Answer the questions below then check your answers.

1. Define the term electronegativity.

2. What is the difference between a covalent bond and a polar covalent bond?

3. In order for a bond to be polar covalent approximately how large should the differences in the electronegativity values for the atoms involved in the bond be?

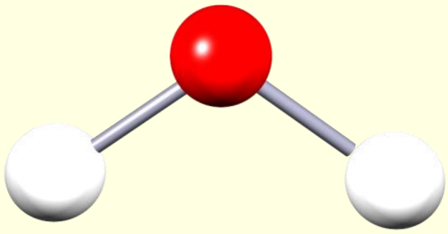
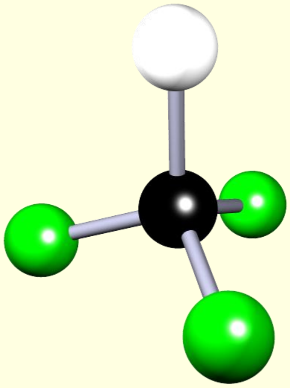
a. What happens to the polarity of a bond as the difference in electronegativity values for each atom in the bond increases?

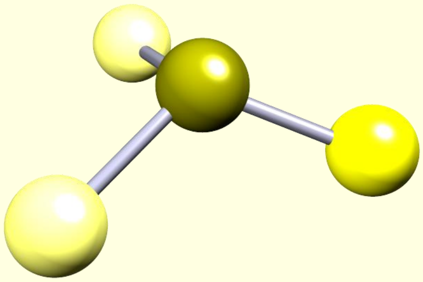
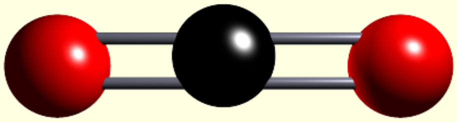
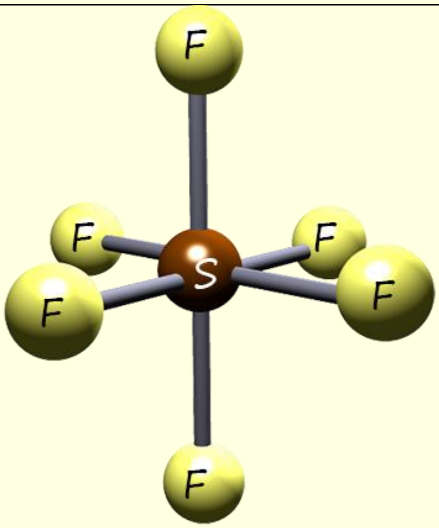
4. What do the symbols δ^+ and δ^- next to an atom in a bond indicate? What is a dipole?

5. Explain why a molecule which has polar covalent bonds may not in fact be a polar molecule and not possess a dipole moment.

a. What is a dipole moment?

6. For each molecule below indicate the presence of any dipoles present by adding the symbols for δ^+ and δ^- to show the presence of any bond dipoles in the molecule. Also decide if the molecule is polar or not.

Molecule	Formula	Bond dipoles shown	Is this a polar molecule?
	Water H_2O		
	Chlorine Cl_2		
	chloromethane $HCCl_3$		

Molecule	Formula	Bond dipoles shown	Is this a polar molecule?
	Phosphorus trifluoride PF_3		
	Carbon dioxide CO_2		
	Sulfur hexafluoride SF_6		

Answers

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1. Define the term electronegativity.

   Power or ability of an atom in a covalent bond to attract electron density towards itself.

2. What is the difference between a covalent bond and a polar covalent bond?

   In a covalent bond the electrons are shared equally but in a polar covalent bond the electrons are shared unequally.

3. In order for a bond to be polar covalent approximately how large should the differences in the electronegativity values for the atoms involved in the bond be?

   Between 0.5-1.9 as a good working approximation for difference in electronegativity values for a bond to be polar covalent. Less than 0.5 and its likely to be covalent, more than 1.7-1.9 (depends on the scale used - but figures are a guide only) and its likely to be ionic

a. What happens to the polarity of a bond as the difference in electronegativity values for each atom in the bond increases?

