**ANSWERS: Additional questions on explaining polarity of molecules**

**Key points to consider are**

**1) contain polar bond(s), you must refer to a difference in electronegativity between the relevant atoms**

**2) have lone pair(s) around the central atom**

**3) have a symmetrical shape**

**4) whether the bond dipoles cancel**

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| **CS2**  **CS2** is a non-polar molecule. The C−S bonds of CS2 are polar due to the differing electronegativities of C and S atoms.  However, as there are only 2 bonding regions and no lone pairs about the central C atom, the bond dipoles are arranged symmetrically about the C atom with a linear shape.  The effect of these bond dipoles is cancelled, so that the molecule is nonpolar. | **N2**  **N2** is a non-polar molecule. There is a triple bond between the 2 nitrogen atoms, bonds between 1 N atom and another N atom are non- polar due to the same electronegativities of the 2 nitrogen atoms.  As there is only 1 region of electron repulsions between the 2 N atoms, the triple bond between the 2 N atoms is symmetrical with a linear shape so the molecule is nonpolar. | **CH3OH**  In **CH3OH**, there are bond dipoles within CH3OH due to differences in electronegativity between the C, H and O atoms. There are 4 bonding regions of electron repulsion around the central C atom, with no lone pairs. Because of the higher electronegativity of the O atom, the bond dipoles are not spread evenly around the central C atom, are asymmetrical and the bond dipoles do not cancel, and the molecule is polar overall. |
| **HCN**  HCN is a polar molecule. The C-H and C−N bonds of HCN are polar due to the differing electronegativities of C, H and N atoms. However, as there are only 2 electron repulsions (2 bonding regions and no lone pairs) about the central C atom, the bond dipoles are symmetrical about the C atom with a linear shape, and the effect of these bond dipoles is cancelled. The molecule is symmetrical so that the molecule is nonpolar. | **PCl3**  In PCl3, the P–Cl bonds are polar due to differences in electronegativity between P and Cl atoms. There are 4 regions of electron density around the central P atom, 3 of these are bonding regions and 1 is a lone pair. The three polar P–Cl bonds are not spread symmetrically around the trigonal pyramid shaped molecule, due to the lone pair of electrons, therefore the molecule is polar.  other similar examples are PH3 and NBr3 | O2  O2 is similar to N2, although there is a double bond between O atoms. |

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| **CH3COCH3**  http://s3.amazonaws.com/readers/2010/12/14/acetonestructural_1.png  There are 3 regions of electron density, 3 bonding regions and no lone pairs around the central carbon atom which results in a trigonal planar shape. However, there is an electronegativity difference between the carbon and oxygen atoms resulting in an uneven distribution of charge, asymmetrical so the molecule is polar. | **CH4**  In CH4, the C–H bonds are very slightly polar, due to differences in electronegativity of C and H atoms. However, four C–H bonds are arranged symmetrically in a tetrahedral  shape, with 4 bonding regions and no lone pairs around the central atoms and the charges are spread evenly, resulting in a non-polar molecule. | **C2H4**  **There is a slight electronegativity difference between the C and H atoms. However the central C atoms have no electronegativity difference between them. The**  The carbon atoms in C2H4 have three bonding regions and no lone pairs around them. This results in a trigonal planar shape. Since the molecule is symmetrical, there is an even distribution of charge and so the molecule is non-polar. |
| HCl  HCl is a polar molecule. There is a single bond between the H and Cl atoms and a difference in electronegativity between the H and Cl atoms. The bond between the H and Cl atoms is non-symmetrical with a linear shape so the molecule is polar. | **SF2**  In SF2, the S-F bonds are polar, due to differences in electronegativity of S and F atoms. There are 4 regions of electron repulsion around the central S atom, 2 bonding regions and 2 regions of lone pairs. The 2 lone pair of electrons on the S atom causes the SF2 to occupy a bent or V shape around the central S. Therefore the effect of these bond dipoles is not cancelled, they are arrange asymmetrically so that the molecule is polar. | O3    O3 is a polar molecule. The O−O bonds of O3 are non-polar due to the same electronegativities between the O atoms. There are 3 regions of electrons around the central O atom, 2 bonding pairs and 1 lone pair. The parent geometry is trigonal planar. The lone pair of electrons on the O atom causes the O3 to occupy a bent or V shape around the central O. Therefore, the effect of these bond dipoles is not cancelled, the bond dipoles are arranged asymmetrically, so that the molecule is polar. |

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