

**Dipole moment ( $\mu$ ):** Dipole moment of a polar molecule is equal to the product of the magnitude of the charge ( $e$ ) & the distance ( $d$ ).

**Dipole moment ( $\mu$ )** =  $e \times d = (4.8 \times 10^{-10} \text{ esu}) \times (10^{-8} \text{ cm.}) = 4.8 \times 10^{-18} \text{ esu. cm} = 4.8 \text{ Debye}$

[separation of one full  $e^-$  charge by  $10^{-8} \text{ cm}$  distance]

[1 Debye = 1D =  $10^{-18} \text{ esum.cm}$ ]

CGS unit of dipole moment: Debye (D) & SI unit: Coulomb-meter (C.m).

$1\text{C.m} = 2.9962 \times 10^{29} \text{ D}$

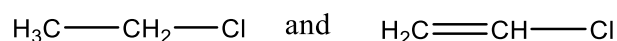
Q-1. The dipole moment of methyl halides is:  $\text{CH}_3\text{F}$  (1.82 D),  $\text{CH}_3\text{Cl}$  (1.94 D),  $\text{CH}_3\text{Br}$  (1.79 D) &  $\text{CH}_3\text{I}$  (1.64D). Explain.

Solution: The decreasing order of electronegativity of halogen and polarity of C-X (X = halogens) bonds are  $\text{F} > \text{Cl} > \text{Br} > \text{I}$  and  $\text{C-F} > \text{C-Cl} > \text{C-Br} > \text{C-I}$  respectively. So, it is expected that the decreasing order of dipole moment of methyl halides will be  $\text{CH}_3\text{F} > \text{CH}_3\text{Cl} > \text{CH}_3\text{Br} > \text{CH}_3\text{I}$ . But the dipole moment of  $\text{CH}_3\text{Cl}$  is higher than  $\text{CH}_3\text{F}$ . This can be explained by the shorter C-F bond distance than C-Cl bond distance. In  $\text{CH}_3\text{F}$ , the shorter C-F bond distance tends to decrease the value of  $\mu$  (i.e.,  $\mu = e \times d$ ) even though F is more electronegative than Cl.

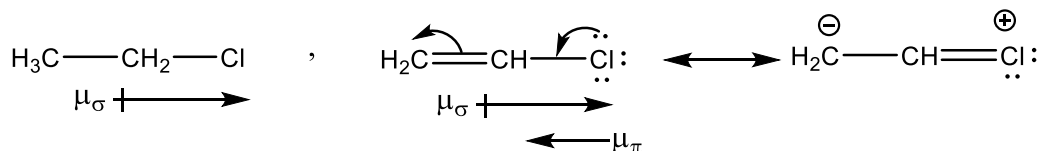
Q-2. The dipole moment of methyl chloride than methyl fluoride. Explain.

Solution: Dipole moment of a polar molecule is equal to the product of the magnitude of the charge ( $e$ ) & the distance ( $d$ ) i.e.,  $\mu = e \times d$ . As F is more electronegative than Cl, the magnitude of 'e' in  $\text{CH}_3\text{F}$  is higher than that in  $\text{CH}_3\text{Cl}$  but the C-F bond ( $d$ ) is shorter than the C-Cl bond. Because of this, the value of the product of 'e' & 'd' i.e.,  $\mu$  is larger for  $\text{CH}_3\text{Cl}$  & smaller for  $\text{CH}_3\text{F}$ . Therefore, the dipole moment of  $\text{CH}_3\text{Cl}$  is higher than  $\text{CH}_3\text{F}$ .

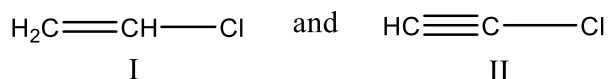
Q-3. Which of the following compounds will have higher dipole moment & why?



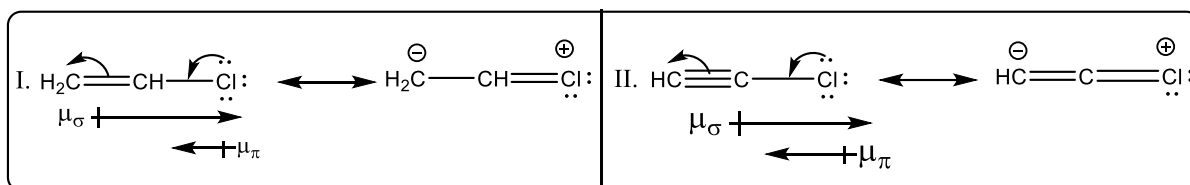
Solution: Chlorine is more electronegative than carbon. As a result, the C-Cl bond in ethyl chloride becomes polar & the compound shows considerable dipole moment. In vinyl chloride, the lone pair on chlorine atom becomes involved in resonance interaction with  $\pi$ -orbital of the double bond. As a result, in vinyl chloride, the electron withdrawing -I & +R effect of chlorine atom operates in opposite directions thereby decreasing its dipole moment as compared to that of ethyl chloride.



Q-4. Compare the dipole moment for following compounds.

