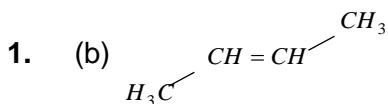


## Dipole moment, resonance and reaction intermediates



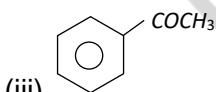
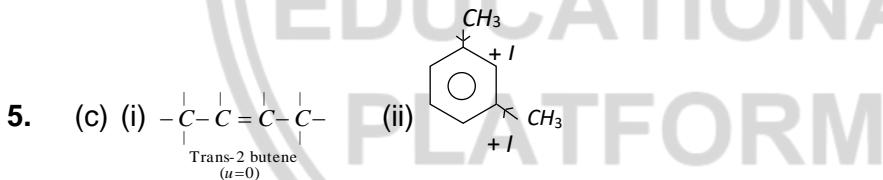
$\mu = 0$  symmetrical structure.

2. (b) Due to presence of two chlorine atom on the same side of carbon atom produces dipole moment in molecule.

3. (b) A molecule shows **dipole moment** when:

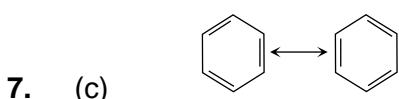
- It is **polar**
- Dipole vectors **do not cancel each other**
- Leads to a **net  $\mu$  (dipole moment)  $\neq 0$**

4. (c) We know that there is more difference in the electronegativities of hydrogen and chlorine. Therefore  $HCl$  is a polar compound.



The dipole moment is the highest for Acetophenone.

6. (d) Resonance structure of molecule does not have identical bonding.



All the bonds ( $C-C$ ) are equal in benzene. The  $C-C$  bond length is  $1.39\text{\AA}$  which is in between  $C-C$  bond ( $1.54\text{\AA}$ ) and  $C=C$  ( $1.34\text{\AA}$ ).

8. (d) Benzene's aromatic nature is supported by **multiple theories**, not just one.

Theory	What it explains
Aromatic sextet theory	Explains the <b>six <math>\pi</math>-electrons</b> in a cyclic system (Hückel's rule).
Resonance theory	Shows how benzene exists as a <b>resonance hybrid</b> , delocalization of electrons.
Molecular orbital theory	Explains <b>continuous cyclic <math>\pi</math>-overlap</b> and formation of <b><math>\pi</math>-MO energy levels</b> .

9. (b)  (1) Molecule is planar.  
(2)  $6\pi$  electrons are present.

10. (c)  $-NR_2 < -OR < -F$

11. (d) Benzene is unreactive instead of having  $3\pi$  bonds because of resonance  $\pi$  -electrons are delocalized.

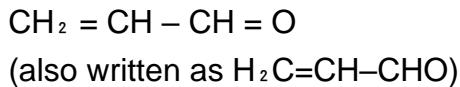
12. (b) Carboxylic acids are easily ionized because there is resonance in carboxylate ion due to  $\pi$ - electron shifting so  $H^+$  get ionised very easily.



13. (a) Due to delocalisation of  $\pi$  electrons benzene has resonance.

14. (c) Kekulé

- 15 (c) Acrolein structure:



**Key idea:**

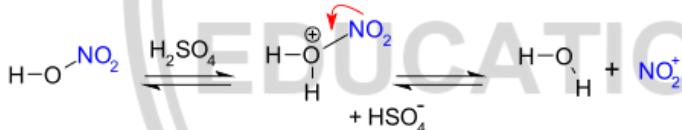
- The **C=O group is strongly electron withdrawing** (O is more electronegative → pulls electron density).
- Therefore **electron flow shifts from the double bond towards the carbonyl group.**
- Hence: **CH<sub>2</sub> gets δ-, the β-carbon becomes δ+, and C=O gets δ- (on O) and δ+ on C.**

So the correct polarization pattern is:

$$CH^{2(\delta-)} = CH^{\delta+} - CH = O$$

This matches **option (c).**

- 16 (b) It is formed by protonation + dehydration:



- 17 (d): (a) Benzene

Aromatic — 6 π electrons (Hückel rule:  $4n+2$ ).

(b) Cyclooctatetraenyl dianion

Original COT = 8 π electrons → antiaromatic.

But **dianion adds 2 electrons → 10 π electrons**, fits  $4n+2$  ( $n=2$ ).

So **aromatic**.

(c) Tropylium cation ( $C_7H_7^+$ )

7-membered ring with **6 π electrons** → aromatic.

(d) Cyclopentadienyl cation

Has **4 π electrons** → antiaromatic → **not aromatic**.



18 (b)  $CH_3 - CH_2 - <(CH_3)_2 - CH - <(CH_3)_3 - C -$

19. (a)  $> C^+ = \overset{\curvearrowleft}{C} <$

20. (a) Electromeric effect