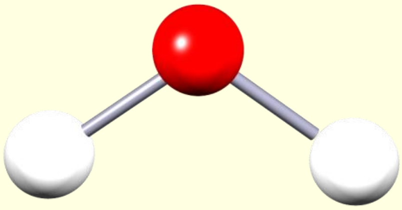
4. What do the symbols δ^{+} and δ^{-} next to an atom in a bond indicate? What is a dipole? These symbols indicate that the molecule has charged ends or a dipole. If the molecule is symmetrical then all the dipoles will cancel out and the molecule will be non-polar, however if it is not symmetrical then the molecule will be polar and have a permanent dipole.

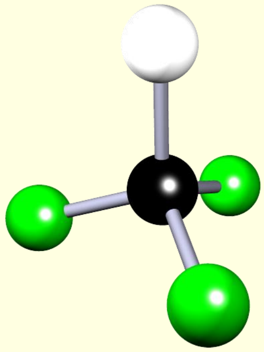
5. Explain why a molecule which has polar covalent bonds may not in fact be a polar molecule and not possess a dipole moment. Answered in Q4.

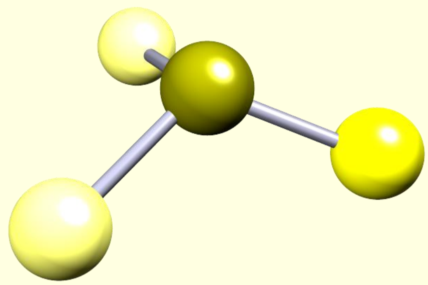
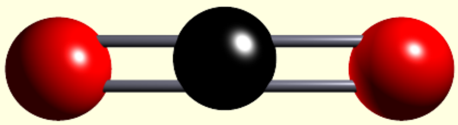
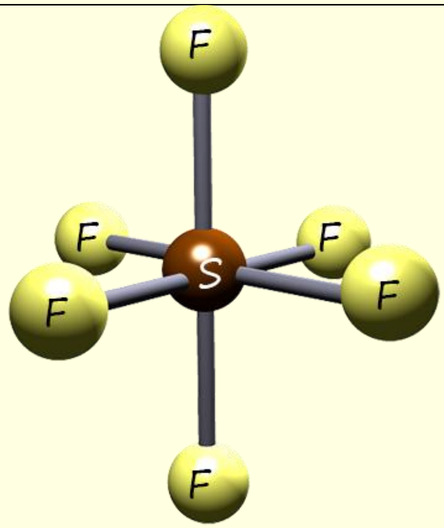
a. What is a dipole moment?

In a polar covalent bond there is a separation of charge. This produces a bond dipole. The size of the dipole produced depends on how far the charges are separated and how much charge is separated, more charge and greater distance gives larges dipoles. The dipole moment of a molecule is simply the addition of all the bond dipoles to give the overall molecular dipole.

6. For each molecule below indicate the presence of any dipoles present by adding the symbols for δ^+ and δ^- to show the presence of any bond dipoles in the molecule. Also decide if the molecule is polar or not.

Molecule	formula	Bond dipoles shown	Is this a polar molecule?
	Water H_2O	Hydrogen atoms will be δ^+ and the oxygen atom will be δ^-	Yes this molecule is polar, the centres of positive and negative charge are not overlapping, this molecule has a dipole moment.
	Chlorine Cl_2	Bond is covalent, no dipoles produced here.	Molecule is non-polar.

	chloromethane $HCCl_3$	C-H bond is non-polar, small difference in electronegativity here between atoms. C-Cl bonds are polar, C will be δ^+ and Cl atoms will be δ^+	Yes this molecule is polar, the centres of positive and negative charge are not overlapping, this molecule has a dipole moment.

Molecule	Formula	Bond dipoles shown	Is this a polar molecule?
	Phosphorus trifluoride PF_3	P–F bond is polar, P will be δ^+ and F atoms will be δ^-	Molecule is not symmetrical, will be polar molecule.
	Carbon dioxide CO_2	C=O bonds are polar, C will be δ^+ and O will be δ^-	Molecule is symmetrical, centers of positive and negative charge on bond dipoles are directly on top of each other.
	Sulfur hexafluoride SF_6	S–F bond is polar, P will be δ^+ and F atoms will be δ^-	Molecule is highly symmetrical, centres of positive and negative charge on all bond dipoles lie directly in the centre of the sulfur atom.