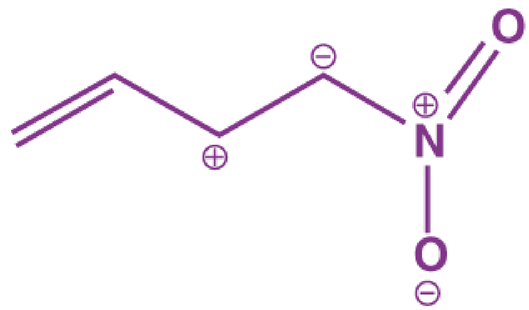
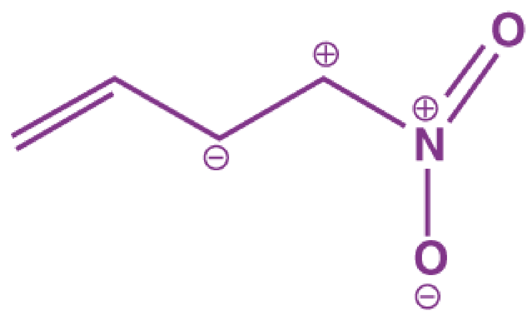
Resonance Structures Chemistry Questions with Solutions

Q1. Which is the least stable resonance structure among the following?



a.)



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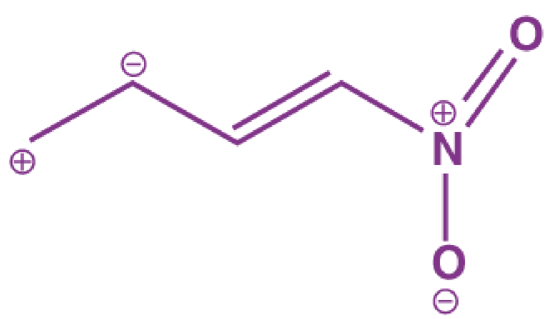
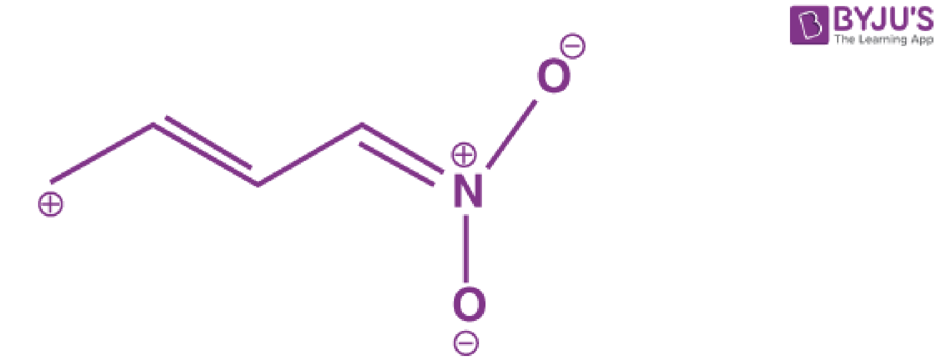
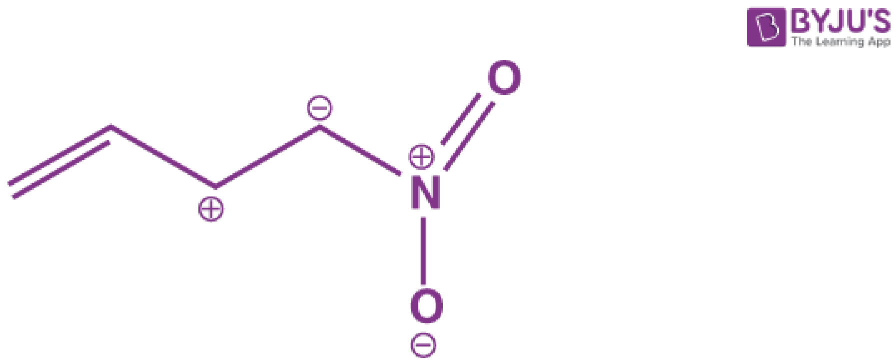


c.)



d.)

