Assignment 5 (1524883)

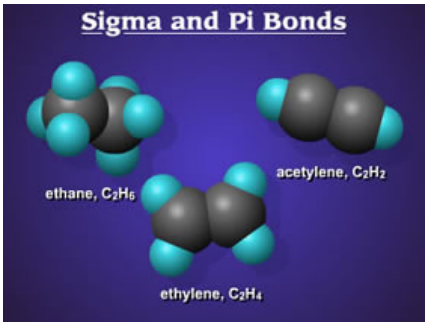
Question **12345678910111213141516171819202122232425262728293031323 3**

1. Question DetailsChang10 10.A.03. [1135911]

2.

Question DetailsChang10 10.A.04. [1135887]

Sigma-Pi Bonding ***Use the animation to answer the following questions.***



This animation will begin with a narration when you click "Open in New Window" below. To restart the narration, click "Open in New Window" again.

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(a) In the acetylene molecule there are:

- 1 π bond.
- 2 VSEPR electron pairs around C_1 and C_2.
- 3 σ and 1 π bond.
- 2 σ bonds.

(b) In ethylene C_1 and C_2 are joined:

- to each other by 1 π and 2 σ bonds
- to each other by 2 VSEPR pairs
- by a π bond formed from the overlap of their $2p_x$ orbitals.
- to the hydrogens by 4 σ bonds

(c) Consider the molecules as shown at the beginning of the animation. In this series which of the following does **not** decrease from left to right?

- total number of σ bonds
- total number of bonds of all types
- total number of π bonds
- total number of VSEPR pairs

(d) Rotation can occur around:

- the C to C bond in ethylene.
- the C to C bond in acetylene.
- the C to C bond in ethane.
- all the C to C bonds shown in the animation.

(e) In ethylene, **VSEPR** predicts:

- unhybridized d orbitals.
- formation of no σ and π bonds.
- trigonal planar geometry.
- sp^3 hybridization occurs.

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3. Question DetailsChang10 10.Supp.3.05. [1133012]

A "p-p" overlap of atomic orbitals would occur in which of the following bonds?

- H-F
- H-H
- Li-H
- S-S

Solution or Explanation

Two (empty) p orbitals are available for overlap.

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4. Question DetailsChang10 10.Supp.3.02. [1132386]

A pi orbital is formed from _____ atomic orbitals aligned _____ .

- p, end-to-end
- hybrid, parallel to one another
- p, parallel to one another
- hybrid, end-to-end

Solution or Explanation

Parallel overlap of "p" orbitals form pi bonds.

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5. Question DetailsChang10 10.Supp.3.01. [1132226]

Which of the following is a hybrid orbital?

- 3d
- pi
- sigma
- sp^2

Solution or Explanation

Combination of orbitals written as one.

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6. Question DetailsBurdgeChem2 9.EOCP.037. [1416010]

Specify which hybrid orbitals are used by carbon atoms in the following species.

(a) NCO^-

sp

(b) $CHCl_3$

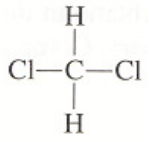
sp^3

(c) CN^-

sp

7. Question DetailsBurdgeChem2 9.EOCP.040. [1413715]

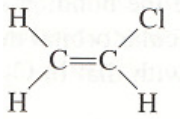
How many sigma bonds and pi bonds are there in each of the following molecules?



(a)

sigma bonds 4

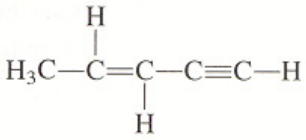
pi bonds 0



(b)

sigma bonds 5

pi bonds 1



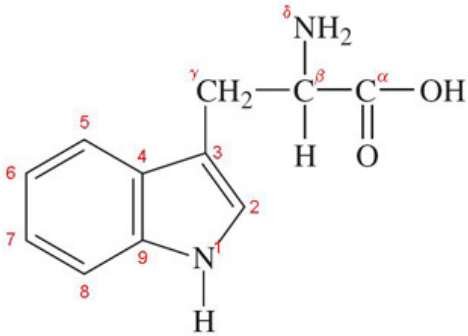
(c)

sigma bonds 10

pi bonds 3

8. Question DetailsBurdgeChem2 9.EOCP.042. [1413920]

Tryptophan is one of the 20 amino acids in the human body. Describe the hybridization state of the C and N atoms, and determine the number of sigma and pi bonds in the molecule.



N-1	sp^3
C-2	sp^2

C-3	sp^2
C-4	sp^2
C-5	sp^2
C-6	sp^2
C-7	sp^2
C-8	sp^2
C-9	sp^2
C-α	sp^2
C-β	sp^3
C-γ	sp^3
N-δ	sp^3

number of σ bonds [ ] 28

number of π bonds [ ] 5

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9. Question DetailsLairdUChem1 4.Supp.1-23. [952374]

What is the ideal Cl-C-Cl bond angle in C_2Cl_4?

