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McCord CH301
50070

Exam 4

Nov 14, 2017
Tuesday

Remember to refer to the Periodic Table handout that is separate from this exam copy.

NOTE: Please keep this exam copy intact (all pages still stapled - including this cover page). You must turn in ALL the materials that were distributed. This means that you turn in your exam copy (name and signature included), bubble sheet, periodic table handout, and all scratch paper. Please also have your UT ID card ready to show as well.

This print-out should have 20 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

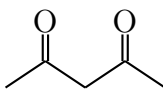
001 5.0 points

A solid sample dissolves in water but does not conduct electricity. The sample melts at 433K. Which type of solid is this?

1. Metallic solid
2. Ionic solid
3. Covalent network solid
4. Molecular solid

002 5.0 points

What types of intermolecular forces are present in a homogenous mixture of the molecule shown below?



1. dispersion forces, dipole-dipole
2. dispersion forces only
3. hydrogen bonding only
4. dispersion forces, dipole-dipole, hydrogen bonding
5. dispersion forces, hydrogen bonding
6. dispersion forces, dipole-dipole, ion-dipole

003 5.0 points

Rank the following substances in order of freezing point: Ne, Rn, Kr, He

1. Rn < He < Ne < Kr
2. Kr < Ne < Rn < He

3. He < Ne < Kr < Rn

4. Kr < Ne < He < Rn

5. He < Ne < Rn < Kr

004 5.0 points

Arrange the following substances in order from highest to lowest melting point:

SiO₂ , CH₃CH₂OH , RbF , CaSO₄

1. SiO₂ > CaSO₄ > RbF > CH₃CH₂OH
2. CH₃CH₂OH > CaSO₄ > RbF > SiO₂
3. SiO₂ > RbF > CaSO₄ > CH₃CH₂OH
4. SiO₂ > CaSO₄ > CH₃CH₂OH > RbF
5. CH₃CH₂OH > RbF > CaSO₄ > SiO₂

005 5.0 points

Which of the following best describes why H₂Te has a higher boiling point than H₂S?

1. H₂Te is more polar than H₂S
2. H₂S is larger than H₂Te
3. H₂Te is capable of hydrogen bonding
4. H₂S is more polarizable than H₂Te
5. H₂Te is more polarizable than H₂S
6. None of the above

006 5.0 points

State the dominant intermolecular force in each compound, respectively:

CBr₄ , NH₃ , CH₃F , C₁₂H₁₄

1. dipole-dipole, hydrogen-bonding, dipole-dipole, hydrogen-bonding
2. dipole-dipole, hydrogen-bonding, hydrogen-bonding, dispersion

3. dispersion, hydrogen-bonding, dipole-dipole, dispersion

4. dipole-dipole, dispersion, hydrogen-bonding, dispersion

5. dispersion, hydrogen-bonding, hydrogen-bonding, dispersion

6. dispersion, dipole-dipole, hydrogen-bonding, dispersion

007 5.0 points

In a molecular orbital diagram for C_2 , the LUMO refers to the

1. σ_{2s}^*

2. π_{2p}^*

3. σ_{2p}^*

4. σ_{2s}

5. σ_{2p}

6. π_{2p}

008 5.0 points

Which of the following statements is true regarding molecular orbital theory?

1. Energy is conserved when pure atomic orbitals combine to form bonding and antibonding orbitals

2. Antibonding orbitals lend energetic stability to the overall molecule

3. All diatomic molecules with an even number of total electrons are diamagnetic

4. Molecular orbital theory can only depict the bonding of homonuclear diatomic molecules

009 5.0 points

A liquid poured into a graduated cylinder

forms a concave meniscus. Which of the following statements is true regarding this liquid sample?

1. The meniscus is formed to minimize the attractive forces between the liquid molecules and the walls of the container

2. The meniscus is concave because the adhesive forces are lower in energy than the cohesive forces

3. The meniscus forms to maximize the potential energy of the liquid

4. The liquid molecules on the surface are more attracted to each other than the walls of the container

010 5.0 points

Consider the MO diagram for F_2^+ . What is the bond order? Is F_2^+ paramagnetic or diamagnetic?

1. 2, paramagnetic

2. 1, diamagnetic

3. 2.5, paramagnetic

4. 2, diamagnetic

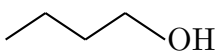
5. 2.5, diamagnetic

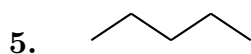
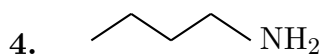
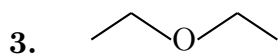
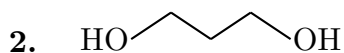
6. 1.5, diamagnetic

7. 1.5, paramagnetic

011 5.0 points

Which of the following has the lowest surface tension?

