Neap

Trial Examination 2023

# VCE Chemistry Units 3&4

## Written Examination

## Question and Answer Booklet

Reading time: 15 minutes
Writing time: 2 hours 30 minutes

Student's Name: _____

Teacher's Name: _____

**Structure of booklet**

| *Section* | *Number of questions* | *Number of questions to be answered* | *Number of marks* |
|---|---|---|---|
| A | 30 | 30 | 30 |
| B | 10 | 10 | 90 |
| | | | Total 120 |

Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers and one scientific calculator.

Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

**Materials supplied**

Question and answer booklet of 32 pages

Data booklet

Answer sheet for multiple-choice questions

**Instructions**

Write your **name** and your **teacher's name** in the space provided above on this page, and on the answer sheet for multiple-choice questions.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

All written responses must be in English.

**At the end of the examination**

Place the answer sheet for multiple-choice questions inside the front cover of this booklet.

You may keep the data booklet.

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

Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2023 VCE Chemistry Units 3&4 Written Examination.

## SECTION A – MULTIPLE CHOICE QUESTIONS

**Instructions for Section A**

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
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 booklet are **not** drawn to scale.

**Question 1**

Coal seam gas is

**A.** composed largely of butane and propane gases.
**B.** manufactured from surplus brown coal supplies.
**C.** used as a raw material in a wide range of chemicals.
**D.** used in power plants to generate electricity.

**Question 2**

Which one of the following statements is always correct?

**A.** Fuel cells are a type of secondary cell.
**B.** Rechargeable cells use electrolysis reactions.
**C.** Primary cells are more efficient than fuel cells.
**D.** The electrodes in galvanic cells are inert.

**Question 3**

Arachidonic acid is an omega-6 fatty acid.

This means that arachidonic acid has

**A.** twice the number of C=C bonds as an omega-3 fatty acid.
**B.** six C=C bonds per molecule.
**C.** a C=C bond on the sixth carbon atom from the end with the COOH group.
**D.** a C=C bond on the sixth carbon atom from the end without the COOH group.

*Use the following information to answer Questions 4 and 5.*

Aspartame is a manufactured chemical that is used as a substitute for sugar.

**Question 4**

Aspartame is used as a sugar substitute because

**A.** it has the same sweetness as sugar but is not metabolised in the body.

**B.** a smaller amount of aspartame is required to achieve the same sweetness level as sugar.

**C.** it has the same energy content per mole as sugar but is digested more easily.

**D.** it is not soluble in water and so it is not absorbed by the body.

**Question 5**

Which one of the following statements relating to the aspartame molecule is correct?

**A.** Aspartame has a peptide bond and an ether link.

**B.** Aspartame is an ethyl ester of a tripeptide with glycosidic links.

**C.** Aspartame has the same basic structure as all monosaccharides.

**D.** Hydrolysis of the molecule produces an alcohol and two amino acids.

**Question 6**

Which one of the following statements about vitamins is correct?

**A.** The vitamin C molecule forms hydrogen bonds with water molecules.

**B.** Vitamin $D_2$ and vitamin $D_3$ have the same molecular formula.

**C.** Vitamin D is a polar molecule due to the presence of a hydroxyl group.

**D.** Vitamin C and vitamin D are stored in the fat tissue of the body.

**Question 7**

A particular fuel cell uses hydrogen and oxygen gases as reactants, an acidic electrolyte and porous electrodes.

Which one of the following statements about this fuel cell is correct?

**A.** The overall cell reaction differs from the combustion reaction of hydrogen gas.

**B.** The porous electrodes provide a large surface area for the cell reaction to occur.

**C.** The acidic electrolyte allows electrons to flow through it more efficiently.

**D.** As the cell produces electrical energy, the pH of the acidic electrolyte increases.

**Question 8**

A number of food constituents are classified as 'essential'.

An essential food constituent

**A.** can be derived from plants only, not from animals.

**B.** must make up a large proportion of a person's diet.

**C.** is the largest source of energy in the body.

**D.** cannot be generated by the body's chemical reactions.

**Question 9**

A student conducted an experiment to determine the density of water at 25°C and obtained the following results.

| Trial 1 | Trial 2 | Trial 3 | Trial 4 |
|---|---|---|---|
| 1.101 g $mL^{-1}$ | 1.102 g $mL^{-1}$ | 1.100 g $mL^{-1}$ | 1.101 g $mL^{-1}$ |

The student's results show

**A.** accuracy because the average measured value is close to the standard value of the density of water at 25°C.

**B.** precision because the average measured value is close to the standard value of the density of water at 25°C.

**C.** accuracy because all the values are close to the average measured value.

**D.** precision because all the values are close to the average measured value.

**Question 10**

In a volumetric analysis, the concentration of an acid was determined using a sodium hydroxide solution. The sodium hydroxide solution was made by weighing a set mass of sodium hydroxide pellets and then dissolving the pellets in 100.0 mL of water. Recently calibrated glassware was used.

