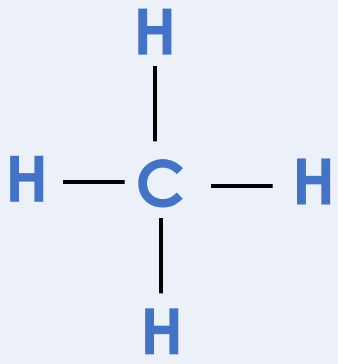
Cracking

Answer the questions below.

1. State the general equation for the combustion of alkanes.
   Alkane + oxygen → carbon dioxide + water
2. Describe when incomplete combustion takes place.
   When there is a limited supply of oxygen.
3. Name the alkane with the chemical formula C_2H_6.
   Ethane
4. Describe what short chain hydrocarbons are used for.
   As fuels for heating or cooking
5. Draw the structural formula for methane.



Do Now

Cracking

Do Now:

1. State the general equation for the combustion of alkanes.
2. Describe when incomplete combustion takes place.
3. Name the alkane with the chemical formula C_2H_6.
4. Describe what short chain hydrocarbons are used for.
5. Draw the structural formula for methane.

Drill:

1. Determine how many hydrogen atoms would be in an alkane with 14 carbon atoms.
2. Determine how many hydrogen atoms would be in an alkane with 60 carbon atoms.
3. Determine how many carbon atoms would be in an alkane with 104 hydrogen atoms.

Do Now

Cracking

Read Now:

According to a survey from 2022, there are about 1.45 billion cars in the world. That means that over 17 % of the human population has a car, but the cars are not spread evenly as some cars have many more cars than others. Many of these cars have petrol engines, which burn petrol as the fuel. Petrol contains relatively short chain hydrocarbons, such as octane (C_8H_{18}). As there is such high demand for these shorter hydrocarbons, some larger hydrocarbons can be broken down in chemical reactions to form these shorter chains. This type of chemical reaction is called cracking and produces a shorter chain hydrocarbon as well as another type of hydrocarbon called an alkene. Alkenes are also useful for many different things, including making plastics.

1. State how many cars there are in the world.
2. Name an alkane found in petrol.
3. Explain why there is high demand for petrol.
4. Describe what happens in a cracking reaction.
5. Name the other type of product from a cracking reaction.

