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Course: Chem113, Fall 2004
Dates:
Available: Thu Jul 1 2004 10:09 PM EST
Due: Sun Nov 28 2004 10:09 PM EST

practice test 3

About this assignment

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1. ZumChem5 5.AE.102. [224665] Acetylene gas, $C_2H_2(g)$, can be produced by reacting solid calcium carbide, CaC_2, with water. The products are acetylene and calcium hydroxide. What volume of wet acetylene is collected at 25°C and 717 torr when 5.60 g calcium carbide is reacted with an excess of water? (At 25°C the vapor pressure of water is 23.8 torr.)

4.0 ☑ _____ L

2. ZumChem5 5.E.061. [224707] A piece of solid carbon dioxide, with a mass of 8.4 g, is placed in a 4.0 L otherwise empty container at 24°C.

What is the pressure in the container after all the carbon dioxide vaporizes?

4.0 ☑ _____ atm

If 8.4 g solid carbon dioxide were placed in the same container but it already contained air at 740 torr, what would be the partial pressure of carbon dioxide, P_{CO_2}?

4.0 ☑ _____ atm

What would be the total pressure, P_{total}, in the container after the carbon dioxide vaporized?

4.0 ☑ _____ atm

3. ZumChem5 8.CP.120. [224840] Which of the following molecules have dipole moments? (Select all that apply.)

(a)

- ☐ CH_2Cl_2
- ☐ CCl_4
- ☐ $CHCl_3$

(b)

- ☐ CO_2
- ☐ N_2O

(c)

- ☐ PH_3
- ☐ NH_3

For the molecules that are polar, indicate the polarity of each bond and the direction of the net dipole moment of the molecule. (Do this on paper. Your instructor may ask you to turn in this work.)

4. ZumChem5 9.E.016. [190176] Give the expected hybridization of the central atom for the following molecules or ions. (Type your answer using the format sp2 for sp^2.)

(a) SO_4^{2-} (b) PO_4^{3-} (c) XeO_4 (d) ClO_2^-

(e) O_3 (f) SO_3 (g) SO_2

5. ZumChem5 9.E.024. [189313] For each of the following molecules or ions that contain sulfur, predict the molecular structure about each sulfur (including bond angles), and give the expected hybrid orbitals for sulfur. (Select all that apply.)

(a) SO_4^{2-}

molecular structure(s)
- ☐ linear
- ☐ octahedral
- ☐ see-saw
- ☐ square planar
- ☐ tetrahedral
- ☐ trigonal planar
- ☐ trigonal pyramidal
- ☐ trigonal bipyramid
- ☐ V-shaped

bond angles
- ☐ 90°
- ☐ 109.5°
- ☐ 120°
- ☐ 180°

hybridization
- ☐ *sp*
- ☐ sp^2
- ☐ sp^3
- ☐ dsp^2
- ☐ dsp^3

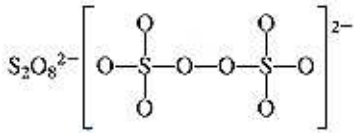
(b) SO_2

molecular structure(s)
- ☐ linear
- ☐ octahedral
- ☐ see-saw
- ☐ square planar
- ☐ tetrahedral
- ☐ trigonal planar
- ☐ trigonal pyramidal
- ☐ trigonal bipyramid
- ☐ V-shaped

bond angles
- ☐ 90°
- ☐ 109.5°
- ☐ 120°
- ☐ 180°

hybridization
- ☐ *sp*
- ☐ sp^2
- ☐ sp^3
- ☐ dsp^2
- ☐ dsp^3

(c)



molecular structure(s)
- ☐ linear
- ☐ octahedral
- ☐ see-saw
- ☐ square planar
- ☐ tetrahedral
- ☐ trigonal planar
- ☐ trigonal pyramidal
- ☐ trigonal bipyramid
- ☐ V-shaped