The volumetric analysis would most likely have

**A.** a source of random error only.

**B.** a source of systematic error only.

**C.** sources of random and systematic errors.

**D.** no random or systematic errors.

**Question 11**

When molten sodium chloride is electrolysed using graphite electrodes, the product formed at the positive electrode is

**A.** sodium metal.

**B.** chlorine gas.

**C.** hydrogen gas.

**D.** oxygen gas.

**Question 12**

An object is to be electroplated with copper using the electrolysis of a copper(II) sulfate electrolyte. The object will be the cathode of the electrolytic cell.

If one Faraday of charge is passed through the cell, the maximum mass of copper that could be deposited would be close to

**A.** 32 g

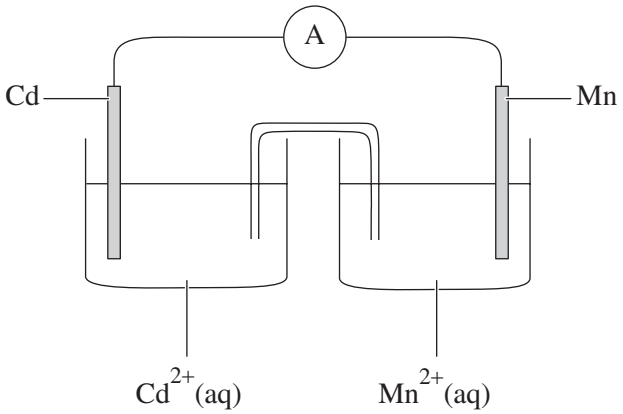
**B.** 64 g

**C.** 96 g

**D.** 128 g

**Question 13**

A galvanic cell was set up under standard conditions as shown in the following diagram.




During the operation of this cell,

**A.** the mass of the Mn electrode increases.

**B.** a different gas forms at each electrode.

**C.** positive ions in the salt bridge move away from the $Cd/Cd^{2+}$ half-cell.

**D.** electrons flow from the Mn electrode to the Cd electrode.

**Question 14**

Which one of the following molecules does **not** contain a chiral carbon atom?

**A.** $CH_3CH_2CH_2COOH$

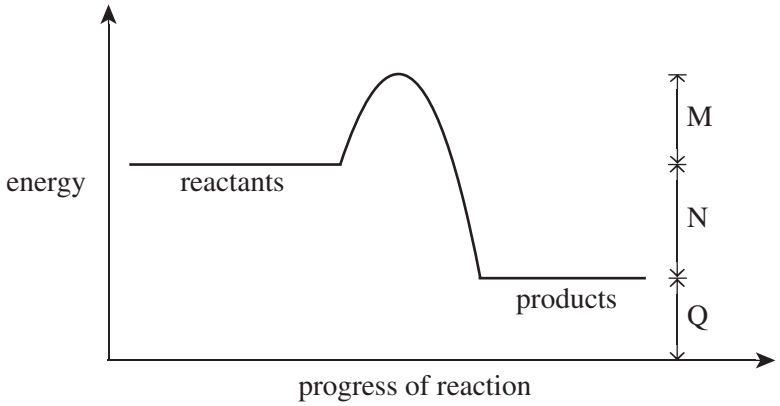
**B.** $CH_3CH(OH)COOH$

**C.** $CH_3CH(OH)CH_2CH_3$

**D.** $NH_2CH(CH_3)CH_2CH_3$

**Question 15**

The energy profile diagram of a reaction is shown below. Certain values are indicated by the letters M, N and Q.




A suitable catalyst is introduced into the reaction.

Which one of the following identifies how the values M, N and Q will be affected?

| | M | N | Q |
|---|---|---|---|
| **A.** | increase | decrease | unchanged |
| **B.** | decrease | decrease | increase |
| **C.** | unchanged | increase | increase |
| **D.** | decrease | unchanged | unchanged |

**Question 16**

The recharge reaction for the silver oxide–zinc secondary cell is represented by the following equation.

$$ZnO + 2Ag \rightarrow Zn + Ag_2O$$

The cell uses an alkaline electrolyte.

