Electronegativity and Intermolecular Forces for KS5 Chemistry - Worksheet

If you need to revise the different types of bonding, watch this lesson first

https://stemlearning.wistia.com/medias/b8zofx9hkf

1. Define Electronegativity

   ……

   ……...

2. In the Periodic Table, how does electronegativity change;
   a. Down a group?

   ……...

   b. Across the period?

   ……...

3. Explain the changes, from Q 2, in terms of atomic structure.

   ……

   ……

   ……

   ……...

4. Complete the table, for Shapes of Molecules

Number of electron pairs around the central atom	Name of the shape	Bond angle(s)
2		
3		
4		
5		
6		

STEM LEARNING

Electronegativity and Intermolecular Forces for KS5

5. How does the strength of repulsion of lone pairs of electrons compare to bonding pairs of electrons?

……

6. Shape of a CH_4 molecule.
    a. Draw a dot and cross diagram to show the bonding in CH_4

    b. How many pairs of electrons does it have in its highest energy level (outer shell)?

……

    c. What is the name of this shape?

……

    d. What are the bond angles in this shape?

……

    e. Draw a fully labelled 3D model of this molecule.

7. Shape of BF_3 molecule.
    a. Draw a dot and cross diagram to show the bonding in BF_3

b. How many pairs of electrons does it have in its highest energy level (outer shell)?

.....

c. What is the name of this shape?

.....

d. What are the bond angles in this shape?

.....

e. Draw a fully labelled 3D model of this molecule.

8. Work out the shapes and bond angles of the following:
   a. $BeCl_2$

.....

   b. BF_3

.....

   c. CH_3Cl

.....

   d. PH_3

.....

   e. H_2S

.....

9. A bond between hydrogen and chlorine can be described as polar. What is a polar bond?

.....

10. What does the δ+ symbol represent?

.....

11. Draw a molecule of hydrogen chloride adding the partial charges.

.....

12. What type of intermolecular force holds molecules of Iodine (I_2) together?

.....

13. Iodine (I_2) and chlorine (Cl_2) molecules are held together by the same intermolecular force. Iodine is a solid at room temperature but chlorine is a gas. With reference to the intermolecular forces, explain the difference in state.

.....

.....

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14. Methane (CH_4) and Hydrogen chloride (HCl) both contain polar bonds, in one the molecules are held together by Van der Waals forces the other by dipole-dipole forces. Explain why they are different.

.....

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.....

.....

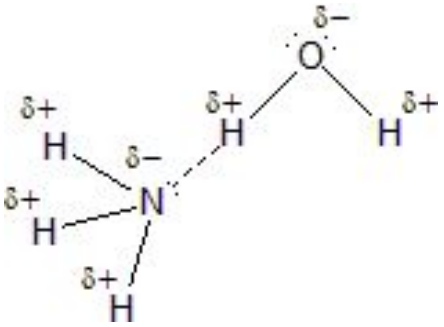
15. Which intermolecular force holds ammonia (NH_3) molecules together?

.....

16. Draw a molecule of ammonia and label the bond angles.

17. Draw a diagram to show the intermolecular forces between two ammonia molecules.

18. Water molecules can form a bond with ammonia molecules, as shown below. How would this bond affect the bond angles in ammonia?



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19. In some ionic compounds the bromide ions are polarised.

    a. What is a polarised bromide ion?

.....

    b. What feature of a cation causes a bromide ion to become polarised?

.....

20. What property of the atoms joined by a covalent bond causes the bond to be polar?

.....

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1. Define Electronegativity

   The ability of an atom to attract the pair of electrons in a covalent bond.

2. In the Periodic Table, how does electronegativity change;
   a. Down a group?

      decreases

   b. Across the period?

      increases

3. Explain the changes, from Q 2, in terms of atomic structure.

   Electronegativity increases with nuclear charge (number of protons) and smaller atomic size (less shielding by the electron shells)

   Down a group: Atomic size and shielding increase

   Across a period: Atomic size and shielding decrease, despite nuclear charge increasing.

4. Complete the table, for Shapes of Molecules

Number of electron pairs around the central atom	Name of the shape	Bond angle(s)
2	liner	180°
3	trigonal planar	120°
4	tetrahedral	109.5°
5	trigonal btpyramidal	120° & 90°
6	Octahedral	90°

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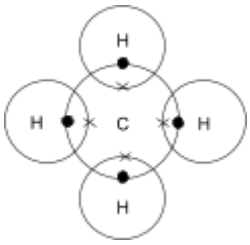
Electronegativity and Intermolecular Forces for KS5

5. How does the strength of repulsion of lone pairs of electrons compare to bonding pairs of electrons?

   lone pairs repel more than bonding pairs

6. Shape of a CH_4 molecule.
   a. Draw a dot and cross diagram to show the bonding in CH_4



   b. How many pairs of electrons does it have in its highest energy level (outer shell)?

