OCR (A) Chemistry A-level

Topic 6.1.1 - Aromatic compounds

Flashcards

What is the structure and formula of Benzene?

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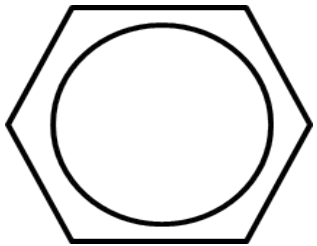
C_6H_6



What is the empirical formula of Benzene?

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CH

What is the state of benzene at room temperature?

What is the state of benzene at room temperature?

Liquid

What is the bond angle of benzene?

What is the bond angle of benzene?

Bond angle = 120°

What are the 3 features of benzene that don't support Kekule's model?

What are the 3 features of benzene that don't support Kekule's model?

- Benzene is resistant to addition reactions
- Enthalpy change of hydrogenation of benzene is more stable than predicted
- All the carbon bonds are same length

What technique was used to find the bond lengths of benzene?

What technique was used to find the bond lengths of benzene?

X ray diffraction

What happens to the 4th electron in the p-orbital of each carbon atom in benzene?

What happens to the 4th electron in the p-orbital of each carbon atom in benzene?

It delocalises to form rings of electron density above and below the hexagon, forming rings of delocalised electron density above/below the hexagon.

How do the rings of electron density affect the stability of Benzene?

How do the rings of electron density affect the stability of Benzene?

Makes benzene very stable, even though it is unsaturated (aromatic stability)

Draw the skeletal structure of cyclohexa-1,3,5-triene.

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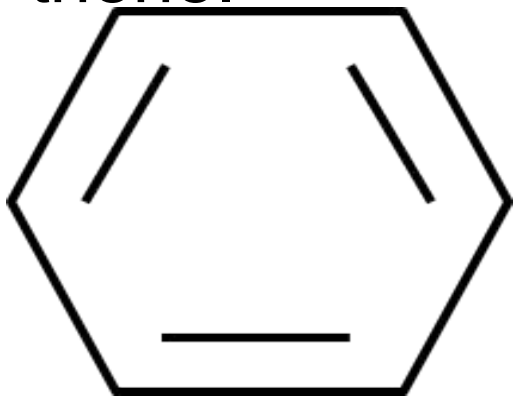

Why does benzene have a relatively high melting point?

Why does benzene have a relatively high melting point?

Close packing of flat hexagonal molecules when solid

Is benzene soluble in water? Explain why?

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No because it is non polar

Dangers of benzene - why it is not used in schools?

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It is a carcinogen

How do you name compounds containing a benzene ring?

How do you name compounds containing a benzene ring?

-benzene, or phenyl- ; can designate position on ring using numbers if there is more than one substituent

Why is benzene attacked by electrophiles?

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High electron density above/below ring due to delocalised electrons

Draw a general electrophilic substitution mechanism of benzene, using El+ to represent an electrophile

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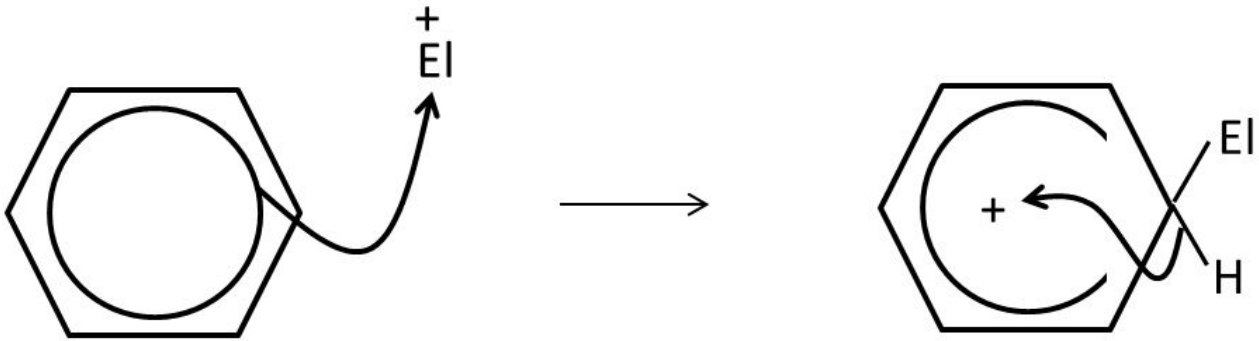

Nitration of benzene is what type of reaction?

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Electrophilic substitution reaction

Which ion is used to nitrate benzene?

Which ion is used to nitrate benzene?

NO_2^+

What is the catalyst in nitration of benzene?

What is the catalyst in nitration of benzene?

Sulfuric acid

How is this NO_2^+ ion generated? (conditions and equations)

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Concentrated H_2SO_4 and concentrated HNO_3.

$$H_2SO_4 + HNO_3 \rightarrow H_2NO_3^+ + HSO_4^-$$

$$H_2NO_3^+ \rightarrow H_2O + NO_2^+$$

Overall: $H_2SO_4 + HNO_3 \rightarrow HSO_4^- + NO_2^+ + H_2O$

How is the H_2SO_4 catalyst regenerated in the nitration of benzene?

