

★ **UNITS 1&2** ★
NEW FOR 2021

INTRODUCING THE
UNITS 1-4
EDROLO
CHEMISTRY
TEXTBOOKS

 **Edrolo**

VCE CHEMISTRY

Units 1-4

- **VCAA-style questions** based on a thorough analysis of the past 8-10 exams
- **Multiple lesson questions** covering concepts from different areas of the study design
- **Exemplar answers** with a **checklist** and **video solution** for every exam-style question
- **Chapter review tests** for valuable SAC & exam practice
- **Key science skills question** at the end of each chapter
- **Concise theory** covers the core knowledge required within the scope of the VCAA Study Design
- **Theory summaries** concisely reiterate the key points from the lesson
- **Key Science Skills & Scientific Investigation** covered in a dedicated chapter
- **Edrolo Theory Master videos** aligned directly to textbook chapters
- **Experiments** at the end of each chapter
- **Full lessons dedicated to difficult concepts** deep dive into areas of the Study Design students find most challenging:
 - Accuracy vs precision
 - Writing a scientific report
 - Biodiesel vs petrodiesel
 - Redox reactions
 - Equilibrium reactions
 - Organic reaction pathways
 - Volumetric analysis

AT THE BEGINNING OF EACH LESSON YOU WILL FIND:

Key Knowledge dot-points from the study design provide explicit links to the syllabus.

Key Knowledge Units (KUs) show a breakdown of the lesson.

Key terms and definitions are listed at the beginning of the chapter. All key terms are collated in the glossary in the back of the book.

Knowledge Unit overview provides a brief description of what will be covered next using basic terminology to introduce concepts.

7F TYPES OF ORGANIC REACTIONS

In this lesson, we will be learning about reactions between organic compounds and how to measure the efficiency of a chemical reaction.

7A Structure of organic compounds	7B Naming of organic compounds	7C Isomers	7D Chirality	7E Properties of organic compounds	7F Types of organic reactions
Study design dot points					
<ul style="list-style-type: none"> organic reactions, including appropriate equations and reagents, for the oxidation of primary and secondary alcohols, substitution reactions of haloalkanes, addition reactions of alkenes, hydrolysis reactions of esters, the condensation reaction between an amine and a carboxylic acid, and the esterification reaction between an alcohol and a carboxylic acid the pathways used to synthesise primary haloalkanes, primary alcohols, primary amines, carboxylic acids and esters, including calculations of atom economy and percentage yield of single-step or overall pathway reactions. 					
Key knowledge units					
Substitution reactions	4.15.1.1				
Addition reactions	4.15.1.2				
Oxidation of alcohols	4.15.1.3				
Condensation reactions	4.15.1.4				
Esterification reactions	4.15.1.5				
Hydrolysis reactions	4.15.1.6				
Reaction pathways	4.1.6.1				
Efficiency of reactions	4.1.6.2				

Key terms and definitions

- Actual yield** amount of product that is actually produced as a result of a chemical reaction
- Addition reaction** reaction where one molecule combines with another to form a larger molecule with no other products
- Atom economy** extent to which the reactants are used to make the desired product(s)
- Condensation reaction** chemical reaction where two molecules combine with the release of a water molecule
- Esterification** chemical reaction between organic compounds that forms at least one ester as a product
- Hydrolysis** chemical reaction where water is used to break the bonds of a substance
- Reaction pathway** one or more reactions designed to convert a reactant to a desired product
- Substitution reaction** chemical reaction where an atom, or group of atoms in a compound are replaced by another atom, or group of atoms
- Theoretical yield** expected amount of a product produced in a chemical reaction
- Percentage yield** efficiency of a chemical reaction that has taken place

Substitution reactions 4.15.1.1

OVERVIEW

Function of galvanic cells 3.1.1.2

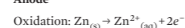
OVERVIEW

Galvanic cells generate electrical energy for electronic devices from the redox reactions occurring in the half-cells.

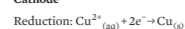
THEORY DETAILS

In a galvanic cell, chemical energy is converted to electrical energy. The oxidation reaction always occurs at the anode, whilst the reduction reaction always occurs at the cathode. For the galvanic cell in figure 4, Zn is oxidised to Zn²⁺ at the anode and Cu²⁺ is reduced to Cu at the cathode. The redox reactions occurring at the half-cells of the galvanic cell in figure 4 are summarised as:

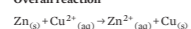
Anode



Cathode

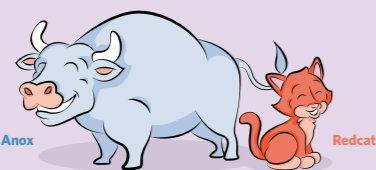


Overall reaction



The electrons produced from the oxidation reaction at the anode flow through the wire from the anode to the cathode providing electrical power to light up the bulb.

