HW06 - Bonding & Energy Transfer

1 5 points

Which of the following has bond angles slightly LESS than 120°?

○ NO_3^-

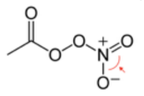
○ CH_2O

○ SF_2

○ O_3

2 5 points

Consider the compound peroxyacetylnitrate, an eye irritant in smog.



Predict the indicated bond angle.

○ slightly less than 109.5°

○ 90°

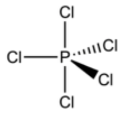
○ 109.5°

○ slightly less than 120°

○ 120°

3 5 points

What is the shape of phosphorus pentachloride?



○ trigonal bipyramidal

○ trigonal planar

○ octahedral

○ tetrahedral

○ trigonal planar

4 5 points

Referring to the phosphorus pentachloride molecule shown above, what is the bond angle between a chlorine in the axial position and a chlorine in the equatorial position?

○ 180°

○ 360°

○ 120°

○ 109.5°

○ 45°

○ 90°

5 5 points

Referring again to phosphorus pentachloride, what are the bond angles between the two axial chlorine atoms?

○ 109.5°

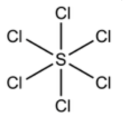
○ 120°

○ 90°

○ 180°

6 5 points

What is the shape of sulfur hexachloride?



○ octahedral

○ tetrahedral

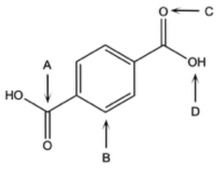
○ hexahedral

○ trigonal bipyramid

○ trigonal planar

7 4 points

Which labelled bond angles are 120°?



☐ C

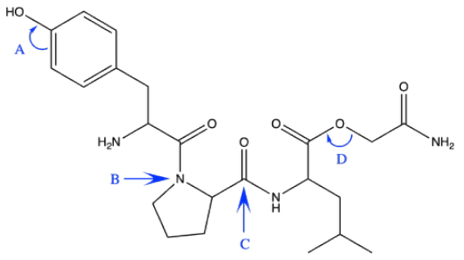
☐ B

☐ A

☐ D

8 5 points

One of the cool things you should be able to do now is look at a big molecule and make detailed conclusions about unique groups within that molecule, such as determining the shape, bond angles, and the number of implied lone pairs. Answer the following questions about this molecule shown below. Fun fact, this molecule is just a small component of the hormone, oxytocin. Oxytocin is secreted as a result of social bonding and promotes feelings of closeness to others.



The bond angle around the carbon labeled A is ______.

The electronic geometry around the nitrogen labeled B is ______.

The molecular geometry around the carbon labeled C is ______.

The bond angle around the oxygen labeled D is ______.

There are a total of ______ lone pairs on this molecule.

⣿360˚ ⣿180˚ ⣿90˚ ⣿109.5˚ ⣿120˚ ⣿trigonal planar

⣿trigonal pyramidal ⣿trigonal bipyramidal ⣿bent ⣿tetrahedral

⣿see-saw ⣿tetrahedral ⣿bent ⣿trigonal pyramidal

⣿trigonal bipyramidal ⣿trigonal planar ⣿120˚ ⣿exactly 109.5˚

⣿exactly 180˚ ⣿slightly less than 109.5˚ ⣿slightly less than 180˚

⣿slightly less than 90˚ ⣿2 ⣿12 ⣿11 ⣿16 ⣿20 ⣿8

⣿0 ⣿30

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9 5 points

What is the geometry around the left-most carbon in the molecule CH_2CHCH_3 ?

○ trigonal planar
○ tetrahedral
○ linear
○ trigonal pyramidal

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10 5 points

What is the shape (molecular geometry) of $COCl_2$?

○ T-shaped
○ trigonal pyramidal
○ trigonal planar
○ tetrahedral

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11 5 points

What is the molecular geometry of the nitrite ion, NO_2^- ?

○ trigonal pyramidal
○ none of these
○ linear
○ trigonal planar
○ bent

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12 5 points

A molecule has three bonds and one lone pair. What are the electronic and molecular geometries, respectively?

○ trigonal pyramid, tetrahedral
○ trigonal planar, trigonal pyramid
○ tetrahedral, trigonal pyramid
○ tetrahedral, tetrahedral
○ tetrahedral, trigonal planar

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13 5 points

Determine the molecular geometry of BrF_5.

This molecule exhibits "expanded valence," meaning it disobeys the octet rule that allows $S = N - A$ to work. You can try it out on your own or search the internet for the structure before determining the shape.