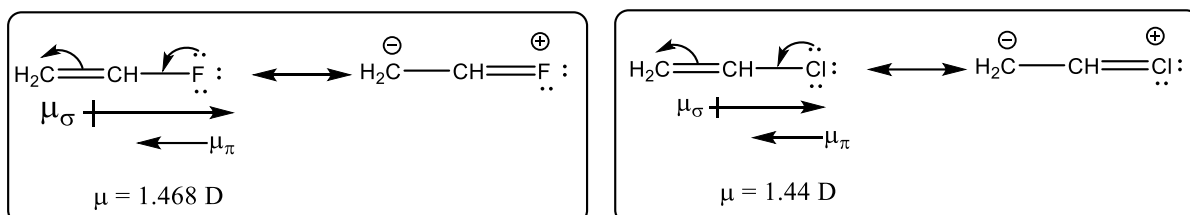


Solution: Chlorine is more electronegative than carbon. As a result, the C-Cl bond in both compound I & II becomes polar & the compound shows considerable dipole moment. In both compound I & II, the lone pair on chlorine atom becomes involved in resonance interaction with  $\pi$ -orbital of the double bond. The magnitude of  $\mu_{\pi}$  in compound II is higher than that of  $\mu_{\pi}$  in compound I. But the C-Cl bond moment ( $\mu_{\sigma}$ ) is equal in magnitude in both compound I & II. In both compounds, the electron withdrawing -I & +R effect of chlorine atom operates in opposite directions thereby decreasing their dipole moment. As a result, the dipole moment of compound II is lower than that of compound I.

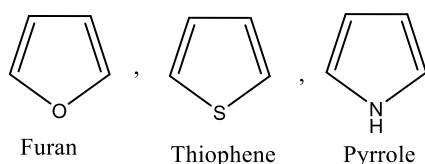


Q-5. Which one of the following has higher dipole moment & why? Vinyl chloride & vinyl fluoride. [C.U-2012]

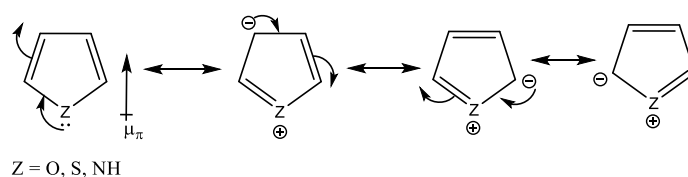
Solution: Fluorine is more electronegative than chlorine. As a result, C-F bond in vinyl fluoride is more polar than C-Cl bond in vinyl chloride. In both compounds, vinyl fluoride & vinyl chloride, the lone pair of halogen atom (F or Cl) becomes involved in resonance interaction with  $\pi$ -orbital of the double bond. The magnitude of  $\mu_{\pi}$  in vinyl fluoride is higher than that of  $\mu_{\pi}$  in vinyl chloride due to greater  $2p_{\pi}-2p_{\pi}$  overlapping between C-F bond in vinyl fluoride. Considering the opposing moment  $\mu_{\pi}$  &  $\mu_{\sigma}$ , the dipole moment of vinyl fluoride is slightly greater than that of vinyl chloride.

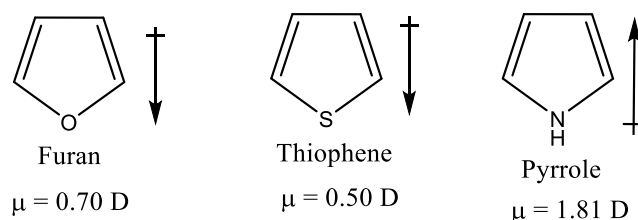


Q-5. Compare the value & the direction of dipole moment for each of following aromatic heterocyclic compounds.



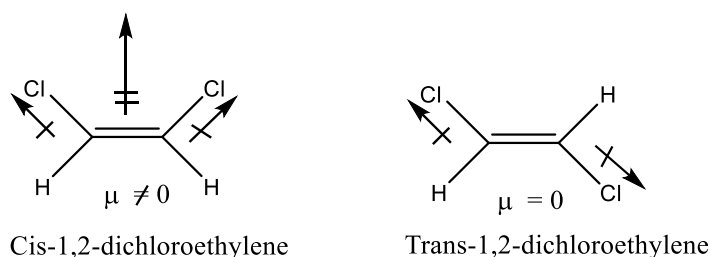
Solution: In the aromatic heterocyclic compounds, the lone pair on heteroatom is conjugated with the  $\pi$ -orbitals of the ring. In furan & thiophene, the dipole moment associated with the  $\pi$ -system (i.e.,  $\mu_{\pi}$ ) cancels the  $\sigma$ -moment (i.e.,  $\mu_{\sigma}$ ) considerably. As a result, the net dipole moment of furan & thiophene is reduced. Due to greater electronegativity of oxygen atom, the  $\pi$ -moment of furan is lower than that of thiophene. So, furan has greater dipole moment than thiophene. In pyrrole, the  $\pi$ -moment is larger than  $\sigma$ -moment & because of this, the direction of the net dipole moment is actually reversed from its saturated counterpart.





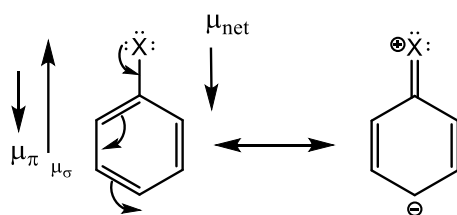
Q-6. Explain why trans-1,2-dichloroethylene has no dipole moment but cis-1,2-dichloroethylene does? [B. U-2001]

Solution: The carbon atoms in these compounds is  $sp^2$  hybridized. So, all the atoms of each molecule lie in the same plane. Since the chlorine atom in the cis-isomer lie on the same side of the double bond, there is a net dipole moment resulting from two individual C-Cl bond moments. In the trans-isomer the Cl atoms lie on the opposite sides of the double bond & the C-Cl bond moments are antiparallel. So, the individual C-Cl bond moments cancel each other & the molecule becomes non-polar.