Tip In a galvanic cell, electrons always flow from the anode to the cathode.
'Anox' - Anode is where oxidation takes place.
'Redcat' - Reduction occurs at the cathode.



In the Zn/Zn²⁺ half-cell, the oxidation of Zn causes the accumulation of Zn²⁺ ions in the half-cell, meaning that there is an excess amount of positively charged ions there. Therefore, it is important for the negative ions (such as NO₃⁻) in the salt bridge to migrate to the Zn/Zn²⁺ half-cell (on left in diagram) to maintain electrical neutrality. On the other hand, Cu²⁺ ions are being consumed in the Cu/Cu²⁺ half-cell to form Cu meaning that there is only a small amount of positively charged ions there. Hence, the positive ions (such as K⁺) of the salt bridge migrate to the Cu/Cu²⁺ half-cell (on the right in the diagram). The role of the salt bridge is to complete the circuit and maintain the overall electrical neutrality of the galvanic cell so that electricity can continue to be produced. There are several key requirements that need to be met with respect to the composition of the salt bridge. The ionic compound (salt) has to be very soluble in water, unreactive and not form an insoluble compound (precipitate) with any of the reactant species in either of the half-cells.

Identifying half-reactions in galvanic cells 3.1.1.3.2.1

OVERVIEW

Half-reactions in galvanic cells are determined based on the standard electrode potentials of the redox reactions occurring in the half-cells.

THEORY DETAILS

Redox reactions in galvanic cells are spontaneous. To determine which redox reaction occurs at each electrode, we need to consider the standard electrode potentials of the half-reactions of the half-cells. Standard electrode potentials can be found in the chemistry data book.

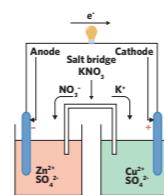


Figure 4 Illustration of a galvanic cell's function

Important note

In a galvanic cell, negative ions from the salt bridge migrate to the anode and positive ions from the salt bridge migrate to the cathode. Electrons never flow through the salt bridge.

Tips provide important insights into what VCAA assessors look for in exam responses.

Lesson overview summarises the key points being covered.

Diagrams help students understand and remember key theory.

Lesson links highlight the connection between theory across lessons to create a holistic understanding of the course.

QUESTIONS, SOLUTIONS, & CALCULATOR INSTRUCTIONS

CHAPTER 3: COMBUSTION

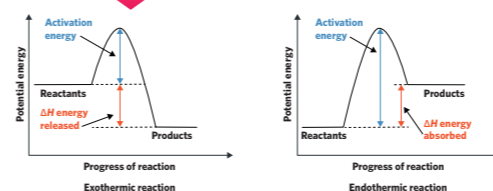


Figure 1 Energy profile diagrams of exothermic reactions and endothermic reactions

The opposite is shown for endothermic reactions. However, both energy profile diagrams show the **activation energy** of the reaction which is the minimum initial energy required to break the bonds of the reactants so that the reaction can proceed. It is represented as E_a . It is an energy barrier that first needs to be overcome in order for a reaction to take place and whilst it cannot be represented in thermochemical equations, it is shown in energy profile diagrams. It exists for both endothermic and exothermic reactions but varies in magnitude depending on the reaction.

The heat energy released when one mole of a fuel undergoes complete combustion is known as the heat of combustion, which is measured in kJ mol^{-1} . It is important to note that this is represented as a positive value, even though the enthalpy change of a combustion reaction is exothermic, requiring a negative value.

Many fuels such as petrodiesel are a mixture of compounds and so their **heat of combustion** cannot be measured in kJ mol^{-1} as molecular weight cannot be determined, hence moles cannot be calculated. Therefore, their heats of combustion are measured in kJ g^{-1} .

The heat of combustion value can be used to compare the energy released from the combustion of different substances, regardless of the efficiency of the reaction. To calculate the energy released when n mol of fuel burns, or is combusted, use the following equation.

$$E = n \times \Delta H_c$$

The subscript c in ΔH_c denotes that it is the enthalpy value for a combustion reaction.

Tip The heat of combustion of some common fuels can be found in the data book.

Tip To calculate the heat of combustion of a substance per gram, divide the heat of combustion per mol by the molar mass of the substance.

