**ANSWERS: Explaining polarity of molecules**

**Key points to consider for an Excellence grade are...**

**Does the molecule…**

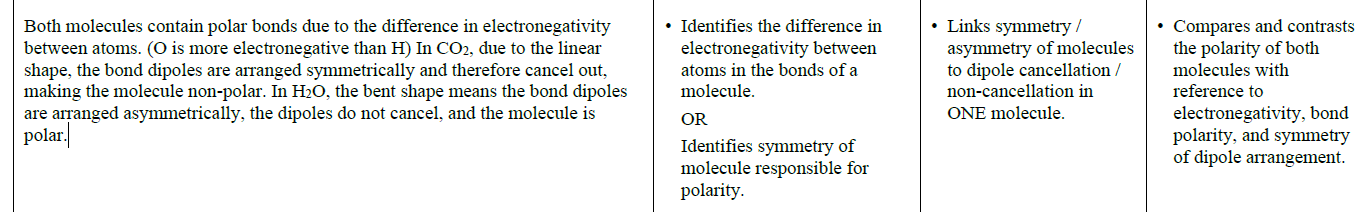
**1) contain polar bond(s)? you must refer to a difference in electronegativity between the relevant atoms.**

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

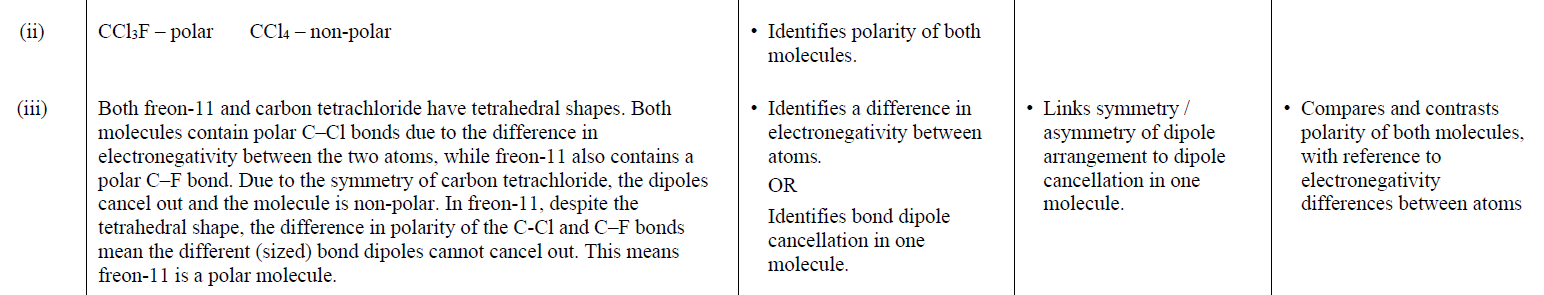
**3) have a symmetrical shape?**

**4) whether the bond dipoles cancel.**

**2023**



**2022**



**2021**

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**2020**

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| **2019** | **Evidence** | **Achievement** | | **Merit** | | **Excellence** |
| **(i)**  **(ii)** | CHCl3 is polar.  NH3 is polar.  In CHCl3, there are two types of bond, C–H and C–Cl, each polar, due to the difference in electronegativity between C and H and C and Cl atoms. These dipoles have different polarities / sizes as H and Cl have different electronegativities. (Despite the tetrahedral arrangement appearing symmetrical) the different (sized) bond dipoles do not cancel each other out, so CHCl3 is polar.  In NH3, the three N–H bonds are polar, i.e. have a dipole, due to the difference in electronegativity between N and H atoms. These (equally sized) dipoles are arranged in a non-symmetrical trigonal pyramidal shape, resulting in the bond dipoles not  cancelling each other out, so NH3 is polar. | • Identifies polarity of both molecules.  • Identifies bonded atoms have different  electronegativity (values). | | • Links bond polarity to  electronegativity differences  between bonded atoms for all  bonds in one molecule.  OR  Uses lack of symmetry for NH3  OR  differing bond dipoles for  CHCl3 to link molecule polarity  to dipoles not cancelling in one  molecule. | | • Justifies polarity of  both molecules by referring to  differences in electronegativity,  dipoles, and non-symmetrical  arrangement of NH3 dipoles. |
| **2018** | **Evidence** | | **Achievement** | | **Merit** | **Excellence** |
|  | In HCN, the two bonds are polar due the difference in electronegativity between H and C, and C and N. The resulting bond dipoles are differing in size as H and N have different electronegativities, so despite the symmetric linear arrangement the bond dipoles do not cancel and HCN is overall polar.  The C=O bond is also polar due to O being more electronegative than C giving these bonds dipoles. But because both bonds are identical and are arranged symmetrically in a linear shape, the bond dipoles cancel and the molecule is non-polar overall. | | • Identifies that the atoms within a bond have different electronegativities.  OR  Linear is recognised as symmetric. | | • Links bond polarity to  electronegativity differences  between atoms for ONE  molecule OR uses symmetry  to link polarity to bond  dipoles cancelling / not  cancelling for ONE molecule. | • Justifies polarity of BOTH molecules by referring to differences in electronegativity,  dipoles and symmetry of molecules. |

