

AS and A LEVEL
Transition Guide

CHEMISTRY A AND CHEMISTRY B (SALTERS)

H032/H432 and H033/H433
For first teaching in 2015

KS4–KS5 Focus
Enthalpy changes

Version 1



AS and A LEVEL**CHEMISTRY A AND CHEMISTRY B (SALTERS)**

Key Stage 4 to 5 Transition guides focus on how a particular topic is covered at the different key stages and provide information on:

- Differences in the demand and approach at the different levels;
- Useful ways to think about the content at Key Stage 4 which will help prepare students for progression to Key Stage 5;
- Common student misconceptions in this topic.

Transition guides also contain links to a range of teaching activities that can be used to deliver the content at Key Stage 4 and 5 and are designed to be of use to teachers of both key stages. Central to the transition guide is a Checkpoint task which is specifically designed to help teachers determine whether students have developed deep conceptual understanding of the topic at Key Stage 4 and assess their 'readiness for progression' to Key Stage 5 content on this topic. This checkpoint task can be used as a summative assessment at the end of Key Stage 4 teaching of the topic or by Key Stage 5 teachers to establish their students' conceptual starting point.

Key Stage 4 to 5 Transition Guides are written by experts with experience of teaching at both key stages.

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Key Stage 4 Content

In the pre-2016 specifications (which will be the prior knowledge for learners progressing to A Level up to and including 2017) the treatment of energetics varies from one GCSE specification to another. The content from the OCR Gateway Chemistry specification is given below.

- Know that in an exothermic reaction, the energy released from forming new bonds is greater than the energy needed to break bonds, and in an endothermic reaction, the energy needed to break bonds is greater than the energy released from forming new bonds.
- Calculate and compare the amount of energy released by different fuels given the equation:
 $q = mc\Delta T$
- Calculate the energy output in J/g.
- Draw and interpret energy level diagrams.

From 2018 onwards, (most) learners will enter A Level after taking the reformed (from 2016) GCSE qualifications. These cover common subject content.

The following content is covered in both GCSE Chemistry and GCSE Combined Science:

- distinguish between endothermic and exothermic reactions on the basis of the temperature change of the surroundings
- draw and label a reaction profile for an exothermic and an endothermic reaction, identifying activation energy
- explain activation energy as the energy needed for a reaction to occur
- calculate energy changes in a chemical reaction by considering bond making and bond breaking energies.



Key Stage 5 Content

- enthalpy changes, including standard enthalpy changes of reaction, formation and combustion
- average bond enthalpies
- use of Hess's law to calculate enthalpy changes
- use of energetics, including entropy, to predict the feasibility of reactions (A Level only)

An understanding of enthalpy profile diagrams and energy level diagrams will be required.

Comment

A level builds on the ideas met at GCSE of using bond enthalpies to explain exothermic and endothermic reactions and introduces the concept of enthalpy change being negative or positive with units of kJ mol^{-1} . In A level, learners need to develop skills to tackle less-structured bond enthalpy calculations involving a range of different reactions.

A level also builds on the experimental determination of enthalpy changes, using $q = mc\Delta T$, again the main differences being the amount of guidance given in exam questions and the wider range of reactions. This bigger emphasis on the quantitative approach means learners need to have the opportunity to practise calculations and comment on the values they have worked out.

At A Level, it is important for learners to be aware of the links between different areas of the specification, so teachers need to show how bond enthalpy calculations relate to other A Level work involving both organic and inorganic reactions.

A Level then extends the concept of enthalpy to include standard conditions, specific enthalpy changes and how enthalpy changes can be determined indirectly using Hess's Law. A thorough understanding of the basic concepts is needed for this topic to be grasped successfully and for learners to feel confident dealing with unfamiliar enthalpy cycles. Relating these ideas to everyday situations helps learners to gain a better appreciation of the concepts.

The basic concepts learnt at KS4 must be clearly understood, so it is important to start with finding out what learners already know and understand.

A common area of difficulty at GCSE is learners not realising that bond breaking requires energy whereas bond making releases energy. To address this issue, bond energy calculations should be revised at the beginning of teaching this topic at A level using reactions that are familiar to them.