1 Worked example

Calculate the amount of energy released when 2.6 kg of propane (C_3H_8) is burned in an excess supply of oxygen, given that the heat of combustion of propane is 2220 kJ mol^{-1} .

What information is presented in the question?

Molecular formula of propane C_3H_8
 2.6 kg of propane was burnt.
 $\Delta H_c(\text{C}_3\text{H}_8) = -2220 \text{ kJ mol}^{-1}$

What is the question asking us to do?

Calculate the energy released in the combustion of 2.6 kg of propane.

What strategy(ies) do we need in order to answer the question?

- Convert the mass of propane to grams.
- Calculate the number of moles of propane.
- Multiply the number of moles by the heat of combustion to calculate the energy released.

Answer

$n(\text{C}_3\text{H}_8) = \frac{2.6 \times 10^3}{44.0}$
 $= 59.09 \text{ mol}$
 Energy released $= 59.09 \times 2220$
 $= 131\,181 \text{ kJ}$
 $= 1.3 \times 10^5 \text{ kJ (2 s.f.)}$

Worked examples guide students through the analysis of a question, the steps required, and a thorough work-through of how to reach the answer.

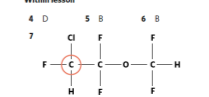
7D Chirality

Theory review questions

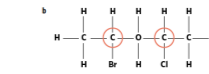
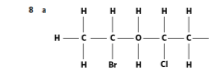
1 B 2 D 3 C

Exam-style questions

Within lesson



(The orange circle signifies the chiral carbon)



(circles identify chiral centres)

9 a C_2 , C_4 , C_6 , C_8

b [All chiral compounds have a chiral centre however achiral compounds can also contain chiral centres.]¹ It is possible to have achiral compounds that have multiple chiral centres that can be superimposed on their mirror image.² (As a result, the statement that the student made was inaccurate.)³

I have explained what chiral molecules are.¹

I have used a diagram to show that the molecules are non-superimposable.²

I have linked my answer to the question.³

I have identified that achiral compounds can also contain chiral centres.¹

I have explained how compounds with chiral centres cannot be considered as chiral.²

I have commented on the accuracy of the statement.³

10 Chiral molecules are molecules whose structures and their mirror images cannot be superimposed.¹ (In regards to the two molecules, if the molecule on the right were rotated, it is possible for that molecule to be superimposed on the original molecule (the one on the left).²) (As a result, these two molecules are achiral.)³

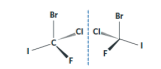
I have explained what chiral molecules are.¹

I have identified that the molecules are superimposable.²

I have linked my answer to the question.³

I have included a diagram in my answer.

11 a [Chiral molecules have non-superimposable mirror images.¹ (As seen in the diagram, the mirror image of this molecule cannot be superimposed onto the original molecule.)²



(As a result, we can consider this as being a chiral compound.)³

I have explained what chiral molecules are.¹

I have used a diagram to show that the molecules are non-superimposable.²

I have linked my answer to the question.³

I have identified that achiral compounds can also contain chiral centres.¹

I have explained how compounds with chiral centres cannot be considered as chiral.²

I have commented on the accuracy of the statement.³

12 a

b This molecule has no chiral centre

c

(circles identify chiral centres)

13 a

b 1

c 2-aminoethanoic acid

I have explained what chiral molecules are.¹

I have identified that the molecules are superimposable.²

I have linked my answer to the question.³

I have included a diagram in my answer.

14 a

b

c

I have explained what chiral molecules are.¹

I have identified that the molecules are superimposable.²

I have linked my answer to the question.³

I have included a diagram in my answer.

15 a [Chiral molecules have non-superimposable mirror images.¹ (As seen in the diagram, the mirror image of this molecule cannot be superimposed onto the original molecule.)²

TEXTBOOK QUESTIONS:

- Theory review questions** are multiple-choice questions that assess a student's comprehension of the theory covered in the lesson.
- Exam-style questions** provide frequent, valuable exam practice with questions covering content from within the lesson and also from previous lessons to reinforce the interconnected nature of the curriculum.
- Key Science Skills questions** assess skills outlined in the VCAA Study Design through experimental design or data analysis questions.

TEXTBOOK SOLUTIONS:

- Exemplar response:** written responses to every exam-style question provide students with an example of a full-mark answer.
- Checklists** provide a breakdown of the exemplar response to guide students when self-marking their answers.
- Video solutions** in your Edrolo account explain and deconstruct every single exam-style question.

FOR MORE INFO SEE THE **TEXTBOOK TRAINING VIDEO** IN YOUR **EDROLO ACCOUNT**.

