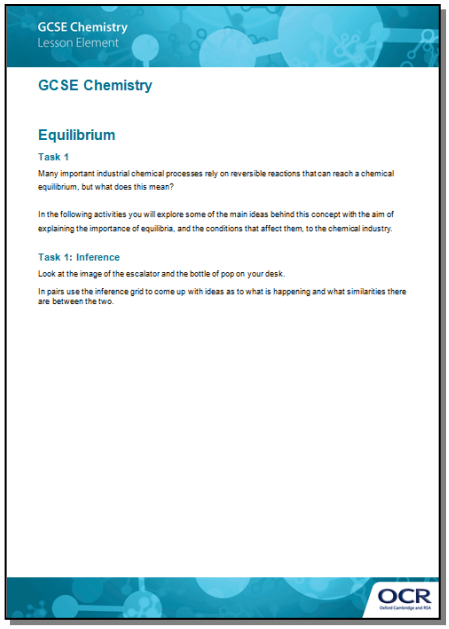
GCSE Chemistry

Equilibrium

Instructions and answers for teachers

***These instructions should accompany the OCR resource 'Equilibrium' activity** which supports OCR GCSE Chemistry.*


GCSE Chemistry
Lesson Element

GCSE Chemistry

Equilibrium

Task 1

Many important industrial chemical processes rely on reversible reactions that can reach a chemical equilibrium, but what does this mean?

In the following activities you will explore some of the main ideas behind this concept with the aim of explaining the importance of equilibria, and the conditions that affect them, to the chemical industry.

Task 1: Inference

Look at the image of the escalator and the bottle of pop on your desk.

In pairs use the inference grid to come up with ideas as to what is happening and what similarities there are between the two.

OCR

The Activity:

Learning outcomes:

- To be able to recall that at equilibrium the rate of forward and reverse reactions of a reversible chemical reaction are equal
- To be able to describe the factors that affect the equilibrium
- To research the Haber and Contact processes.

This activity offers an opportunity for English skills development.

This activity offers an opportunity for maths skills development.

Associated materials:

Equilibrium Lesson Element learner activity sheet. Equilibrium card sheets, Equilibrium player counters, Equilibrium game board, Equilibrium PowerPoint presentation.

Introduction

Many important industrial chemical processes rely on reversible reactions that can reach a chemical equilibrium. This activity focuses on the equilibrium between the two directions of a reversible reaction and on the nature of the equilibrium position. Learners should understand that some chemical reactions are reversible and recognise the symbol for such reactions; understand that reversible reactions can reach a state of equilibrium and understand the dynamic equilibrium explanation for chemical equilibrium.

Reversible changes and equilibrium are amongst the most challenging or least familiar topics for teachers and this therefore impacts on their ability to put across appropriately the concepts to learners without developing further misconceptions. Learners will be familiar with the idea of an irreversible change from Key Stage 3 and will have had this idea challenged in relation to the extraction of metals and the use of energy (ie electrolysis to reverse a reaction to obtain the initial elements from a compound.) They will also be familiar with the concept of rate and the factors which can affect the rate of a reaction. However experience shows that learners struggle to link these ideas when considering the production of vital chemicals in the industry (Ammonia through the Haber Process and Sulphuric Acid through the Contact Process).

Modelling is used as a theme throughout the activity to develop student understanding of the concepts involved. Learners progress through a development of their understanding through the idea of dynamic equilibrium, to rate of forward and reverse reactions and closed system. Finally they use the ‘board game’ model to understand the impact of the various factors which influence the equilibrium position.

Key terms: Exothermic; Endothermic; Concentration; Temperature; Pressure; Reversible; Equilibrium; Dynamic; Static; Activation Energy; Gaseous; Solution.

Task 1: Inference

This introductory activity aims to deal with the rate at which the forward and reverse reactions are happening by tackling the common misconception; nothing is happening at equilibrium.

Give learners an image of someone going the wrong way on an escalator (could be displayed on the whiteboard) and a bottle of pop (mini bottles of lemonade or cola would be sufficient.)

In pairs ask them to use the inference grid to come up with ideas/questions as to what is happening and what similarities there are between the picture and the bottle.

Show video clip: http://www.youtube.com/watch?v=GKzyVox5N5o

Resources required:

Copies of Inference Grid.

Task 2: Bail Out

Bail Out introduces the idea of the reversible reaction and the closed system and also links into the rate of the forward and reverse reactions.

Learners follow instructions for transferring water from one measuring cylinder to another and use questions to develop understanding of key terms shown in bold in the questions.

Resources required per group:

- 2 100cm^3 measuring cylinders
- 2 glass tubes, long enough to reach the bottom of the cylinders and of **different** internal diameters
- Water
- Food Dye.