      4 pairs

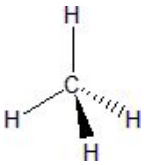
   c. What is the name of this shape?

      tetrahedral

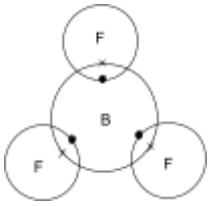
   d. What are the bond angles in this shape?

      109.5°

   e. Draw a fully labelled 3D model of this molecule.



7. Shape of BF_3 molecule.
   a. Draw a dot and cross diagram to show the bonding in BF_3



b. How many pairs of electrons does it have in its highest energy level (outer shell)?

3 pairs

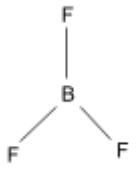
c. What is the name of this shape?

trigonal planar

d. What are the bond angles in this shape?

120°

e. Draw a fully labelled 3D model of this molecule.



8. Work out the shapes and bond angles of the following:
   a. $BeCl_2$
      linear, 180°
   b. BF_3
      trigonal planar, 120°
   c. CH_3Cl
      tetrahedral, 109.5°
   d. PH_3
      pyramidal, 107°
   e. H_2S
      bent, 105°
9. A bond between hydrogen and chlorine can be described as polar. What is a polar bond?

   unequal sharing of the bonding pair of electrons

10. What does the δ+ symbol represent?

    partial positive charge

11. Draw a molecule of hydrogen chloride adding the partial charges.

    $^{\delta+}H\text{-}Cl^{\delta-}$

12. What type of intermolecular force holds molecules of Iodine, I_2, together?

    Van der Waals

13. Iodine (I_2) and chlorine (Cl_2) molecules are held together by the same intermolecular force. Iodine is a solid at room temperature but chlorine is a gas. With reference to the intermolecular forces, explain the difference in state.

    Both held together by Van der Waals, which increase in strength as Mr increases. Mr of I_2 > Mr of Cl_2. Therefore the Van der Waals forces are stronger.

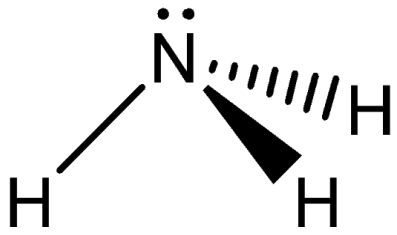
14. Methane (CH_4) and Hydrogen chloride both contain polar bonds, in one the molecules are held together by Van der Waals forces the other by dipole-dipole forces. Explain why they are different.

    Methane contains Van der Waals, Hydrogen chloride contains dipole-dipole. Methane is tetrahedral (symmetrical) so all polarities cancel out.

15. Which intermolecular force holds ammonia (NH_3) molecules together?

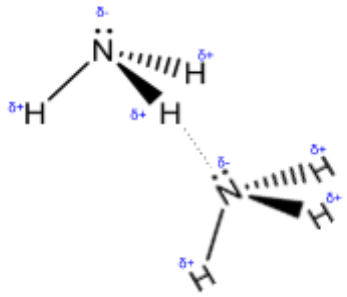
    Hydrogen bonding

16. Draw a molecule of ammonia and label the bond angles.

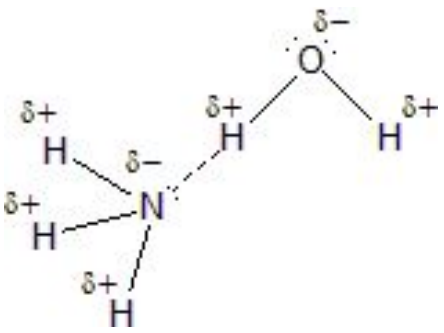


Bond angle 107°

17. Draw a diagram to show the intermolecular forces between two ammonia molecules.



18. Water molecules can form a bond with ammonia molecules, as shown below. How would this bond affect the bond angles in ammonia?



Lone pairs on N behave more like a bonding pair, so they repel less. Bond angle > 107°

19. In some ionic compounds the bromide ions are polarised.
    a. What is a polarised bromide ion?
       not symmetrical / distorted
    b. What feature of a cation causes a bromide ion to become polarised?
       high charge / small size
20. What property of the atoms joined by a covalent bond causes the bond to be polar?
    difference in electronegativity