Name: _____

Teacher's name: _____

Write your **student number** in the boxes above. **Letter**

Chemistry

Question and Answer Book

VCE Units 3&4 Trial Examination 2024 (Trial 1)

- Reading time is **15 minutes.**
- Writing time is **2 hours 30 minutes.**

Approved materials

- One scientific calculator.

Materials supplied

- Question and Answer Book of 33 pages.
- Additional space is available at the end of this book if you need extra space to complete an answer.
- Data Book (please refer to the VCAA Data Book).
- Multiple-Choice Answer Sheet.

Instructions

- Follow the instructions on your Multiple-Choice Answer Sheet.
- At the end of the examination, place your Multiple-Choice Answer Sheet inside the front cover of this book.

Students are **not** permitted to bring mobile phones and/or any unauthorised electronic devices into the examination room.

Contents page

Section A – Multiple-choice questions

Instructions

- Answer **all** questions in pencil on the Multiple-Choice Answer Sheet.
- Choose the response that is **correct** or that **best answers** the question.
- A correct answer scores 1; an incorrect answer scores 0.
- Marks will **not** be deducted for incorrect answers.
- No marks will be given if more than one answer is completed for any question.
- Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Question 1
Renewable fuels
A. form over millions of years in the earth's crust.
B. are produced in a relatively short period of time.
C. do not produce greenhouse gas emissions during combustion.
D. do not produce greenhouse gas emissions during production.

Question 2
Fats and oils have a higher energy content than carbohydrates because
A. carbohydrate molecules have a higher degree of oxidation than fats and oils.
B. fats and oils are more easily broken down during digestion.
C. foods generally contain more fats than carbohydrates per gram.
D. fats and oils are composed of triglycerides with long hydrocarbon chains.

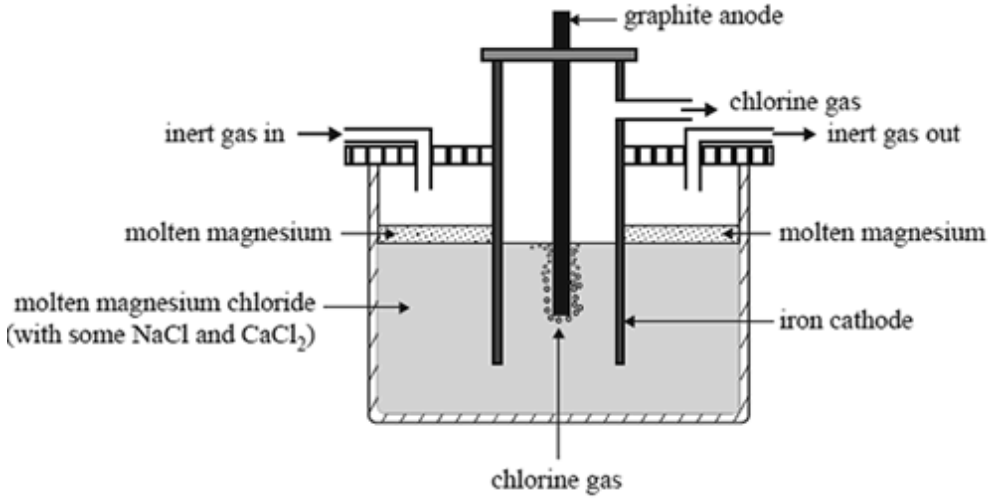
Question 3
The thermochemical equation for photosynthesis is
A. $6CO_2(g) + 6H_2O(l) \rightarrow C_6H_{12}O_6(aq) + 6O_2(g)$ $\Delta H = +2803$ kJ/g
B. $C_6H_{12}O_6(aq) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$ $\Delta H = -2803$ kJ/g
C. $6CO_2(g) + 6H_2O(l) \rightarrow C_6H_{12}O_6(aq) + 6O_2(g)$ $\Delta H = +2803$ kJ
D. $C_6H_{12}O_6(aq) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$ $\Delta H = -2803$ kJ

Question 4
Fermentation of glucose to produce bioethanol is shown by the equation:
$C_6H_{12}O_6(aq) \rightarrow 2C_2H_5OH(l) + 2CO_2(g)$
The process is carried out at 35°C because
A. the reaction rate decreases as the temperature increases.
B. the enzyme catalysts will be destroyed at higher temperatures.
C. ethanol has a very low boiling point and must be kept in the liquid state.
D. the reaction is exothermic and an increase in temperature favours the reverse reaction.

Question 5
The amount of energy released when 10.0 kg of liquid butane undergoes complete combustion in a portable stove is equal to
A. 497 kJ
B. 4.97×10^2 J
C. 497000 J
D. 4.97×10^5 kJ

Question 6

The diagram below shows a commercial, electrolytic cell, used in the production of magnesium metal. Which option shows the correct half equation and electrode combination for the cell when it is in operation?



Source: Mg_by_electrolysis.png

A. $2Cl^-(l) \rightarrow 2e^- + Cl_2(g)$ at the positive electrode
B. $2e^- + Cl_2(g) \rightarrow 2Cl^-(l)$ at the cathode
C. $2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$ at the anode
D. $Mg^{2+}(aq) + 2e^- \rightarrow Mg(s)$ at the negative electrode