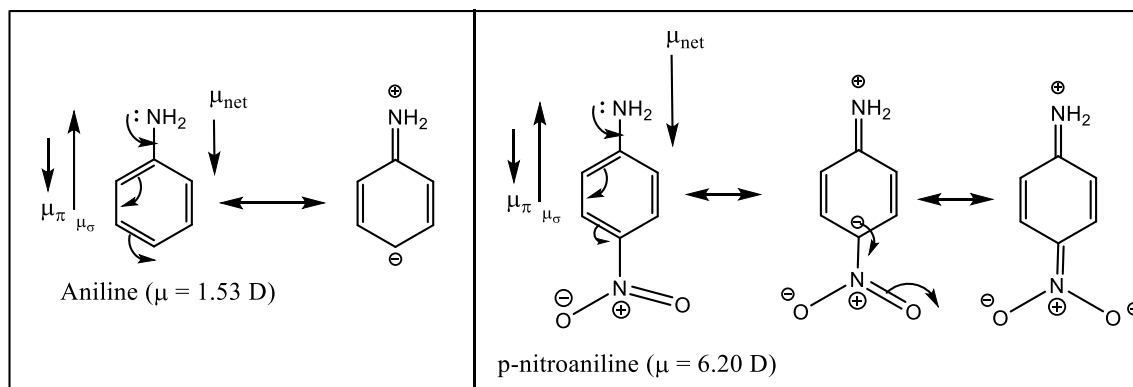
Q-7. The decreasing order of dipole moment of  $C_6H_5X$  is  $X = Cl > Br > I > F$ . Explain.

The decreasing order of electronegativity of halogens is  $F > Cl > Br > I$ . So, the  $\mu_\sigma$  is highest for  $X = F$  but least for  $X = I$ . Similarly,  $\mu_\pi$  moment is highest for  $X = F$  due to effective 2p-2p overlapping whereas  $\mu_\pi$  is negligible for  $X = Cl/Br/I$  due to less effective 3p-2p, 4p-2p & 5p-2p overlaps respectively. Therefore, the overall effect leads to least dipole moment for PhF & highest for PhCl.

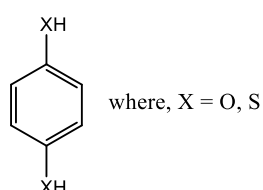


Q-8. The dipole moment of aniline is lower than p-nitroaniline. Explain.

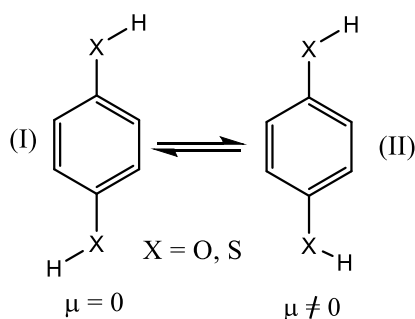
Solution: In aniline, the  $\mu_\sigma$  &  $\mu_\pi$  of  $-NH_2$  group operate in opposite directions thereby decreasing its dipole moment. In this case  $\mu_\pi$  is greater than  $\mu_\sigma$ . As a result, the net dipole moment operates in the direction of  $-NH_2$  group. In p-nitroaniline, -I effect of  $NO_2$  group & +R effect of  $-NH_2$  group act in the same direction. Due to this extended conjugation, the effective length of dipole becomes higher & hence  $\mu$  is higher than the calculated value.



Q-8. The dipole moment of the following compounds is not zero. Explain.

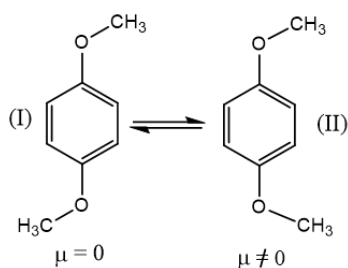


**Solution:** The given compound exists as two rotational isomers (I & II) in equilibrium. In II, the direction of the resultant group moment of each  $-\text{SH}$  group does not lie on the same plane of the ring & also does not act along the diagonal of the ring. Because of this, the given compound possesses appreciable dipole moment.



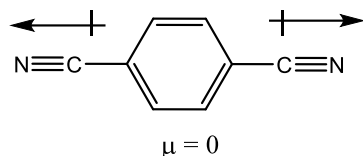
Q-9. The dipole moment of p-dimethoxybenzene is not zero. Explain.

Solution: Similar as the answer of question no. 8



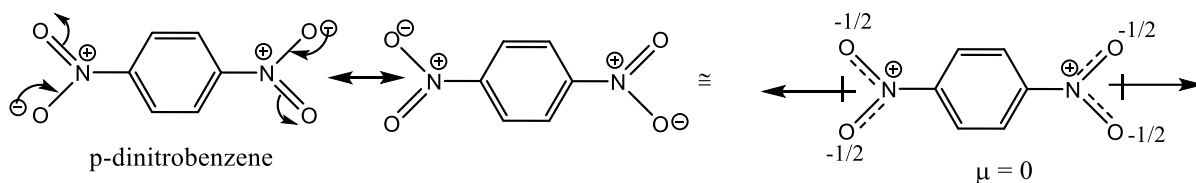
Q-10. the dipole moment of p-dicyanobenzene is zero-explain.

Solution: In p-dicyanobenzene, the direction of the resultant group moment of each -CN group lie on the same plane of the benzene ring. Because of this the  $\mu$  of the p-dicyanobenzene is zero.



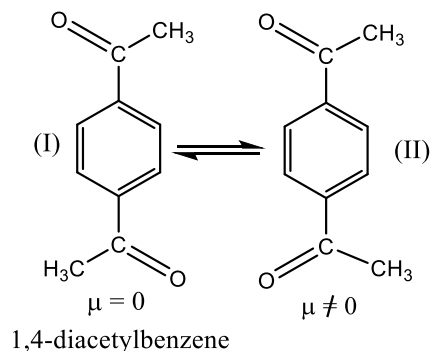
Q-11. The dipole moment of p-dinitrobenzene is zero-explain.

