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VCE Chemistry ½
Polarity [0.6]
Workshop

Error Logbook:



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Section A: Recap



Learning Objective : [1.7.1] - Identify polar & non-polar bonds within a covalent molecule, with reference to electronegativity

- _____ is an atoms' ability to attract an electron towards itself.
- A covalent bond is determined to be **polar** if there is an [even] / [imbalanced] electron distribution.
- If the two atoms in a covalent bond are **equally electronegative**, there [is] / [is no] **net dipole**, meaning the bond is [polar] / [non-polar].
- The **level of polarity** depends on the _____ between the atoms.
- The reason some bonds are **ionic** is because [metals] / [non-metals] wish to **lose** electrons, and as such, **do not** form covalent bonds.
- To figure out what type of bond is formed between atoms, **complete the table below**:

	<u>Bond</u>	<u>Bond</u>	<u>Bond</u>
Electronegativity Difference	0 - 0.4	0.4-1.8	> 1.8
Distribution of Electrons	Electrons are: [Attracted to the more electronegative atom] / [Shared roughly equally] / [Completely transferred to the more electronegative atom].	Electrons are: [Attracted to the more electronegative atom] / [Shared roughly equally] / [Completely transferred to the more electronegative atom].	Electrons are: [Attracted to the more electronegative atom] / [Shared roughly equally] / [Completely transferred to the more electronegative atom].
Examples	F ₂ , C - H, N ₂	N - H, O - H, HCl	NaCl, MgF ₂

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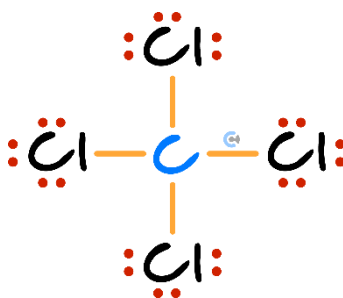
Learning Objective : [1.7.2] - Draw partial charges & corresponding polarity arrows on covalent molecules

- The **more electronegative** atom within a covalent bond gets a **partially** [positive] / [negative] charge.
- The **less electronegative** atom within a covalent bond gets a **partially** [positive] / [negative] charge.
- The two partial charges create two 'poles', known as a _____.
- The charges are **partial** as the electrons are still being [shared] / [transferred], unlike in an **ionic** bond, where they are [shared] / [transferred].
- _____ arrows can be drawn to label the direction in which _____ wishes to move.
- What does each end of a polarity arrow represent?

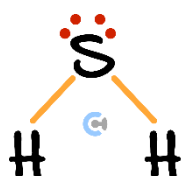


Learning Objective : [1.7.3] - Identify polar & non-polar molecules with reference to polar & non-polar bonds, as well as molecular geometry

- **Symmetrical Molecules with the same bonds** are [polar] / [non-polar] as the **bond dipoles** [cancel] / [do not cancel] each other out. For example:



- **Asymmetrical Molecules** that contain **polar bonds** are [polar] / [non-polar] molecules, as a **net** _____ is created in the molecule. For example:



➤ For a **molecule** to be **polar**:

⚙ There must be [polar] / [non-polar] **bonds** between the atoms.

⚙ **AND** there must [be] / [not be] a **net dipole** (polarity arrows [do] / [do not] cancel out).

➤ For a **molecule** to be **non-polar**:

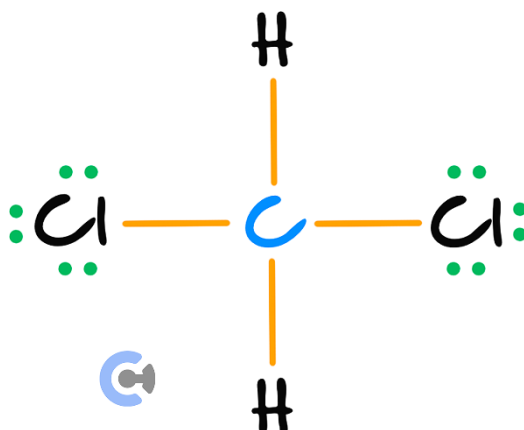
⚙ [Some] / [All] of the bonds must be **non-polar**.

⚙ **OR** The bonds may be polar, but the molecule is [symmetrical] / [asymmetrical], so there [is] / [is no] **net dipole** (polarity arrows [do] / [do not] cancel out).

➤ Since molecules exist in [2D] / [3D] space, the **arrangement of atoms** [does] / [does not] matter in terms of creating a **net dipole**.