Question 7

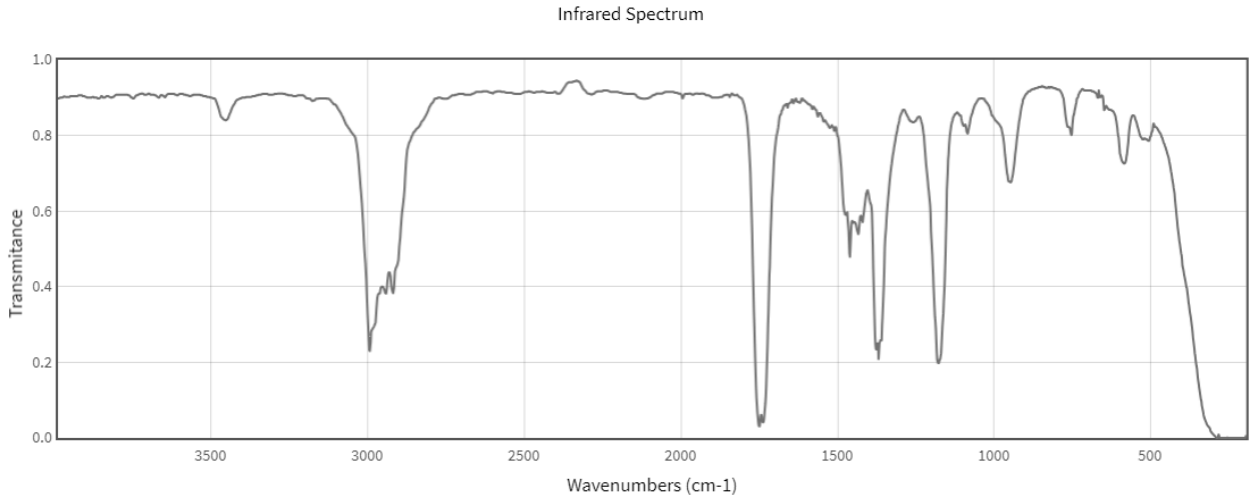
The steel tank shown in the image below contains 9.1kg of propane. What volume of carbon dioxide will be released into the atmosphere if this mass of propane undergoes complete combustion at SLC?

Source: https://upload.wikimedia.org/wikipedia/commons/f/fe/Propane_tank_20lb.jpg

A. 1.7×10^3 L
B. 1.8×10^3 L
C. 1.5×10^4 L
D. 1.6×10^4 L

Question 8

Which organic compound could have produced the infrared spectrum shown below?



Source: 2-Butanone (nist.gov)

A. ethanol
B. propanoic acid
C. 2-butanone
D. ethanamine

Use the following information to answer Questions 9 and 10.

The chemical equation for the complete combustion of methane, at constant temperature and pressure, is shown below:

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

Question 9

Which option correctly identifies the species being reduced and the oxidation number of the oxidant during the complete combustion of methane?

	Species being reduced	Oxidant oxidation number
A.	$CH_4(g)$	-2
B.	$CH_4(g)$	+1
C.	$O_2(g)$	0
D.	$O_2(g)$	-4

Question 10

100 g of methane undergoes complete combustion in 600 g of oxygen at SLC. Calculate the volume of carbon dioxide produced during the reaction.

A. 155 L
B. 233 L
C. 465 L
D. 620 L

Question 11

Consider the unbalanced redox equation shown below:

$$Fe^{2+}(aq) + Cr_2O_7^{2-}(aq) \rightarrow Fe^{3+}(aq) + Cr^{3+}(aq)$$

The balanced, overall equation for this reaction in acidic conditions is

A. $14H^+(aq) + 6Fe^{2+}(aq) + Cr_2O_7^{2-}(aq) \rightarrow 6Fe^{3+}(aq) + 2Cr^{3+}(aq) + 7H_2O(l)$

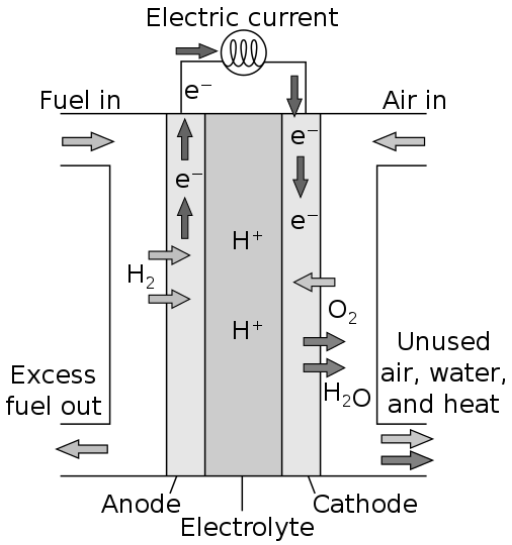
B. $14H^+(aq) + 8Fe^{2+}(aq) + Cr_2O_7^{2-}(aq) \rightarrow 8Fe^{3+}(aq) + 2Cr^{3+}(aq) + 7H_2O(l)$

C. $14H^+(aq) + 9Fe^{2+}(aq) + Cr_2O_7^{2-}(aq) \rightarrow 9Fe^{3+}(aq) + 2Cr^{3+}(aq) + 7H_2O(l)$

D. $14H^+(aq) + 11Fe^{2+}(aq) + Cr_2O_7^{2-}(aq) \rightarrow 11Fe^{3+}(aq) + 2Cr^{3+}(aq) + 7H_2O(l)$

Question 12

The diagram below shows a typical hydrogen fuel cell setup. Which statement correctly describes the processes occurring in the fuel cell?



Source: File:Proton Exchange Fuel Cell Diagram.svg

A. hydrogen is reduced and water is produced as a by-product of the reaction

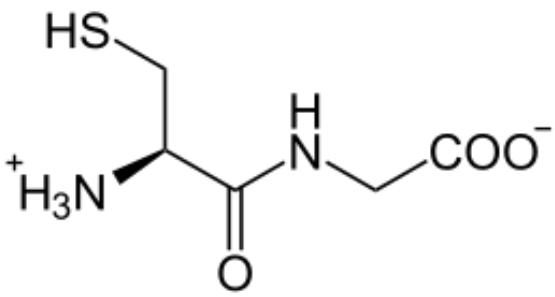
B. an electric current is supplied to the cell to force the oxidation of hydrogen

C. electrical energy is transformed into chemical energy as the cell operates

D. oxidation occurs at the negative electrode and hydrogen ions travel from the anode to the cathode

Question 13

The structure below shows a zwitterion of a dipeptide in a neutral solution. Identify the two amino acid molecules that would be produced when this molecule undergoes hydrolysis.



Source: https://commons.wikimedia.org/wiki/File:L-Cysteinylglycin.svg

A. cysteine and glycine

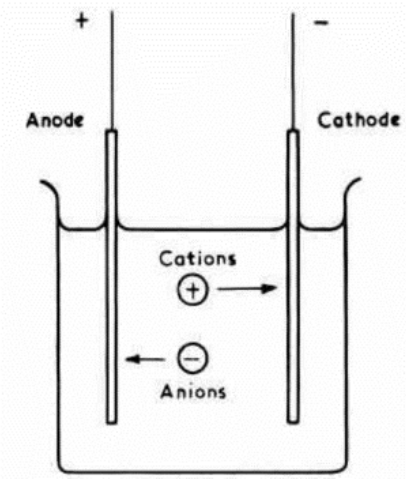
B. alanine and cysteine

C. glycine and lysine

D. valine and methionine

Question 14

The diagram below represents a basic cell set-up, with two solid electrodes and an electrolyte solution.