Solution: The -NO<sub>2</sub> group has a symmetrical arrangement of atoms and so, the direction of the resultant group moment lies on the diagonal of the hexagon. For this reason, p-dinitrobenzene has no dipole moment.



Q-12. The dipole moment of 1,4-diacetylbenzene is not zero. Explain.

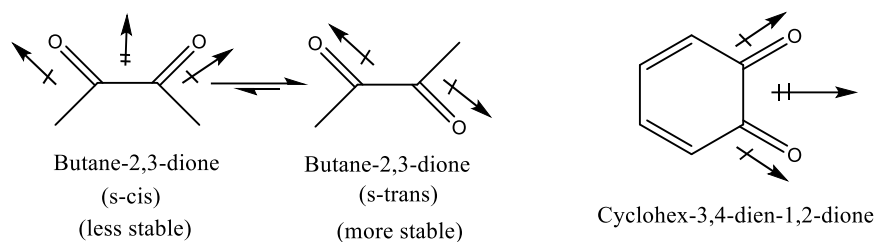
Solution: The 1,4-diacetylbenzene exists as two rotational isomers (I & II) in equilibrium. In II, the direction of the resultant group moment of each -COCH<sub>3</sub> group does not lie on the same plane of the ring & also does not acts along the diagonal of the ring. Because of this, the given compound possesses appreciable dipole moment.



Q-12. The dipole moment of butan-2,3-dione is very small whereas that of cyclohex-3,5-dien-1,2-dione is very large. Explain. [C.U-2019]

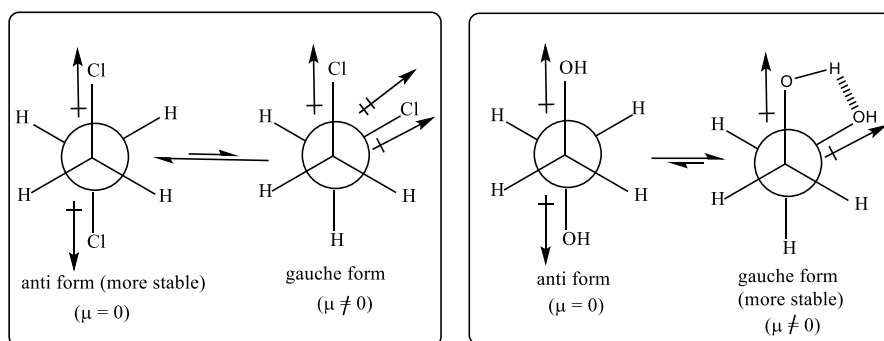
Solution: Butane-2,3-dione may exist in s-cis & s-trans conformations. The dipole-dipole repulsion is avoided in s-trans form. Thus, 1,2-diketo form gets stabilization by assuming antiparallel orientation of two keto groups. As a consequence, the compound exists almost exclusively in the more stable s-trans configuration & the overall  $\mu$  of the compound is very small.

In of cyclohex-3,5-dien-1,2-dione, there is no antiparallel orientation of the two keto groups is possible due to rigid structure of the compound. Because of this, the compound possesses a large dipole moment.



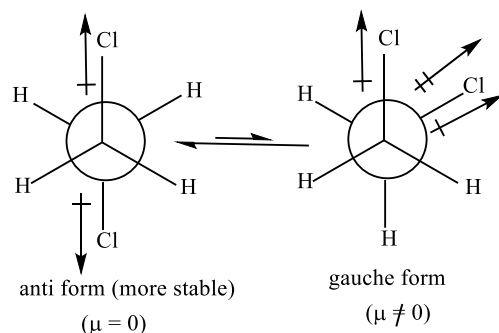
Q-13. 1,2-dichloroethane has a very little dipole moment whereas 1,2-ethanediol has considerable dipole moment. Explain. [B.U-2014]

Solution: 1,2-dichloroethane exist in anti & gauche forms. The  $\mu$  of anti-form is zero because the two C-Cl dipoles are anti parallel. But in gauche form, there is dipole moment. In vapor phase, because of dipole-dipole repulsion & steric repulsion, the gauche form is less stable than the anti-form. Therefore, the compound exists almost in anti-form & the overall dipole moment of this compound is very small. In the case of ethane-1,2-diol, the gauche form is more stable due to intramolecular hydrogen bonding than anti form. In gas phase, the compound exists almost in the gauche form & the compound ethane-1,2-diol possesses considerable dipole moment.



Q-14. The dipole moment of 1,2-dichloroethane increases as the temperature is increased.

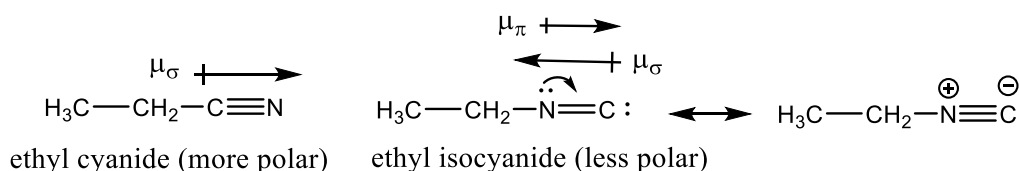
Solution: 1,2-dichloroethane exist in anti & gauche forms. The  $\mu$  of anti-form is zero because the two C-Cl dipoles are anti-parallel. But in gauche form, there is dipole moment. In vapor phase, because of dipole-dipole repulsion & steric repulsion, the gauche form is less stable than the anti-form. As the temperature increases, the population of gauche conformer (less stable) increases & so, the overall dipole moment of the compound increases.



