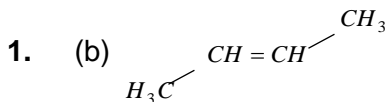


**Dipole moment, resonance and reaction intermediates**


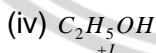
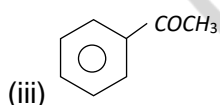
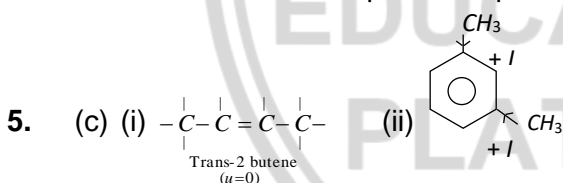
$\mu = 0$  symmetrical structure.

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:

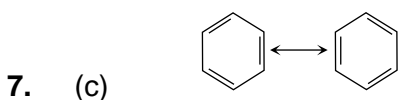
- It is **polar**
- Dipole vectors **do not cancel each other**
- Leads to a **net  $\mu$  (dipole moment)  $\neq 0$**

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.

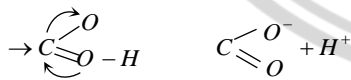
Theory	What it explains
Aromatic sextet theory	Explains the <b>six <math>\pi</math>-electrons</b> in a cyclic system (Hückel's rule).
Resonance theory	Shows how benzene exists as <b>a resonance hybrid</b> , delocalization of electrons.
Molecular orbital theory	Explains <b>continuous cyclic <math>\pi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

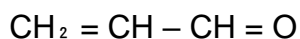
12. (b) Carboxylic acids are easily ionized because there is resonance in carboxylate ion due to  $\pi$ -electron shifting so  $H^+$  get ionised very easily.



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

14. (c) Kekule

- 15 (c) **Acrolein structure:**



(also written as  $\text{H}_2\text{C}=\text{CH}-\text{CHO}$ )



**Key idea:**

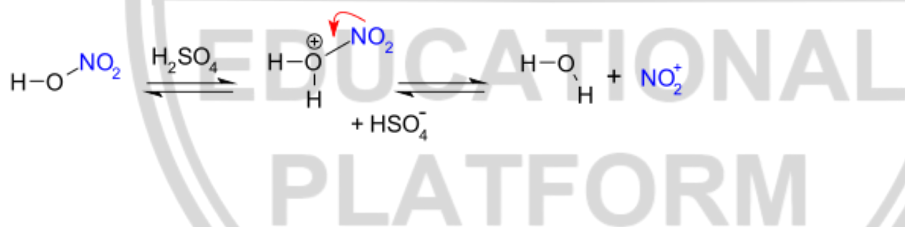
- The **C=O group is strongly electron withdrawing** (O is more electronegative → pulls electron density).
- Therefore **electron flow shifts from the double bond towards the carbonyl group**.
- Hence: **CH<sub>2</sub> gets δ<sup>-</sup>, the β-carbon becomes δ<sup>+</sup>, and C=O gets δ<sup>-</sup> (on O) and δ<sup>+</sup> 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  $\pi$  electrons (Hückel rule:  $4n+2$ ).
- (b) Cyclooctatetraenyl dianion  
Original COT = 8  $\pi$  electrons → antiaromatic.  
But **dianion** adds 2 electrons → **10  $\pi$  electrons**, fits  $4n+2$  ( $n=2$ ).  
So **aromatic**.
- (c) Tropylium cation ( $C_7H_7^+$ )  
7-membered ring with **6  $\pi$  electrons** → aromatic.
- (d) Cyclopentadienyl cation  
Has **4  $\pi$  electrons** → antiaromatic → **not aromatic**.



18 (b)  $\text{CH}_3 - \text{CH}_2 - < (\text{CH}_3)_2 - \text{CH} - < (\text{CH}_3)_3 - \text{C} -$

19. (a)  $> \text{C}^+ \equiv \text{C} <$

20. (a) Electromeric effect