Source: https://commons.wikimedia.org/wiki/File:Coulometer_in_A._Horsfield,_%22The_Faraday_and_Its_Significance_in_Determining_the_Fundamental_Constants%22.jpg

The cell shown in the diagram could be used to

A. provide a sustainable source of energy.
B. convert chemical energy to electrical energy.
C. oxidise an impure metal at the positive electrode.
D. electroplate an object with copper at the positive electrode.

Question 15

Two electrolytic cells are constructed to compare the mass of electroplated material that is deposited at the cathode. Both cells operate for 15.0 minutes with a current of 20.0 A under standard conditions.

Cell A contains an object to be plated at the cathode, copper anode and electrolyte containing Cu^{2+} ions.

Cell B contains an object to be plated at the cathode, tin anode and electrolyte containing Sn^{2+} ions.

Which statement is correct regarding the mass of metal plated at the cathode?

A. the mass of tin plated is the same as the mass of copper plated
B. almost 0.2 g more tin than copper is plated
C. just over 5 g more tin than copper is plated
D. just over 10 g more tin than copper is plated

Question 16
Consider the following statements regarding the structure and bonding of carbon atoms.

I Carbon has a valence electron number of six.
II The bond energy of a carbon-to-carbon double bond is greater than for a single carbon-to-carbon bond.
III Carbon and silicon have the same valence electron number and form a similar range of compounds.
IV Carbon can form single and multiple bonds with itself and a range of other elements.

Which of the statements above are correct?
A. I and III only
B. II and IV only
C. III and IV only
D. I, II, III and IV

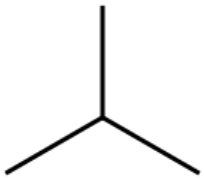
Question 17
Which of the following pieces of information can be obtained from the high-resolution ^{1}H spectrum of an organic compound?
A. the number of unique hydrogen environments, based on splitting patterns of the signals
B. the number of neighbouring hydrogen atoms adjacent to each environment, based on chemical shift data
C. the length of the molecule, based on the number of signals
D. the ratio of hydrogen atoms in each environment, based on signal integration

Question 18
Select the option that correctly defines the reactions occurring in a secondary cell.

	During discharge	During recharge
A.	galvanic operation, oxidation at negative electrode	electrolytic operation, oxidation at positive electrode
B.	electrolytic operation, oxidation at positive electrode	galvanic operation, oxidation at negative electrode
C.	galvanic operation, oxidation at positive electrode	electrolytic operation, oxidation at negative electrode
D.	electrolytic operation, oxidation at negative electrode	galvanic operation, oxidation at positive electrode

Question 19

The skeletal structure of an organic compound is shown below.



Source: File:I-Butane-2D-Skeletal.svg

What is the IUPAC, systematic name of the compound?

A. ammonia
B. methylethane
C. 2-methylpropane
D. 1,1-dimethylethane

Question 20

The reaction $Fe^{3+}(aq) + SCN^{-}(aq) \rightarrow FeSCN^{2+}(aq)$ has a value of K equal to $9 \times 10^{2}\ M^{-1}$ at 25°C.

At a certain point in time during the reaction, at 25°C, the concentration of each species was found to be:
$[Fe^{3+}] = 0.01$ M
$[SCN^{-}] = 0.01$ M
$[FeSCN^{2+}] = 0.1$ M

The relationship between Q and K, at this point in time, is

A. Q > K and the forward reaction will be favoured.
B. Q > K and the reverse reaction will be favoured.
C. K > Q and the forward reaction will be favoured.
D. K > Q and the reverse reaction will be favoured.

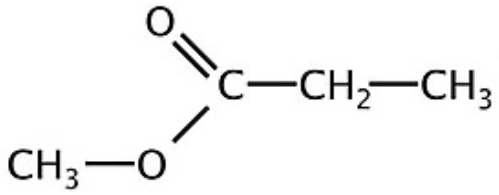
Question 21

Select the structure below that is likely to have the lowest viscosity.

A. $CH_3(CH_2)_9CH_3$
B. CH_3CH_2COOH
C. CH_3COCH_3
D. $CH_3CHCHCH_2CH_3$

Question 22

Which two molecules undergo a condensation reaction to produce the larger molecule shown in the diagram below?

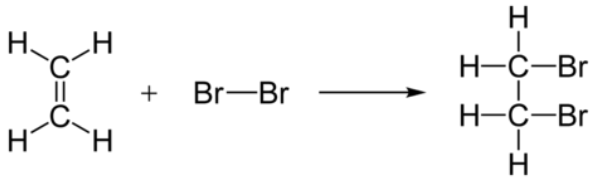


Source: https://commons.wikimedia.org/wiki/File:%D8%A7%D9%84%D8%A7%D8%B3%D8%AA%D8%B1%D8%A7%D8%AA_1.jpg

A. methanol and propanoic acid
B. propan-1-ol and methanoic acid
C. methyl propanoate and water
D. propyl methanoate and water

Question 23

The diagram below shows the reaction of ethene with bromine.



Source: File:Bromine-adds-to-ethene.png

The reaction is

A. an addition reaction and bromine changes from colourless to brown.
B. a substitution reaction that tests for the presence of halogen functional groups.
C. an addition reaction that tests for the presence of carbon-carbon double bonds.
D. a substitution reaction and bromine changes from brown to colourless.