Q-15. Which one of following will have lower dipole moment and why?

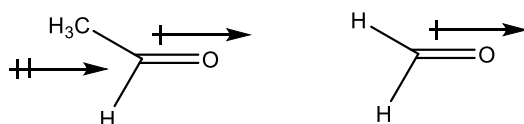
$C_2H_5CN$  &  $C_2H_5NC$

Solution: Nitrogen is more electronegative than carbon. As a result, the C-N bond in both compound ethyl cyanide & ethyl isocyanide becomes polar & the compound shows considerable dipole moment due to  $\mu_\sigma$ . In ethyl isocyanide, the lone pair on nitrogen atom becomes involved in resonance interaction with carbon atom. So, in ethyl isocyanide,  $\mu_\sigma$  &  $\mu_\pi$  operates in opposite directions thereby decreasing its dipole moment. As a result, the dipole moment of ethyl cyanide is higher than that of ethyl isocyanide.



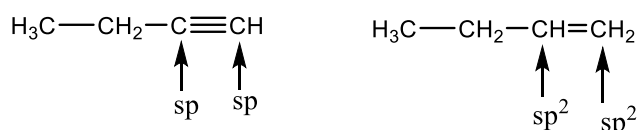
Q-16. How can you explain that acetaldehyde has a greater dipole moment than formaldehyde?

Solution: In acetaldehyde, the dipole moment of C=O bond is assisted by the resultant of the  $CH_3-C_{sp^2}$  &  $C_{sp^2}-H$  bonds & hence the molecule has greater dipole moment than formaldehyde. Formaldehyde possesses dipole moment due to only C=O bond. Therefore, acetaldehyde has a greater dipole moment than formaldehyde.



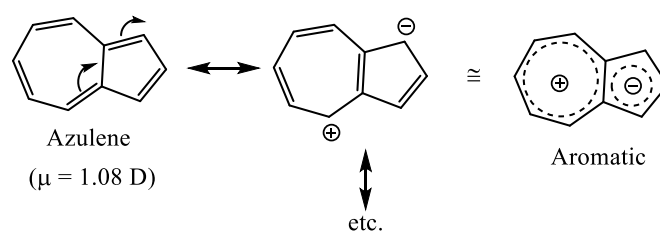
Q-17. Why 1-butyne has higher dipole moment than 1-butene? [B.U-2012]

**Solution:** A C- $C_{sp}$  bond is more polarized than a C- $C_{sp^2}$  bond because the carbon atom with more 's' character is more electronegative. Therefore, 1-butyne has higher dipole moment than 1-butene.

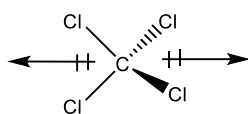


Q-17. Can a molecule have a dipole moment if it has no polar covalent bonds? Can a molecule have polar bonds but no dipole moment? Justify your answer with an example.

**Solution:** Azulene (hydrocarbon) molecule has no polar bonds but it has high dipole moment ( $\mu = 1.08$  D). Azulene (ten  $\pi$ -electrons system) is aromatic compound and both the ring possess a close loop of six  $\pi$ -electrons. Due to gain aromaticity, the major contributing structure of azulene has charge separated and it may be regarded as a combination of aromatic cycloheptatrienyl cation & the aromatic cyclopentadienyl anion. So, it has higher dipole moment.

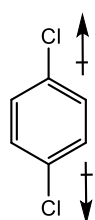


Carbon tetrachloride ( $\text{CCl}_4$ ) molecule has four C-Cl bonds but it has no dipole moment.  $\text{CCl}_4$  molecule has tetrahedral geometry. So, the resultant dipole moment of any two adjacent C-Cl bonds gets cancelled by an equal & opposite resultant dipole moment of the remaining two C-Cl bonds. As a result, the net dipole moment of the molecule is zero.



Carbon tetrachloride ( $\mu = 0$ )

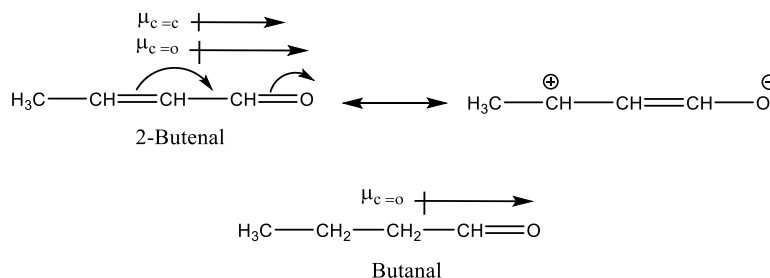
Chlorine is more electronegative than carbon. In 1,4-dichlorobenzene, the two electronegative atoms are present exactly opposite to each other. Their dipole moments cancel out each other. In 1,4-dichlorobenzene, So, the individual C-Cl bond moments are equal in magnitude but opposite in direction and they cancel each other. As a result, the molecule becomes nonpolar.



1,4-dichlorobenzene ( $\mu = 0$ )

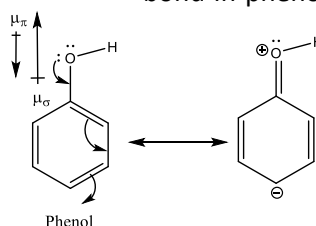
Q-18. 2-butenal has higher dipole moment than butanal. Explain.