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| **2017** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| **(i)**  **(ii)** | Dichloromethane is polar. Tetrachloromethane is non-polar.  In CCl4, the four C–Cl bonds are polar, i.e. have a dipole, due to the difference in electronegativity between C and Cl. These (equally sized) dipoles are arranged in a symmetric **tetrahedral** shape, resulting in the dipoles / bond polarities cancelling each other out, so CCl4 is non-polar.  In CH2Cl2, there are two types of bond, C–H and C–Cl, each polar with dipoles due to the difference in electronegativity between C and H and C and Cl. These dipoles have different polarities / sizes as H and Cl have different electronegativities. (Despite the symmetric tetrahedral arrangement) the different (sized) dipoles / bond polarities do not cancel each other out, so CH2Cl2 is polar. | Identifies polarity of both molecules.  Identifies that the atoms **within the**  **bond**s have different electronegativities.  (For one type of bond) | Links bond polarity / or bond dipoles / atoms δ- and δ+ to  electronegativity differences between **bonded** atoms for one  molecule.  **OR**  Uses symmetry / differing  dipoles to link molecule polarity to dipoles cancelling / not cancelling for one molecule. | Justifies polarity of dichloromethane and non-polarity of tetrachloromethane by referring to differences in electronegativity,  dipoles, and symmetry of molecules. |

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| **2016** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  | Each N-H bond in NH3 is polar / forms a dipole because the N and H atoms have different electronegativities. The shape of the molecule (due to the presence of one non-bonding electron pair) is trigonal pyramidal which is asymmetrical, so the dipoles / bond polarities do not cancel. The resulting NH3 molecule is polar.  Each B-H bond in BH3 is polar / forms a dipole because the B and H atoms have different electronegativities. The shape of the molecule is trigonal planar which is symmetrical, so the dipoles / bond polarities cancel. The resulting BH3 molecule is non-polar. | Identifies that the atoms within the bonds have different electronegativities. | Links bond polarity to  electronegativity differences  between atoms for one molecule  OR  Uses symmetry to link molecule polarity to bond dipoles cancelling / not cancelling for 1 molecule | Justifies polarity of ammonia and borane referring to differences in electronegativity, dipoles, and symmetry (shape) of molecules. |

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| **2015** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  | Both molecules are non-polar.  The Be-Cl bond is polar because Cl is more electronegative than Be / the atoms have different electronegativities*.*  Since both the bonds are the same and arranged symmetrically around the central atom, in a linear arrangement, the bond dipoles cancel out, resulting in a non-polar molecule.  The B-F bond is polar because F is more electronegative than B / the atoms have different electronegativities. Since all three bonds are the same and arranged symmetrically around the central atom, in a trigonal planar arrangement, the bond dipoles cancel out, resulting in another non-polar molecule. | * Identifies electronegativity difference between atoms.   OR  Identifies the polarity of either the Be-Cl or B-F bond correctly.  OR  States that polarity of the molecule depends on the symmetry of the molecule. | * Non polar circled PLUS   Links the polarity of either Be-Cl or B-F bonds to the differences in electronegativity of the atoms involved.  OR  Links the even spread of polar bonds / bond dipoles around the central atom to their cancelling out and therefore to the overall non-polarity of the molecule. | * Justifies choice of polarity in terms of polarity of bonds, due to differences in electro negativities of the atoms, and the cancelling out of bond dipoles / polar bonds due to the symmetry and shape of each molecule. |

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| **2014** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  | SO2 moleculeis polar.  CO2 molecule is non-polar.  The S–O / S=O bond is polar due to the difference in electronegativity between S and O atoms. The bonds are arranged asymmetrically in a bent shape around the central S atom; therefore the (bond) dipoles do not cancel and the molecule is polar.  The C=O bond is polar due to the difference in electronegativity between C and O atoms. The bonds are arranged symmetrically in a linear shape around the central C atom; therefore the (bond) dipoles cancel and the molecule is non-polar. | * One bond correctly identified as being polar.   OR  Atoms have different electronegativities | * Explains polar bonds is due to the difference in electronegativity between   S and O (atoms) or  C and O (atoms).  OR  Bond dipoles cancelling or not cancelling linked to the overall molecule polarity of either SO2 or CO2 molecule. | The polarity of both molecules is justified with reference to the polarity of the bonds, the shape and the polarity of the molecule. |

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