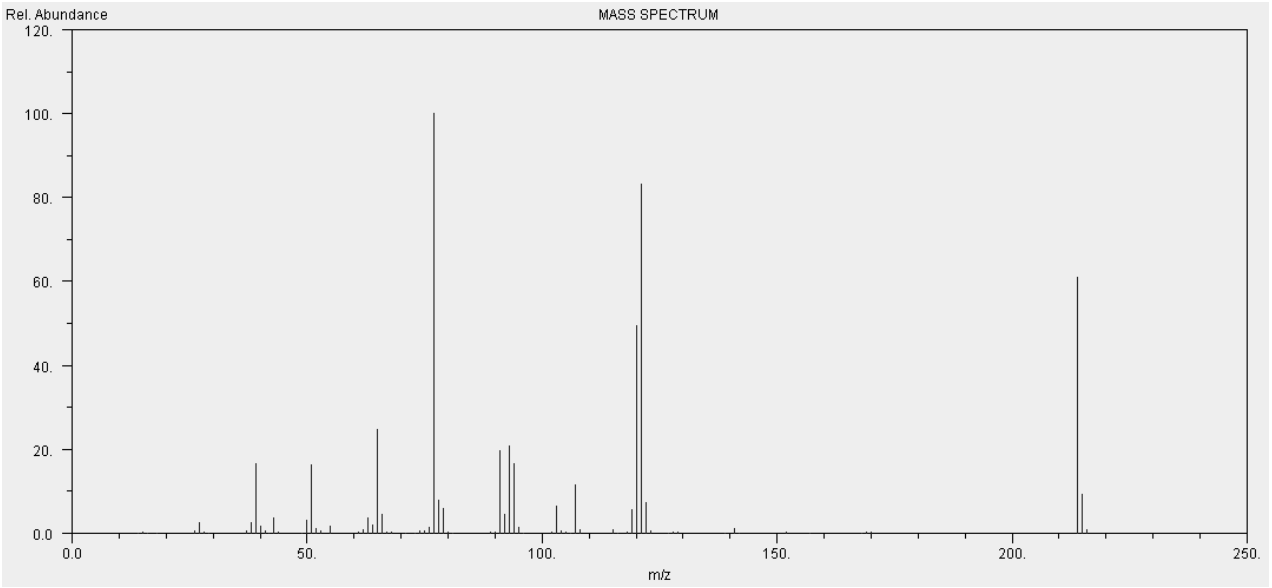
Question 24

Which of the following is not produced via a condensation reaction?

A. cellulose
B. glucose
C. an ester
D. a triglyceride

Question 25

The diagram below shows the mass spectrum of an unidentified, organic compound with molecular formula $C_{14}H_{14}O_2$.



Source: File:Difenossi etano spectrum mass.png

From the information provided, it can be assumed that

A. the base peak is at m/z 214 and a $[CH_3CH_2]^+$ fragment is possible.

B. the molar mass of the compound is 215 g mol^{-1} and there are isotopes of carbon-13 in the compound.

C. the m/z 121 peak could be produced by a $[C_8H_9O]^+$ fragment and the molecular mass of the compound is 216 g mol^{-1}.

D. the molecular mass of the compound is 214 g mol^{-1} and a benzene functional group could produce the peak with greatest abundance.

Question 26

Which of the following does not correctly describe an instrumental analysis technique commonly used to determine the purity of commercial products?

A. using reference samples to determine the identity of specific impurities using IR spectroscopy

B. using known standards and NMR spectra to analyse organic samples for substitution of ingredients

C. identifying additional peaks in IR spectra that should not be present according to database records of pure compounds

D. identifying contaminant functional groups from peak splitting patterns produced during mass spectrometry

Question 27

The solvent extraction process can be used to extract medicinal components from plants. For the process to work effectively

A. both the solvent and the plant matter should be in liquid form.

B. the temperature of the solvent should always be close to boiling point.

C. the leaves should not be blended or shredded as this breaks down their structure.

D. the polarity of the component being extracted should be the same as the solvent.

Question 28

Which option correctly lists specific bonding types present in the primary, secondary and tertiary folding patterns of protein molecules?

	Primary folding	Secondary folding	Tertiary folding
A.	covalent bonds	covalent bonds	a variety of bond types
B.	hydrogen bonds	hydrogen bonds	a variety of bond types
C.	covalent bonds	a variety of bond types	dipole-dipole forces and ionic bonds
D.	covalent bonds	hydrogen bonds	covalent and hydrogen bonds

Question 29

A group of Year 12 students conducted multiple trials of a volumetric analysis investigation over several days. They noticed that their results fluctuated, depending on the student carrying out the titration each day. The results are shown in the table below:

Day	Conducted by	Volume of acid required to reach the end point (mL)
Mon	Student 1	24.50
Tues	Student 1	24.55
Wed	Student 1	24.55
Thurs	Student 1	24.45
Mon	Student 2	26.25
Tues	Student 2	26.20
Wed	Student 2	26.25
Thurs	Student 2	26.20

From the results, it can be concluded that

A. the method has high repeatability.
B. the method has high reproducibility.
C. results from Student 1 are more accurate than Student 2.
D. results from Student 1 are more precise than Student 2.

Question 30

High-performance liquid chromatography (HPLC) is an analytical technique used to separate and identify components in a mixture. An increase in the length of the column would

A. increase the peak area.
B. not affect relative retention times of components.
C. reduce overall analysis time if the flow rate remains unchanged.
D. increase the separation resolution of the components.

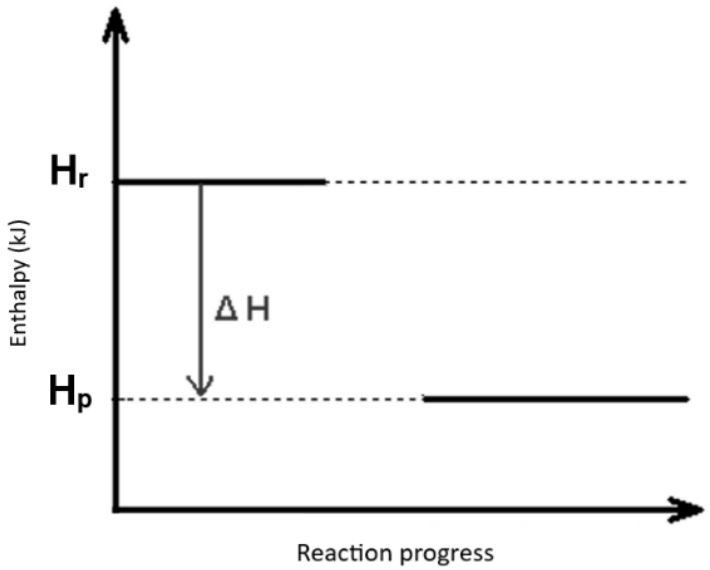
End of Section A

Section B

Instructions

- Answer all questions in the spaces provided.
- Write your responses in English.
- Give simplified answers to all numerical questions, with an appropriate number of significant figures; unsimplified answers will not be given full marks.
- Show all working in your answers to numerical questions; no marks will be given for an incorrect answer unless it is accompanied by details of the working.
- Ensure chemical equations are balanced and that the formulas for individual substances include an indication of state, for example, $H_2(g)$, NaCl(s).
- Unless otherwise indicated, the diagrams in this book are not drawn to scale.