Solution: In 2-butenal, the  $\pi$ -electrons of  $\text{C}=\text{C}$  is delocalized with the  $-\text{CH}=\text{O}$  group and the dipole moment of  $\text{C}=\text{O}$  bond is assisted by the  $\mu_\pi$  of  $\text{C}=\text{C}$  bond. So, the molecule has greater dipole moment than butanal. But butanal possesses dipole moment due to only  $\text{C}=\text{O}$  bond. Therefore, 2-butenal has a greater dipole moment than butanal.



Q. Why polarizability of O-H bond in phenol is higher than the O-H bond of methyl alcohol? [C.U-2015]

Solution: In phenol, the lone pair on oxygen atom is delocalized with the  $\pi$ -electrons of benzene ring. The C-O bond in phenol becomes partial double bond character and there is positive charge on oxygen atom due to electron withdrawing benzene ring. So,  $\mu_\sigma$  of C-OH is opposed by  $\mu_\pi$  of C-OH. Therefore, the polarizability of O-H bond is less in phenol. In methanol, there is no such positive charge on oxygen atom. Therefore, the polarizability of O-H bond in phenol is higher than the O-H bond of methyl alcohol.

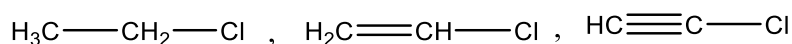




**University of Calcutta**

Q-1. Rationalize with reasoning, which compound in each of the following pair has the higher dipole moment: (i) Butanal & 2-butenal, (ii) p-Diacetylbenzene and p-dicyanobenzene. [C.U-1999]

Q-2. Arrange, with explanation, the following compounds in order of increasing dipole moment. [C.U-2000]



Q-3. which has the higher dipole moment-allyl bromide or vinyl bromide? Why? [C.U-2001]

Q-4. Justify with reasoning, which compound in the following pair has greater dipole moment:

4-nitroaniline and 2,3,5,6-tetramethyl-4-nitroaniline. [C.U-2002]

Q-5. Which one of following will have lower dipole moment and why? [C.U-2003]

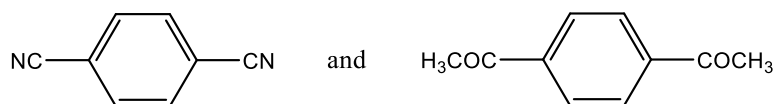
$\text{C}_2\text{H}_5\text{CN}$  &  $\text{C}_2\text{H}_5\text{NC}$

Q-6. Explain which one has got higher dipole moment- $\text{CH}_3\text{Cl}$  or  $\text{CH}_3\text{F}$ . [C.U-2004]

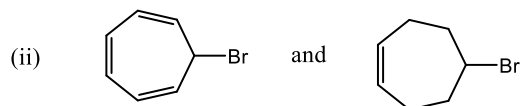
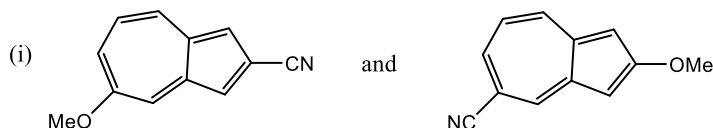
Q-7. How does bond polarity differ from bond polarizability? Explain with suitable examples. [C.U-2007]

Q-8. Compare the dipole moment of  $\text{CHCl}_3$  and  $\text{CH}_2\text{Cl}_2$  with reasons. [C.U-2007]

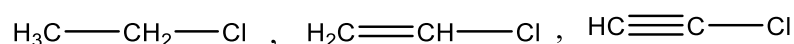
Q-9. Compare the dipole moment of following compounds: [C.U-2008]



Q-10. Compare the dipole moments of the following compounds with reason: [C.U-2009]



Q-11. Arrange, with explanation, the following compounds in order of increasing dipole moment. [C.U-2010]



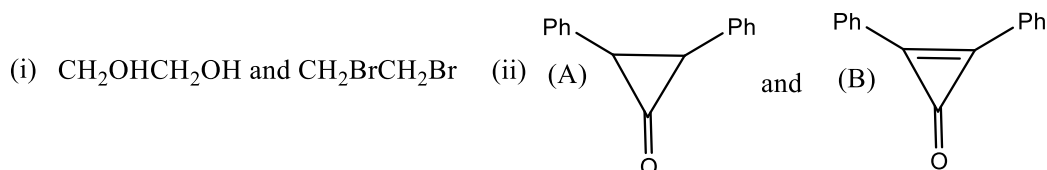
Q-12. Dipole moments of MeF (1.56 D) and MeCl (1.51D) are similar even though fluorine is considerably more electronegative than chlorine. [B.U-2011]

Q-13. Which of the following has higher dipole moment and why? Vinyl chloride and vinyl fluoride. [C.U-2012]

Q-14. Predict, with reasoning, which compounds in each of the following pairs has the higher dipole moment. [C.U-2013]

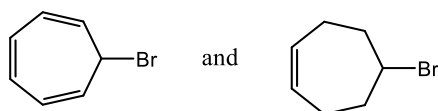
(i)  $\text{H}_3\text{C}-\text{CH}=\text{CH}-\text{Cl}$  and  $\text{H}_3\text{C}-\text{C}\equiv\text{C}-\text{Cl}$  (ii) p-diacetylbenzene and p-dicyanobenzene

Q-15. Compare the dipole moment in each of the following pairs: [C.U-2014]



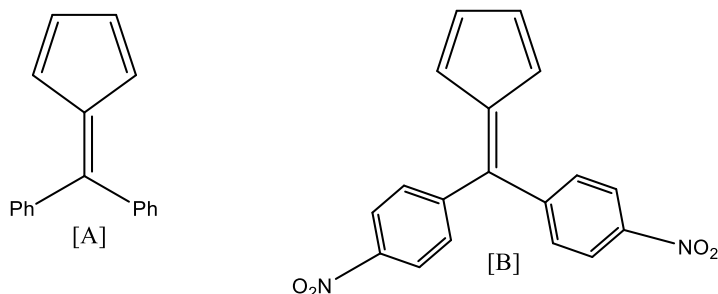
Q-16. why dipole moment of cyclopentadienone is less than cyclopentanone? [C.U-2015]