Which one of the following equations represents the reaction occurring at the positive electrode when electrical energy is being produced by the cell?

**A.** $Ag_2O + H_2O + 2e^- \rightarrow 2Ag + 2OH^-$

**B.** $ZnO + H_2O + 2e^- \rightarrow Zn + 2OH^-$

**C.** $2Ag + 2OH^- \rightarrow Ag_2O + H_2O + 2e^-$

**D.** $Zn + 2OH^- \rightarrow ZnO + H_2O + 2e^-$

**Question 17**

Bromine, $Br_2$, and iodine, $I_2$, gases react according to the following equation.

$$Br_2(g) + I_2(g) \rightleftharpoons 2IBr(g)$$

At 150°C, the equilibrium constant, $K_c$, is $1.2 \times 10^2$. A sealed vessel contains 1.0 mol of $Br_2$, 1.0 mol of $I_2$ and 1.0 mol of IBr at 150°C.

Based on the information provided, which one of the following statements is correct?

**A.** The system is not at equilibrium and the reaction will move towards the products.

**B.** The system is not at equilibrium and the reaction will move towards the reactants.

**C.** The system is at equilibrium with equal rates of the forward and reverse reactions.

**D.** No conclusion can be made as the volume of the vessel is not specified.

**Question 18**

500 g of water at 20°C was heated by burning 2.78 g of propane, $C_3H_8$, in excess oxygen.

What was the change in the temperature of the water?

**A.** 57°C

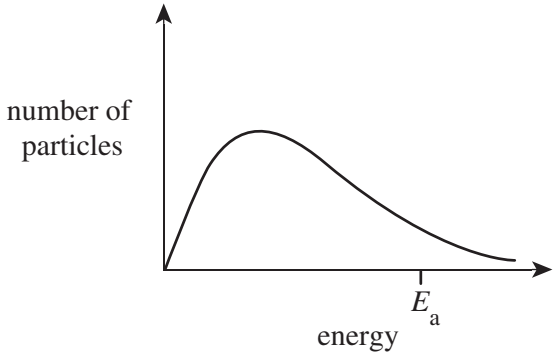
**B.** 67°C

**C.** 77°C

**D.** 87°C

*Use the following information to answer Questions 19 and 20.*

The distribution of energies of reactant gas particles in a sealed container and the activation energy ($E_a$) are shown in the following graph.




The temperature of the gas in the reaction is decreased.

**Question 19**

Which one of the following will occur in response to the temperature decrease?

**A.** The peak of the curve will move to the right.

**B.** The area under the graph will increase.

**C.** The area under the graph to the right of $E_a$ will decrease.

**D.** The shape of the graph will flatten.

**Question 20**

What conclusion can be made from the information provided?

**A.** When the temperature is lowered, the gas pressure decreases.

**B.** When the temperature is lowered, the value of the equilibrium constant, $K_c$, decreases.

**C.** Energy is produced by the forward reaction and therefore the reaction is exothermic.

**D.** Increasing the temperature moves the position of equilibrium towards the reactants.

*Use the following information to answer Questions 21 and 22.*

A fruit drink contained vitamin C ($C_6H_8O_6$). The amount of vitamin C in the fruit drink was determined by titration using the following reaction.

$$C_6H_8O_6(aq) + I_3^-(aq) \rightarrow C_6H_6O_6(aq) + 2H^+(aq) + 3I^-(aq)$$

A 20.00 mL sample of the fruit drink was diluted to 250.0 mL in a volumetric flask. 25.00 mL aliquots were titrated in conical flasks with a solution of $I_3^-$.

**Question 21**

The five pieces of glassware used (20.00 mL pipette, 250.0 mL volumetric flask, 50.0 mL burette, 25.00 mL pipette, a conical flask) were initially rinsed with distilled water but not dried.

How many of these pieces of glassware can be used when wet with distilled water **without** affecting the accuracy of titration results?

**A.** 0

**B.** 1

**C.** 2

**D.** 3

**Question 22**

In the titration reaction,

**A.** the oxidation number of hydrogen increased.

**B.** vitamin C was the reducing agent and underwent oxidation.

**C.** oxygen was reduced as its oxidation number decreased.

**D.** the triiodide ion, $I_3^-$, was the oxidising agent and underwent oxidation.

**Question 23**

A particular fuel has the following characteristics.

