Science KS4: Blended Learning Booklet

Stewards Academy

C7 Hydrocarbons

Name:

Form:

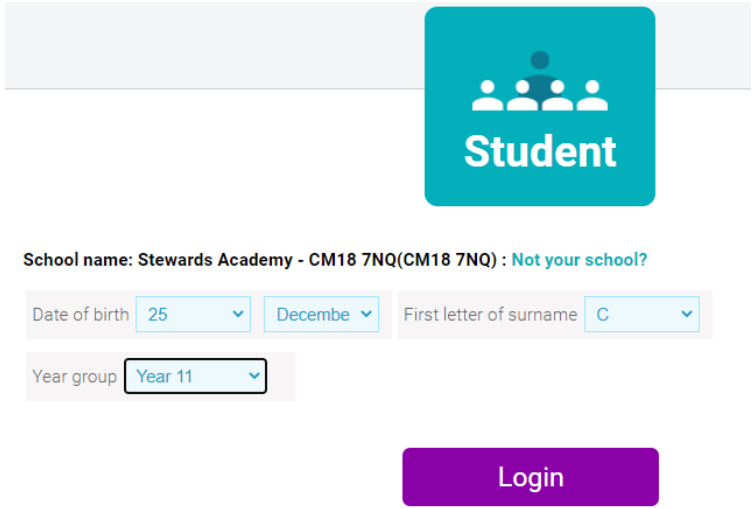
Aim to complete four lessons each week. Watch the videos and follow the four part lesson plan

All video clips are online using the ClassCharts link. Upload all work onto ClassCharts for feedback.

The online textbook has all the key information and vocabulary to help you with this unit

To log on to the online textbook:

- https://connect.collins.co.uk/school/portal.aspx
- Type in “stewards” and select Stewards Academy
- Login using your date of birth,
  initial of your surname and your
  academic year



Contents

Contents

(T) = Triple scientists only

Big Picture – Year 10 Overview

Science

Unit Test

End of Year Exams

Nest Year

IR emission and absorption (T)

Colour, lenses, images and magnification (T)

The electro-magnetic spectrum

Sound waves and seismic waves (T)

Properties of waves

UNIT P6

Unit Test

Spectroscopy and other instrumental methods (T)

Tests for gases, metals, hydroxides and anions (T)

Pure substances and chroma-tography

Polymers and poly-merisation (T)

Waves

I will be able to describe characteristics of waves that can be measured. **I will** be able to measure reflection and refraction of waves and explain why they occur. **I will** be able to place visible light withing the electromagnetic spectrum. ***I will*** *be able to sound waves can reveal structures (T).* ***I will*** *be able to explain how lenses work (T)*

Hydrocarbons & Chemical analysis

I will be able to describe the properties of hydrocarbons. ***I will*** *be able to describe the properties of alkenes, alcohols, carboxylic acids and polymers (T).* **I will** be able to use techniques to produce and identify a pure substance. ***I will*** *be able to identify positive and negative ions and evaluate different analysis techniques (T).*

Meiosis and reproduction

Genetics and gene disorders

The work of Gregor Mendel (T)

Unit Test

UNIT C7 & C8

Crude oil, hydrocarbons and fractional distillation

Combustion and cracking of alkanes

Alkenes, alcohols and carboxylic acids (T)

DNA structure and protein production (T)

Genetics

I will be able to explain how we inherit our characteristics as a result of our genes which are made of DNA. **I will** be able to explain how the DNA is replicated and packaged in a specialised way to form the sex cells. ***I will*** *be able to describe the work by Gregor Mendel around plant genetics*

I will be able to explain how forces affect motion and how an understanding of these forces can make driving safer. ***I will*** *be able to explain the effects of forces on levers and in creating pressure (T).* I will be able to explain the effects of forces applied to springs.