NAVIGATING YOUR EDROLO TEXTBOOK ONLINE

PLANNING
AHEAD

VCE CHEMISTRY UNITS 3&4 [2020 TEXTBOOK]

Bookmarks All videos View printable unit plan

To assist with planning, there is an editable and downloadable **unit plan** available for your course.

ACCESSING THE
TEXTBOOK PDFS,
DIGITAL TEXTBOOK
QUESTIONS AND
SOLUTIONS

Unit 3 AOS 1			
Chapter 4 - Redox reactions - Edrolo - Textbook - Solutions PDF Chapter 4 - Redox reactions - Edrolo - Textbook PDF Chapter 3 - Combustion - Edrolo - Textbook - Solutions PDF			
Chapter 3 - Combustion - Edrolo - Textbook PDF Chapter 2 - Fuels - Edrolo - Textbook - Solutions PDF Chapter 2 - Fuels - Edrolo - Textbook PDF			
Chapter 2			
2A Fossil fuels	12 min video	Class progress	15 questions
2B Biofuels	11 min video	Class progress	16 questions
2C Comparison of fuels	7 min video	Class progress	13 questions
Chapter 2 review			29 questions

All questions found in the text are also available as interactive digital questions. To access these, click on the **X questions** button next to the corresponding theory lesson.

For multiple-choice questions, students receive immediate feedback.

Q2

Which of the following statements is correct about the difference between petrodiesel and biodiesel?

A Petrodiesel has a higher viscosity than biodiesel.

B Biodiesel has a higher viscosity than petrodiesel.

C Biodiesel is non-renewable while petrodiesel is renewable.

D Both biodiesel and petrodiesel are biodegradable.

I'm confident in my understanding
If I came across this question again I'm confident I'd succeed.

I need help, or more study
I'm not confident enough with the concepts to succeed on this question in future.

Click the **Additional Resources** icon beside each Area of Study to find your Textbook PDFs.

For short-answer questions, students self-mark their work using the **exemplar response** and **digital checklist**.

- I have compared the distance travelled by each type of diesel.¹
- I have linked the distance travelled to the viscosity of each type of diesel.²
- I have used the intermolecular forces present in each diesel to explain the difference in viscosity.³
- I have determined the diesel contained in each cylinder.⁴

Exemplar Response

The diesel in cylinder A moved a shorter distance than the diesel in cylinder B.¹ This indicates that the diesel in cylinder A is more viscous than the diesel in cylinder B.² Biodiesel molecules are held tightly by permanent dipole-dipole bonds due to the presence of polar COO groups whereas non-polar petrodiesel molecules are held loosely by dispersion forces, leading to its lower viscosity.³ Therefore, cylinder A contains biodiesel and cylinder B contains petrodiesel.⁴

CHECKING STUDENT
RESPONSES

Name	Understands?	Understands				Answered correctly
		A	B	C	D	
Ashamed Antelope	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Casual Caribou	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Comfortable Chimpanzee	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Global Gerbil	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Material Monkey	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Main Mosquito	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Misleading Mouse	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Ready Rabbit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Small Sheep	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Separate Sow	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Swift Sow	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Written Wallaby	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Multiple-choice results: see each student's answer and reflection on their understanding as well as a summary of your whole class.

Q11c

I have explained the molecular mechanism for BMP4 in jaw formation in cichlids. 6/8

I have explained that BMP4 expression varies within cichlids. 4/8

I have explained how variation in BMP4 expression led to adaptive radiation in cichlids. 2/8

Animal	Assessment	Response
Controversial Caterpillar	<input checked="" type="checkbox"/>	Balanced Badger <input checked="" type="checkbox"/>
Senior Sheep	<input checked="" type="checkbox"/>	Classical Crocodile <input checked="" type="checkbox"/>
		Long Leopard <input checked="" type="checkbox"/>
		Recent Reindeer <input checked="" type="checkbox"/>
		Wrong Walrus <input checked="" type="checkbox"/>
		Zany Zebra <input checked="" type="checkbox"/>

Balanced Badger's response

The BMP4 gene is a regulatory master gene, that is a signaling protein. This gene can cause major phenotypic changes in a short period of time. This explains how speciation has occurred much quicker throughout evolution rather than the theory that different mutations occur slowly over time. This gene alters beak size in galapagos finches and jaws in cichlid fish, high levels producing a short robust jaw or beak with great width and depth.

Extended response: see how each student self-assessed against the checklist. Click on any of the **checklist items** and click a student's name to view their response.