+} \text{(g)} + \text{e}^{1-} \rightarrow \text{Na (g)}$
 - Not enough information given or none of the above
- Ans: _____
11. A valid Lewis structure of _____ cannot be drawn without violating the octet rule.
- CCl₄
 - PO₄³⁻
 - SBr₄
 - SiH₄
 - Not enough information given or none of the above
- Ans: _____
12. Of the following molecules, determine which are nonpolar: PCl₃, CCl₄, TeCl₄, XeF₄.
- Only CCl₄ and XeF₄
 - Only PCl₃ and CCl₄
 - Only PCl₃ and TeCl₄
 - Only TeCl₄ and XeF₄
 - Not enough information given or none of the above
- Ans: _____
13. A nonmetal oxide reacts with water to produce a/an:
- Acid
 - Allotrope
 - Base
 - Salt
 - Not enough information given or none of the above
- Ans: _____
14. Formation of a bond is:
- Always endothermic.
 - Always exothermic.
 - Equal to zero.
 - Sometimes endothermic, sometimes exothermic.
 - Not enough information given or none of the above
- Ans: _____

SECTION II: Free Response

15. (20 pts) Consider the molecule SiCl_3F .

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

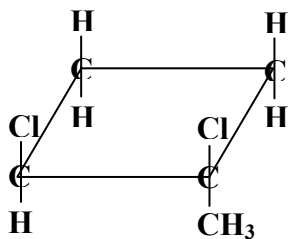
b. (3 pts) What is the electron-domain geometry of this molecule? _____

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

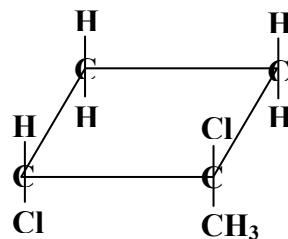
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Name:



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

c. (5 pts) (Bromine / Chlorine / Selenium) has the largest ionization energy because...

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