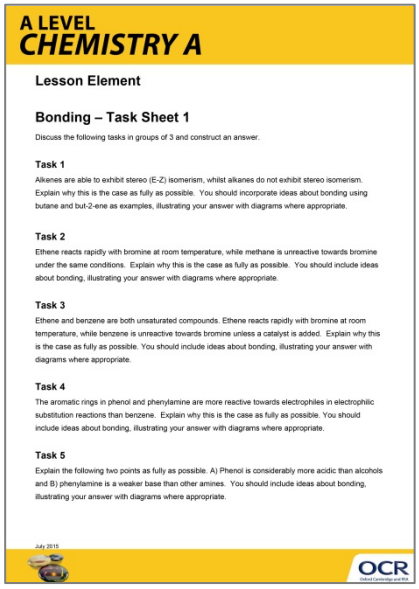
Checkpoint Task

Bonding

Instructions and answers for teachers

These instructions should accompany the OCR resource 'Bonding' activity *which supports OCR A Level Chemistry.*


A LEVEL
CHEMISTRY A

Lesson Element

Bonding – Task Sheet 1

Discuss the following tasks in groups of 3 and construct an answer.

Task 1

Alkenes are able to exhibit stereo (E-Z) isomerism, whilst alkanes do not exhibit stereo isomerism. Explain why this is the case as fully as possible. You should incorporate ideas about bonding using butane and but-2-ene as examples, illustrating your answer with diagrams where appropriate.

Task 2

Ethene reacts rapidly with bromine at room temperature, while methane is unreactive towards bromine under the same conditions. Explain why this is the case as fully as possible. You should include ideas about bonding, illustrating your answer with diagrams where appropriate.

Task 3

Ethene and benzene are both unsaturated compounds. Ethene reacts rapidly with bromine at room temperature, while benzene is unreactive towards bromine unless a catalyst is added. Explain why this is the case as fully as possible. You should include ideas about bonding, illustrating your answer with diagrams where appropriate.

Task 4

The aromatic rings in phenol and phenylamine are more reactive towards electrophiles in electrophilic substitution reactions than benzene. Explain why this is the case as fully as possible. You should include ideas about bonding, illustrating your answer with diagrams where appropriate.

Task 5

Explain the following two points as fully as possible. A) Phenol is considerably more acidic than alcohols and B) phenylamine is a weaker base than other amines. You should include ideas about bonding, illustrating your answer with diagrams where appropriate.

July 2015

OCR

The Activity:

This Checkpoint Task should be used in conjunction with the KS5-HE Transition Guide – Bonding.

This checkpoint task comprises a set of relatively open questions which can be posed to students either individually or in groups. It is intended that these would be used after the relevant topics have been covered in teaching, but they might also be used together as a synoptic revision exercise towards the end of the second year of A Level.

This activity offers an opportunity for English skills development.

Associated materials:

'Bonding Activity'

Suggested Outline

A suggested outline for how the Checkpoint Task could be deployed is given below:

1. Question(s) issued to students to discuss in groups of 3 and construct an answer (10 mins max).(Task Sheet 1)
2. Checklist issued to students so they can check their content. They should be given time to refine their answers (10 mins max).(Task Sheet 2)
3. When groups think they have finished, they should compare their answers with other groups who have also finished. If they find any differences, they should discuss which is the better answer and why (10 mins max).
4. The teacher provides guidance on what the correct answer is (it is recognised that different teachers might want to go into different levels of detail here depending on student ability, the specification studies, time available etc).

An alternative to 4) would be to ask the students to research the topic as an independent study task for homework, with the opportunity to critique and refine their answer.

Task 1

Alkenes are able to exhibit stereo (E-Z) isomerism, whilst alkanes do not exhibit stereo isomerism. Explain why this is the case as fully as possible. You should incorporate ideas about bonding using butane and but-2-ene as examples, illustrating your answer with diagrams where appropriate.

Checklist: Does your answer include the following?

