Symmetry and Molecular Polarity

New Regents original practice • Name: _____ Date: _____
Show your work for written answers.

A bond dipole points toward the more electronegative atom. A molecule has a net dipole when its bond dipoles do not cancel.

1 Two equal bond dipoles point in opposite directions along the same line. What is their net dipole?

(1) Zero

(2) Equal to either dipole alone

(3) Twice the size of either dipole

(4) The larger dipole points backward.

2 Two equal bond dipoles point at an angle of 105° to each other. Explain why their net dipole is not zero. [1]

Answer and work

3 In a tetrahedral molecule, four identical bond dipoles point symmetrically toward the four corners. What happens to their sum?

(1) It points toward any one chosen corner.

(2) It is zero.

(3) It equals one bond dipole.

(4) It is four times one bond dipole in every direction.

4 A diatomic molecule has a single polar bond. Explain why it cannot cancel that bond dipole through molecular symmetry. [1]

Answer and work

Comparing Molecular Structures

Use the information below to answer the questions.

A chemistry display lists three molecular models. The bonds listed within each model have equal dipole magnitudes. The geometry gives their directions.

Model	Molecular geometry	Bond-dipole directions
CO_2	Linear	From C toward each O
H_2O	Bent	From each H toward O
CF_4	Tetrahedral	From C toward each F

5 Which molecule has a nonzero net dipole in these models?

(1) CO_2 only

(2) H_2O only

(3) CF_4 only

(4) All three

6 Use the geometry and bond directions to explain how CO_2 can have polar bonds and a zero net dipole. [1]

Answer and work

7 Which pair both have cancelling dipoles, though their shapes differ?

(1) CO_2 and H_2O

(2) CO_2 and CF_4

(3) H_2O and CF_4

(4) All three

8 Suppose one F in the CF_4 model is replaced by Cl, with a different bond-dipole magnitude. Explain what changes about the cancellation. [1]

Answer and work