- 60°
- 109.5°
- 180°
- 120°

Solution or Explanation

AX_3 arrangement predicts 120 degree bond angle.

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10. Question DetailsLairdUChem1 4.Supp.1-22. [951164]

Which of the following molecules has both an electron group geometry and a molecular geometry described as trigonal planar?

- SiH_4
- BF_3
- OF_2
- CHF_3

Solution or Explanation

AX_3 is indicated with no nonbonding pairs present in the structure.

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11. Question DetailsLairdUChem1 4.TB.026. [953285]

Indicate the type of hybrid orbitals used by the central atom in CCl_4.

- sp^3
- sp^3d^2
- sp
- sp^3d
- sp^2

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12. Question DetailsLairdUChem1 4.TB.030. [953637]

In which one of the following molecules is the central atom sp^2 hybridized?

- SO_2
- PF_5
- NF_3
- N_2O
- $BeCl_2$

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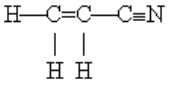
13. Question DetailsLairdUChem1 4.TB.035. [953098]

The number of pi bonds in the molecule below is



- 3
- 1
- 9
- 5
- 2

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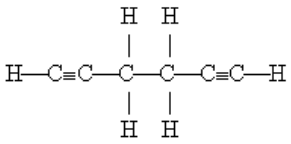
14. Question DetailsLairdUChem1 4.TB.036. [953476]

The number of pi bonds in the molecule below is



- 15
- 4
- 10
- 2
- 6

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15. Question DetailsLairdUChem1 4.TB.038. [953360]

Consider the species Cl_2^+, Cl_2, and Cl_2^-. Which of these species will be paramagnetic?

- Cl_2 and Cl_2^-
- All three are paramagnetic
- Only Cl_2
- Cl_2^+ and Cl_2^-
- Cl_2^+ and Cl_2

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16. Question DetailsBurdgeChem2 9.Supp.4-20. [1412883]

The electron pairs on the central nitrogen atom can be considered to be in sp^2-hybridized orbitals in all of the following species except

- HNNH
- NNN^-
- NO_2^-
- NO_3^-

Solution or Explanation

Since NNN^- is linear, sp hybridization is indicated.

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17. Question DetailsBurdgeChem2 9.Supp.4-18. [1416220]

For which of the following species can the bonds formed by the central atom be described in terms of sp^2 hybrid orbitals?

- H_2O
- CO_3^{2-}
- SO_4^{2-}
- ClF_3

Solution or Explanation
Triangular arrangement of orbitals indicates sp^2.

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18. Question DetailsBurdgeChem2 9.Supp.4-16. [1413525]
Which statement is incorrect?

- An sp hybridization produces a tetrahedral molecule.
- Hybrid orbitals are combination of atomic orbitals.
- The bond length is the internuclear distance.
- There are the same number of hybrid orbitals produced as the number of atomic orbitals combined.

Solution or Explanation
Sp^3 is characteristic of tetrahedral geometry.

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19. Question DetailsBurdgeChem2 9.Supp.4-15. [1413797]
For $BeCl_2$, what is the hybridization on the central atom?

- sp^2
- sp
- sp^3d
- sp^3

Solution or Explanation
Linear shape indicates sp hybridization.

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20. Question DetailsBurdgeChem2 9.Supp.4-13. [1416303]
All of the following are true concerning the bonding in methane, CH_4, except:

- these sp^3 orbitals combine with the s orbitals of the hydrogen to form molecular orbitals.
- the compound has tetrahedral geometry.
- some of the C-H bonds are stronger than others.
- the carbon s and p orbitals combine to form four equivalent sp^3 orbitals.

Solution or Explanation
All the C-H would have the same bond dissociation energy and are equivalent.

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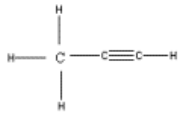
21. Question DetailsBurdgeChem2 9.Supp.4-11. [1412280]
Which of the pairs of molecules below have the same hybridization on the central atom in each molecule? (The central atom is in bold.)

- H**O**Cl, **Cl**F_2
- H**C**N, **C**O_2
- **Be**H_2, **N**H_3
- H_2**O**, H**N**O

Solution or Explanation
Both compounds are linear and sp hybridized.

22. Question DetailsBurdgeChem2 9.Supp.4-09. [1414406]

Consider the following three molecules, and identify the compound(*s*) that contain(*s*) both sp and sp^3-hybridized carbon atoms:

1. 
2. 
3.

- 2 only
- 1 only
- 2 and 3 only
- 3 only

Solution or Explanation

The carbon-carbon triple shows "sp" while the tetrahedral part or C-H 's indicate sp^3.

23. Question DetailsBurdgeChem2 9.Supp.4-06. [1413681]

One resonance structure of N_2O is shown in the diagram [N ≡ N-O]. The hybridized atomic orbitals of the central nitrogen atom, which are consistent with this structure, are:

- four sp^3 orbitals
- three sp^2 orbitals and a "p" orbital
- two sp^2 orbitals and two sp orbitals
- two sp orbitals and two "p" orbitals

Solution or Explanation

Linear shape suggests sp hybridization.