Question 1 (12 marks)
The diagram below shows an incomplete energy profile diagram for an exothermic chemical reaction. The ΔH for this reaction was found to be -726 kJ mol^{-1} at SLC.



Source: Adapted from https://commons.wikimedia.org/wiki/File:Entalpia_r_exotermica.PNG

a. With reference to the diagram, explain why energy is released as the reaction progresses. 2 marks

b. The ΔH for this reaction is -726 kJ mol^{-1} at SLC. Explain why exothermic reactions have a negative ΔH value. 2 marks

c. Explain the exothermic nature of the reaction with reference to bond breaking and bond forming as the reaction progresses. 1 mark

d. The activation energy for the reaction is +100 kJ mol^{-1}. Complete the energy profile by sketching a curve on the diagram to show the magnitude of the activation energy. 1 mark

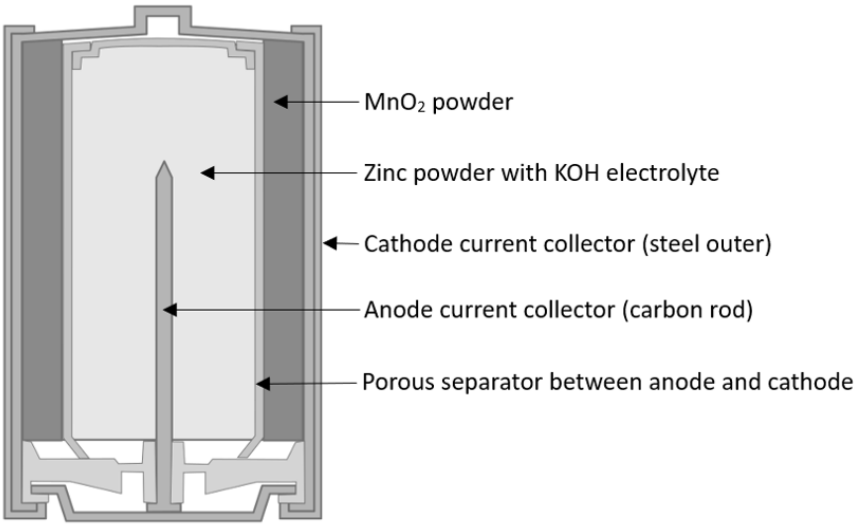
e. Write the thermochemical equation for the complete combustion of liquid methanol at SLC. 3 marks

f. Calculate the volume of CO_2 released into the atmosphere if 1.00 L of pure methanol undergoes complete combustion in excess oxygen at SLC. The density of methanol is 0.791 g mL^{-1}. 3 marks

Do not write in this area.

Question 2 (12 marks)

In an alkaline battery, zinc powder reacts at the anode and manganese dioxide powder reacts at the cathode. Potassium hydroxide is used as the electrolyte. The diagram below shows the setup of the cell.



Adapted from: https://commons.wikimedia.org/wiki/File:Alkaline-battery-english.svg

a. Explain why the solid reactants are present in powdered form. 2 marks

bi. The reaction occurring at the cathode during discharge is: 2 marks

$2MnO_2(s) + H_2O(l) + 2e^- \rightarrow Mn_2O_3(s) + 2OH^-(aq)$

Use oxidation numbers to show that manganese undergoes reduction during the reaction.

bii. Write the half-cell equation for the reaction occurring at the anode during discharge, where Zn(s) is oxidised to ZnO(s). 1 mark

Do not write in this area.

biii. Write the overall equation for the alkaline battery during discharge. 1 mark

c. Battery technology has improved greatly over the past few years with respect to energy output, charge time and safety. Many of these improvements have been in the development of battery technology for Electric Vehicles (EVs). 3 marks
Compare the energy efficiency of a battery designed for an EV with a traditional petrol combustion engine.

d. Hydrogen fuel cells offer another possibility for electricity generation in EVs. 1 mark
Explain why fuel cells are usually designed with porous electrodes.

e. State one advantage and one disadvantage of using hydrogen fuel cell technology to power EVs instead of batteries. 2 marks

Question 3 (11 marks)

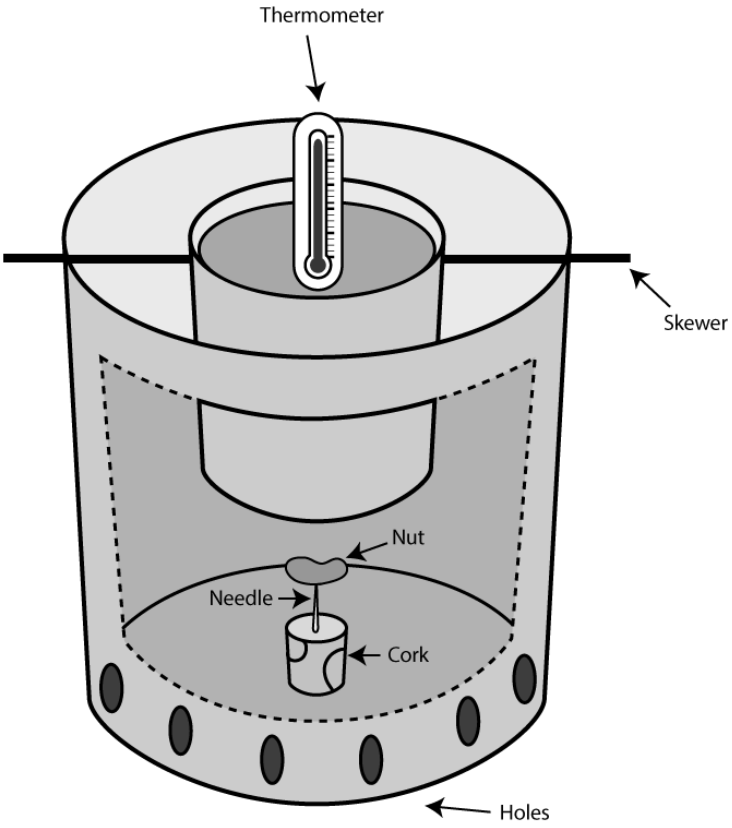
Almonds are considered a nutritious food option with many health benefits, including lowering blood sugar and cholesterol levels. They contain healthy fats, protein, fibre and a range of vitamins and minerals. They are also an excellent source of energy for the body.