Q-17. Compare the dipole moments of the following compounds with explanation: [C.U-2016]



Q-18. 1,2-dichloroethane has zero dipole moment in gaseous phase but in solution the dipole moment increases with increases in polarity of the solvent. Explain. [C.U-2017]

Q-19. Dipole moment of [A] is higher than [B]. Explain. [C.U-2018]



Q-12. The dipole moment of butan-2,3-dione is very small whereas that of cyclohex-3,5-dien-1,2-dione is very large. Explain. [C.U-2019]

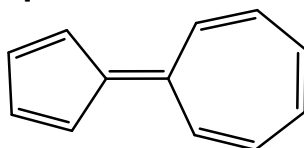
**The University of Burdwan**

Q-1. Which one of the following pairs will have higher dipole moment? Give reasons for your answer. P-dinitrobenzene and p-dihydroxybenzene. [B.U-1999]

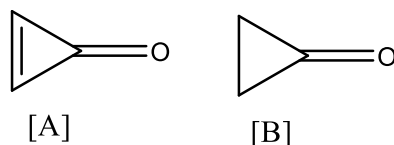
Q-2. How would you assign structures to three dichlorobenzenes from their dipole moment? [B.U-2000]

Q-3. Arrange the following compounds in order of increasing dipole moment:  $\text{CH}_3\text{Cl}$ ,  $\text{CH}_2\text{Cl}_2$ ,  $\text{CHCl}_3$ . [B.U-2001]

Q-4. The following hydrocarbon has an unusual high dipole moment. Explain how a large dipole moment might arise. [B.U-2001]



Q-5. Compound A has stronger dipole moment than compound B. Why? [B.U-2002]



Q-6. Which compound has higher dipole moment? Butane-2,3-dione and cyclopentane-1,2-dione. [B.U-2003, 2005]

Q-7. Why 1-butene has higher dipole moment than 2-butene? [B.U-2004]

Q-8. Which of the following compounds will have zero dipole moment? (i) cis-1,2-dichloroethylene (ii) trans-1,2-dichloroethylene (iii) 1,1-dichloroethylene. [B.U-2006, 2007]

Q-9. The dipole moment of methyl halides is:  $\text{CH}_3\text{F}$  (1.82 D),  $\text{CH}_3\text{Cl}$  (1.94 D),  $\text{CH}_3\text{Br}$  (1.79 D) &  $\text{CH}_3\text{I}$  (1.64D). Explain. [B.U-2006, 2008]

Q-10. Which of the following compounds have/ has no dipole moment? (i) propylene (ii) 1-butene (iii) cis-2-butene (iv) trans-2-butene. [B.U-2006, 2008]

Q-11. which one has greater dipole moment between  $\text{CHCl}_3$  &  $\text{CH}_2\text{Cl}_2$ ? Why? [B.U-2007]

Q-12. Can a molecule have a dipole moment if it has no polar covalent bonds? Can a molecule have polar bonds but no dipole moment? Justify your answer with an example. [B.U-2008, 2011]

Q-13. Explain why the dipole moment of  $\text{CHCl}_3$  is less than that of  $\text{CH}_2\text{Cl}_2$ . [B.U-2009]

Q-14. Which of the following compounds will have higher dipole moment and why? [B.U-2010]

(i)  $\text{CH}_3\text{CH}_2\text{-Cl}$  (ii)  $\text{CH}_2=\text{CH-Cl}$

Q-15. Compare the dipole moments of the following pairs: (i) trans and cis-1,2-dichloroethene

(ii) p-dichlorobenzene and p-dihydroxybenzene. [B.U-20112]

Q-16. Can you predict the direction of dipole moments in the following molecules? [B.U-2013]

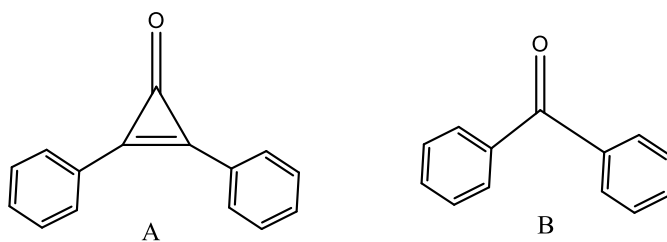
ICl, Br<sub>2</sub>, CH<sub>2</sub>=CH-Br, propyne.

Q-17. Compare the dipole moments of cis- and trans-3-chloro-2-butene. [B.U-2013]

Q-18. 1,2-Dichloroethane has a very low dipole moment, whereas 1,2-ethanediol has a considerably dipole moment-explain. [B.U-2014]

Q-19. How can you explain that acetaldehyde has a greater dipole moment than formaldehyde? [B.U-2015]

Q-20. Which of the following has greater dipole moment and why? [B.U-2015]



Q-21. Azulene has an unexpectedly high dipole moment. Why? [B.U-2017]

Q-22. Dipole moment of CH<sub>2</sub>=CH-CN greater than that of CH<sub>2</sub>=CH-CN. Why? [B.U-2017]

Q-23. Azulene is a non-benzenoid compound. Account for its aromaticity and relatively high dipole moment. [B.U-2018]

Q-24. Compare the dipole moments of the following pairs: [B.U-2019]

(i) p-dichlorobenzene and p-dihydroxy benzene (ii) o-nitro toluene & p-nitro toluene.