24. Question DetailsBurdgeChem2 9.Supp.4-04. [1413355]

The geometry of sp^3 hybridized orbitals is

- tetrahedral
- linear
- octahedral
- triangular

Solution or Explanation

sp^3 is characteristic of tetrahedral geometry.

25. Question DetailsBurdgeChem2 9.Supp.4-01. [1413399]

What is the type of hybridization used by carbon in C_2H_2, (acetylene)?

- sp^2
- sp
- sp^3
- sp^2d

Solution or Explanation
Only two orbitals are needed which suggests sp hybridization.

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26. Question DetailsBurdgeChem2 9.Supp.3-16. [1415293]
According to the valence-bond method, which of the following molecules involves sp^2 hybridization of orbitals on the carbon atom?

- C_2H_6
- CO_2
- CO
- C_2H_4

Solution or Explanation
C=C bonds involve sp^2 due to the triangular arrangement of orbitals.

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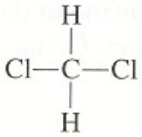
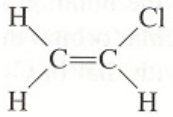
27. Question DetailsChang10 10.EOCP.041. [1156416]
How many sigma bonds and pi bonds are there in each of the following molecules?

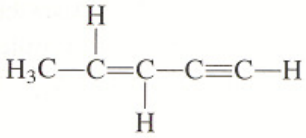
(a)



(b)



(c)



(a)
sigma bonds 4
pi bonds 0

(b)
sigma bonds 5
pi bonds 1

(c)
sigma bonds 10
pi bonds 3

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28. Question DetailsChang10 10.P.03. [1135944]
Hybrid Orbitals

(a) The fact that the BCl_3 molecule is planar means that the B atom is which of the following?

- unhybridized
- sp^3 hybridized
- sp^2 hybridized
- *sp* hybridized

Hint

(b) Hybridizing one *s* atomic orbital and one *p* atomic orbital would not yield which of the following?

- a linear geometry
- 2 equivalent hybrid orbitals
- sp^2 hybridization

- a 180° angle

Hint

(c) Which combination of hybrid orbitals and electron pair geometries is incorrect?

- sp^2 = trigonal planar
- sp^3 = tetrahedral
- sp^3d = square planar
- sp^3d^2 = octahedral

Hint

(d) Which of the following statements is true concerning sp^3d hybrid orbitals?

- One *s* atomic orbital, three *p* atomic orbitals and 2 *d* atomic orbitals combine to make sp^3d hybrid orbitals.
- The resulting angles of sp^3d hybrid orbitals are 90° and 109.5°
- Trigonal bipyramidal geometry is a result of sp^3d hybrid orbitals.
- There are four equivalent sp^3d hybrid orbitals produced.

Hint

(e) What is a common feature of *sp*, sp^2, sp^3, sp^3d, and sp^3d^2 hybrid orbitals?

- They all incorporate at least one *s* atomic orbital and one *p* atomic orbital.
- There are at least 3 equivalent hybrid orbitals of each type.
- They all only use *s* atomic orbitals.
- They all use at least *s* atomic orbital, one *p* atomic and one *d* atomic orbital.

Hint

29. Question DetailsChang10 10.PE.03. [1243644]

Practice Exercise 10.3

Enter the hybridization state of the underlined atoms in the following compounds.

(a) $\underline{C}O_2$

sp

(b) $\underline{C}Cl_4$

sp^3

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30. Question DetailsChang10 10.PE.05. [1243582]

Practice Exercise 10.5

Describe the bonding in the thiocyanate ion, SCN^-. Assume that N is *sp*-hybridized.
geometry

- bent
- linear
- trigonal planar
- tetrahedral

hybridization of C atom

sp

HINTS
I'm Stuck

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31. Question DetailsChang10 10.Supp.3.16. [1132111]
According to the valence-bond method, which of the following molecules involves sp^2 hybridization of orbitals on the carbon atom?

- C_2H_6
- C_2H_4
- CO_2
- CO

Solution or Explanation
C=C bonds involve sp^2 due to the triangular arrangement of orbitals.

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32. Question DetailsChang10 10.Supp.4.04. [1134011]
The geometry of sp^3 hybridized orbitals is

- tetrahedral
- linear
- octahedral
- triangular

Solution or Explanation
sp^3 is characteristic of tetrahedral geometry.

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33. Question DetailsChang10 10.Supp.6.03. [1133382]
In which of the following molecules would you expect the nitrogen to nitrogen bond to be the shortest?

- N_2H_4
- N_2O_4
- N_2
- N_2O

Solution or Explanation
N_2 has the highest bond order.

Assignment Details

Submissions Allowed: **5**

Category: **Homework**

Code:

Locked: **Yes**

Author: **Hammond, Nicholas (** hmnd@bu.edu **)**

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