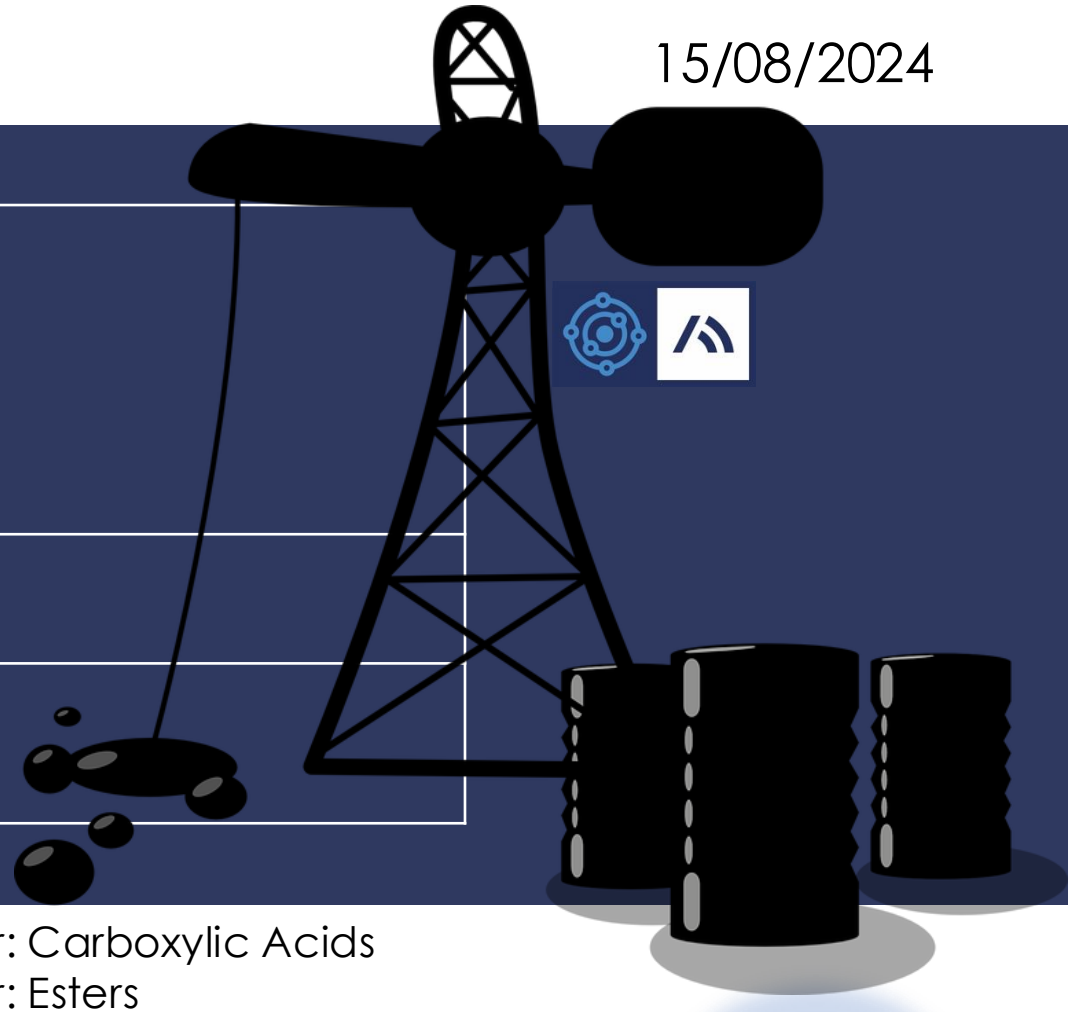
Do Now

15/08/2024

Cracking

C5.1.5

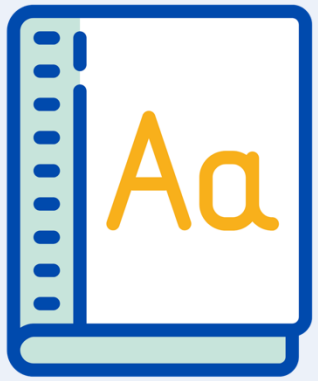
Science Mastery



Following this lesson, students will be able to:

- Determine the formulae of compounds produced from cracking
- Explain why cracking is useful
- Explain how bromine water can be used to distinguish between alkanes and alkenes

Key Words:



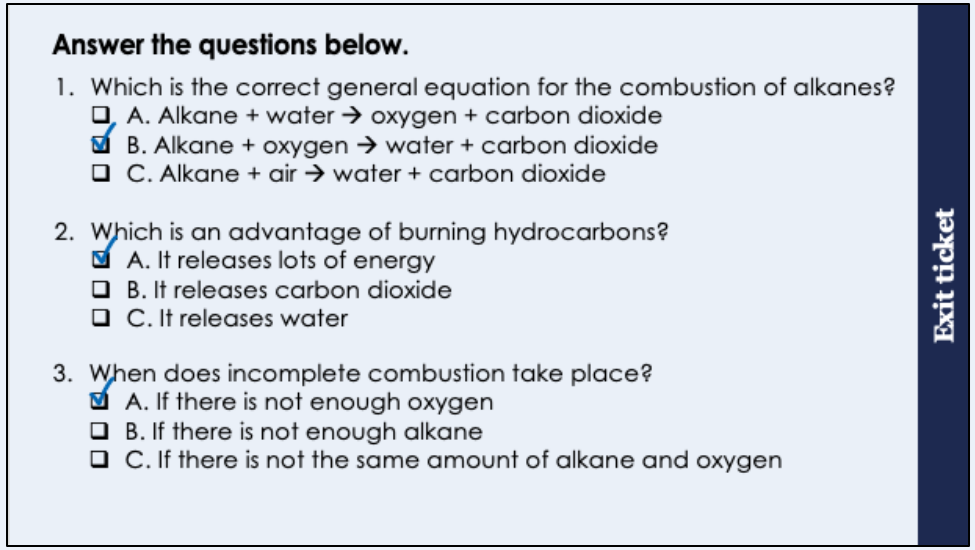
cracking	**alkene**	**unsaturated**	**bromine water**
conditions	**steam**	**catalytic**	