How is the H_2SO_4 catalyst regenerated in the nitration of benzene?

$HSO_4^- + H^+ \rightarrow H_2SO_4$ (H^+ from benzene ring)

Draw a mechanism and write an overall equation for the nitration of benzene.

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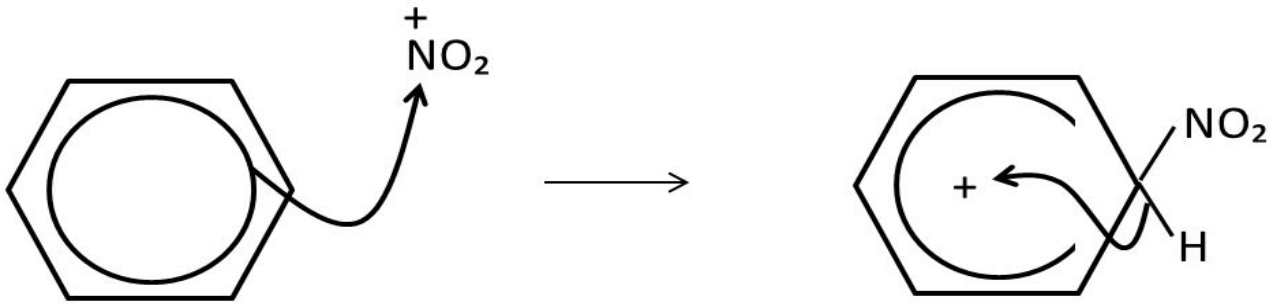
$$C_6H_6 + HNO_3 \rightarrow C_6H_5NO_2 + H_2O$$



What type of catalyst is used for a Friedel-Crafts reaction?

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A halogen carrier (e.g. $AlCl_3$)

Why does benzene not react directly with halogens?

Why does benzene not react directly with halogens?

The aromatic ring is too stable

What is happening when $AlCl_4^-$ is formed in terms of electrons?

What is happening when $AlCl_4^-$ is formed in terms of electrons?

The lone pair of electrons on the chlorine atom is forming a coordinate bond to Al

How is the $AlCl_3$ catalyst reformed?

How is the $AlCl_3$ catalyst reformed?

$AlCl_4^- + H^+ \rightarrow HCl + AlCl_3$ (H^+ from benzene)

How could you use a Friedel-Crafts mechanism to add a methyl group to a benzene ring?

How could you use a Friedel-Crafts mechanism to add a methyl group to a benzene ring?

Use a halogenoalkane and $AlCl_3$ to create an electrophile that can attack benzene

Draw the mechanism for the acylation of benzene from RCO^+.

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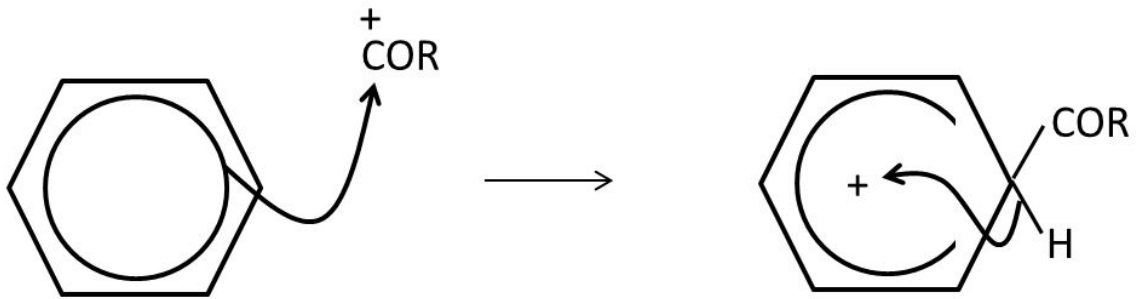
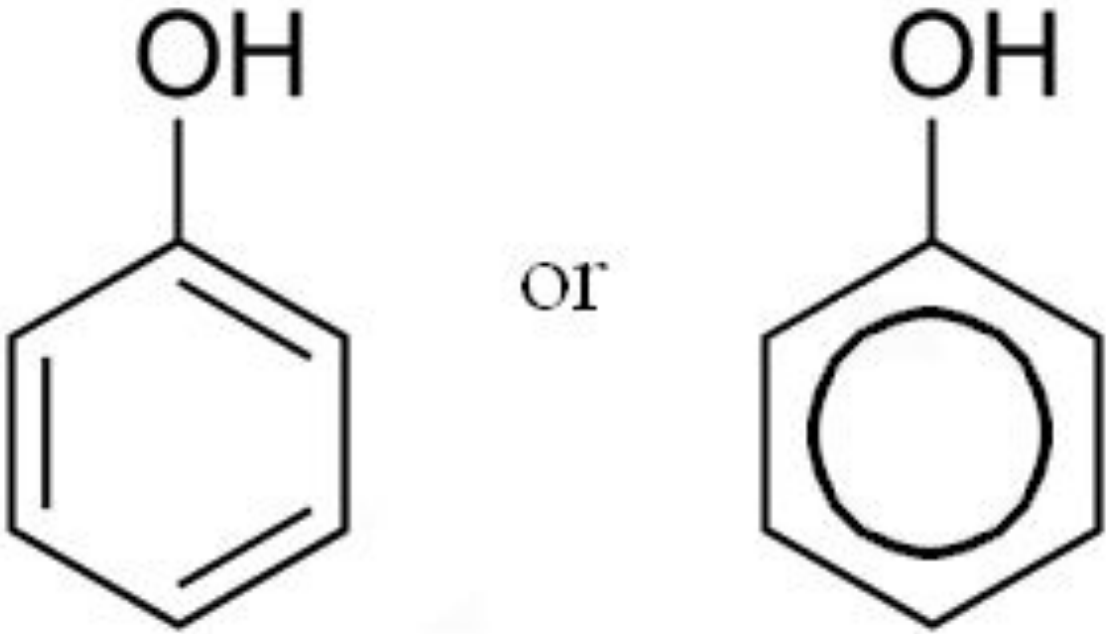