Correct Answer– (a.)



Explanation– The charge separation between like charges is minimal, which increases and decreases stability.

Q2. How many resonance structure will N^{3-} will have?

a.) 1
b.) 2
c.) 3
d.) None of the above

Correct Answer– (c.) 3

Q3. The number of resonance structures that NO_2 has is/are?

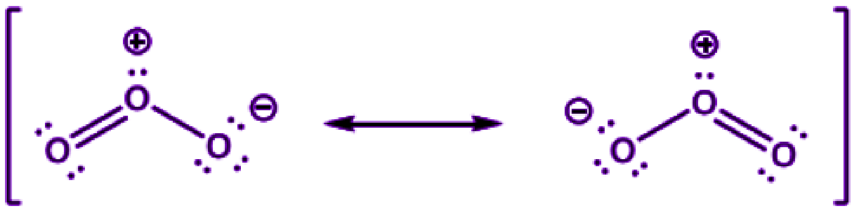
a.) 1
b.) 2
c.) 3
d.) None of the above

Correct Answer– (b.) 2

Q4. The number of resonance structure in ozone are-

a.) 1
b.) 2
c.) 3
d.) 4

Correct Answer– (b.) 2

Explanation– 

Q5. Resonance structures can be drawn for:

a.) O_3
b.) NH_3
c.) CH_3
d.) H_2O

Correct Answer– (a.) O_3

Q6. Write the resonance structure of CH_3COO^-

Answer. The resonance structure of CH_3COO^- is as follows-

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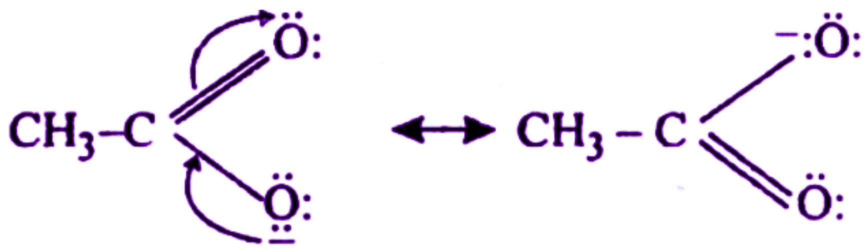
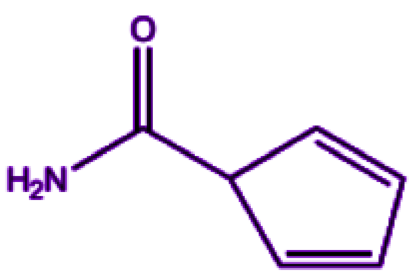


Q7. What is the difference between isomers and resonance structures?

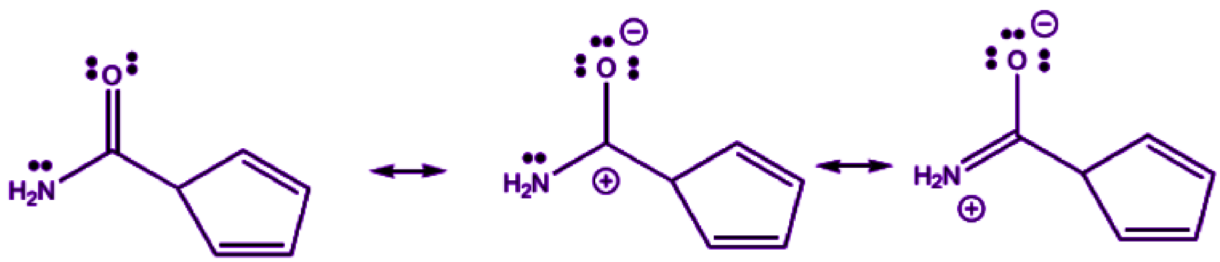
Answer. Isomers do not exist for resonance structures. Isomers have different atom and electron arrangements. The only difference between resonance forms is the arrangement of electrons.

Since they clearly show bonding in molecules, resonance structures are a better representation of a Lewis dot structure.

Q8. Draw all resonance structure for the following-



Answer.



Q9. State True or False.

All resonating structures must have same number of valence electrons.