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Q-1. Which compound of the following pair has higher dipole moment? Explain. 1,2-dibromoethane and 1,2-ethanediol. [B.U-2005]

Q-2. Arrange the following organic compounds in order of decreasing polarity: Give reasons:

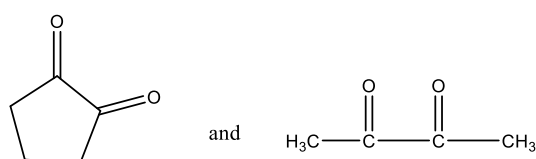
CH<sub>4</sub>, CH<sub>3</sub>Cl, CH<sub>3</sub>F, CH<sub>3</sub>Br. [V.U-2005]

Q-3. Which of the following pairs has higher dipole moment? Give reason. [V.U-2006]

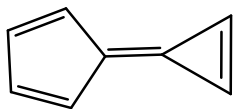
(i) CH<sub>3</sub>F and CH<sub>3</sub>Cl (ii) butane-1,2-dione and cyclopentane-1,2-dione

Q-4. how do you compare the dipole moments of NH<sub>3</sub> and NF<sub>3</sub>? Explain. [V.U-2006]

Q-5. Which of the following compounds has higher dipole moment and why? [V.U-2009]

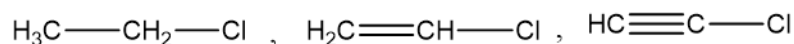


Q-4. The following hydrocarbon has an unusual high dipole moment. Explain. [V.U-2010]



Q-5. Which has higher dipole moment and explain p-Fluorophenol and p-chlorophenol. [V.U-2011]

Q-6. Arrange the following molecules with their increasing order of dipole moments: [V.U-2012]

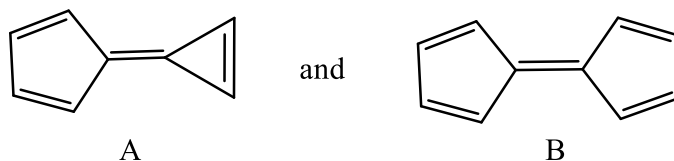


Q-7. The measured dipole moment of 4-nitro aniline (6.2 D) is larger than the value of calculated using standard group dipoles (5.2 D). [V.U-2012]

Q-8. "Dipole moment of MeF (1.56D) and MeCl (1.51D) are similar even though fluorine is considerably more electronegativity than chlorine". Explain with reason. [V.U-2013]

Q-9. Sesquifulvalene, a hydrocarbon, has unusually high dipole moment. Explain. [V.U-2013]

Q-10. Which compound possesses high dipole moment? Why? [V.U-2015]

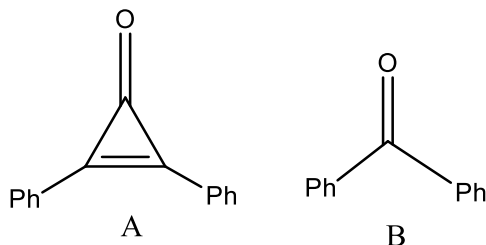


Q-11. Compare dipole moment for following compounds. [V.U-2016]



Q-12. What is the difference between polarity and polarizability? Explain with example. [V.U-2016]

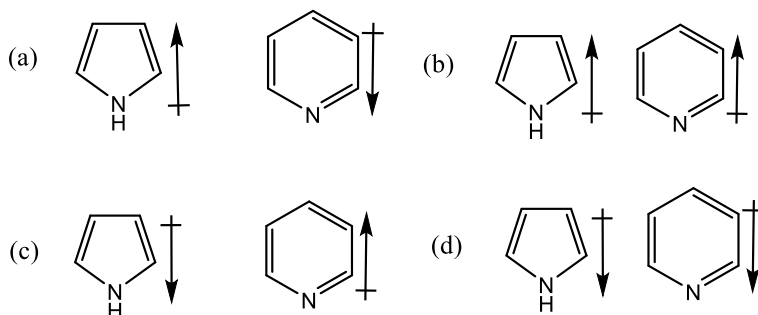
Q-13. Compare the dipole moment of [V.U-2017]



Q-14. Compare the dipole moments between  $\text{CH}_3\text{CH}_2\text{Cl}$  and  $\text{CH}_2=\text{CH}-\text{Cl}$ . [V.U-2018]

### Entrance Gallery

Q-1. The correct orientation of dipoles in pyrrole and pyridine is [JAM-2014]



Q-2. The correct order of dipole moments ( $\mu$ ) of the following compounds is [JAM-2008]

1.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$     2.  $\text{CH}_3\text{CH}=\text{CH}-\text{CHO}$     3.  $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$

- (a)  $\mu_1 > \mu_2 > \mu_3$     (b)  $\mu_2 > \mu_3 > \mu_1$     (c)  $\mu_3 > \mu_1 > \mu_2$     (d)  $\mu_2 > \mu_1 > \mu_3$

Q. Why polarizability of O-H bond in phenol is higher than the O-H bond of methyl alcohol? [C.U-2015]

Solution: In phenol, the lone pair on oxygen atom is delocalized with the  $\pi$ -electrons of benzene ring. The C-O bond in phenol becomes partial double bond character and there is positive charge on oxygen atom due to electron withdrawing benzene ring. So,  $\mu_\sigma$  of C-OH is opposed by  $\mu_\pi$  of C-OH. Therefore, the polarizability of O-H bond is less in phenol. In methanol, there is no such positive charge on oxygen atom. Therefore, the polarizability of O-H bond in phenol is higher than the O-H bond of methyl alcohol.

