ANSWERS: Describing and explaining shapes and polarity of molecules

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| **2019** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  | ClF5 has six electron clouds about the central atom, including five bond pairs and one lone pair. The electron clouds repel as far apart as possible; this produces the square pyramidal shape.  There is an electronegativity difference between Cl and F, so the Cl–F bonds are polar covalent. The square pyramidal shape arranges these dipoles asymmetrically due to the lone pair on the central atom. The dipoles do not cancel so ClF5 is a polar molecule. | Names shape / 6 regions, 5 bonding, 1 not.  OR  Recognises influence of electronegativity  difference. | Explains shape  OR  polarity  OR  Explains shape and polarity with a minor omission in each part. | Fully explains shape and  polarity of ClF5. |

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| **2018** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  | There are six electrons clouds about the central atom; four bond pairs and two lone pairs of electrons. The six electron pairs about the central Xe atom are arranged as far apart as possible in an octahedral geometry to minimise repulsion, but due to the two lone pairs, XeF4 has a square planar shape. There is an electronegativity difference between Xe and F, so the Xe-F bonds are polar covalent. This molecule is symmetrical due to the position of the two lone pairs  around Xe being above and below the plane, so the effect of the bond dipoles cancel, i.e. there is an even spread of charge. Therefore, XeF4 is a non-polar molecule. | TWO correct statements. | Links shape to arrangement of electron pairs about central atom.  OR  Links polarity to shape and  electronegativity. | Fully explains shape and polarity for XeF4 |

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| **2017** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (i)  (ii)  (iii) | Arrangement of areas of electron density around the central I atom is trigonal bipyramidal due to five regions of negative charge. These areas all repel each other.  As there are three non-bonding pairs (in the equatorial area) and two bonded atoms, the shape is linear.  Polar.  The I-F bond is polar due to a difference in electronegativity.  There are six regions of negative charge giving IF5 an octahedral geometry. The five bonded and one lone pair around the central iodine atom gives it the square pyramid shape. This means the molecule is asymmetric so the bond polarities dipoles don’t cancel causing the molecule to be polar. | * Correct Lewis Structure.   • ONE Correct statement.  • Polar, with ONE correct statement. | • Correct explanation.  • Link shape of IF5 to electron arrangement around the central atom  OR  Link shape to polarity. | • Full explanation of shape and polarity of IF5. |

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| **2016** | **Evidence** | **Achievement** | **Achievement with Merit** | * **Achievement with Excellence** |
| (i) | 91390assq1c_1 | * One correct shape or Lewis diagram. | * One correct Lewis diagram with corresponding shape. |  |
| (ii) | No. There is an electronegativity difference between Se and F, so the Se-F bonds are polar covalent. The six bond pairs around the central Se atom arrange themselves as far apart as possible to minimise repulsion, so SeF6 has an octahedral shape. Since this is a symmetrical shape, the bond dipoles cancel out, so SeF6 is a non-polar molecule. Water is a polar solvent. Non-polar molecules like SeF6 are not attracted to polar molecules like water, i.e. the intermolecular attraction between the water molecules and the SeF6 molecules is insufficient to overcome the attraction between the water molecules. Therefore, SeF6 is insoluble in water. | * Recognises SeF6 is insoluble in water AND states shape or polarity of molecule. | * Links the shape of SeF6 to the arrangement of electron pairs around the central atom.   OR  Links the polarity of SeF6 to its shape. | * Full explanation of shape and polarity of SeF6 linked to its solubility in water as a polar solvent. |

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| **2015** | **Evidence** | **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| (a) | Description: http://www.sxmufyc.edu.cn/jianyan/wjhx/lx/lx7/lx7.ht9.jpg  Trigonal bipyramidal Octahedral | * ONE correct shape. * ONE Lewis diagram. |  |  |
| (b) | XeO2F2 is polar. It has 5 areas of electron density around the central Xe atom, one of which is a lone pair. Maximum separation for minimum repulsion means that the shape is based on a trigonal bipyramid structure, but is actually see-saw. The Xe=O bonds are polar, due to the greater electronegativity of O, and the Xe-F bonds even more polar, due to the F atom having the highest electronegativity on the periodic table. The molecule is not symmetrical, and so the dipole moments cannot cancel, making the molecule polar.  GeH4 is non-polar. It has 4 areas of electron density around the central Ge atom, all of which are bonded. Maximum separation for minimum repulsion means that the shape is tetrahedral. This is a symmetrical structure, thus the bond dipole moments cancel, and therefore the molecule is non-polar. | * Recognises XeO2F2 is polar and GeH4 is non-polar. | * One molecule correctly and completely explained.   OR  Both molecules partially explained. | * Polarities and shapes of both molecules are correctly compared and contrasted. |
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| **2014** | **Evidence** | **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| (i) | *lowest* B N Ne He*highest*  1. δ– δ+ 2. δ+ δ–  F---Cl At---Cl | * Correct order. * Both correct. |  |  |

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| **2013** | **Evidence** | **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| (i)  (ii) | BrF3: T-shaped: PCl6–: Octahedral  ass91390aQ1c1  ass91390aQ1c2  There is a difference in electronegativity between S and F, so the S-F bonds are polar covalent. SF4 has a see-saw shape (distorted tetrahedron) due to the repulsions between four bonding regions and one non-bonding region of charge, which is asymmetric therefore the polarities/dipoles do not cancel. As a result, SF4 is a polar molecule.  There is a difference in electronegativity between Xe and F, so the Xe-F bonds are polar covalent. XeF4 has a square planar shape, due to the repulsions between four bonding regions and two non-bonding regions of charge; therefore the polarities/dipoles do cancel. As a result, XeF4 is a non-polar molecule. | * TWO correct Lewis diagrams.   OR  TWO correct shapes.  OR  ONE correct Lewis diagram and corresponding name.   * Both shapes correct OR   Both polarities correct OR  One shape and corresponding polarity   * Identifies polar bonds due to F having a different electronegativity to both Xe and S. OR   Links polarity to symmetrical or asymmetrical arrangement of polar bonds. | * ALL correct * Both polarities correct and full discussion of polarity for both molecules. OR   Both shapes correct and full discussion of shape for both. OR  Shape and polarity correct and full discussion for one molecule. OR  Both shapes and polarities correct with essentially correct discussions but omissions in both. | * Correct discussion for polarities of BOTH molecules. |

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