The information table below shows some of the nutrient data for raw almonds per 100 g.

	per 100 g
Total Protein (g)	19.7
Total Fat (g)	50.5
Total Carbohydrate (g)	5.4

a. Use the data in the table to calculate the energy content of almonds in kJ g^{-1}. 2 marks

b. A basic calorimeter was set up in a school laboratory to determine the energy content of almonds, as shown in the diagram below. 2 marks



Source: https://www.education.com/science-fair/article/how-much-potential-energy-do-different/

One small almond, with a mass of 0.950 g, underwent complete combustion in the calorimeter. 100 g of water in the suspended cup showed an increase in temperature of 11.3°C after combustion.

Calculate the energy content of almonds in kJ g^{-1}.

c. Compare your answers for Questions 3a and 3b. State one likely reason for the difference in calculated values. 2 marks

d. Calorimeters can be calibrated to improve accuracy. Describe how this simple calorimeter could be calibrated before being used in an investigation. 2 marks

e. Explain why calibrated calorimeters are more accurate than non-calibrated calorimeters. 2 marks

f. State the main purpose of the holes in the bottom of the calorimeter. 1 mark

Question 4 (14 marks)
The Haber process is used to produce ammonia from hydrogen gas and nitrogen gas. The equation for the reaction is shown below.

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \quad \Delta H = -92.4kJ$

A summary of operating conditions and processes is shown below.

Condition/Process	Haber Cell
Temperature	High
Pressure	Moderately high
Catalyst	Yes
Recycling of unreacted gases	Yes

ai. Explain the effect of high pressure on the rate of production of ammonia. 2 marks

aii. Explain the effect of low temperatures on the yield of ammonia. 2 marks

bi. Manufacturers of ammonia must compromise on the operating conditions and processes to balance the rate, yield and cost of production. 1 mark

State one reason why temperature is set at a moderately high level, rather than low.

bii. Explain why recycling of the unreacted gases leads to a higher yield. 1 mark

c. Describe the role of the catalyst in the Haber process, with reference to the temperature stated in the operating conditions table. 2 marks

d. 30.0 mol of N_2 gas and 90.0 mol of H_2 gas are added to a 10.0 L tank at a particular temperature and pressure. At equilibrium, 10.0 mol of ammonia, NH_3, is present. 4 marks

Calculate the equilibrium constant, K, for the reaction under these conditions.

e. State two ways the processes and operating conditions associated with the industrial production of ammonia are designed to meet the green chemistry principle of 'designing for energy efficiency'. 2 marks

Question 5 (15 marks)

The table below compares some of the common properties and structural features of two organic compounds, propan-1-ol and propanoic acid.

Property/Structure at SLC	**propan-1-ol**	**propanoic acid**
Molecular formula	C_3H_8O	$C_3H_6O_2$
Boiling point	97.2 °C	141.1 °C
Flash point	23 °C	53 °C

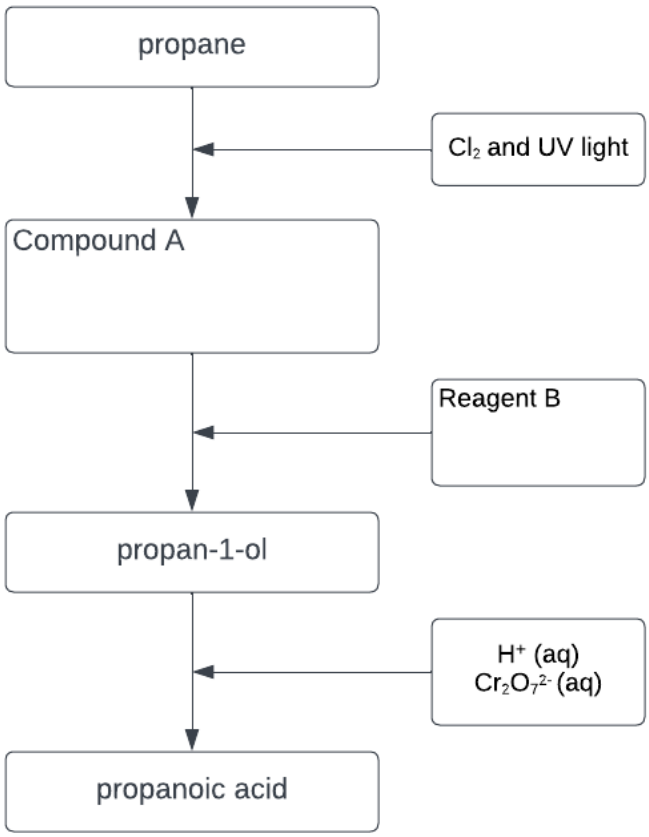
a. Draw the full, structural formulas of propan-1-ol and propanoic acid into the boxes below. 2 marks

propan-1-ol	***propanoic acid***

b. Explain why the boiling point of propanoic acid is higher than the boiling point of propan-1-ol. 2 marks

c. The 'flash point' is the lowest temperature of a liquid at which the vapours forming above a substance can ignite in the presence of an ignition source. Use the data to explain why a Safety Data Sheet for propan-1-ol lists 'Use only non-sparking tools' as a precautionary measure. 2 marks

di. Propanoic acid can be synthesised in a laboratory from propane, a constituent of crude oil. The reaction pathway is shown below. 1 mark