Forces

DNA, genes and the human genome

UNIT B6

Unit Test

Forces and energy in springs

Moments, levers and pressure (T)

Momentum and road safety

Mass and Weight

Forces, speed and acceleration

UNIT P5

Energy Changes & Reaction Rates

I will be able to describe, explain and represent energy changes in chemical reactions and link them to bond energies and the particle theory. ***I will*** *be able to explain how dells produce a voltage and how fuel cells work (T).* **I will** be able to measure and calculate the rate of a reaction and describe factors that can affect rate. ***I will*** *be able to apply Le Chatelier's principle to reactions in equilibrium (T).*

Unit Test

Exo and endo thermic reactions

Reaction profiles

Cells, batteries and fuels cells (T)

Measuring rates of reaction

Factors affecting rates of reaction

Catalysts and collision theory

Reversible reactions and energy changes

Factors affecting equilibrium

UNIT C5 & C6

I will be able to explain how conditions in the body, processes and organ systems are coordinated and controlled. **I will** be able to describe how hormones control sexual development and human reproduction, *as well as how hormones enable plants to respond to stimuli (T)*

Homeostasis

Unit Test

Plant hormones (T)

Human reproduction and IVF

The endocrine system and the kidneys (T)

The nervous system *and the eye (T)*

Homeostasis

UNIT B5

Unit Test

Nuclear fission and fusion (T)

Hazards and uses of radiation

I will be able to reconise an atomic isotope and explain how one isotope can turn into another through three different forms of radioactive decay. **I will** be able to represent radioactive decay using a nuclear equation.

Atomic structure

Titration (T)

Electrolysis

Oxidation and reduction)

Unit Test

UNIT P4

Atomic structure

Radioactive decay

Nuclear equations

Neutralisation

Chemical changes

I will be able to describe why some metals are more reactive than others, **I will** be able to describe how neutralization occurs and how salts are formed. **I will** be able to explain how some metals are extracted by electrolysis rather than oxidation

I will be able to describe how lifestyle choices can affect the risk of catching a non-communicable disease. **I will** be able to explain how communicable diseases are spread and how we can control their spread. ***I will*** *be able to describe how plants are affected by and protected from disease causing organisms (T).*

Health

Metal reactivity

UNIT C4

Unit Test

Plant diseases & defenses (T)

Protecting the body

Malaria

Pathogens

Health and disease

UNIT **B4**

Year 10

ZOOM IN...

MY LEARNING JOURNEY:

Subject: Hydrocarbons Year: 10 Unit: C7

UP NEXT

Chemical analysis

- Formulations
- Chromatography
- Gas tests
- Chemical tests
- Spectroscopy

CAREERS

- Petrochemcial Industry
- Refrigerator engineer
- Gas engineer

AIMS

Students will cover the chemistry and properties of Crude Oil and Hydrocarbons. Students will build on knowledge acquired in previous lessons regarding atomic structure, covalent bonding and chemical change. They have previously studied Groups 1, 7 and 0 and the transition elements. In this chapter, they study, in addition, the compounds of Group 4 elements, especially carbon. This will also link to climate change, greenhouse gases and carbon footprints by looking at the chemistry of combustion. Finally they will learn how to carry out chemical tests for hydroxides and metal anions; as well as how to interpret spectroscopic data.

DEVELOPING COURAGE

C Chemical processes allow us to make the best use out of the hydrocarbons we have left

O To utilise the molymods

U How important hydrocarbons are in our daily life

R Learn the names and structures of the different groups of hydrocarbons

A Appreciate how crude oil is processed to make many useful materials

G Share scientific understanding with others

E Investigating combustion of hydrocarbons

PREVIOUS LEARNING

Pupils will have some knowledge about how crude oil and other fossil fuels are made and the fact that petrol and diesel come from crude oil. Understand the difference between complete and incomplete combustion, also the need for fuels to provide heating and transport.

WHAT WE KNOW/ REMEMBER

- .....
- .....
- .....
- .....
- .....

RECOMMENDED READING

1. A Play for Oil: The Stories Behind the Discovery of Oil and Gas by Tim Daley,
2. Car Science: How Cars Work Paperback by Richard Hammond, Heat and
3. Combustion (ChemLab) by Keith Walshaw.

PERSONAL OBJECTIVES

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Lesson 1: C7.1 – Crude oil, hydrocarbons and alkanes

Connection

Have a look at the topic overview and the C7 zoom in.

Populate what you know and your personal objectives.

