PRACTICE SET 3

Passage IV: Dipole Moments

6 questions (17–22) · suggested time 9 minutes

1. Read the passage and answer all 6 questions on your own. No notes, no calculator.
2. Check your answers with the key on the last page.
3. Watch the walkthrough video to see how each question is broken down.

Passage IV

Many chemical bonds are not purely ionic or covalent, but polar covalent. For example, in an HCl bond, chlorine has a greater attraction for electrons than hydrogen does and therefore develops a partial negative charge with respect to the hydrogen atom.

If the partial charges are separated by a known distance, the *dipole moment*, a measure of the charge separation in a bond or molecule, can be calculated by the following equation.

$$\text{dipole moment} = \text{charge} \times \text{separation distance}$$

Dipole moments are usually measured in debyes (D), where $1\ \text{D} = 3.34 \times 10^{-30}$ coulomb · meter.

The molecular geometry of some simple molecules can be determined based on the presence or absence of a net dipole moment in the molecule. The observed molecular dipole moments of various compounds are reported in Table 1.

Table 1 Dipole Moments for Various Compounds

Molecule	Dipole moment (D)
$SnBr_4$	0
$HgBr_2$	0
SO_2	1.47
HF	1.82
HNO_3	2.17
BaO	7.95
KCl	10.27

17 Which of the following best explains the observed molecular dipole moment of $SnBr_4$?

(A) Sn and Br have the same effective nuclear charge.

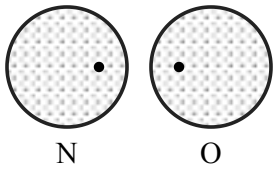
(B) Sn and Br are the same size.

(C) Sn attracts electrons more strongly than predicted by its electronegativity.

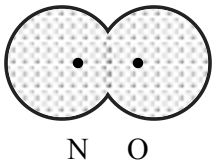
(D) The geometry of the molecule causes the bond moments to cancel.

18 Which of the following figures most accurately depicts the σ_{2s} electron cloud in the NO molecule?

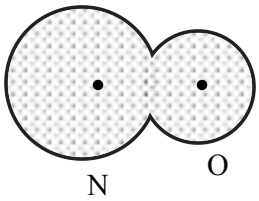
(A)



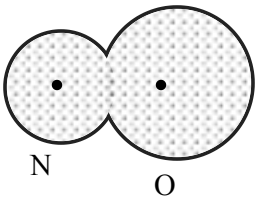
(B)



(C)



(D)



19 Based on the observed dipole moment of HF in Table 1, what is the observed dipole moment for HCl?

(A) 0.02 D

(B) 1.08 D

(C) 4.22 D

(D) 8.97 D

Continued on next page

20 Which of the following best explains why HCl bonds are polar covalent?

- (A) H atoms are smaller than Cl atoms.
- (B) H atoms are more electronegative than Cl atoms.
- (C) Cl and H atoms have equal electronegativities.
- (D) Cl atoms have a greater effective nuclear charge than H atoms do.

21 If an O atom is removed from a CO_2 molecule, the observed molecular dipole moment will:

- (A) decrease, because a lone pair of electrons will be formed on the carbon.
- (B) decrease, because the net charge will increase.
- (C) remain constant, because the geometry will not change.
- (D) increase, because a charge separation will develop.

22 Which of the two compounds, PCl_3 or PCl_5, can be expected to have a larger dipole moment?

- (A) PCl_3, because its geometry is trigonal planar
- (B) PCl_3, because its geometry is pyramidal
- (C) PCl_5, because its geometry is octahedral
- (D) PCl_5, because its geometry is trigonal bipyramidal

Finished all 6 questions?

Only check the key once you've committed to an answer for every question.

YOUR ANSWERS

17	18	19	20	21	22	Score / 6

Q	ANSWER	
17	D	The geometry of the molecule causes the bond moments to cancel.
18	D	Figure D
19	B	1.08 D
20	D	Cl atoms have a greater effective nuclear charge than H atoms do.
21	D	increase, because a charge separation will develop.
22	B	PCl_3, because its geometry is pyramidal

NOW WATCH THE WALKTHROUGH

Solving AAMC MCAT Passage-Based Questions (Biology and Chemistry)

Every question broken down step by step: where the information is in the passage, and why each wrong option is wrong.