

CH301 Fall 2008 Practice Exam 2

1. Which of the following statements are true?

I. Bond polarity can be calculated using the differences in electronegativity values.

II. Bond polarity describes to what degree electrons are shared between two atoms (i.e. Is one atom “hogging” the electrons and how much?).

III. Homonuclear bonds are always polar.

IV. F—Br is a more polar bond than F—I

V. Li—B is less polar than O—H

VI. O—O is more polar than H—H

1. I, II, and VI

2. I only

3. I and II

4. I, II, V

5. II, V, VI

6. II, IV, V

7. II and V

2. Which of the following molecules is non-polar?

1. CO₂

2. H₂O

3. CH₃F

4. O₃

5. NO

3. Which of the following statements are ?

I. If a central atom is bonded to five other atoms, it is hypovalent and trigonal bipyramidal.

II. If a central atom is bonded to three identical atoms, it must be nonpolar.

III. A molecule of generalized formula AB₂U₂ always has an angular shape.

1. II only

2. I only

3. III only

4. I and II

5. I and III

6. II and III

7. I, II, and III

4. What bond angles exist in PCl₅?

1. 109.5°, 180°

2. 90°, 60°

3. 120°

4. 30°, 109.5°

5. 90°, 120°, 180°

5. Which of the following statements are true regarding Valence Bond Theory?

I. The number of orbitals is conserved when hybridizing.

II. An sp orbital has twenty five percent more s character than an sp³ orbital.

III. Valence bond theory is lame.

1. I only

2. II only

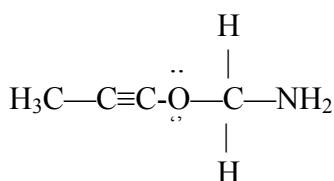
3. III only

4. I and II
5. I and III
6. II and III
7. I, II and III

6. Which of the following molecules is matched with its electronic geometry?

1. BH_3 , trigonal planar
2. H_2O , angular
3. NH_3 , trigonal planar
4. XeF_4 , tetrahedral
5. CH_4 , square planar

7. What molecular geometries can you find in this molecule?



- I. tetrahedral
 - II. linear
 - III. angular
 - IV. trigonal bipyramidal
 - V. trigonal planar
 - VI. trigonal pyramidal
 - VII. Waldo
1. I, II, III, VI
 2. I, II, V
 3. I, II, VI
 4. II and V
 5. II, III and VI
 6. VII only

8. How many sigma (σ) and pi (π) bonds are in the Lewis structure for HCOCHCHCH_3 ?

1. 7 σ and 1 π
2. 10 σ and 2 π
3. 12 σ and 0 π
4. 8 σ and 2 π
5. 7 σ and 2 π

9. In carbon dioxide, the carbon must hybridize its _____ atomic orbitals to make _____ to bond to the oxygens.

1. 2s and 2p; an sp orbital
2. 1s and 1p; two sp orbitals
3. 2s and 2p; two sp orbitals
4. 1s, 2s, and 2p; three sp orbitals
5. 1s, 2s and 2p; two sp orbitals

10. Which of the following statements concerning molecular orbital theory is/are true?

- I. MO theory explains resonance but cannot predict paramagnetism. VB theory is superior because it can do both.

- II. MO theory describes the nature of bonds and why they form.
- III. To fill up a MO electronic diagram, you use the same rules we used for an AO electronic diagram.
- IV. He₂ does not exist because its four electrons all raise its energy relative to unbonded He atoms.
- I only
 - II only
 - III only
 - I and II
 - I and III
 - I and IV
 - II and III
 - II and IV
 - III and IV
 - I, II, and III
 - I, II, and IV
 - I, III, and IV
 - II, III and IV

11. List, in order of increasing energy, the names of the molecular orbitals for N₂.

- $\sigma_{1s}^* < \sigma_{1s} < \sigma_{2s}^* < \sigma_{2s} < \pi_{2py}^* = \pi_{2pz}^* < \sigma_{2p} < \pi_{2py} = \pi_{2pz} < \sigma_{2p}^*$
- $\sigma_{1s} < \sigma_{1s}^* < \sigma_{2s} < \sigma_{2s}^* < \pi_{2py} = \pi_{2pz} < \sigma_{2p} < \pi_{2py}^* = \pi_{2pz}^* < \sigma_{2p}^*$
- $\sigma_{1s} < \sigma_{2s}^* < \pi_{2py} = \pi_{2pz} < \sigma_{2p}$
- $\sigma_{1s} < \sigma_{1s}^* < \sigma_{2s} < \sigma_{2s}^* < \pi_{2p} < \pi_{2pz} < \sigma_{2p} < \pi_{2py}^* < \pi_{2pz}^* < \sigma_{2p}^*$
- $\sigma_{1s} < \sigma_{1s}^* < \sigma_{2s} < \sigma_{2s}^* < \sigma_{2p} < \pi_{2py} = \pi_{2pz} < \pi_{2py}^* = \pi_{2pz}^* < \sigma_{2p}^*$

12. Calculating bond order from MO

What is the bond order in carbon monoxide, CO?