Lesson Objectives

This is the fix-it portion of the lesson

The **fix-it** is an opportunity to respond to gaps in knowledge, especially those identified by the **pre-unit quiz**.

- The teacher should customise this slide as needed, to facilitate
  - **reteach**, **explanation, demonstration** or **modelling** of ideas and concepts that students have not yet grasped or have misunderstood.
  - **practise** answering specific questions or of key skills.
  - **redrafting** or **improving** previous work.



Fix-it

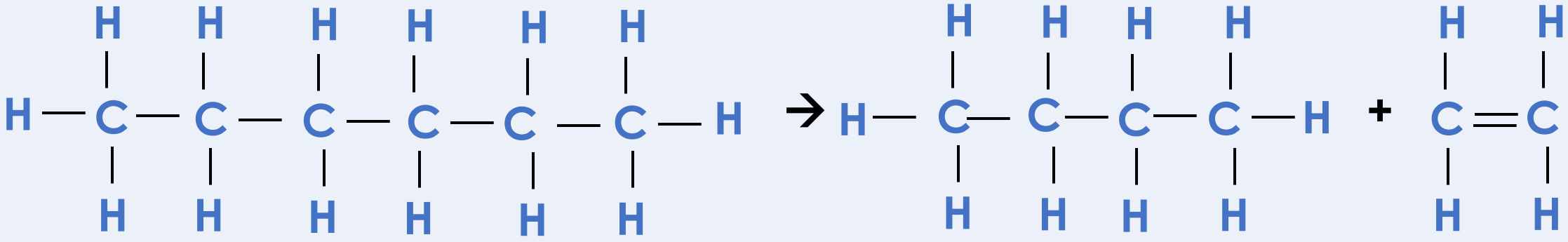
Cracking

Small hydrocarbon chains are in high **demand** because they are highly **flammable** so are useful as **fuels**.

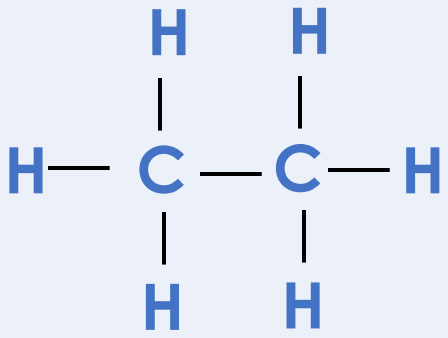
Larger hydrocarbon chains can be broken down to form smaller chains through a chemical reaction called **cracking**.

Hexane → **Butane** + **Ethene**

C_6H_{14} → C_4H_{10} + C_2H_4

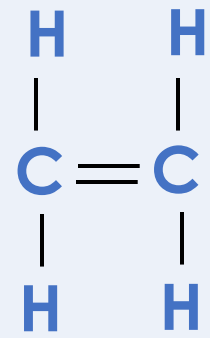


Testing for Alkenes



Alkane

saturated



Alkene

unsaturated

Add bromine water

Stays orange

Turns colourless

Conditions for Cracking

Cracking is the chemical reaction where a longer chain alkane is broken down to form a shorter chain alkane and an alkene.

It can be carried out using different methods and reaction conditions:

- **Catalytic cracking** involves a temperature of 550 °C and a catalyst called a zeolite
- **Steam cracking** involves a temperature of 850 °C and no catalyst

Which statements do you agree with?

Alkenes turn bromine water cloudy

Alkanes turn bromine water colourless

Alkenes turn bromine water colourless

Alkanes do not react with bromine water, so it stays orange

Talk Task

Is this correct?

