Dipole moment

1. (b) CO_2 is a symmetrical molecule so its dipole moment is zero.

2. (d) These all have zero dipole moment.

3. (d) HF has largest dipole moment because electronegativity difference of both is high so it is highly polar.

4. (a) **Dipole**

   Explanation:
   When two atoms in a covalent bond have **different electronegativities**, the shared electron pair is **unequally distributed**.
   This creates a **partial positive charge (δ^+)** on one atom and a **partial negative charge (δ^-)** on the other, resulting in the formation of a **dipole**.

   Hence, **unequal sharing of electrons causes a dipole** in the molecule.

5. (c) Due to its symmetrical structure.

6. (c) Chloroform has 3 chlorine atom and one hydrogen atom attached to the carbon so it is polarised and it will show dipole moment.

7. (a) **Water**

   Explanation:
   In a **water molecule (H_2O)**, the oxygen atom is more electronegative than hydrogen, and the molecule has a **bent (V-shaped)** structure.
   This causes the individual O–H bond dipoles to **not cancel each other**, resulting in a **net dipole moment**.

   In contrast:

- **BF_3** and **CCl_4** are **symmetrical**, so their bond dipoles **cancel out**.
- **Benzene** is also **non-polar** due to its **symmetrical ring structure**.

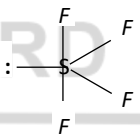
Hence, **water** possesses a **dipole moment**.

8. (a) The dipole moment of two dipoles inclined at an angle θ is given by the equation

$$\mu = \sqrt{X^2 + Y^2 + 2XY\cos\theta}$$

$\cos 90^\circ = 0$. Since the angle increases from $90 - 180$, the value of $\cos\theta$ becomes more and more $-$ *ve* and hence resultant decreases. Thus, dipole moment is maximum when $\theta = 90^\circ$.

9. (c) *Due to distorted tetrahedral geometry SF_4 has permanent dipole moment*



10. (b) CCl_4 has no net dipole moment because of its regular tetrahedral structure.

11. (b) **$CHCl_3$ (Chloroform)**

Explanation:

- **CH_4 (Methane)** and **CCl_4 (Carbon tetrachloride)** are **symmetrical molecules**, so their bond dipoles **cancel out**, resulting in **zero dipole moment**.
- **$CHCl_3$ (Chloroform)** is **asymmetrical**, and the C–Cl bond dipoles do not cancel completely, giving it a **net dipole moment**.
- **CHI_3 (Iodoform)** has a **smaller electronegativity difference** between C and I, so its dipole moment is **less than that of $CHCl_3$**.

Hence, **$CHCl_3$ has the largest dipole moment** among the given molecules.

12. (d) *H-F* is polar due to difference of electronegativity of hydrogen and fluorine so it shows positive dipole moment.

13. (b) **Electronegativity**

Explanation:

- The **polarity of a covalent bond** arises due to the **unequal sharing of electrons** between atoms.
- This unequal sharing occurs when the two bonded atoms have **different electronegativities** — the more electronegative atom pulls the shared electrons closer.
- Greater the **difference in electronegativity**, greater is the **bond polarity**.

14. (c) BCl_3 has zero dipole moment because of its trigonal planar geometry.

15. (d) **trans–1,2–dichloroethene**

Explanation:

- In *trans*–1,2–dichloroethene, the two chlorine atoms are placed **opposite to each other** on the double bond.
- Their **individual bond dipoles cancel out** due to symmetry, resulting in a **net dipole moment of zero**.
- In contrast, *cis*–1,2–dichloroethene has both Cl atoms on the same side, so dipoles **add up**, giving a **nonzero dipole moment**.

16. (c) Dipole moment of CH_3OH is maximum in it.

17. (c) *trans*-Butene-2

Explanation: In *trans*-Butene-2, the dipole moments of the C–H and C–CH_3 bonds are equal and opposite, cancelling each other. Hence, the molecule has a nearly **zero net dipole moment**

18. (a) CCl_4

Explanation: Carbon tetrachloride (CCl_4) has a **tetrahedral structure** with four identical C–Cl bonds symmetrically arranged. The bond dipoles cancel out, giving a **net dipole moment of zero**.

19. (c) CS_2

Explanation: Carbon disulphide (CS_2) is a **linear molecule (S=C=S)**. The two polar C=S bonds are equal and opposite, so their dipoles **cancel each other**, resulting in **zero permanent dipole moment**.

20. (b) CH_4 have regular tetrahedron so its dipole moment is zero.