○ Octahedral
○ Trigonal pyramidal
○ Trigonal bipyramidal
○ Square pyramidal

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14 3 points

State the strongest intermolecular force possible for each compound, respectively:

O_3 , NH_3 , C_6H_{14}

○ dipole-dipole, hydrogen bond, dipole-dipole,
○ dispersion, dipole-dipole, dipole-dipole
○ dispersion, dipole-dipole, hydrogen boond
○ dipole-dipole, hydrogen bond, dispersion

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15 3 points

Consider the following boiling point data:

- HBr, T_b = -66 ˚C
- HI, T_b = -35 ˚C

From this data, we can interpret that HI has stronger intermolecular forces. Which of the following best explains why HI has stronger IMFs than HBr?

○ The bond in HI are more polar than HBr
○ HI is trigonal planar
○ HI is more polarizable than HBr
○ The bond in HBr are more polar than HI

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16 2 points

Nucleotides, the molecules that make up DNA have average molecular weights around 400-500 g/mol. They contain polar functional groups and can hydrogen bond. However, the *stability* of DNA depends on dispersion forces. Why might this be?

○ Large organic molecules can make*stronger* individual dispersion forces, which can be stronger than individual hydrogen bonds
○ 400-500 g/mol is a small molar mass, which diminishes the strength of the dipole-dipole and hydrogen bonds
○ 400-500 g/mol is a small molar mass, which will result in closer interactions and stronger dispersion forces
○ Large organic molecules can make*more* dispersion forces, which can add up to being stronger than other intermolecular forces.

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17 2 points

Draw the following two molecules: H_2S and SiH_4. Which one will have the stronger intermolecular forces and why?

○ H_2S is more polarizable
○ H_2S is more polar
○ SiH_4 is more polar
○ SiH_4 is more polarizable

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18 5 points

About what percentage of Earth's dry (no water) atmosphere is able to absorb IR radiation?

○ 1%
○ Less than 1%
○ IR is absorbed evenly by all atmospheric gases
○ Only gases in the mesosphere
○ Roughly 50%

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19 4 points

Select the molecules that are capable of absorbing IR radiation.

☐ $CF_3CH_2CF_3$
☐ Ar
☐ CH_4
☐ Ne
☐ H_2O
☐ CO_2
☐ O_2

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20 2 points

What is the advantage of HFCs over the HCFCs that are used in present day appliances?

○ HFCs do not absorb in the IR region
○ HFCs are inflammable
○ HFCs are less reactive than HCFCs
○ HFCs do not contain ozone-depleting chlorine

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21 2 points

Which of the following is a concern with long-term use of HFCs?

○ They are highly toxic
○ They are flammable
○ They will result in large-scale depletion of the ozone layer
○ They absorb IR radiation, resulting in global warming risks

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22 2 points

Which of the following contribute significantly to the hole in the ozone layer?

○ All of these are correct
○ Chlorofluorocarbons
○ Deforestation
○ Automobile exhaust

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23 2 points

The ozone layer is found in the...

○ Mesosphere
○ Troposphere
○ Stratosphere
○ Biosphere

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24 2 points

You are running a chemical reaction using a catalyst. Which of the following statements is true?

○ The catalyst will speed up your reaction.
○ You will need to constantly add more catalyst because the chemical reaction will always rapidly deplete the catalyst.
○ You should not use a catalyst because it will deplete your desired products.
○ The catalyst has no affect on the reaction mechanism.

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25 2 points

The depletion of the ozone layer is catalyzed by chlorine. Which of the following best relates stratospheric chlorine to ozone levels?

○ As chlorine levels increase, ozone levels increase
○ As chlorine levels increase, the amount of ozone depletion cannot be predicted
○ As chlorine levels increase, ozone levels decrease

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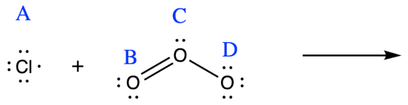
26 5 points



Fill in each blank for the reaction shown above.

The formal charge on the chlorine radical labeled A is equal to

. The formal charge on the oxygen labeled B is equal to

. The formal charge on the oxygen labeled C is equal to

. The formal charge on the oxygen labeled D is equal to

. This reaction is the first step of the

in the atmosphere.

+1 | 0 | -1 | +2 | -2 | +1 | +2 | -1 | 0

-2 | -1 | +2 | +1 | -2 | 0 | 0 | +2 | -2

+1 | -1 | formation of chlorine gas | addition of chlorine to ozone

catalyzed decomposition of ozone | formation of HCFCs