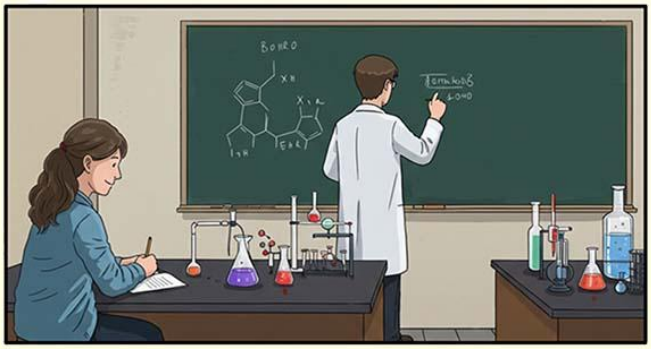
Answer: all the questions below as fully as you can then check your Answers

1. What is an electrophile? Give two common examples of electrophiles.

2. What is the molecular formula of benzene?



3. What type of reaction do alkenes typically undergo with electrophiles?

4. What is the key structural feature of benzene that contributes to its stability?

5. What is the overall result of an electrophilic substitution reaction on benzene?

6. Why doesn't benzene undergo electrophilic addition reactions like alkenes? Explain in terms of the delocalised pi electron system.

7. Explain in your own words why the intermediate carbocation formed in an electrophilic substitution reaction is described as "resonance stabilised."

8. Why is the addition of an electrophile to a benzene ring is likely to be a slow step in the overall electrophilic substitution reaction?

9. What is the overall effect of electrophilic substitution reactions on a benzene ring?

10. How does the concept of "resonance" explain the extra stability of benzene compared to a hypothetical molecule with three isolated double bonds?

11. Why is it not correct to say that delocalised electrons are free to move within a molecule? Explain what a correct way to describe delocalised electrons is.

Answers

1. What is an electrophile? Give two common examples of electrophiles.

Answer:: An electrophile is an electron-deficient species. Examples may include: hydrogen ions (H^+) and nitronium ions (NO_2^+)

2. What is the molecular formula of benzene?

Answer: C_6H_6

3. What type of reaction do alkenes typically undergo with electrophiles?

Answer: Electrophilic addition reactions.

4. What is the key structural feature of benzene that contributes to its stability?
Answer: A delocalised system of pi (π) electrons.

5. What is the overall result of an electrophilic substitution reaction on benzene?
Answer: A hydrogen atom on the benzene ring is replaced by the electrophile.

6. Why doesn't benzene undergo electrophilic addition reactions like alkenes? Explain in terms of the delocalised pi electron system.

Answer: Addition would destroy the delocalised pi system, which provides significant stability to the benzene ring. This loss of aromaticity is energetically unfavourable.

7. Explain in your own words why the intermediate carbocation formed in an electrophilic substitution reaction is described as "resonance stabilised."

Answer: The positive charge on the carbocation isn't localised on one carbon atom but is spread out (delocalised) over several carbon atoms due to the movement of electrons within the structure. This delocalisation leads to several possible "resonance structures" which increases the stability of the carbocation.

8. Why is the addition of an electrophile to a benzene ring is likely to be a slow step in the overall electrophilic substitution reaction?

Answer: The addition of the electrophile disrupts the stable delocalised pi electron system (aromaticity), requiring energy input, making it the rate-determining step.

9. What is the overall effect of electrophilic substitution reactions on a benzene ring?

Answer: They all involve the substitution of a hydrogen atom on the benzene ring by an electrophile. They all follow the same basic mechanism.

10. How does the concept of "resonance" explain the extra stability of benzene compared to a hypothetical molecule with three isolated double bonds?

Answer: Resonance describes the delocalization of pi electrons, which spreads out the electron density and lowers the energy of the molecule, making it more stable. Benzene's delocalised pi system allows for resonance, whereas isolated double bonds would not.

11. Why is it not correct to say that delocalised electrons are free to move within a molecule? Explain what a correct way to describe delocalised electrons is.
Answer: Delocalised electrons are not moving around. Instead, the electron density is spread out over multiple atoms. The electrons are described as being spread out, not as moving.