➤ For example, if there are **polar bonds** within a tetrahedral molecule with all 4 groups **not** being identical, the molecule will be [polar] / [non-polar] **regardless** of the way the atoms are arranged.

➤ As such, this arrangement of CH_2Cl_2 is [polar] / [non-polar]:



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Section B: Warm Up (13.5 Marks)

INSTRUCTION: 13.5 Marks. 9 Minutes Writing.



Question 1 (2 marks)

For each of the following bonds, draw their polarity arrows.

a. C – N. (0.5 marks)

c. H – Br. (0.5 marks)

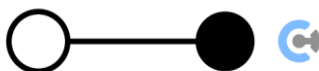
b. N – N. (0.5 marks)

d. O – H. (0.5 marks)

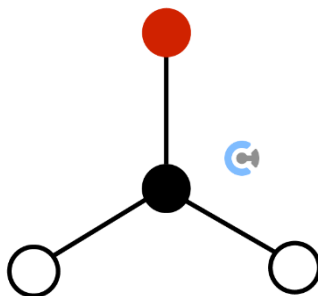
Question 2 (2.5 marks)

Examine the symmetry of each of these general diagrams of molecular structures, and determine if the molecules are likely to be polar or non-polar. The white, black, and red circles represent atoms with different electronegativities.

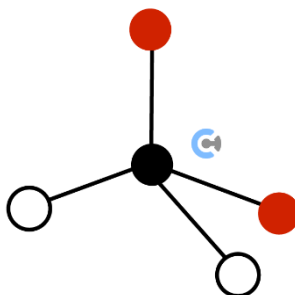
a. (0.5 marks)



b. (0.5 marks)



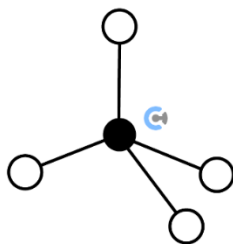
c. (0.5 marks)



d. (0.5 marks)



e. (0.5 marks)



Question 3 (1 mark)

State what is the factor that determines the polarity of a covalent bond.

Question 4 (1 mark)

For each of the following bonds, rank them from the least to most polar.



Question 5 (2 marks)

For each of the following molecules, state whether they are non-polar covalent or polar covalent.

a. H_2 . (0.5 marks)

[polar] / [non-polar]

b. NH_3 . (0.5 marks)

[polar] / [non-polar]

c. CF_4 . (0.5 marks)

[polar] / [non-polar]

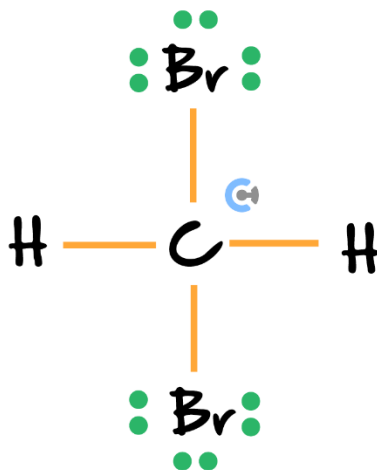
d. HCN . (0.5 marks)

[polar] / [non-polar]

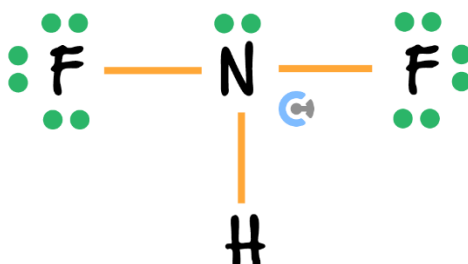
Question 6 (5 marks)

All of the following molecules have four electron groups around the central atom. State the molecular geometry of the molecules, and state whether it is polar or non-polar.

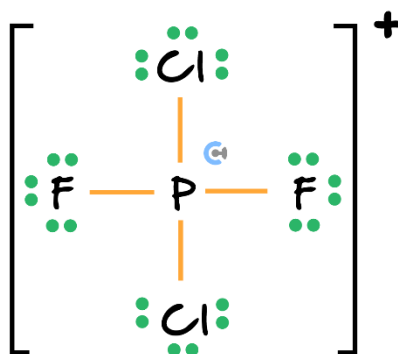
a. (1 mark)



b. (1 mark)



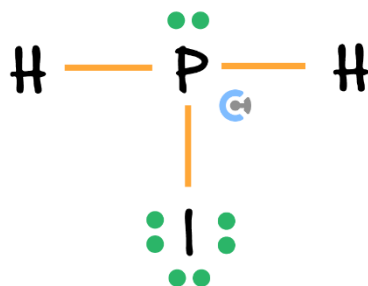
c. (1 mark)



d. (1 mark)



e. (1 mark)



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Section C: Ramping Up (18 Marks)

INSTRUCTION: 18 Marks. 13 Minutes Writing.