1.  OH



012 5.0 points

Comparing organic molecules, more double bonds correspond to a smaller HOMO-LUMO gap. For example, β -carotene has a pi bond network of 11 bonds and absorbs light in the visible spectrum. An advantage of this is that organic molecules can be selectively synthesized to absorb at specific wavelengths. Based on this information, if you wanted to synthesize a sunscreen that absorbs light in the UV range you would want

1. to absorb at longer wavelengths than β -carotene
2. a larger network of pi bonds than β -carotene
3. none of the above
4. a smaller network of pi bonds than β -carotene
5. a smaller HOMO-LUMO gap than β -carotene

013 5.0 points

The instability of a bond associated with anti-bonding orbitals is best explained by...

1. Molecular Orbital Theory

2. Valence Bond Theory

014 5.0 points

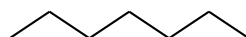
A theoretical central atom has three bonding regions and two lone pair(s). What is the hybridization of this atom?

1. sp^3
2. sp^3d
3. sp
4. sp^3d^2
5. sp^2

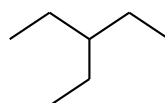
015 5.0 points

The following structures are constitutional isomers, meaning they share the same molecular formula but the atoms are connected differently.

n-heptane:



3-ethyl pentane:



Which of the following best explains why *n*-heptane has a higher boiling point than 3-ethyl pentane?

1. 3-ethyl pentane is an overall larger molecule, which interferes with intermolecular forces
2. *n*-heptane has a greater surface area of overlap that can polarize to form instantaneous dipoles

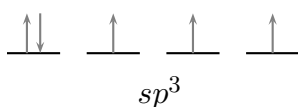
3. *n*-heptane is an overall larger molecule, which interferes with intermolecular forces

4. Branched molecules allow dispersion forces to be more tightly packed than linear molecules

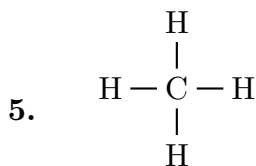
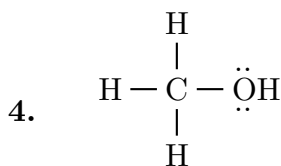
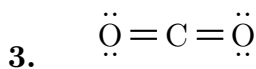
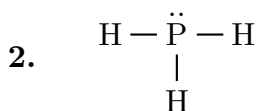
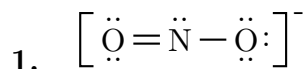
5. *n*-heptane is a more polar molecule

016 5.0 points

Consider the valence bond configuration for a central atom:



This central atom belongs to which of the following molecules?



017 5.0 points

You are able to extract two saturated hydrocarbons, octane and decane, from a liquid organic mixture. Both molecules are linear hydrocarbons (i.e. there is no branching). Compared to octane, decane appears more viscous. You can conclude that decane also

has:

I. a higher molecular weight

II. a smaller surface area

III. a higher boiling point

IV. a higher vapor pressure

1. III only

2. I, II and III only

3. none of the above

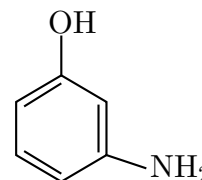
4. I and III only

5. II and III only

6. I, II, III, and IV

018 (part 1 of 2) 5.0 points

Consider the following organic line structure:



According to the valence bond theory, how many sigma and pi bonds are in the organic structure above?

1. 3 σ and 12 π

2. 14 σ and 3 π

3. 18 σ only

4. 18 σ and 3 π

5. 15 σ and 3 π

019 (part 2 of 2) 5.0 points

For the structure shown above, what is the hybridization around oxygen?

1. sp^2

2. None of the above

3. sp^3

4. sp

5. sp^3d^2

6. sp^3d

020 5.0 points

Name the bond in carbon dioxide (CO_2) that overlaps above and below the internuclear axis.

1. σ_{sp-sp}

2. σ_{sp^2-2p}

3. $\sigma_{sp^2-sp^2}$

4. $\pi_{sp^2-sp^2}$

5. σ_{2p-2p}

6. $\pi_{sp^3-sp^3}$

7. π_{2p-2p}

8. σ_{sp^2-sp}