Activation

LI: explain the structures and formulae of alkanes.

https://www.youtube.com/watch?v=ykIFTtTjoso

1. Make a note of the title and the LI
2. Read pages 228-229
3. Define “hydrocarbon” and “alkane” using the glossary
4. Copy the table for the first four alkanes
5. Copy the formula for alkanes

Demonstration

Attempt questions 1-7.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C7 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

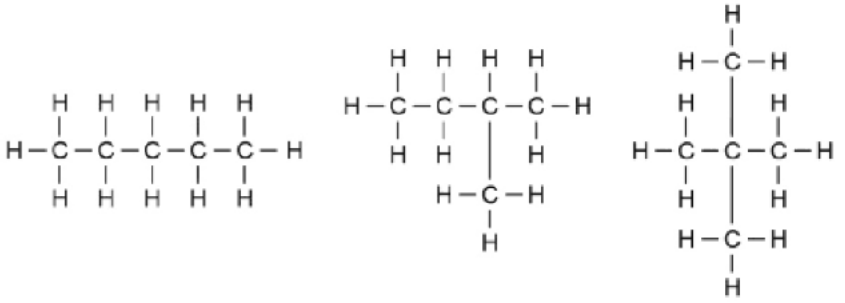
Answers: C7.1 – Crude oil, hydrocarbons and alkanes

Connection

1 NA
2 NA
3 NA

Demonstration

1 Coal / natural gas.
2 Fossil fuels are non-renewable and polluting. Alternative energy sources are "greener".
3 1 carbon and 2 hydrogens are added each time (– CH2–).
4 C8H18
5 n = number of carbons = 18. So CnH2n+2 = C18H38
6 CH3CH2CH2CH2CH2CH2CH3 ; (CH3)2CHCH2CH(CH3)2or other suitable isomers
7



Lesson 2: C7.2 – Fractional distillation and petrochemicals

Connection

Q1. What is the formula for alkanes

Q2. Pentane is the fifth alkane in the series. What is its formula and its displayed formula?

Q3. Why is conservation of fossil fuels like crude oil important?

Activation

LI: Explain how crude oil is separated by fractional distillation

1. https://www.youtube.com/watch?v=CjmriZq5xRo
2. Make a note of the title and the LI
3. Read pages 230-231
4. Define "Fractional distillation" using the glossary
5. Draw and label figure 7.4
6. Draw and label figure 7.5
7. Explain why larger molecules have higher boiling points

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C7 DIP file

Demonstration

Attempt questions 1-4.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

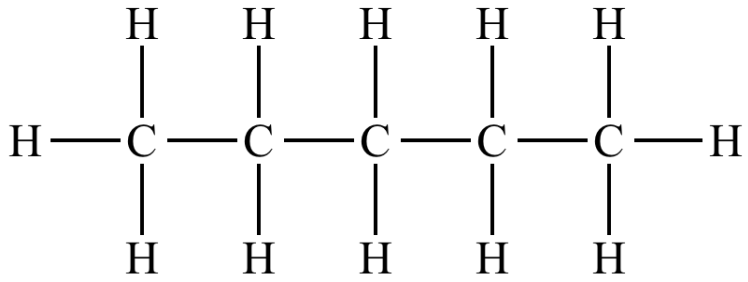
Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: : C7.2 – Fractional distillation and petrochemicals

Connection

1 C_nH_{2n+2}

2 C_5H_{12}



3 crude oil is a fossil fuel and a finite resource. This means that we will eventually run out of the resource.

Demonstration

1 Fuels are used to produce energy. Petrochemicals are substances produced from crude oil fractions that are used for a variety of purposes such as solvents etc.

2 It contains a large number of different hydrocarbons with different properties.

3 C6H14 and C7H16. They have similar number of carbons.

4 Y must have more carbons since it has a higher boiling point (condenses at at a higher temperature). So the intermolecular forces of attraction between molecules of Y are greater. These greater forces mean the Y molecules can condense at higher temperatures where there is more energy.

Lesson 3: C7.3 – Properties of hydrocarbons

Connection

Q1. Name three uses of crude oil?

Q2. Why does LPG reach the top of the fractional distillation column?

Q3. Why do large hydrocarbons have high melting points?

