

General Chemistry I (CHEM 1411)

Exam III

Time: 2 Hours

Student Name: _____ Student ID # _____

Instructor: Dr. Emad Akeer

100 Points

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) Of the following, which gives the correct order for atomic radius for Mg, Na, P, Si and Ar? 1) _____
- A) $\text{Si} > \text{P} > \text{Ar} > \text{Na} > \text{Mg}$
 - B) $\text{Na} > \text{Mg} > \text{Si} > \text{P} > \text{Ar}$
 - C) $\text{Mg} > \text{Na} > \text{P} > \text{Si} > \text{Ar}$
 - D) $\text{Ar} > \text{Si} > \text{P} > \text{Na} > \text{Mg}$
 - E) $\text{Ar} > \text{P} > \text{Si} > \text{Mg} > \text{Na}$
- 2) Which isoelectronic series is correctly arranged in order of increasing radius? 2) _____
- A) $\text{Ca}^{2+} < \text{K}^+ < \text{Ar} < \text{Cl}^-$
 - B) $\text{K}^+ < \text{Ca}^{2+} < \text{Ar} < \text{Cl}^-$
 - C) $\text{Cl}^- < \text{Ar} < \text{K}^+ < \text{Ca}^{2+}$
 - D) $\text{Ca}^{2+} < \text{K}^+ < \text{Cl}^- < \text{Ar}$
 - E) $\text{Ca}^{2+} < \text{Ar} < \text{K}^+ < \text{Cl}^-$
- 3) Which of the following correctly represents the second ionization of aluminum? 3) _____
- A) $\text{Al}^- (\text{g}) + \text{e}^- \rightarrow \text{Al}^{2-} (\text{g})$
 - B) $\text{Al} (\text{g}) \rightarrow \text{Al}^+ (\text{g}) + \text{e}^-$
 - C) $\text{Al}^+ (\text{g}) \rightarrow \text{Al}^{2+} (\text{g}) + \text{e}^-$
 - D) $\text{Al}^+ (\text{g}) + \text{e}^- \rightarrow \text{Al} (\text{g})$
 - E) $\text{Al}^+ (\text{g}) + \text{e}^- \rightarrow \text{Al}^{2+} (\text{g})$
- 4) Which equation correctly represents the first ionization of calcium? 4) _____
- A) $\text{Ca} (\text{g}) + \text{e}^- \rightarrow \text{Ca}^- (\text{g})$
 - B) $\text{Ca} (\text{g}) \rightarrow \text{Ca}^- (\text{g}) + \text{e}^-$
 - C) $\text{Ca}^+ (\text{g}) + \text{e}^- \rightarrow \text{Ca} (\text{g})$
 - D) $\text{Ca}^- (\text{g}) \rightarrow \text{Ca} (\text{g}) + \text{e}^-$
 - E) $\text{Ca} (\text{g}) \rightarrow \text{Ca}^+ (\text{g}) + \text{e}^-$

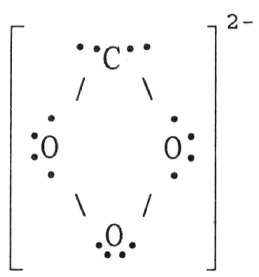
Consider the following electron configurations to answer the questions that follow:

- (i) $1s^2 2s^2 2p^6 3s^1$
(ii) $1s^2 2s^2 2p^6 3s^2$
(iii) $1s^2 2s^2 2p^6 3s^2 3p^1$
(iv) $1s^2 2s^2 2p^6 3s^2 3p^4$
(v) $1s^2 2s^2 2p^6 3s^2 3p^5$
- 5) The electron configuration belonging to the atom with the highest second ionization energy is _____ 5) _____
A) (i) B) (ii) C) (iii) D) (iv) E) (v)
- 6) Which one of the following compounds would produce an acidic solution when dissolved in water? 6) _____
A) CO_2 B) CaO C) MgO D) SrO E) Na_2O
- 7) Which of the following statements is not true for oxygen? 7) _____
A) Oxygen forms peroxide and superoxide anions.
B) Dry air is about 79% oxygen.
C) Oxygen is a colorless gas at room temperature.
D) The most stable allotrope of oxygen is O_2 .
E) The chemical formula of ozone is O_3 .
- 8) Using the Born-Haber cycle, the ΔH°_f of KBr is equal to _____. 8) _____
A) $\Delta H^\circ_f[\text{K}(\text{g})] + \Delta H^\circ_f[\text{Br}(\text{g})] + I_1(\text{K}) + E(\text{Br}) - \Delta H_{\text{lattice}}$
B) $\Delta H^\circ_f[\text{K}(\text{g})] - \Delta H^\circ_f[\text{Br}(\text{g})] - I_1(\text{K}) - E(\text{Br}) - \Delta H_{\text{lattice}}$
C) $\Delta H^\circ_f[\text{K}(\text{g})] - \Delta H^\circ_f[\text{Br}(\text{g})] + I_1(\text{K}) - E(\text{Br}) + \Delta H_{\text{lattice}}$
D) $\Delta H^\circ_f[\text{K}(\text{g})] + \Delta H^\circ_f[\text{Br}(\text{g})] + I_1(\text{K}) + E(\text{Br}) + \Delta H_{\text{lattice}}$
E) $\Delta H^\circ_f[\text{K}(\text{g})] + \Delta H^\circ_f[\text{Br}(\text{g})] - I_1 - E(\text{Br}) + \Delta H_{\text{lattice}}$
- 9) In which of the molecules below is the carbon-carbon distance the shortest? 9) _____
A) $\text{H}_2\text{C}=\text{CH}_2$
B) $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_3$
C) $\text{H}_3\text{C}-\text{CH}_3$
D) $\text{H}_2\text{C}=\text{C}=\text{CH}_2$
E) $\text{H}-\text{C}\equiv\text{C}-\text{H}$
- 10) The Lewis structure of N_2H_2 shows _____. 10) _____
A) a nitrogen-nitrogen single bond
B) each hydrogen has one nonbonding electron pair
C) a nitrogen-nitrogen triple bond
D) each nitrogen has two nonbonding electron pairs
E) each nitrogen has one nonbonding electron pair

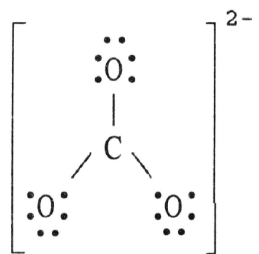
11) The Lewis structure of the CO_3^{2-} ion is _____.

11) _____

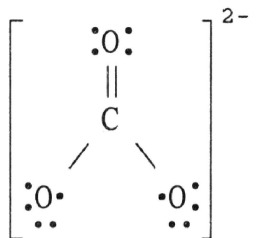
A)



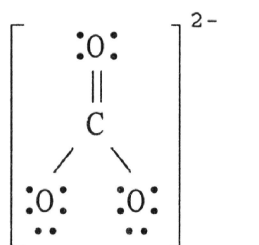
B)



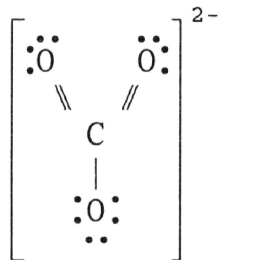
C)



D)



E)

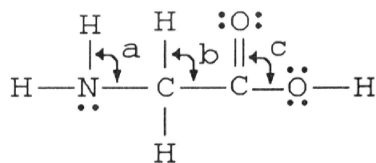


- 12) In the nitrite ion (NO_2^-), _____. 12) _____
- A) both bonds are single bonds
 - B) both bonds are the same
 - C) both bonds are double bonds
 - D) there are 20 valence electrons
 - E) one bond is a double bond and the other is a single bond

For the questions that follow, consider the BEST Lewis structures of the following oxyanions:

- (i) NO_2^- (ii) NO_3^- (iii) SO_3^{2-} (iv) SO_4^{2-} (v) BrO_3^-
- 13) There can be four equivalent best resonance structures of _____. 13) _____
- A) (i)
 - B) (ii)
 - C) (iii)
 - D) (iv)
 - E) (v)
- 14) Based on the octet rule, boron will most likely form a _____ ion. 14) _____
- A) B^{2+}
 - B) B^+
 - C) B^{3+}
 - D) B^{3-}
 - E) B^{2-}
- 15) A valid Lewis structure of _____ cannot be drawn without violating the octet rule. 15) _____
- A) SO_2
 - B) CO_2
 - C) SiF_4
 - D) NI_3
 - E) ICl_5
- 16) Which atom can accommodate an octet of electrons, but doesn't necessarily have to accommodate an octet? 16) _____
- A) N
 - B) B
 - C) C
 - D) O
 - E) H
- 17) Of the bonds C-N, C=N, and C≡N, the C-N bond is _____. 17) _____
- A) weakest/longest
 - B) intermediate in both strength and length
 - C) strongest/shortest
 - D) weakest/shortest
 - E) strongest/longest
- 18) The electron-domain geometry of _____ is tetrahedral. 18) _____
- A) XeF_4
 - B) CBr_4
 - C) PH_3
 - D) CCl_2Br_2
 - E) all of the above except XeF_4
- 19) The molecular geometry of the BrO_3^- ion is _____. 19) _____
- A) trigonal pyramidal
 - B) tetrahedral
 - C) T-shaped
 - D) bent
 - E) trigonal planar

20) The bond angles marked a, b, and c in the molecule below are about _____, _____, and _____ respectively. 20) _____



- A) 120°, 109.5°, 120°
- B) 109.5°, 109.5°, 109.5°
- C) 90°, 180°, 90°
- D) 109.5°, 109.5°, 90°
- E) 109.5°, 109.5°, 120°

21) The electron-domain geometry and the molecular geometry of a molecule of the general formula AB_n are _____. 21) _____

- A) sometimes the same
- B) never the same
- C) mirror images of one another
- D) always the same
- E) not related

22) Of the molecules below, only _____ is polar. 22) _____

A) SeF₄ B) CCl₄ C) CH₄ D) SiCl₄

23) The molecular geometry of the BCl₃ molecule is _____, and this molecule is _____. 23) _____

- A) trigonal bipyramidal, polar
- B) trigonal pyramidal, polar
- C) trigonal pyramidal, nonpolar
- D) trigonal planar, nonpolar
- E) trigonal planar, polar

24) The hybridizations of iodine in IF₃ and IF₅ are _____ and _____, respectively. 24) _____

- A) sp³d, sp³
- B) sp³d², sp³d
- C) sp³d², sp³d²
- D) sp³, sp³d
- E) sp³d, sp³d²

25) The electron-domain geometry of the AsF₅ molecule is trigonal bipyramidal. The hybrid orbitals used by the As atom for bonding are _____ orbitals. 25) _____

- A) sp³d² B) sp² C) sp²d² D) sp³d E) sp³

26) There are _____ σ bonds and _____ π bonds in H₃C-CH₂-CH=CH-CH₂-C≡CH. 26) _____

- A) 10, 3 B) 13, 2 C) 14, 2 D) 12, 2 E) 16, 3

- 27) In a typical multiple bond, the σ bond results from overlap of _____ orbitals and the π bond(s) result from overlap of _____ orbitals. 27) _____
- A) hybrid, atomic
 - B) hybrid, hybrid
 - C) hybrid or atomic, hybrid or atomic
 - D) hybrid, hybrid or atomic
 - E) atomic, hybrid
- 28) The hybridization of carbon in the $\text{H}-\text{C}\equiv\text{N}$: molecule is _____. 28) _____
- A) sp
 - B) sp^2
 - C) s^3p
 - D) sp^3
 - E) s^2p
- 29) According to MO theory, overlap of two s atomic orbitals produces _____. 29) _____
- A) two bonding molecular orbitals and one antibonding molecular orbital
 - B) one bonding molecular orbital and one antibonding molecular orbital
 - C) two bonding molecular orbitals
 - D) one bonding molecular orbital and one hybrid orbital
 - E) two bonding molecular orbitals and two antibonding molecular orbitals
- 30) Based on molecular orbital theory, the bond order of the Be–Be bond in the Be_2 molecule is _____. 30) _____
- A) 0
 - B) 1
 - C) 2
 - D) 3
 - E) 4

Answer Key

Testname: CHEM1411 EXAM 2 SPRING 2018

- 1) B
- 2) A
- 3) C
- 4) E
- 5) A
- 6) A
- 7) B
- 8) A
- 9) E
- 10) E
- 11) D
- 12) B
- 13) D
- 14) C
- 15) E
- 16) B
- 17) A
- 18) E
- 19) A
- 20) E
- 21) A
- 22) A
- 23) D
- 24) E
- 25) D
- 26) E
- 27) A
- 28) A
- 29) B
- 30) A