Task 3: Equilibrium the Board Game

This board game attempts to tackle common misconceptions around Le Chatelier's Principle as learners sometimes find it difficult to grasp the idea that Le Chatelier's Rule is about disturbing the equilibrium and driving the system to a new equilibrium state.

The key aim of this activity is for learners to consider the impact, on the direction of the equilibrium, of changing various conditions by introducing the factors which can be of importance.

- Learners work in pairs (two taking on role of reactants and two taking on role of products)
- Reactant pair throw the dice and move around the board. They repeat their turn three times
- Product pair then join in
- Pairs work their way around the board independently
- When players reach an 'Equilibrium' block on the board they select a card and follow instructions
- Challenge questions require candidates to make a decision about how conditions affect the equilibrium position
- The game should be played for around 15 minutes or until one party reaches the completion point
- Players then answer some questions relating to the game format.

Resources required per group:

- Laminated Equilibrium board
- Laminated Equilibrium cards
- 2 Dice or spinners.

Extension Activities

More able learners could be challenged to produce their own cards for the game.

Learners could research either the Haber or Contact Process and the requirement for the various conditions of production. More able learners could consider researching other reactions or investigate the impact of altering pH on certain reactions.

Further suggested practical activities can be found on the RSC website http://www.rsc.org/resources-tools/

Equilibrium

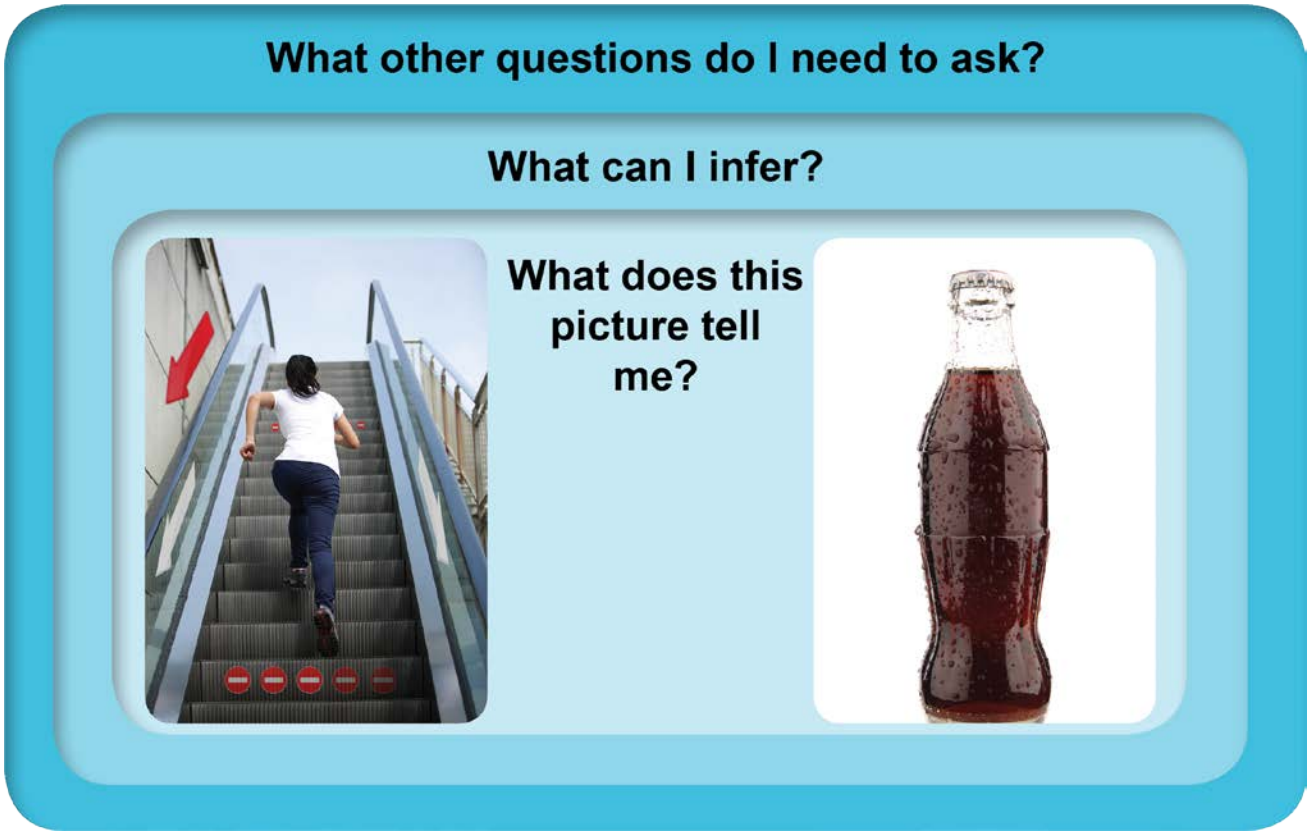
Many important industrial chemical processes rely on reversible reactions that can reach a chemical equilibrium, but what does this mean?