Cracking and fractional distillation are both physical processes

Talk Task

Drill

1. Explain the difference between supply and demand.
2. Describe what happens during cracking.
3. Name the two types of product produced through cracking.
4. Give two reasons why cracking is useful.
5. Describe what happens when bromine water is added to alkanes.
6. Describe what happens when bromine water is added to alkenes.
7. Explain why alkenes are described as unsaturated.
8. Name two different methods of cracking.
9. Describe the conditions needed for catalytic cracking.
10. Describe the conditions needed for steam cracking.

Check for understanding

Drill answers

1. Supply is how much of something is produced whereas demand is how much of something is needed.
2. A longer chain hydrocarbon is broken down to make a shorter chain hydrocarbon.
3. A (shorter chain) alkane and an alkene
4. It increases supply of the smaller molecules used for fuels and it produces alkenes which are used as feedstocks in the petrochemical industry.
5. Bromine water stays orange.
6. Bromine water turns colourless.
7. They contain a C=C double bond.
8. Catalytic cracking and steam cracking
9. A temperature of 550 °C and a catalyst
10. A temperature of 850 °C

Check for understanding

I: Determining the products of cracking

Dodecane ($C_{12}H_{26}$) is cracked to produce octane (C_8H_{18}).

$$C_{12}H_{26} \rightarrow C_8H_{18} + \_\_\_\_\_$$

What is the chemical formula for the other product formed?

C_4H_8

What homologous group does the other product belong to?

Alkenes

Explain how you could tell the difference between the two products once they were separated.

Add bromine water to each. Octane will cause the bromine water to stay orange and the alkene will turn the bromine water colourless.

Explain why it is useful to crack dodecane.

There is greater demand for shorter molecules like octane, as they can be used as fuels.

Apply

We: Determining the products of cracking

Decane ($C_{10}H_{22}$) is cracked to produce heptane (C_7H_{16}).

$$C_{10}H_{22} \rightarrow C_7H_{16} + \_\_\_\_\_$$

What is the chemical formula for the other product formed?

C_3H_6

What homologous group does the other product belong to?

Alkenes

Explain how you could tell the difference between the two products once they were separated.

Add bromine water to each. Heptane will cause the bromine water to stay orange and the alkene will turn the bromine water colourless.

Explain why it is useful to crack decane.

There is greater demand for shorter molecules like heptane, as they can be used as fuels.

Apply

You: Determining the products of cracking

Octane (C_8H_{18}) is cracked to produce hexane (C_6H_{14}).

$$C_8H_{18} \rightarrow C_6H_{14} + \_\_\_\_\_$$

What is the chemical formula for the other product formed?

C_2H_4

What homologous group does the other product belong to?

Alkenes

Explain how you could tell the difference between the two products once they were separated.

Add bromine water to each. Hexane will cause the bromine water to stay orange and the alkene will turn the bromine water colourless.

Explain why it is useful to crack octane.

There is greater demand for shorter molecules like hexane, as they can be used as fuels.

Apply

Answer the questions below.

1. Which explains why cracking is useful?
   - ☐ A. It increases demand for shorter hydrocarbon chains
   - ☑ B. It increases supply of shorter hydrocarbon chains
   - ☐ C. It separates crude oil into different useful fractions

2. What is the formula of the other product of this cracking reaction?

$$C_{10}H_{22} \rightarrow C_8H_{18} + \_\_\_\_\_$$

   - ☑ A. C_2H_4
   - ☐ B. C_2H_6
   - ☐ C. $C_{18}H_{40}$

3. What is the difference between alkanes and alkenes?
   - ☐ A. Alkanes have a C=C double bond
   - ☑ B. Alkenes have a C=C double bond
   - ☐ C. Alkenes contain more hydrogen atoms

Exit ticket

Feedback

Lesson C5.1.5	
What was good about this lesson?	What can we do to improve this lesson?

Send us your feedback by clicking this link
or by emailing sciencemastery@arkonline.org
Thank you!