Draw the structure of phenol?



What reactions can you carry out to show the weak acidity of phenol?

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A neutralisation reaction with NaOH occurs but absent when you react phenol with carbonates

Write the equation of the reaction between phenol with bromine to 2,4,6-tribromophenol?

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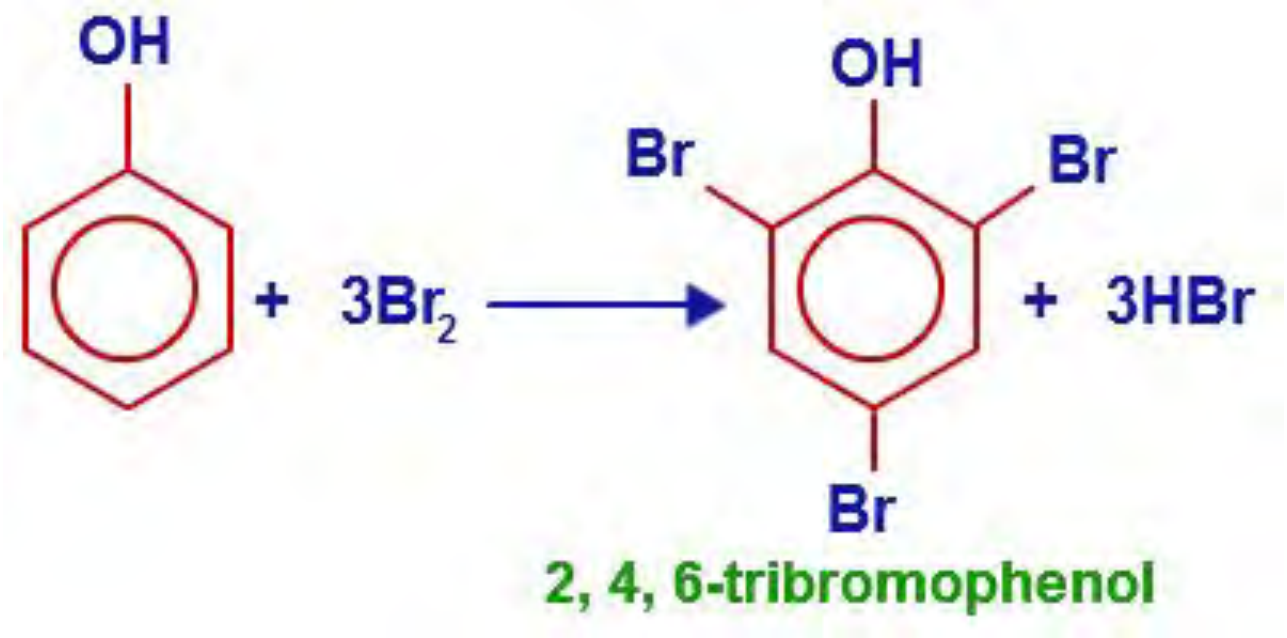

Write the equation for the reaction between phenol with dilute nitric acid.

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What is the relative ease of electrophilic substitution of phenol compared to benzene and why?

What is the relative ease of electrophilic substitution of phenol compared to benzene and why?

It is easier for electrophilic substitution to occur with phenol because oxygen lone pair of electrons from the -OH group are partially delocalised into ring therefore this increases the electron density of the ring thus electrophiles are more attracted phenol

What is the directing effect of electron donating groups OH and NH_2?

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They direct group to the 2 and 4 position of the ring in electrophilic substitution of aromatic compounds

What is the directing effect of electron withdrawing group NO_2?

What is the directing effect of electron withdrawing group NO_2?

NO_2 directs atoms to the 3 position of the ring in electrophilic substitution of aromatic compounds