- absorbs moisture from the atmosphere
- is more viscous than water
- tends to degrade when stored

Which one of the following fuels is most likely to exhibit these characteristics?

**A.** unleaded petrol

**B.** liquefied petroleum gas (LPG)

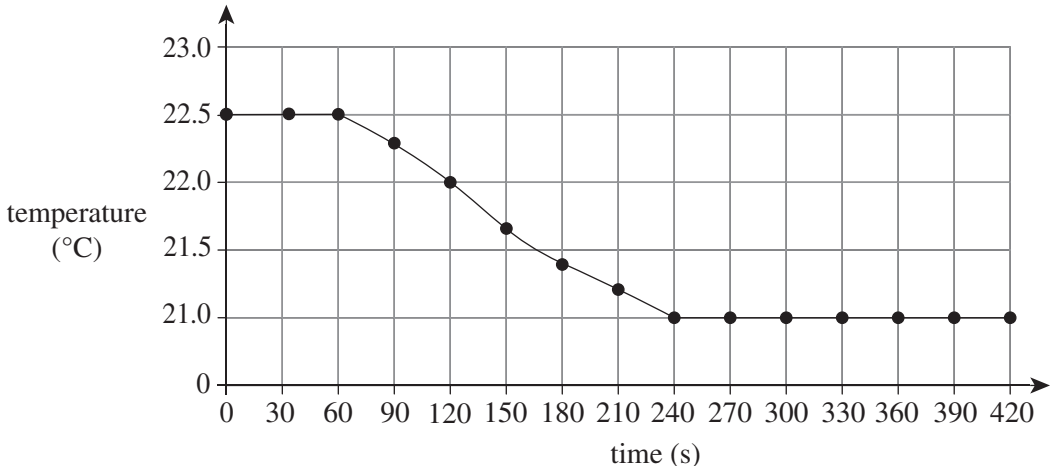
**C.** biodiesel

**D.** petrodiesel

**Question 24**

A solution calorimeter was calibrated using a chemical method. After stabilising the temperature of 100 mL of distilled water in the calorimeter, 2.50 g of potassium nitrate was added to the calorimeter while stirring. The temperature was recorded at 30 second intervals. The relevant thermochemical data and the temperature–time graph are shown below.

$$KNO_3(s) \rightarrow KNO_3(aq) \qquad \Delta H = +35 \text{ kJ mol}^{-1}$$




The calibration factor for the calorimeter and contents is

**A.** 58.3 J °C$^{-1}$

**B.** 418 J °C$^{-1}$

**C.** 577 J °C$^{-1}$

**D.** 583 J °C$^{-1}$

*Use the following information to answer Questions 25 and 26.*

The reaction for the combustion of methanol in excess oxygen is represented by the following equation.

$$2CH_3OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 4H_2O(g) \qquad \Delta H = -1452 \text{ kJ mol}^{-1}$$

**Question 25**

Which one of the following statements about this reaction is correct?

**A.** 484 kJ of energy is absorbed when 1 mol of oxygen reacts.

**B.** 1452 kJ of energy is released when 1 mol of methanol reacts.

**C.** 363 kJ of energy is released when 18 g of water is produced.

**D.** 726 kJ of energy is released when 88 g of carbon dioxide is produced.

**Question 26**

If methanol gas was used in the complete combustion reaction, then the enthalpy change, $\Delta H$, would be

**A.** more negative than $-1452$ kJ mol$^{-1}$.

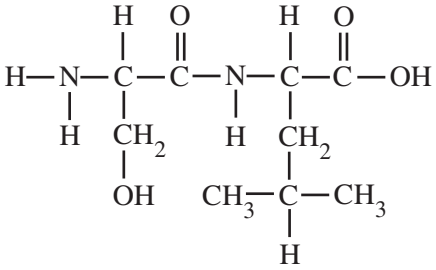
**B.** equal to $-1452$ kJ mol$^{-1}$.

**C.** less negative than $-1452$ kJ mol$^{-1}$.

**D.** impossible to estimate without further data being provided.

**Question 27**

The structural formula of a particular compound is shown below.