Activation

LI: describe how different hydrocarbon fuels have different properties

1. https://www.youtube.com/watch?v=4EAh9E2KhOE
2. Make a note of the title and the LI
3. Read pages 232-233
4. Define “viscosity” and “flammability” using the glossary
5. Copy the table showing uses for various hydrocarbons

Demonstration

Attempt questions 1-5.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in **blue pen**

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C7 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C7.3 – Properties of hydrocarbons

Connection

1. Plastics, fuel, detergent

2. LPG has the lowest boiling point

3. There are more intermolecular forces between large hydrocarbons than small hydrocarbons

Demonstration

1 Diesel oil. It has lower viscosity than kerosene.
2 (i) Viscosity increases with increasing number of carbons.(ii) Flammability decreases with increasing number of carbons.
3 350 – 400 oC
4 The longer the hydrocarbon chain the greater the intermolecular forces. So longer chains slide over each other less easily since stronger forces need to be broken. Therefore longer chain hydrocarbons are more viscous.
5 a a As carbon number increases, melting point increases. This is because intermolecular forces between molecules increases with increasing chain length. Therefore more energy is required to separate the alkanes.
b Alkanes with odd number of carbons have lower melting points than expected (compared to the even numbered alkane to the left). This is because even numbered alkanes can pack together more easily so the intermolecular forces are greater.

Lesson 4: C7.4 – Combustion

Connection

Q1. How does flammability change as the number of carbon atoms increases?

Q2. How does viscosity change as the number of carbon atoms increases?

Activation

LI: describe the process of complete combustion

1. https://www.youtube.com/watch?v=cRnpKjHpFyg
2. Make a note of the title and the LI
3. Read pages 234-235
4. Define “combustion” using the glossary
5. Write down the general formula for complete combustion and incomplete combustion
6. Write down the balanced equation for the combustion of methane

Demonstration

Attempt questions 1-5.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in **blue pen**

Challenge yourself to answer as many as you can:
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Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C7 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C7.4 – Combustion

Connection

1 Flammability decreases as the number of carbon atoms increases

2 Viscosity increases as the number of carbon atoms increases

Demonstration

1 Air hole closed: insufficient oxygen so incomplete combustion. Air hole open: sufficient oxygen so complete combustion.
2 C_4H_{10}.
3 $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$
4 $C_{10}H_{22} + 10½O_2 \rightarrow 10CO + 11H_2O$
5
a $C_8H_{18} + 12½O_2 \rightarrow 8CO_2 + 9H_2O$ Complete $C_8H_{18} + 8½O_2 \rightarrow 8CO + 9H_2O$ Incomplete

b Complete combustion. All of the carbon in the hydrocarbon is oxidised to carbon dioxide. With incomplete combustion, the carbons are only partially oxidised so less energy is released.

Lesson 5: C7.5 – Cracking and alkenes

Connection

Q1. What is the general word equation for complete combustion?

Q2. What is the general word equation for incomplete combustion?

Q3. Why is carbon monoxide dangerous?

Activation

LI: describe the usefulness of cracking

1. https://www.youtube.com/watch?v=bOiYLKX9ZRY
2. Make a note of the title and the LI
3. Read pages 236-237
4. Define “cracking” and “alkene” using the glossary
5. Describe in steps how long chain hydrocarbons can be cracked
6. Write an equation showing how a long chain hydrocarbon is cracked

Demonstration

Attempt questions 1-5
In 10 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C7 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C7.5 – Cracking and alkenes

Connection

1
Fuel + oxygen →water + carbon dioxide

2
Fuel + oxygen → water + carbon monoxide + carbon

3. Carbon monoxide is toxic and binds to the red blood cells so that they cannot carry oxygen

Demonstration

1 More petrol is needed than can be supplied. So diesel and kerosene (less needed than can be supplied) should be cracked.
2 High temperature and a catalyst or very high temperature and steam.
3 Pentene since it is an alkene. The bromine adds across the C=C bond.
4 D = 1, E = 1, F = 1, G = 2.
5 $C_{10}H_{22} \rightarrow C_8H_{18} + C_2H_4$. Other equations are possible.

Lesson 6: C7.6 – Structure and formulae of alkenes

Connection

Q1. What is the definition of cracking?

Q2. What are the products of cracking?

Q3. Describe the process of cracking?

Activation

LI: describe the difference between an alkane and an alkene

1. https://www.youtube.com/watch?v=Sfm3eHe57PU
2. Make a note of the title and the LI
3. Read pages 238-239
4. Define “homologous series” using the glossary
5. Copy the table showing the structure of different alkenes
6. Copy the formula for alkenes

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C7 DIP file

Demonstration

Attempt questions 1-7
In 10 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Answers: C7.6 – Structure and formulae of alkenes

Connection

1 cracking the process of breaking down large hydrocarbons into smaller molecules

2 Alkanes and Alkenes

3 This process involves heating long-chain hydrocarbons to vaporise them. The vapours are either passed over a hot catalyst or mixed with steam and heated to a very high temperature so that thermal decomposition reactions then occur.

