

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

Which of the following molecules is/are polar?

- I) NO_3^-
 II) NO
 III) NO_2

- II only
- III only
- II and III **correct**
- I only
- I and II
- I, II and III
- I and III

Explanation:

All of the molecules contain polar N-O and N=O bonds. But, nitrate is symmetrical and therefore non-polar. Nitric oxide and nitrogen dioxide are both asymmetrical and polar.

002 10.0 points

Which of the following is the correct Lewis structure of Nitric Oxide (NO)?

- $:\text{N} \equiv \dot{\text{O}}:$
- $:\ddot{\text{N}} = \dot{\text{O}}:$
- $:\dot{\text{N}} = \ddot{\text{O}}:$ **correct**
- $:\dot{\text{N}} \equiv \text{O}:$

Explanation:

003 10.0 points

Which of the following is the correct Lewis structure of Sodium Fluoride (NaF)?

- $\text{Na} - \ddot{\text{F}}:$
- $:\ddot{\text{Na}} - \ddot{\text{F}}:$
- $\text{Na}^+, \left[:\ddot{\text{F}}: \right]^-$ **correct**
- $\left[:\ddot{\text{Na}}: \right]^+, \text{F}^-$

Explanation:

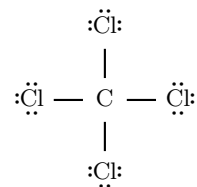
004 10.0 points

Which of the following statements about polarity is false?

- CCl_4 is a polar molecule. **correct**
- Lone (unshared) pairs of electrons on the central atom play an important role in influencing polarity.
- Polar molecules must have a net dipole moment.
- Dipole moments can “cancel”, giving a net non-polar molecule.
- Linear molecules can be polar.

Explanation:

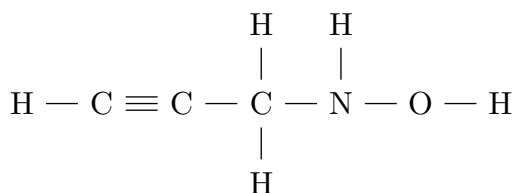
The Lewis Dot structure for CCl_4 is



The molecule has tetrahedral electronic and molecular geometry. The C–Cl bond is polar, but because of the symmetry of the molecule, the individual dipole moments cancel. The molecule is therefore nonpolar.

005 10.0 points

How many different molecular geometries are necessary to describe the central atoms in the molecule below?



(Note: You will need to add the non-bonding electron pairs.)

1. 4 correct

2. 2

3. 3

4. 1

Explanation:

The central atoms' molecular geometries from left to right are: linear, linear tetrahedral, trigonal pyramidal, bent, for a total of 4 different molecular geometries.

006 10.0 points

Which of the following is a polar molecule composed entirely of non-polar bonds?

1. SiCl₄

2. BI₃

3. O₃ correct

4. C₂H₄

5. CS₂

Explanation:

Ozone (O₃) is the only polar molecule composed of non-polar bonds. The other molecules are all symmetrical and therefore non-polar.

007 10.0 points

Which of the following substances has a delocalized bond?

1. NH₃

2. CO₃²⁻ correct

3. CO₂

4. CO

5. ClO₃⁻

Explanation:

Delocalized bonds occur whenever resonance occurs. In a molecule that exhibits resonance, the bond has partial double and partial single bond character. This means that electrons are delocalized around the resonance bond. CO₃²⁻ is the only compound that exhibits resonance and therefore delocalization.

008 10.0 points

The electronic geometry of the central atom in H₂O is (angular, tetrahedral); its molecular geometry (angular, linear, tetrahedral).

1. angular; angular

2. angular; tetrahedral

3. tetrahedral; linear

4. tetrahedral; angular correct

5. tetrahedral; tetrahedral

Explanation:

H₂O has 2 O—H single bonds and 2 lone pairs on O. There are 4 regions of HED corresponding to tetrahedral electronic geometry. The molecular geometry is angular because of the presence of the 2 lone pairs on O. The bond angle is slightly less than 109.5°.

009 10.0 points

Which of the following is a polar molecule?

1. CO₂

2. SiH₄

3. AsCl₃ correct

4. CCl₄

5. Br₂**Explanation:**

010 10.0 pointsHow many π bonds are in the molecule ethyne (HCCH or acetylene)?