bond angles
- ☐ 90°
- ☐ 109.5°
- ☐ 120°
- ☐ 180°

hybridization
- ☐ *sp*
- ☐ sp^2
- ☐ sp^3
- ☐ dsp^2

☐ d^2sp^3

☐ d^2sp^3

☐ dsp^3
☐ d^2sp^3

(d) SF_2

molecular structure(s)
- ☐ linear
- ☐ octahedral
- ☐ see-saw
- ☐ square planar
- ☐ tetrahedral
- ☐ trigonal planar
- ☐ trigonal pyramidal
- ☐ trigonal bipyramid
- ☐ V-shaped

bond angles
- ☐ 90°
- ☐ 109.5°
- ☐ 120°
- ☐ 180°

hybridization
- ☐ sp
- ☐ sp^2
- ☐ sp^3
- ☐ dsp^2
- ☐ dsp^3
- ☐ d^2sp^3

(e) SF_6

molecular structure(s)
- ☐ linear
- ☐ octahedral
- ☐ see-saw
- ☐ square planar
- ☐ tetrahedral
- ☐ trigonal planar
- ☐ trigonal pyramidal
- ☐ trigonal bipyramid
- ☐ V-shaped

bond angles
- ☐ 90°
- ☐ 109.5°
- ☐ 120°
- ☐ 180°

hybridization
- ☐ sp
- ☐ sp^2
- ☐ sp^3
- ☐ dsp^2
- ☐ dsp^3
- ☐ d^2sp^3

(f) F_3S-SF

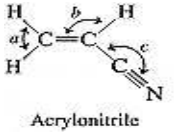
molecular structure(s)
- ☐ linear
- ☐ octahedral
- ☐ see-saw
- ☐ square planar
- ☐ tetrahedral
- ☐ trigonal planar
- ☐ trigonal pyramidal
- ☐ trigonal bipyramid
- ☐ V-shaped

bond angles
- ☐ 90°
- ☐ 109.5°
- ☐ 120°
- ☐ 180°

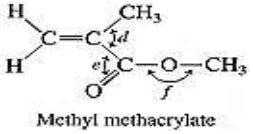
hybridization
- ☐ sp
- ☐ sp^2
- ☐ sp^3
- ☐ dsp^2
- ☐ dsp^3
- ☐ d^2sp^3

Write the Lewis structure(s) for each molecule or ion. (Do this on paper. Your instructor may ask you to turn in this work.)

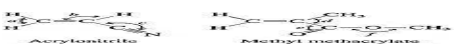
6. ZumChem5 9.E.028. [227668] Many important compounds in the chemical industry are derivatives of ethylene (C_2H_4). Two of them are acrylonitrile and methyl methacrylate.



Acrylonitrile



Methyl methacrylate



Complete the Lewis structures, showing all lone pairs. (Do this on paper. Your instructor may ask you to turn in this work.)

Give approximate values for bond angles *a* through *f*.

(a) ____ °
(b) ____ °
(c) ____ °
(d) ____ °
(e) ____ °
(f) ____ °

Give the hybridization of all carbon atoms. (Type your answer using the format sp2 for sp^2.)

acrylonitrile
double-bonded carbons
____
triple-bonded carbon
____

methyl methacrylate
double-bonded carbons
____
carbon double bonded to oxygen
____
methyl carbons
____

In acrylonitrile, how many of the atoms in the molecule lie in the same plane?
____

How many σ bonds and how many π bonds are there in methyl methacrylate and acrylonitrile?
methyl methacrylate
σ bonds
____
π bonds
____

acrylonitrile
σ bonds
____
π bonds
____

7. ZumChem5 9.E.037. [227672] Using the molecular orbital model, write electron configurations for the following diatomic species and calculate the bond orders, BO (enter 1/2 as 0.5). How many unpaired

electrons are present in each one? (Type your answers in the format (S2s)2(S2s*)2(P2p)4(S2p)2 for $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^4(\sigma_{2p})^2$ where S stands for σ and P stands for π.)

