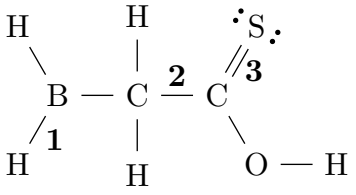
This print-out should have 16 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 10.0 points

Based only on the difference in electronegativity (ΔEN) identify the types of the labeled bonds in the molecule below, from left to right:



1. ionic, non-polar covalent, ionic

2. polar covalent, non-polar covalent, non-polar covalent

3. polar covalent, non-polar covalent, polar covalent **correct**

4. ionic, polar covalent, polar covalent

5. non-polar covalent, non-polar covalent, polar covalent

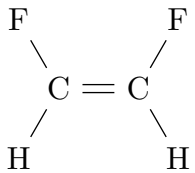
Explanation:

The B-H bond will have a ΔEN of less than 2 but more than zero, and thus will be a polar covalent bond. The C-C bond will have a ΔEN of zero, and thus will be non-polar covalent. The C=S bond will have a ΔEN of less than 1 but more than zero, and thus will be polar covalent.

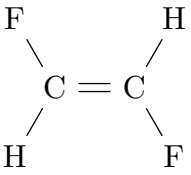
002 10.0 points

Which of the following molecules is/are polar?

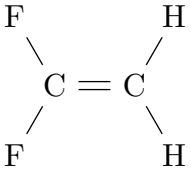
I)



II)



III)



1. III only

2. II only

3. II, III

4. I, II, III

5. I, III **correct**

6. I only

7. I, II

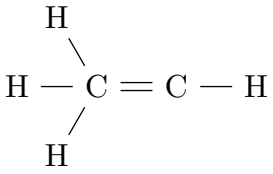
Explanation:

Molecule II is symmetrical and therefore its individual dipole moments cancel, making it non-polar. Molecules I and III are asymmetrical and therefore polar.

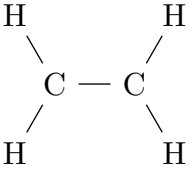
003 10.0 points

Which of the following is the correct Lewis structure for ethene (C_2H_4)?

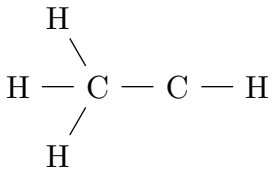
1.



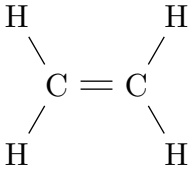
2.



3.



4.



correct

Explanation:

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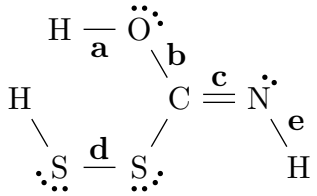
004 10.0 points

Rank the labeled bonds in the molecule below from least to most polar.



1. c < d < e < b < a

2. c < e < b < a < c

3. d < c < e < b < a **correct**

4. d < c < b < e < a

5. c < d < e < a < b

Explanation:

Bonds a, b, c, d, and e have a ΔEN of 1.4, 1.0, 0.5, 0.0, and 0.9, respectively.

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005 10.0 points

Rank the following by the polarity of their **bonds**, from most polar to least: LiH, NH_3, BH_3, HF.

1. $NH_3 > HF > BH_3 > LiH$

2. $HF > LiH > NH_3 > BH_3$ **correct**

3. $NH_3 > BH_3 > HF > LiH$

4. $BH_3 > HF > LiH > NH_3$

5. $LiH > NH_3 > BH_3 > HF$

Explanation:

Note that all of the bonds within both NH_3, BH_3 are identical to each other and the fact that there are multiple bonds does not change the polarity of the individual bonds. The ΔEN for LiH, NH_3, BH_3, HF are 1.2, 0.8, 0.2, 1.8, respectively. Arranged from greatest to least: $HF > LiH > NH_3 > BH_3$.

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006 10.0 points

In which of the following do the unbonded electron pairs **not** distort the bond angles?

1. H_2O

2. I_3^- **correct**

3. SF_4

4. NH_3

5. O_3

Explanation:

All of the choices except I_3^- have asymmetrically placed non-bonding electron pairs on their central atoms and thus have distorted bond angles. I_3^- has three non-bonding electron pairs in equatorial positions and thus has a single bond angle of exactly 180°.