Answer. True.
All resonating structures must have same number of valence electrons.
Electrons cannot be create or destroyed themselves. The structures you create must have the same number of electrons as the starting structure.

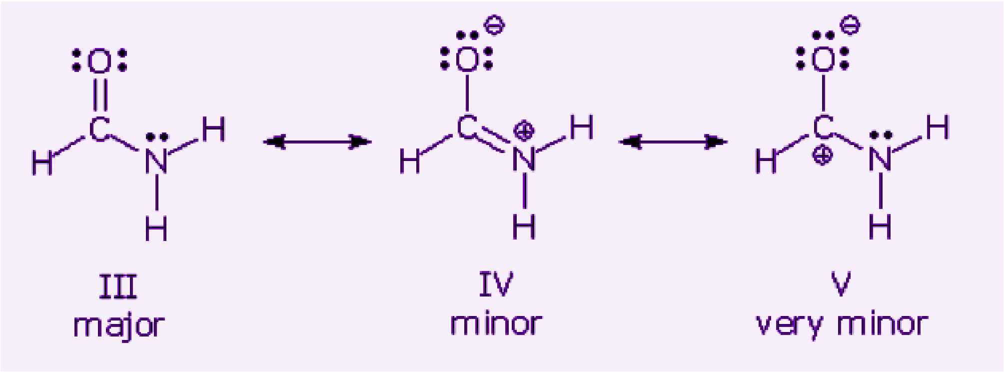
Q10. What are minor resonance structures?

Answer. All resonance contributors with higher energy than the lowest-energy contributor are considered minor resonance structures.
For example, in formamide $HCONH_2$, we can identify three potential contributors.
We must determine which of these has the lowest energy. That will be the most significant contributor. All of the others will be minor contributors.
Some rules that help to decide, in order of importance:

- Follow the octet rule
- Minimise charge separation.
- Charge the more electronegative atom with a negative charge.

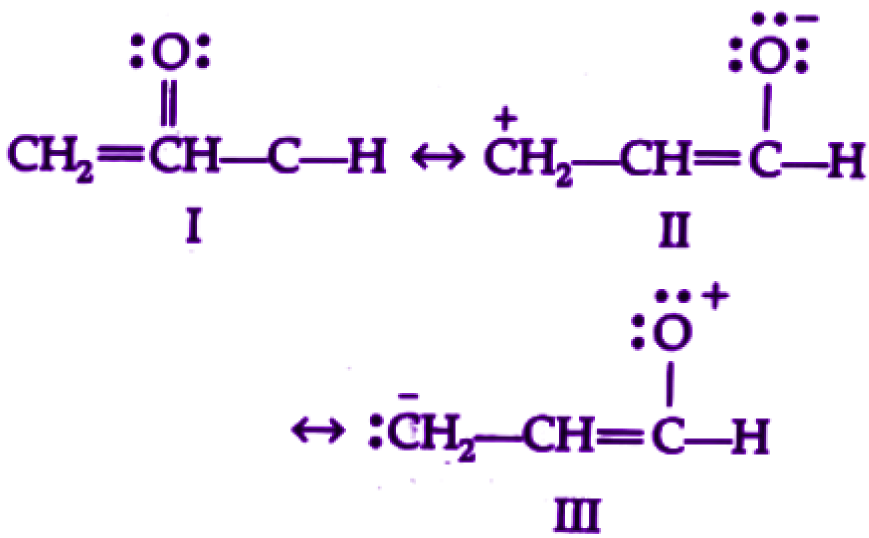
Structures III and IV both follow the octet rule, but Structure III lacks charge separation. Structure V does not provide an octet to the C atom.
III is the most important contributor. As a result, IV and V are minor contributors.
IV is a greater contributor than V because it follows the octet rule.

Thus, we can say that IV is a minor contributor, while V is a very minor contributor.



Q11. Write the resonance structure of $CH_2 = CH – CHO$. Indicate the relative stability of the contributing structure.

