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VCE Chemistry ½

Polarity [1.7]

Test Solutions

20 Marks. 1 Minute Reading. 16 Minutes Writing.

Results:

Test Questions	_____ / 15
Extension	_____ / 5

Section A: Test Questions (15 Marks)

Question 1 (3 marks)

Tick whether the following statements are **true** or **false**.

	True	False
a. Electronegativity is affected by the number of electron shells an atom has.	✓	
b. Dipoles form when an atom loses or gains an electron.		✓
c. Fluorine is always more electronegative than chlorine.	✓	
d. In an ionic bond electrons are completely transferred to the more electronegative atom, which is not the case in covalent bonds.	✓	
e. The overall polarity of carbon dioxide is non-polar.	✓	
f. CF_4 is a pyramidal non-polar molecule.		✓

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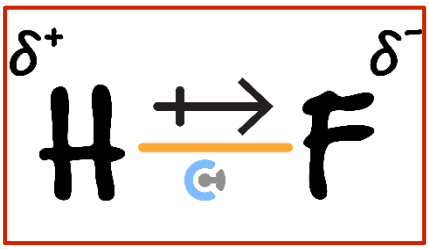
Sub-Section: Short Answer Questions

Question 2 (4 marks)

Ryan the chemist is experimenting with the molecule HF and ponders how the compound stays together in a liquid state, given that other compounds containing hydrogen such as H_2 are in a gaseous state. To begin Ryan draws a molecule of HF labelling the dipoles that form.

a. Draw the diagram which Ryan might have drawn. (1 mark)



b. Explain why HF maybe a liquid at room temperature whereas hydrogen gas is a gas. (2 marks)

The hydrogens form a positive dipole since the fluorine is very electronegative and hence attracts the electrons closer to it, forming a negative dipole. This allows HF to form dipole-dipole bonds, where as hydrogen gas has no dipoles.

c. Is this molecule overall polar, or non-polar? (1 mark)

Polar

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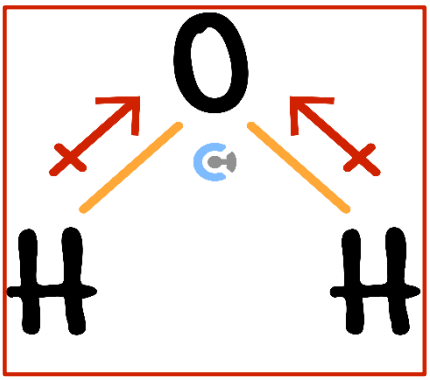
Question 3 (3 marks)

a. Label the following diagram with the relevant polarity arrows. (1 mark)



b. Another molecule which is liquid at room temperature is water. Explain why water is a dipolar molecule and how this affects its overall polarity. (2 marks)

Water is dipolar because the oxygen is a lot more electronegative, so it attracts the electrons closer towards it in the covalent bond. However, due to its V-shape, the molecule is overall polar due to having a positive dipole on the hydrogen side of the molecule and a negative dipole on the oxygen side.

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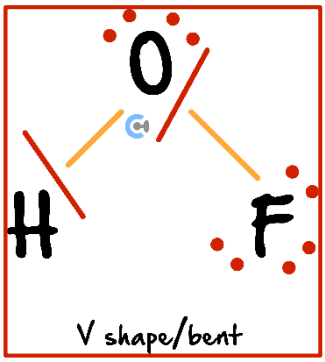
Question 4 (5 marks)

In the lab, Jeff was working with a number of fluorine-containing covalent molecules.

a. Consider the molecule FOH. Draw the molecule below, describing its molecular geometry. (2 marks)



b. Explain which of the atoms in FOH have the strongest attraction to electrons. What does this mean for the polarity of this atom in the molecule? (1 mark)

Fluorine is the most electronegative atom in this molecule, meaning that it will attract electrons the most. Since, electrons are negatively charged, it means that the fluorine will have a negative dipole.

c. Another Fluorine containing compound is HF, which has similar chemical properties to the molecule HCl. However, Jasmine works out that it takes much more energy to split a HF molecule into its individual atoms, as compared to a HCl molecule. Why is this the case? (2 marks)

Fluorine is much more electronegative than chlorine, and hence will have a stronger attraction toward the electrons in the covalent bond. This means that the HF covalent bond is stronger and more polar, and hence more energy would be needed to break it.

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Section B: Extension (5 Marks)

Question 5 (5 marks)

At the MakeAMolecule (MAM) factory, Daniel is making molecules of his choice. He can choose between hydrogen and the following atoms:

- ATOM A – Electronegativity of 4.4.
- ATOM B – Electronegativity of 3.5.
- ATOM C – Electronegativity of 8.1.

Ryan wants to make a molecule, which is unlikely to ever break.

a. Explain which of the following atoms Ryan should combine. (1 mark)

Ryan should combine atom B and C. This creates the greatest electronegativity difference, and thus the strongest and shortest covalent bond.

b. Ryan later combines two "C" atoms together, but notices a lack of any polarity at all. Why is this the case? (1 mark)

Whenever we have two of the same atoms they take on a linear shape, which means that the electronegativities of both of the C atoms would cancel each other out. Hence, there would be no overall polarity.

c. At the MAM factory, Ryan makes a V-shaped molecule using 1 atom "B" and two hydrogen atoms. Explain using the concept of electronegativity and molecular geometry what the polarity of this molecule would be. (2 marks)

As the atom B's are electronegative, they would attract the electrons in their bonds with the hydrogen atoms, and form a negative dipole, causing hydrogen to become positive.
Further, the overall V shape causes there to be an overall polarity since one side of the molecule will be more negative due to a lack of symmetry on all axis.

d. Explain the trend between the number of electron shells and the electronegativity of atoms. (1 mark)

As the number of electron shells increase, the electronegativity decreases since there is a greater distance between the charged core and the valence shell which can accept electrons.

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