Question 7 (9 marks)

For each of the following molecules, draw the electron dot diagram, describe the shape, and state whether the molecule is polar or non-polar.

a. CH_4 . (3 marks)

Lewis Structure:

Shape: _____

Polarity: [polar] / [non-polar]

b. CO_2 . (3 marks)

Lewis Structure:

Shape: _____

Polarity: [polar] / [non-polar]

c. NH_3 . (3 marks)

Lewis Structure:

Shape: _____

Polarity: [polar] / [non-polar]

Question 8 (3 marks)

Are the following molecules polar or non-polar?

Draw structural formulas to help you decide.

a. CS_2 . (0.5 marks)

[polar] / [non-polar]

b. Cl_2O . (0.5 marks)

[polar] / [non-polar]

c. SiH_4 . (0.5 marks)

[polar] / [non-polar]

d. CH_3Cl . (0.5 marks)

[polar] / [non-polar]

e. CH_3CH_3 . (0.5 marks)

[polar] / [non-polar]

f. CCl_4 . (0.5 marks)

[polar] / [non-polar]

Question 9 (6 marks)

For each of the following pairs of molecules, state and explain which one is more polar.

a. CH_3Cl and CH_4 . (2 marks)

b. H_2S and H_2O . (2 marks)

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Section D: Getting Trickier I (12 Marks)

INSTRUCTION: 12 Marks.10 Minutes Writing.



Question 10 (5 marks)

Oxygen difluoride, OF_2 was first noticed in 1929 and reacts with many metals forming oxides.

- a. Draw the electron dot diagram of oxygen difluoride. (1 mark)
- b. Circle the lone pairs of electrons. What effect do they have on the shape of the molecule? (2 marks)
-
-
- c. Is OF_2 polar or non-polar? If it is polar, annotate the diagram using appropriate conventions to show the permanent dipoles. (2 marks)

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Question 11 (4 marks)

Consider molecules with a linear molecular geometry.

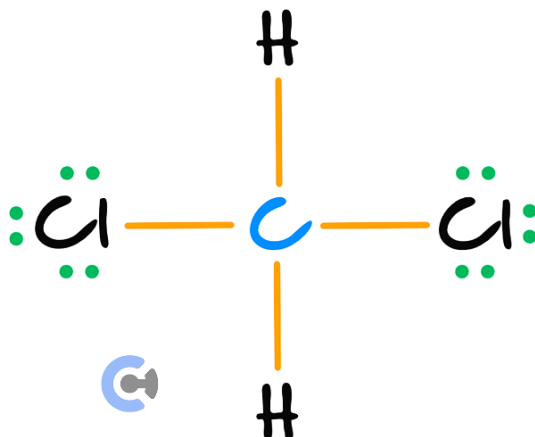
- a. Is CO_2 considered to be polar? Explain your answer. (2 marks)

- b. Are linear molecules always going to be polar? Justify your answer using examples. (2 marks)

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Question 12 (3 marks)

Explain why a molecule of CH_2Cl_2 is considered to be polar, even though it has a tetrahedral molecular geometry.



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Section E: Getting Trickier II (10 Marks)

INSTRUCTION: 10 Marks. 9 Minutes Writing.



Question 13 (10 marks)

Ammonia (NH_3) is a constituent of many cleaning products for bathrooms.

- a.** Draw an electron dot formula of an ammonia molecule, including non-bonding electron pairs. (2 marks)
- b.** Draw a structural formula for two ammonia molecules. Clearly show, and give the name of, the shape of these molecules. On your diagram, label the type of bonds that exist between the: (2 marks)
-  Atoms within each ammonia molecule.
-  Two ammonia molecules.
- c.** Draw a structural formula for a molecule of:
- i.** Nitrogen gas. (1 mark)
- ii.** Carbon dioxide gas. (1 mark)

- d.
- i. Explain why the bonds between nitrogen molecules and those between molecules of carbon dioxide are of the same type even though the bonds inside these molecules differ in strength and polarity. (2 marks)

- ii. Explain why the bonds between ammonia molecules are different from those between nitrogen molecules or carbon dioxide molecules. (2 marks)

*Let's take a **BREAK!***



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Section F: VCAA-Level Questions I (11 Marks)

INSTRUCTION: 11 Marks. 30 Seconds Reading. 10 Minutes Writing.