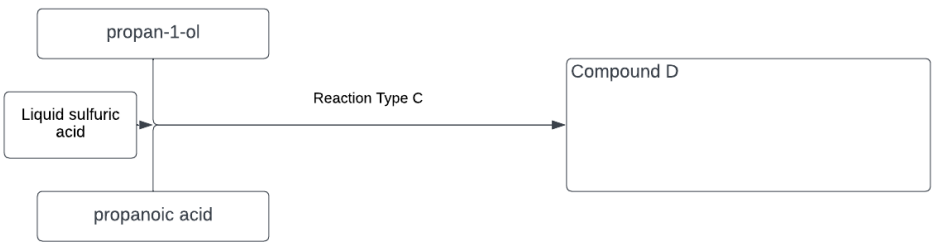
Write the IUPAC name of Compound A into the box provided on the diagram.

dii. In the box provided on the diagram, write the formula of the ionic species that acts as Reagent B. 1 mark

diii. The reaction pathway leads to the production of a significant amount of propan-2-ol. Explain why this isomer does not undergo further synthesis to produce propanoic acid. 2 marks

div. Propan-1-ol and propan-2-ol have similar boiling points. Explain how fractional distillation could be used to separate the two isomers. 1 mark

ei. The diagram below shows the reaction pathway for the production of Compound D. 1 mark



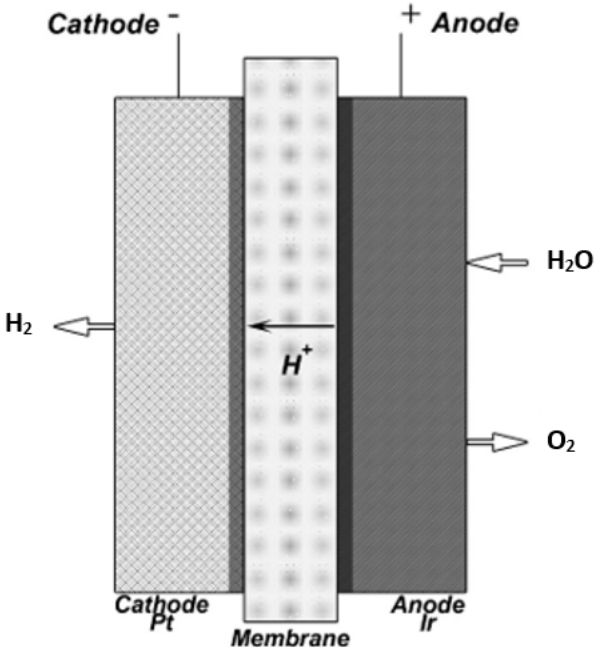
State the name of Reaction Type C.

eii. Write the IUPAC name of the product of this reaction, Compound D, in the box provided on the diagram. 1 mark

eiii. Calculate the atom economy of Reaction Type C to produce Compound D. 2 marks

Question 6 (6 marks)

The diagram below shows the basic operation of a PEM electrolyser.



Source: https://commons.wikimedia.org/wiki/File:PEMelectrolysis.jpg#/media/File:PEMelectrolysis.jpg

a. Other than allowing the passage of hydrogen ions from the anode to the cathode, state two purposes of the membrane in the electrolyser. 2 marks

b. Write the half equation for the reaction occurring at the cathode while the cell is in operation. 1 mark

c. Green chemistry principles require new technologies to be developed with the use of renewable feedstocks where possible. Describe how the PEM electrolyser can produce hydrogen, required as a reactant in hydrogen fuel cells, renewably. 1 mark

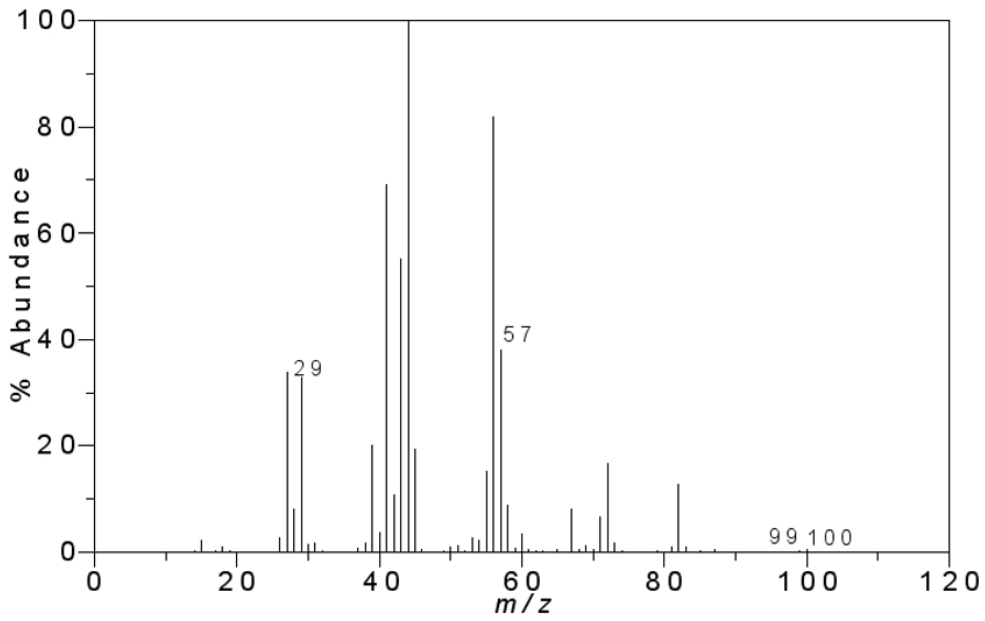
d. Hydrogen can also be produced using a process known as artificial photosynthesis, with a photoelectrochemical cell. Compare artificial photosynthesis to natural photosynthesis, referencing one similarity and one difference between the two processes. 2 marks

Question 7 (10 marks)
The following organic compounds were purified and then used to develop reference data and spectra for the identification of unknown contaminants in consumer products.