Another common misconception is learners not realising that a temperature rise means a negative enthalpy change and a temperature fall means a positive enthalpy change. To address this, energy profile diagrams should be re-visited, again using reactions with which they are familiar, and experimental work should be carried out to reinforce this.

Activities

Getting started

A possible way to start this topic is to ask students working in pairs to write down five things they know about energy changes. Mini-white boards work well, as learners can hold them up for others to see. They should aim to include one "pointless" answer (i.e. one that no-one else has thought of). The teacher can then collect all the points on the board, and include extra points as necessary. Linking enthalpy change to reactions they have already met is really important here.

Exothermic or endothermic

Royal Society of Chemistry

<http://www.rsc.org/learn-chemistry/resource/res00000406/exothermic-or-endothermic>

This is a short practical exercise designed to increase learners' awareness of the difference between exothermic reactions (temperature rises) and endothermic (temperature falls). This could be done as a class practical or a teacher-led activity with a different learner demonstrating each of the different experiments.

Chemistry demonstrations

Royal Society of Chemistry

<http://www.rsc.org/learn-chemistry/resource/res00001970/classic-chemistry-demonstrations-book>

This is an excellent resource for demonstrating a range of visually interesting and explosive exothermic reactions.

Checkpoint Task

This activity tests learners' understanding of energy profile diagrams, exothermic and endothermic reactions, finally leading on bond enthalpy calculations. Activation energy could also be included here, depending on what you know about learners' prior knowledge.

The activity allows teachers to gauge how well the learners understand the main ideas, enabling them to focus on any misconceptions before embarking on the A Level content.

Checkpoint task:

<http://www.ocr.org.uk/Images/361216-enthalpy-changes-ks4-ks5-transition-guide-checkpoint-task.doc>

Activities

Experimental determination of enthalpy changes

Royal Society of Chemistry

<http://www.rsc.org/learn-chemistry/resource/res00000468/heats-of-reaction-exothermic-or-endothermic-reactions>

Within an experimental approach, the qualitative ideas met at GCSE can be extended to consider quantitative aspects. Learners calculate a value for the enthalpy change of a reaction using their own experimental results. The link leads to a good starting point, but many variations are possible.

Starter for Ten - Thermodynamics

Royal Society of Chemistry

<http://www.rsc.org/learn-chemistry/resource/res00000954/starters-for-ten%20-%20!cmpid=CMP00001410#!cmpid=CMP00001410>

This activity is in the Starter for Ten Section 6 (Thermodynamics), activity 6.1. This short starter activity is designed to reinforce definitions of enthalpy changes, and should be done once the main enthalpy changes have been introduced and used. Learners need opportunities to learn definitions and be tested on them at regular intervals.

Teachers need to be aware that an extra definition (enthalpy change of neutralisation) is included in the reformed (from 2015) specifications.

Energy and fuels (Learner Resource 1)

OCR

<http://www.ocr.org.uk/Images/361217-enthalpy-changes-ks4-ks5-transition-guide-learner-resource-1.doc>

This activity covers the main types of calculation required in the first year of A Level, using everyday examples to put the ideas into context. It would be useful at the end of the topic on enthalpy changes as a revision exercise to test understanding.

Activities

Extension questions

Royal Society of Chemistry and Cambridge Chemistry Challenge

<http://www.rsc.org/education/events-and-competitions/olympiad/olympiad-questions-answers.asp>

<http://www.c3l6.org/downloads>

Appropriate extension questions can be found in past Chemistry Olympiad papers and Cambridge Chemistry Challenge papers.

The questions referred to cover other topics as well as enthalpy changes, and require learners to process information and apply their knowledge to unfamiliar situations. This provides learners with opportunities to bring together concepts they have met in other parts of the course, and relate them to the current topic.

Suggested Olympiad questions: 2013 q1, 2012 q3, 2011 q3

Suggested Cambridge Chemistry Challenge question: 2013 q2

Resources, links and support

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To find out more about GCSE and A Level reform please visit: <http://www.ocr.org.uk/qualifications/gcse-and-a-level-reform>



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