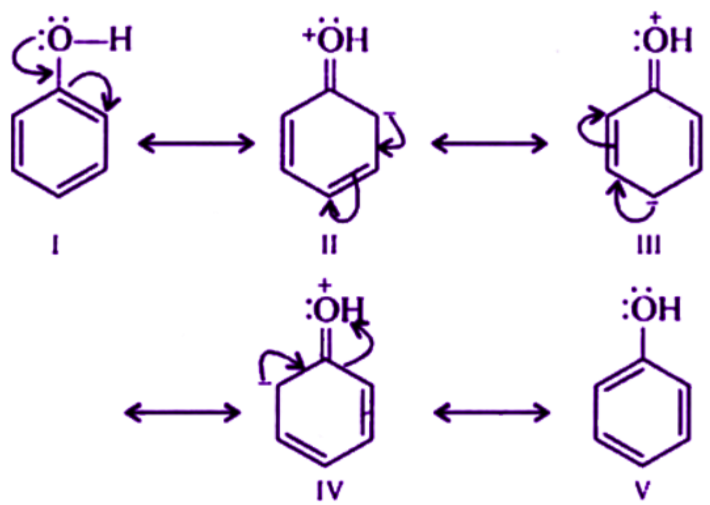
Answer. The resonance structure of $CH_2 = CH – CHO$ is as follows-



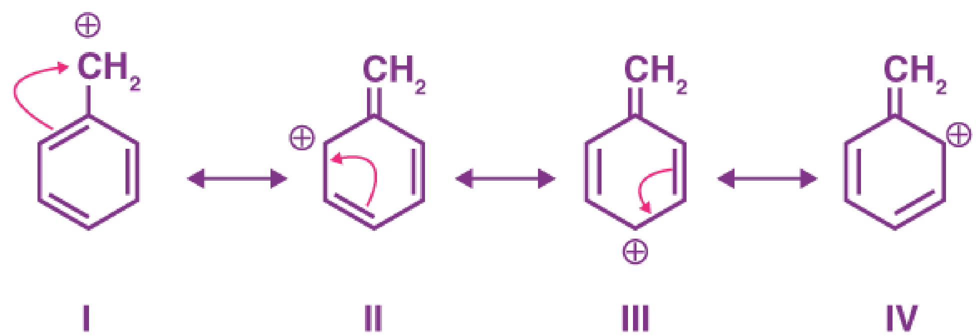
Stability is I > II > III
Structure I is most stable because each carbon and oxygen atom has an octet and no charge separation is present on any of the carbon or oxygen atoms. In structure II, the negative charge is applied to more electronegative atoms, and the positive charge is applied to more electropositive atoms. Structure III does not contribute because oxygen has a positive charge and carbon has a negative charge, making it the least stable.

Q12. Draw the resonance structures for the following compounds
(a) C_6H_5OH
(b) $C_6H_5C^+H_2$

Answer.
The resonance structure for the compounds are as follows-
(a)



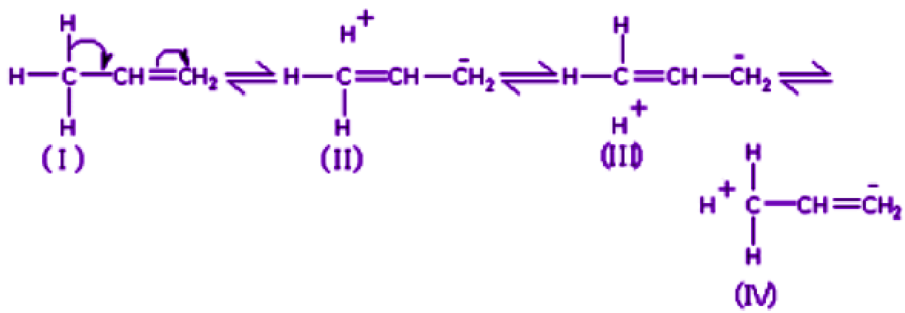
(b)



Q13. Show how hyper conjugation occurs in propene molecule.