Demonstration

1 Hexene. C_6H_{12}.
2 Alkanes have all single C-C bonds. Alkenes have a carbon-carbon double bond, C=C.
3 Because there are double the number of hydrogens compared to carbons. This is show by the general formula for an alkene with n = 16, C_nH_{2n}.
4 a) and d) are alkenes and will turn bromine water colourless. b) and c) are alkanes.
5 $CH_2CHCH_2CH_2CH_2CH_2CH_2CH_3$ / $CH_3CHCHCH_2CH_2CH_2CH_2CH_3$ / $CH_3CH_2CHCHCH_2CH_2CH_2CH_3$
6 C_2H_4, C_3H_6, C_4H_8, C_5H_{10}
$C_2H_4 + H_2 \rightarrow C_2H_6$
$C_3H_6 + H_2 \rightarrow C_3H_8$
$C_4H_8 + H_2 \rightarrow C_4H_{10}$
$C_5H_{10} + H_2 \rightarrow C_5H_{12}$
7 a C_nH_{2n-2}.
b $C_{10}H_{18}$

Lesson 7 C7.7 – Reactions of alkenes

Connection

Q1. What is the formula for Alkenes?

Q2. What is the formula for Hexene?

Q3. What is the definition of an unsaturated hydrocarbon?

Activation

LI: explain how alkenes react with hydrogen, water and the halogens.

1. https://www.youtube.com/watch?v=83Is-rouV-U
2. Make a note of the title and the LI
3. Read pages 240-241
4. Define “catalyst” using the glossary
5. Write down the equation for complete combustion of Ethene
6. Write down the equation for incomplete combustion of Ethene
7. Draw an addition reaction between Ethene and Bromine
8. Draw an addition reaction between Ethene and hydrogen
9. Draw an addition reaction between Ethene and water

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C7 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Demonstration

Attempt questions 1-10
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
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Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Answers: C7.7 – Reactions of alkenes

Connection

1 C_nH_{2n}

2 C_6H_{12}

3. a hydrocarbon containing fewer than the maximum number of hydrogen atoms possible, and so at least one double bond.

Demonstration

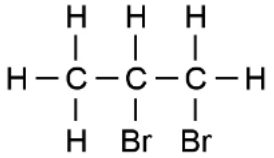
1 $C_2H_4 + O_2 \rightarrow 2C + 2H_2O$

2 $C_4H_8 + 4O_2 \rightarrow 4CO + 4H_2O$

3 They are more prone to incomplete combustion. So they would produce more carbon monoxide which is toxic. They also burn with more smoky flames and this would not be suitable for domestic use. Alkenes are also more reactive than alkanes and are more useful as starting material to make other organic molecules.

4 C_5H_{10}. It is an alkene and the others are alkanes. Alkenes tend to incompletely combust.

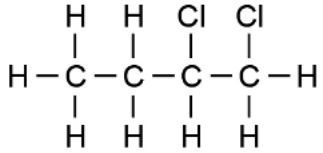
5



6 $CH_3CHClCHClCH_2CH_3$

7 Butane, C_4H_{10}.

8



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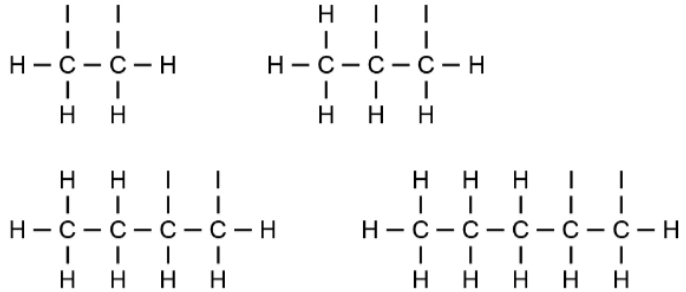

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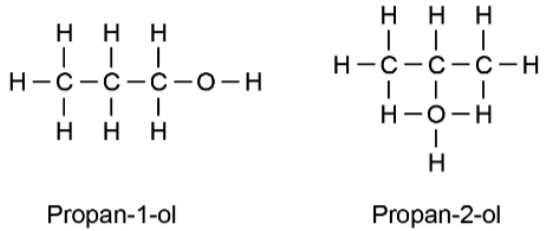

Propan-1-ol

Propan-2-ol