

Bonding – HW FRQ #1 Answer Document

Part 1:

- (a) Hydrogen bonding (or dipole -dipole attraction) in HF is greater than it is in HCl *1 point*
1 point

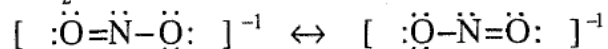
(Note: only 1 point earned if simply stated that HF has greater intermolecular forces than HCl)

- (b) AsF₃ has a trigonal pyramid shape and bond dipoles do NOT cancel (or, asymmetric molecule) *1 point*

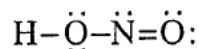
AsF₅ has a trigonal bipyramid shape and bond dipoles cancel (or, symmetric molecule) *1 point*

(Notes: explanation must refer to shape in order to earn point; 1 point earned if only correct Lewis structures are given)

- (c) NO₂⁻ has resonance structures *1 point*



HNO₂ has no resonance structures



OR,

one N-O single bond, one N=O double bond

1 point

(Note: 1 point earned if only correct Lewis structures, including resonance for NO₂⁻, are given)

- (d) Sulfur uses *d* orbitals (or expanded octet), oxygen has no *d* orbitals in its valence shell *1 point*
1 point

OR,

Sulfur is a larger atom, can accommodate more bonds *2 points*

Part 2:

(a)



(Trigonal) pyramid(al)



(Trigonal) bipyramid(al)

*1 point
for each
structure*

*1 point
for each
geometry*

Note: One point (total) deducted if lone pairs not shown on F atoms in either molecule.

(b) The PF₃ molecule is polar

1 point

The three P-F dipoles do not cancel,

or,

the lone pair on P leads to asymmetrical distribution of charge.

1 point

Note: "Molecule is not symmetrical" does not earn point. Both points can be earned if answer is consistent with incorrect (a).

(c) NF₅ does not exist because no *2d* orbitals exist for use in bonding,

or,

N is too small to accommodate 5 bonding pairs

1 point

AsF₅ does exist because *4d* orbitals are available for use in bonding,

or,

As can accommodate an expanded octet using *d* orbitals

1 point

Note: Response with two correct predictions with no explanations earns one point. Also, argument of "no expanded octet" vs. "expanded octet" alone does not earn explanation point.