Question 14 (11 marks)

Hydrogen peroxide (H_2O_2) and oxygen gas (O_2) both have an oxygen atom covalently bonded to another oxygen atom.

a.

i. Draw a Lewis Structure of hydrogen peroxide. (2 marks)

ii. Draw a Lewis Structure of oxygen gas. (2 marks)

b. Identify the type of oxygen-oxygen covalent bond presented in O_2 . Explain your answer. (2 marks)

c. Identify the type of oxygen-oxygen covalent bond presented in H_2O_2 . Explain your answer. (2 marks)

- d. Hydrogen peroxide undergoes explosive chemical reactions whilst oxygen gas is a stable molecule. With reference to the type of covalent bonds present in both molecules, offer a possible explanation for this dramatic difference in properties. (3 marks)

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Section G: Multiple Choice Questions (7 Marks)

INSTRUCTION: 7 Marks. 7 Minutes Writing.



Question 15 (1 mark)

Which option is the most correct in explaining the level of polarity within a covalent bond?

- A. The number of electron shells that exist in the atoms in the bond.
- B. The atoms that exist in the bond itself.
- C. Whether the atoms in the bond are the same or different.
- D. The difference in electronegativities between the atoms in the bond.

Question 16 (1 mark)

What is false about the bonding in a HCl atom?

- A. HCl is a polar molecule.
- B. The Cl atom steals the electron from hydrogen as the electronegativity difference is extremely high.
- C. Electrons are more attracted towards the chlorine as it is more electronegative.
- D. The hydrogen atom is a partially positive pole in the molecule.

Question 17 (1 mark)

Which of the following bonds are considered the most polar?

- A. O – H
- B. N – H
- C. H – F
- D. H – Cl

Question 18 (1 mark)

Consider the following statements.

- I. A molecule with oxygen in it will automatically be polar as oxygen is electronegative.
- II. A polar bond can exist inside a non-polar molecule.
- III. It is possible for all electrons to be completely stolen by an atom in a bond.

Which one of the following options is true?

- A. I, II, III
- B. I, II
- C. II, III
- D. II only

Question 19 (1 mark)

Which one of the following statements about intramolecular bonds is correct?

- A. All gases exist in their natural state as diatomic molecules.
- B. Covalent bonds are typically non-polar.
- C. A bond in a molecule consisting of a metal and a halogen would be considered ionic.
- D. Difference in electronegativity is not a reliable way to determine the polarity of a molecule.

Question 20 (1 mark)

Which of the following gives the correct shape for each of the molecules listed?

	Linear	V-shaped	Tetrahedral
A.	CO ₂	H ₂ S	CH ₄
B.	H ₂	CO ₂	NH ₃
C.	HF	H ₂ O	NH ₃
D.	H ₂ O	NH ₃	CH ₄

Question 21 (1 mark)

The formula of a molecule is XY_4 . Select the alternative that could match this formula.

- A. OH_4
- B. CH_4
- C. HBr_4
- D. CO_4

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Section H: VCAA-Level Questions II (8 Marks)

INSTRUCTION: 8 Marks. 30 Seconds Reading. 7 Minutes Writing.



Question 22 (8 marks)

Phosphine, which is PH_3 is to be investigated.

- a. Draw the shape diagram for phosphine, making sure you make an attempt to demonstrate its three-dimensional structure and shape. (2 marks)

- b. Does this molecule have any lone pairs on the central P atom? (1 mark)

- c. What is the shape of the phosphine molecule? (1 mark)

- d. Explain how you determined the shape shown in **part a**. (2 marks)

- e. A molecule may have a tetrahedral arrangement of electron pairs around its central atom, but its shape may be described as pyramidal (rather than tetrahedral). Explain. (2 marks)

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Section I: Extension Questions (11 Marks)**Question 23** (11 marks)

Consider a molecule of H_2O .

- a. Explain the polarity of H_2O , with reference to electronegativity. (2 marks)

- b. Draw the Lewis Structure of H_2O , labelling the partial charges on the molecule. (2 marks)

- c. Compare H_2O 's polarity with a molecule of HCl . (2 marks)

- d. State what you think will happen when drops of HCl are released into a beaker of water. Explain your answer with reference to how the molecules will interact with each other. (3 marks)

- e. Would the same observation be made for drops of CH₄? Justify your answer. (2 marks)

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