O_2^+
configuration
bond order
unpaired electrons
O_2
configuration
bond order
unpaired electrons
O_2^-
configuration
bond order
unpaired electrons
O_2^{2-}
configuration
bond order
unpaired electrons

8. ZumChem5 9.E.042. [227674] Using the molecular orbital model, write electron configurations for the following diatomic species and calculate the bond orders. Which ones are paramagnetic?

(a) NO^+
electron configuration
- $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^4(\sigma_{2p})^2$
- $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^4(\sigma_{2p})^2(\pi_{2p}^*)^1$

(b) NO
electron configuration
- $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^4(\sigma_{2p})^2$
- $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^4(\sigma_{2p})^2(\pi_{2p}^*)^1$

(c) NO^-
electron configuration
- $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^4(\sigma_{2p})^2$
- $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^4(\sigma_{2p})^2(\pi_{2p}^*)^1$

◯ $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^4(\sigma_{2p})^2(\pi_{2p}^*)^2$
bond order

paramagnetic or diamagnetic?
◯ paramagenetic
◯ diamagnetic

◯ $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^4(\sigma_{2p})^2(\pi_{2p}^*)^2$
bond order

paramagnetic or diamagnetic?
◯ paramagenetic
◯ diamagnetic

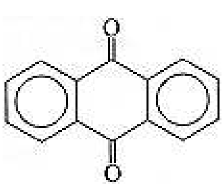
◯ $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^4(\sigma_{2p})^2(\pi_{2p}^*)^2$
bond order

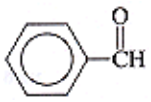
paramagnetic or diamagnetic?
◯ paramagenetic
◯ diamagnetic

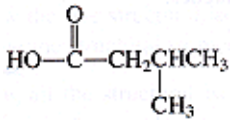
9. ZumChem5 9.E.049. [92521] Describe the bonding in the O_3 molecule and the NO_2^- ion using the localized electron model.

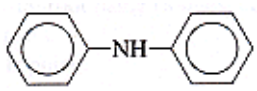
How would the molecular orbital model describe the π bonding in these two species?

10. ZumChem5 22.E.041. [224256] Identify each of the following compounds as a carboxylic acid, ester, ketone, aldehyde, or amine.

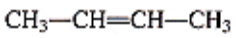


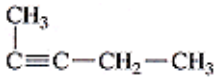


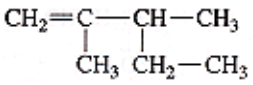




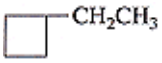
11. ZumChem5 22.E.022. [224251] Name each of the following alkenes or alkynes.





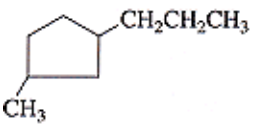


12. ZumChem5 22.E.020. [224250] Name each of the following cyclic alkanes, and indicate the formula of the compound.



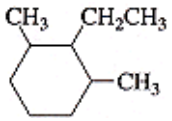
name

formula (Type your answer using the format CH4 for CH_4.)



name

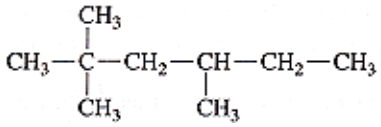
formula

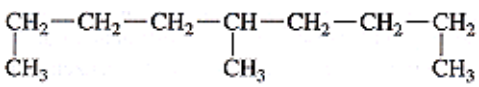


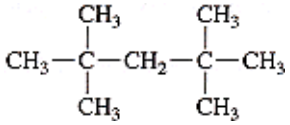
name

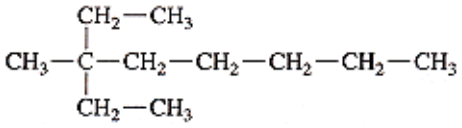
formula

13. ZumChem5 22.E.019. [224249] Name each of the following.









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