1. 0

2. 4

3. 1

4. 3

5. 2 correct

Explanation:The molecule of ethyne contains a triple bond between the two carbon atoms that is composed of one sigma (σ) bond and two pi (π) bonds.

011 10.0 pointsThe electronic geometry of SnCl₅⁻ is

1. tetrahedral.

2. linear.

3. octahedral.

4. trigonal bipyramidal. **correct**

5. trigonal planar.

Explanation:

012 10.0 points

Which of the compounds

I. AlCl₃III. CCl₄II. SF₆IV. XeF₄

follow the octet rule?

1. III only **correct**

2. IV only

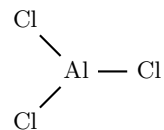
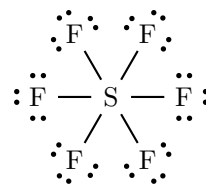
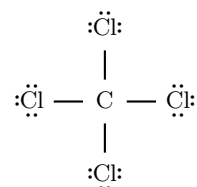
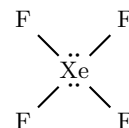
3. I only

4. III and IV only

5. I and III only

Explanation:

Draw the Lewis Dot structure for each.

There are 3 Al — Cl single bonds and no lone pairs around Al in the AlCl₃ molecule; the result is 6 valence electrons around Al.There are 6 S — F single bonds and no lone pairs around S in the SF₆ molecule; the result is 12 valence electrons around S.CCl₄ has 4 C — Cl single bonds and no lone pairs; the result is 8 valence electrons on C, which follows the octet rule.There are 4 Xe — F single bonds and 2 lone pairs on Xe in the XeF₄ molecule; the result is 12 valence electrons.

013 10.0 points

Consider the species

a) I₂, b) O₃, c) I₃⁻, d) CS₂, e) CO.

Which of the species is/are polar?

1. b) and e) only **correct**

2. e) only

3. b) and c) only

4. c) and e) only

Explanation:

Of the species listed, only O_3 and CO are polar. CO is polar due to the difference in electronegativity between O and C ; O_3 is polar because it has 3 RHED and one lone pair on the central atom. This lone pair is an area where negative charge is concentrated, so this results in the molecule having an overall dipole moment. In the other species, I_2 and CS_2 are both linear and in the case of CS_2 , the two opposing dipoles of the $C-S$ bonds will cancel. Finally I_3^- has 5 RHED and three lone pairs on the central atom but they are arranged at 120° so their effects cancel and the ion is nonpolar.

014 10.0 points

Which of the following molecules is polar?

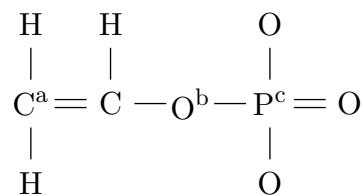
1. CF_4
2. NH_3 **correct**
3. H_2
4. CH_4
5. BH_3

Explanation:

CH_4 and CF_4 are both tetrahedral and symmetric. Polar bonds will cancel. H_2 is a diatomic molecule and is not polar. Both H s have the same EN and therefore there is no ΔEN and the bond is not polar. BH_3 is trigonal planar and symmetric. There are no lone pairs because B is an exception to the octet rule. The 3 $B-H$ bonds cancel each other. NH_3 has 3 polar $N-H$ bonds and 1 lone pair on N . NH_3 has tetrahedral electronic geometry and trigonal pyramidal geometry. The molecule is not symmetric, the $N-H$ bond polarities do not cancel, and it is therefore a polar molecule.

015 10.0 points

What are the molecular geometries of the labeled atoms in the Lewis structure below?
Note: only bonding electrons are shown.



1. trigonal planar; linear; trigonal bipyramidal
2. trigonal planar; bent; tetrahedral **correct**
3. trigonal pyramidal; linear; see-saw
4. bent; tetrahedral; t-shaped
5. bent; trigonal pyramidal; t-shaped

Explanation:

Atom a has three bonded atoms and no non-bonding pairs of electrons and is therefore trigonal planar. Atom b has two bonded atoms and two non-bonding pairs of electrons and is therefore bent. Atom c has four bonded atoms and no non-bonding pairs of electrons and is therefore tetrahedral.

016 10.0 points

Which pair of elements is listed in order of increasing electronegativity?

1. N, O **correct**
2. F, Cl
3. S, As
4. N, C
5. S, Se

Explanation:

Electronegativity generally increases from left to right and from bottom to top of the Periodic Table. Thus $N < O$.