- 0.5
- 1.0
- 1.5
- 2.0
- 2.5
- 3.0
- 3.5
- 4

13. Rank the paramagnetism of the following compounds from least to greatest: B₂⁺, H₂, O₂, Li₂.

- B₂⁺ < H₂ < Li₂ < O₂
- H₂ < Li₂ < B₂⁺ < O₂
- H₂ = Li₂ = O₂ < B₂⁺
- H₂ < Li₂ < O₂ < B₂⁺
- H₂ = Li₂ < B₂⁺ < O₂

14. Rank bond length of the following species from shortest to longest: H₂, He₂, O₂⁺

- H₂ < O₂⁺ < He₂
- H₂ < He₂ < O₂⁺
- O₂⁺ < He₂ < H₂
- O₂⁺ < H₂ < He₂
- He₂ < H₂ < O₂⁺

15. Choose the species below that has the most delocalized electrons.

- HCOO⁻
- O₂

3. C_2H_2
4. $NaCl$
5. XeF_4

16. Which of the following statements about gas laws is/are true?

1. There exists an inverse proportionality between the pressure and volume of a gaseous system.
 2. There exists an inverse proportionality between number of moles and volume of a gaseous system.
 3. The ideal gas constant is larger for heavier gases.
1. I
 2. II only
 3. III only
 4. I, II only
 5. I, III only

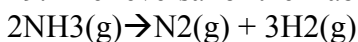
17. If we increase the volume of a gaseous system by a factor of 5 and raise the pressure by a factor of 10, then the temperature of the system will:

1. Increase by a factor of 50
2. Decrease by a factor of 50
3. Increase by a factor of 2
4. Decrease by a factor of 2
5. Not change.

18. What is the density of O_2 gas maintained at a pressure of 2 atm and temperature of 600 K?

1. 2.5 g/L
2. 1 g/L
3. 2 g/L
4. 1.3 g/L
5. 3.7 g/L

19. The reversal of the Haber Process for ammonia synthesis is the reaction below:



Assuming that it goes to completion starting with 10 moles of ammonia in a 50 L container at standard temperature, what is the final pressure?

1. 10.7 atm
2. 8.5 atm
3. 9.0 atm
4. 20.5 atm
5. 25.6 atm

20. At any given temperature, how much more quickly will N_2 diffuse than Cl_2 ?

1. 17 times more quickly
2. 0.5 times more quickly
3. 1.6 times more quickly
4. .03 times more quickly
5. Cl_2 will diffuse faster than N_2

21. Rank the following gases in terms of increasing non-ideality: O_2 , HF, H_2O , Xe.

1. $Xe < HF < H_2O < O_2$
2. $HF < H_2O < O_2 < Xe$
3. $O_2 < Xe < HF < H_2O$
4. $H_2O < HF < Xe < O_2$
5. $H_2O < Xe < O_2 < HF$

22. Which of the following contribute to the non-ideality of gases:
- I. The presence of intermolecular forces
 - II. Pressure of the gas
 - III. Temperature of the gas
 - IV. Bond length of the gas
1. I and III only
 2. I only
 3. II and III only
 4. I, II, and III
 5. All of the above
23. Which of the following statements regarding intermolecular forces (IMF) is/are true?
- I. All intermolecular forces are characterized by bonds inside molecules
 - II. Intermolecular forces are responsible for solution properties such as surface tension
 - III. All molecules have London dispersion forces
1. III only
 2. I only
 3. II only
 4. II and III
 5. I and III
 6. All of the above
24. Which of the following compounds is NOT paired with the strongest IMF that it exhibits?
- I. HBr, hydrogen bonding
 - II. NH₃, hydrogen bonding
 - III. CaO, ion-ion
 - IV. C₆H₆ (benzene), van der Waals forces
 - V. SiH₄, London forces
25. Which of the following compounds is not paired with the strongest IMF that it exhibits?
1. H₂O, hydrogen bonding
 2. CH₄, London Dispersion Forces
 3. HF, hydrogen bonding
 4. HI, dipole-dipole
 5. NaCl, dipole-dipole
26. Capillary action is best described as:
1. The tendency of molecules in the liquid phase to resist motion
 2. The tendency of a liquid to climb the walls of a burette
 3. The phenomenon of an insect walking on water
 4. The likelihood that a molecule in the liquid phase will enter the gas phase
 5. A liquid's resistance to flow
27. Rank the following compounds in terms of increasing vapor pressure: KCl, CH₃OH, H₂O, CaCl₂, CH₄.
1. CaCl₂ < KCl < H₂O < CH₃OH < CH₄
 2. CH₄ < KCl < CaCl₂ < CH₃OH < H₂O
 3. CaCl₂ < H₂O < CH₃OH < KCl < CH₄
 4. CaCl₂ < KCl < CH₃OH < H₂O < CH₄
 5. CH₄ < CaCl₂ < CH₃OH < KCl < H₂O
 6. CH₄ < CH₃OH < H₂O < KCl < CaCl₂

28. Ranking physical properties by IMF

Rank the following liquids in terms of decreasing boiling point: $C_{10}H_{22}$, CH_4 , C_5H_{12} , C_2H_6 , C_7H_{16} .

1. $C_{10}H_{22} > C_2H_6 > CH_4 < C_7H_{16} > C_5H_{12}$
2. $C_{10}H_{22} > C_7H_{16} > C_5H_{12} > C_2H_6 > CH_4$
3. $CH_4 > C_2H_6 > C_5H_{12} > C_7H_{16} > C_{10}H_{22}$
4. $CH_4 > C_7H_{16} > C_{10}H_{22} > C_2H_6 > C_5H_{12}$
5. $CH_4 > C_{10}H_{22} > C_2H_6 > C_7H_{16} > C_5H_{12}$

29. Rank the following species in terms of decreasing evaporation rate: $NaCl$, H_2 , HF , HI , BaS .

1. $BaS > NaCl > HF > HI > H_2$
2. $HF > NaCl > BaS > H_2 > HI$
3. $H_2 > HI > HF > NaCl > BaS$
4. $HF > HI > H_2 > BaS > NaCl$
5. $H_2 > BaS > NaCl > HF > HI$

30. Glucose ($C_6H_{12}O_6$) is an example of what class of solids?

1. metallic solid
2. covalent network
3. molecular covalent
4. ionic solid
5. None of the above