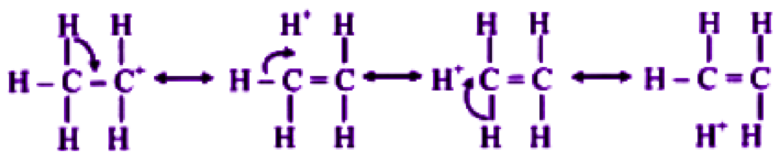
Answer. Hyper conjugation occurs in propene molecules due to a partial overlap of the sp 3-s sigma bond orbital and the empty p-orbital of an adjacent carbon atom. This causes pi-electrons to delocalize and increases molecule stability.

The stabilising interaction that results from the interaction of electrons in a -bond (usually C-H or C-C) with an adjacent empty or partially filled p-orbital or a π-orbital to give an extended molecular orbital that increases the system's stability is known as hyperconjugation.



Q14. Draw the orbital diagram showing hyperconjugation in ethyl cation.

Answer.
i. A positively charged carbon atom is attached to a methyl group to form ethyl cation $CH_3C^+H_2$.
ii. The positively charged carbon atom has six electrons, is sp^2 hybridised, and has an empty p orbital for hyperconjugation.
iii. One of the methyl group's C – H bonds can align with the plane of the empty p orbital. The C – H bond's sigma electrons can be delocalized into this empty p orbital.
iv. As a result of the partial overlap of a C-H bond with an adjacent positively charged carbon atom's empty p orbital, hyperconjugation occurs. Hyperconjugation is thus a σ-π conjugation.
v. In ethyl carbocation, hyperconjugation structures can be represented as:



vi. There is no covalent bond shown between the carbon and one of the α-hydrogens in the contributing structures. As a result, hyperconjugation is also known as 'no bond resonance.'
vii. Because the electron density from the adjacent a bond helps disperse the positive charge, this type of overlap stabilises the cation.

Q15. Explain why is $(CH_3)_3\ C^+$ more stable than $CH_3CH_2^+$ and CH_3^+ is the least stable cation.

Answer. $(CH_3)_3C^+$, i.e. 3° carbocation, is a more stable carbocation than 1° carbocation, i.e. CH_3^+ or $CH_3CH_2^+$, because 3° carbocation has more hyper conjunction effect, i.e. it has 9 alpha hydrogen, which is more stable, whereas CH_3^+ has 0 alpha hydrogen, which is why it is the least stable carbocation, and CH3CH2+ has 3 alpha hydrogen which
The more alkyl groups attached to a positively charged carbon atom, the stronger the hyperconjugation interaction and +I effect of the methyl group, and the more stable the cation.
$CH_3CH_2^+$ is thus more stable than $CH_3CH_2^+$ and CH_3^+.

Practise Questions on Resonance Structures

Q1. Which of the following has the least stable resonating structure?

a.) $\overset{\ominus}{C}H_2 - \overset{\oplus}{C}H - CH = CH - OCH_2 - CH_2 - CH_3$

b.) $\overset{\ominus}{C}H_2 - CH = CH - CH = \overset{\oplus}{O}CH_2 - CH_2 - CH_3$

c.) $CH_2 = CH - \overset{\ominus}{C}H - CH = \overset{\oplus}{O}CH_2 - CH_2 - CH_3$

d.) $CH_2 = CH - \overset{\oplus}{C}H - \overset{\ominus}{C}H - OCH_2 - CH_2 - CH_3$

Correct Answer– (b.) $\overset{\ominus}{C}H_2 - CH = CH - CH = \overset{\oplus}{O}CH_2 - CH_2 - CH_3$

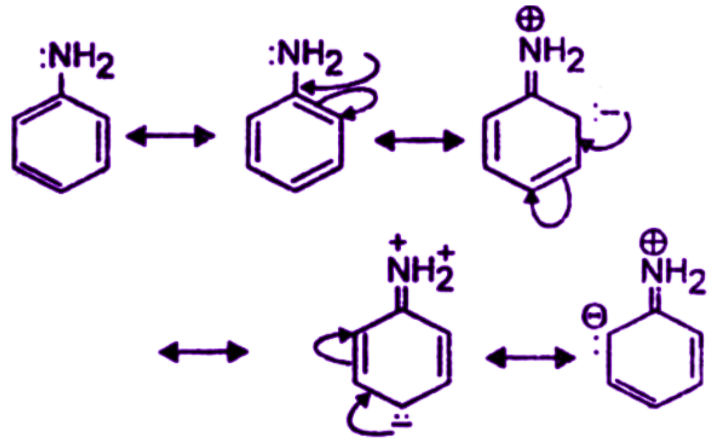
Q2. Which compound will have equally stable resonating structures?