- Discussion regarding the presence of single/double bonds in alkanes and alkenes.
- Discussion of restricted rotation around double bonds.
- A diagram correctly illustrating the presence of σ-bonds and π-bonds between pairs of carbon atoms in alkanes and alkenes.
- An explanation that relates free rotation and restricted rotation around particular bonds between carbon atoms and the nature of the bonding (ie the presence of only σ **or** σ and π bonds between carbon atoms).
- Reference to the energy requirement to break a π bond.
- Diagrams illustrating isomers of the molecules under consideration.

Extension points (HE focus)

- Discussion of the nature of the hybridisation of the carbon atoms in alkanes and alkenes, and how this relates to the presence of single (1 x σ) and double bonds (1 x σ and 1 x π) between pairs of carbon atoms.

Task 2

Ethene reacts rapidly with bromine at room temperature, while methane is unreactive towards bromine under the same conditions. Explain why this is the case as fully as possible. You should include ideas about bonding, illustrating your answer with diagrams where appropriate.

Checklist: Does your answer include the following?

- Discussion regarding the presence of single/double bonds in alkanes and alkenes.
- Discussion of saturation/unsaturation.
- A diagram correctly illustrating the presence of σ-bonds and π-bonds between pairs of carbon atoms in alkanes and alkenes.
- Correct use of terms such as electrophilic **OR** nucleophilic and substitution **OR** addition in describing the mechanism of the reaction
- Discussion about the relative availability of σ and π electrons to be donated to another species during a reaction.
- A full reaction mechanism including curly arrows.
- An explanation of how/why bromine is able to react with ethene.

Extension points (HE focus)

- Discussion of the nature of the hybridisation of the carbon atoms in alkanes and alkenes, and how this relates to the ability of alkenes to undergo this type of reaction.

Task 3

Ethene and benzene are both unsaturated compounds. Ethene reacts rapidly with bromine at room temperature, while benzene is unreactive towards bromine unless a catalyst is added. Explain why this is the case as fully as possible. You should include ideas about bonding, illustrating your answer with diagrams where appropriate.

Checklist: Does your answer include the following?

- Discussion regarding localised and delocalised π electrons, and the availability of pairs of electrons in such systems to be donated to other species.
- Discussion about the relative stability of benzene and comparable alkenes.

- A diagram correctly illustrating the bonding (notably π-bonding) between carbon atoms in ethene and benzene.
- Correct use of terms such as electrophilic **OR** nucleophilic and substitution **OR** addition in describing the mechanisms of the reactions.
- Full reaction mechanisms including curly arrows.
- An explanation of how/why bromine is able to react with ethene but not benzene.

Extension points (HE focus)

- Discussion of the nature of the hybridisation of the carbon atoms in ethene and benzene, and how this is related to the bonding and distribution of electrons in these molecules.

Task 4

The aromatic rings in phenol and phenylamine are more reactive towards electrophiles in electrophilic substitution reactions than benzene. Explain why this is the case as fully as possible. You should include ideas about bonding, illustrating your answer with diagrams where appropriate.

Checklist: Does your answer include the following?

- Discussion about the role of lone pairs on substituent atoms in changing the electron density around the aromatic ring in these compounds relative to benzene, including diagrams to illustrate this.
- Discussion about the influence of the electron density around aromatics ring on the relative rates of reaction with electrophiles.

Extension points (HE focus)

- Discussion of the nature of the hybridisation of the carbon atoms in aromatic rings, and how this is related to the ability of lone pairs on substituent atoms to interact with the π system due to orbital overlap.

Task 5

Explain the following two points as fully as possible. A) Phenol is considerably more acidic than alcohols and B) phenylamine is a weaker base than other amines. You should include ideas about bonding, illustrating your answer with diagrams where appropriate.

Checklist: Does your answer include the following?

- Discussion about the interaction between the π system around an aromatic ring and lone pairs/negative charges on substituent atoms, including diagrams to illustrate this.
- Discussion regarding the stability of the phenoxide ion relative to alkoxides (ie the ions formed by deprotonation of alcohols eg ethoxide from ethanol) (A).
- Discussion regarding the availability of the lone pair in phenylamine for donation to a proton relative to other amines (B).

Extension points (HE focus)

- The nature of the hybridisation of the carbon atoms in aromatic rings, and how this is related to the ability of lone pairs and negative charges on substituent atoms to interact with the π system due to orbital overlap.

.