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007 10.0 points

Which of the following is most likely to form multiple (double or triple) bonds?

1. F

2. Cl

3. Li

4. N **correct**

5. H

Explanation:

Hydrogen can form only one bond, so it can immediately be ruled out as the correct

answer.

Lithium forms ionic bonds rather than covalent bonds, so we can rule it out also.

Both chlorine and flourine need only one more electron to fill their octet and they therefore tend to form only single bonds.

Nitrogen needs 3 more electrons to fill its octet and is therefore most likely to form multiple bonds.

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008 10.0 points

Which would have the largest dipole moment?

1. CCl_4

2. CO_2

3. NH_4^+

4. NF_3 **correct**

Explanation:

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009 10.0 points

The molecular geometry about the carbon atoms in C_2H_6 is

1. tetrahedral. **correct**

2. linear.

3. octahedral.

4. trigonal bipyramidal.

5. trigonal planar.

Explanation:

Threre are 7 bonds in an atom of C_2H_6 and both atoms are bonded to three hydrozen atoms and one carbon atom. This gives each carbon 4 regions of electron density, which indicates sp^3 electronic geometry. Since no lone electron pairs are present, this gives rise to a tetrahedral molecular geometry about the carbon atoms.

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010 10.0 points

Which of the following ions has a tetrahedral molecular geometry?

1. CO_3^{2-}

2. H_2F^+

3. NH_4^+ **correct**

4. H_3O^+

5. NO_3^-

Explanation:

---

011 10.0 points

Which substance has nonpolar covalent bonds?

1. NaCl

2. CO

3. O_2 **correct**

4. NO_2

Explanation:

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012 10.0 points

Which of these is NOT an ionic compound?

1. NH_4I

2. $MgCl_2$

3. K_2CO_3

4. NaSCN

5. HCl **correct**

Explanation:

Hydrogen combined with a nonmetal is considered a covalent bond (in gaseous state).

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013 10.0 points

CHF_3 is (less,more) polar than CHI_3 because

1. more; the C-F bonds are more polar than the C-I bonds. **correct**

2. less; the C-H bond in CHF_3 is a non-polar

bond.

3. more; the C-H bond in CHF_3 is a non-polar bond.

4. less; the three polar C-F bonds are symmetrical and cancel the dipole moments.

5. less; the tetrahedral geometry decreases the polarity of C-F bonds.

Explanation:
Since F is more electronegative than I, a C-F bond will have a greater difference in electronegativities than a C-I bond.

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014 10.0 points

Which of the following only has bond angles of 90° and 180°?

1. IF_5

2. BrF_3 **correct**

3. BCl_3

4. NO_3^-

5. ICl_4^+

Explanation:
BrF_3 exhibits T-shaped molecular geometry.

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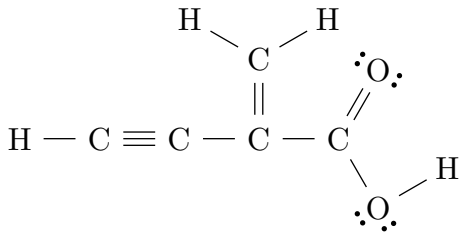
015 10.0 points

How many σ (sigma) and how many π (pi) bonds are there in the Lewis structure of the following organic molecule?



1. 10; 6

2. 12; 0

3. 10; 4 **correct**

4. 14; 0

5. 6; 4

Explanation:

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016 10.0 points

Determine the electronegativity difference, the probable bond type, and the more electronegative atom with respect to bonds formed between between the pair of atoms H and F.

1. 3.1; polar covalent; H

2. 6.1; ionic; H

3. 3.1; ionic; H

4. 3.1; ionic; F

5. 6.1; ionic; F

6. 1.9; polar covalent; F

7. 1.9; ionic; F **correct**

8. 1.9; ionic; H

9. 1.9; polar covalent; H

10. 3.1; polar covalent; F

Explanation:
The electronegativity for F is 4.0.
The electronegativity for H is 2.1.
electronegativity difference = $4.0 - 2.1 = 1.9$
A bond with an electronegativity difference of 1.9 is of the *polar covalent* type.
F is the more negative atom.