hexane **hex-2-ene** **hexan-2-ol** **hexanal**

a. A mixture of hexene and hex-2-ene was purified using high-performance liquid chromatography (HPLC). A non-polar, silica, stationary phase was set up for the separation of the two components. Explain why these two components can be separated using HPLC. 2 marks

bi. The mass spectrum of one of the compounds is shown below. 1 mark

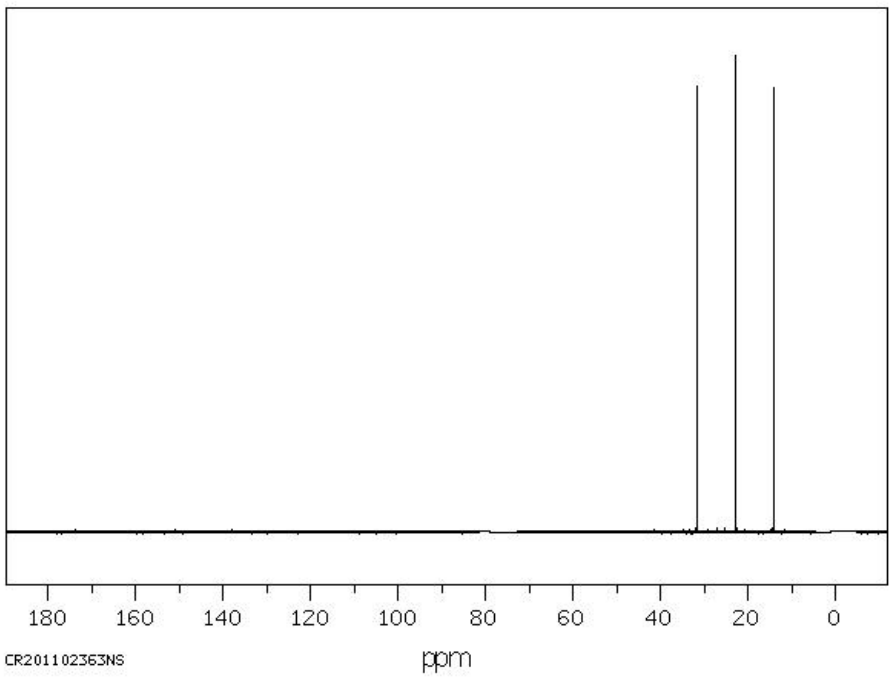


Source: https://commons.wikimedia.org/wiki/File:Hexanal_edited.gif

Identify the fragment, producing a peak at m/z 43, that is common to all four organic compounds.

bii. The mass spectrum was produced by hexanal. State two reasons why this spectrum could not be that of hex-2-ene. 2 marks

c. The ^{13}C NMR spectrum below was obtained during the analysis of the organic compounds. 3 marks



Source: https://www.chemicalbook.com/SpectrumEN_110-54-3_13CNMR.htm

Identify which of the four molecules produced the ^{13}C NMR spectrum. Provide two justifications for your choice.

Do not write in this area.

d. Laboratory tests can be used to identify and distinguish between organic compounds. Next to each test description below, place a tick in the box of the organic molecule it could be used to identify. 2 marks

	hexane	**hex-2-ene**	**hexan-2-ol**	**hexanal**
Iodine, I_2, is added to this compound and the colour changes from brown to colourless				
A test for viscosity shows that this compound has the greatest resistance to pouring				

Do not write in this area.

Question 8 (5 marks)
Catalase is an enzyme that breaks down hydrogen peroxide into water and oxygen gas.
A student-designed an experiment to determine the optimal temperature for catalase activity. A summary of the method is shown below.

1. Set up four water baths at 10°C, 30°C, 50°C and 70°C. Use thermometers to monitor the temperature of each water bath.
2. Measure 2.0 mL of 10% hydrogen peroxide solution into four, separate test tubes.
3. Place a thermometer in each test tube.
4. Put test tube 1 into the 10°C water bath. Wait until the contents of the test tube cool to 10°C.
5. Add one catalase tablet to the test tube and immediately start timing. Stop the timer when oxygen gas stops being produced.
6. Repeat steps 4 and 5 for the other three test tubes in water baths at 30°C, 50°C and 70°C. Record all times and observations in the results table.

Experimental Results

Water Bath Temperature (°C)	**Time for bubbles to stop (sec)**	**Observations**
10°C	205	Bubbles produced slowly
30°C	45	Vigorous fizzing
50°C	95	Bubbles consistently but at a slower rate than at 30°C
70°C	10	Very few bubbles produced

a. Suggest why the enzyme in the 10°C water bath produced bubbles of oxygen for the longest period of time. 1 mark

Do not write in this area.

b. Explain why the 'time for bubbles to stop' data could be misleading at 70°C. 2 marks

c. Based on your understanding of enzyme function, explain why the catalase and hydrogen peroxide reaction lasted for 95 seconds at 50°C but only 10 seconds at 70°C. 2 marks

Question 9 (5 marks)

The development and identification of chiral molecules in medicines have been an important part of the drug manufacturing process since Louis Pasteur discovered molecular chirality in the mid-1800s. Over 50% of the medicines in current circulation consist of chiral molecules. Some drugs are unichiral, with only one enantiomer present, and others are racemic mixtures, consisting of both enantiomers.

Use your understanding of chiral chemistry to explain why chirality has become such a strong focus in the drug development and manufacturing industry.

In your response:

- provide a definition of chirality and how chiral molecules are identified,
- explain the significance of chirality in the production of pharmaceutical medicines, and
- describe specific challenges faced by manufacturers of new medicines due to molecule chirality.

End of examination questions

Extra space for responses

Clearly number all responses in this space.

- If you need extra space to complete an answer, ask the supervisor for an Answer Book.
- Write your student number in the space provided on the front cover of the Answer Book.
- At the end of the examination, place the Answer Book inside the front cover of this book.

VCE UNITS 3&4 CHEMISTRY

Written Examination

ANSWER SHEET – 2024

Student name:	

Use a **PENCIL** for **ALL** entries. For each question, shade the box which indicates your answer.

Marks will **NOT** be deducted for incorrect answers.

NO MARK will be given if more than **ONE** answer is completed for any question.

If you make a mistake, **ERASE** the incorrect answer – **DO NOT** cross it out.

1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D

11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D
16	A	B	C	D
17	A	B	C	D
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24	A	B	C	D
25	A	B	C	D
26	A	B	C	D
27	A	B	C	D
28	A	B	C	D
29	A	B	C	D
30	A	B	C	D