In the following activities you will explore some of the main ideas behind this concept with the aim of explaining the importance of equilibria, and the conditions that affect them, to the chemical industry.

Task 1: Interference

Look at the image of the escalator and the bottle of pop on your desk.

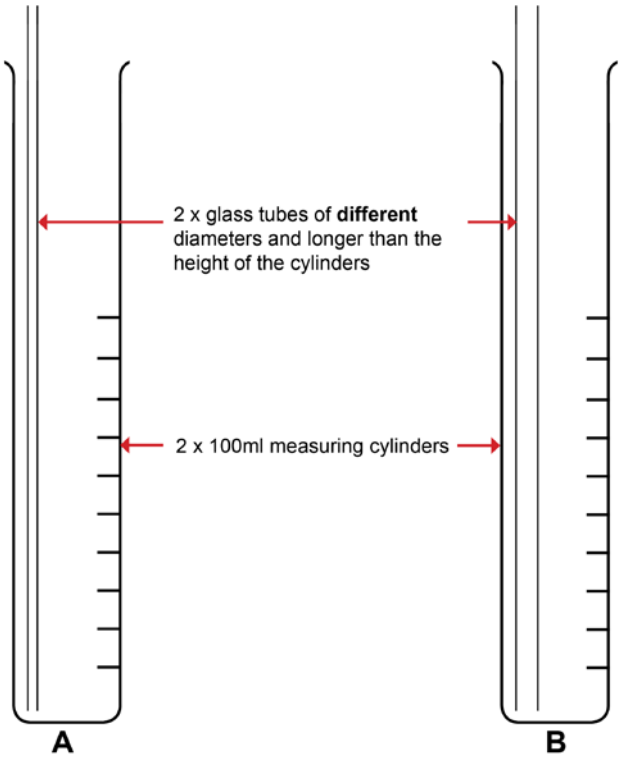
In pairs use the inference grid to come up with ideas as to what is happening and what similarities there are between the two.



Task 2: Bail Out

Per Group

- 2 100cm^3 measuring cylinders
- 2 glass tubes, long enough to reach the bottom of the cylinders and of **different** internal diameters
- Water
- Food Dye



Part 1

- Pour 100 cm3 of water into cylinder A
- Place glass tubes in cylinders, place a finger over the upper end and transfer liquid collected to other cylinder (no water will be transferred from cylinder B to A the first time)
- Repeat this operation many times!
- Note the final levels of water in both cylinders.

Questions

1. How does this simulate a **reversible reaction**?

2. Does this system represent a **closed system**?

3. How does this simulate **equilibrium**?

Part 2

- Repeat the procedure in part 1 except that this time start with 100cm^3 of water in cylinder B.
- Note the final levels of water in both cylinders.

Questions

1. How do the final levels of water in the cylinders compare with the final levels in part 1?

2. What does this tell us about **reversible reactions** and **equilibrium**?

Part 3

- Add a few drops of food dye to one of the cylinders from part 2 and mix thoroughly using the glass tube as a stirrer.
- Continue transferring water between the cylinders in the way described in part 1.
- Note what happens to the colour in both tubes.

Questions

1. How does this help us to understand what is meant by a **dynamic equilibrium**?

Task 3: Equilibrium the Board Game

Rules

- You will need one die and one counter.
- Mix the Challenge and Equilibrium cards up and place them face down in the centre of the board.
- Work in pairs (two taking on role of reactants and two taking on role of products).
- Reactant pair throws the die and moves the counter around the board towards the product. The reactant pair then throws the die a further three times and moves the counter with each throw.
- Product pair then starts, moving towards the reactant' moving in the opposite direction.
- Take it in turns to throw the die and move towards your goal.
- When you reach an ‘Equilibrium’ block on the board select a card from the centre of the board and follow the instructions.
- If you get a Challenge question you need to make a decision about how the conditions on the board affect the equilibrium position. If you want to, you can pass on a Challenge question.
- The game should be played for around 15 minutes or until one party reaches the other side.

After the game, answer the questions relating to the game.

Extension Activities

Produce your own cards for the game.

Research either the Haber or Contact Process and the requirement for the various conditions of production.

Equilibrium Game

Follow up questions

1. Why do you think the Reactants players are allowed a ‘Head Start?’

2. What is meant by exothermic and endothermic in terms of the reactions?

3. Why is the thermal decomposition of Calcium Carbonate not normally considered as a reversible reaction?

5. Describe the factors that affect the Equilibrium position.

6. Why is it important to understand the impact of these factors on a reaction?

7. Why were both teams allowed to move when a catalyst was added?

8. Explain the link between Equilibrium and Rate of Reaction.

‘product’ is required by the Chemical industry.

Extension

Using the Game cards produce a set of rules to show how these factors affect the equilibrium position of a reaction.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