a.) PhO^-
b.) $PhCOO^-$
c.) CO_3^{2-}
d.) $CH_2 = CH\ \text{-}CHO$

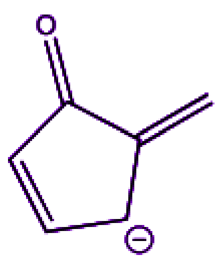
Correct Answer– (c.) CO_3^{2-}

Q3. Write the resonance structure of $C_6H_5NH_2$.

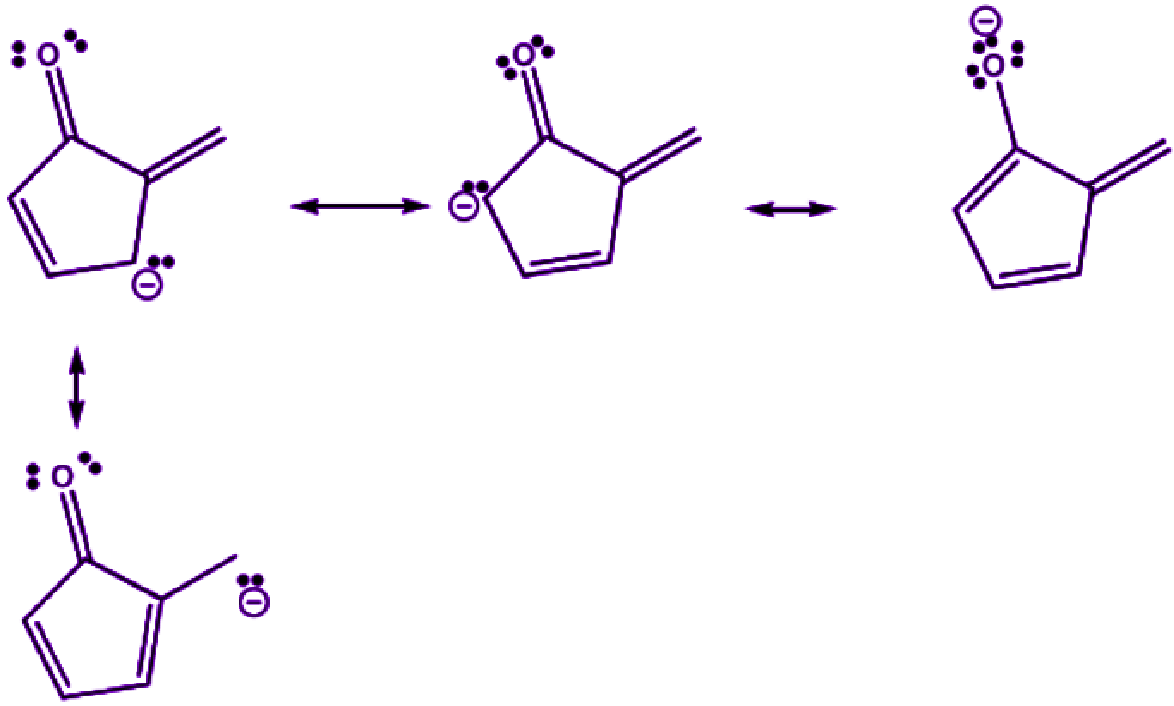
Answer. The resonance structure of $C_6H_5NH_2$ is as follows-



Q4. Draw all resonance structures for the following-



Answer. The possible resonance structures are as follows-



Q5. Fill in the blank.
Resonance structures of a molecule should not have ____.

Answer. Resonance structures of a molecule should not have identical bonding.
Thus is because we are only allowed to move electrons when writing resonance structures, we cannot have identical bonding. If the resonance structures are equivalent, they can have nearly the same energy content.