The molecule is best described as a dipeptide made from

**A.** two α-amino acids and is capable of hydrogen bonding.

**B.** two α-amino acids and is capable of disulfide bonding.

**C.** one α-amino acid and one other type of amino acid.

**D.** two amino acids that are not α-amino acids.

**Question 28**

The following galvanic half-cells were set up in a laboratory.

| Half-cell 1 | Half-cell 2 | Half-cell 3 | Half-cell 4 |
|---|---|---|---|
| metal N in $N^{2+}(aq)$ | metal P in $P^{2+}(aq)$ | metal Q in $Q^{2+}(aq)$ | metal R in $R^{2+}(aq)$ |

Galvanic cells were assembled using various combinations of the half-cells. The following table shows the half-cell combinations and positive electrodes.

| Half-cell combination | Positive electrode |
|---|---|
| 1 and 3 | metal N |
| 2 and 4 | metal R |
| 1 and 2 | metal P |

Which metal is the strongest reducing agent?

**A.** metal N

**B.** metal P

**C.** metal Q

**D.** metal R

**Question 29**

A student wrote the following statements about fuels.

I Electricity can be produced using various fossil fuels and biofuels.

II The burning of biogas in a restricted supply of oxygen produces carbon monoxide gas.

III Biodiesel can be derived from plant material but not animal material.

IV Petroleum gas is not a renewable form of energy.

Which of the student's statements are correct?

**A.** I, II and III only

**B.** I, II and IV only

**C.** II, III and IV only

**D.** III and IV only

**Question 30**

Information about pentan-1-ol is shown in the following table.

| Molecular formula | Molar mass | Molar heat of combustion |
|---|---|---|
| $C_5H_{11}OH$ | 88.0 g $mol^{-1}$ | 3329 kJ $mol^{-1}$ |

How many tonnes of carbon dioxide gas are released for each 5000 MJ of energy produced by the complete combustion of pentan-1-ol?

**A.** $3.30 \times 10^{-3}$ tonnes

**B.** $3.30 \times 10^{-2}$ tonnes

**C.** 0.330 tonnes

**D.** 3.30 tonnes

**END OF SECTION A**

## SECTION B

**Instructions for Section B**

Answer **all** questions in the spaces provided.

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.

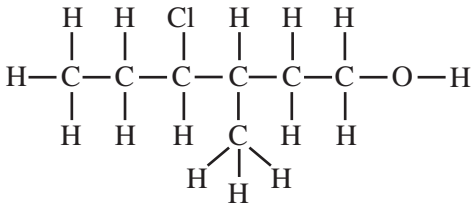
Ensure chemical equations are balanced and that the formulas for individual substances include an indication of state, for example, $H_2(g)$, NaCl(s).

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

**Question 1** (7 marks)

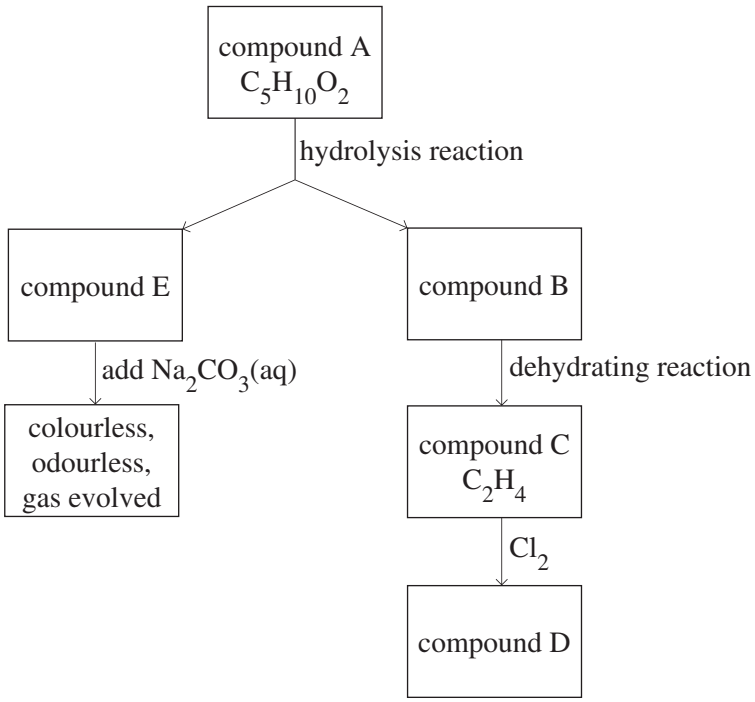
**a.** **i.** Draw the structural formula of 2,3-dibromo-4-methylhexane 1 mark

**ii.** The structural formula of a compound is shown below. 1 mark



State the IUPAC name of the compound.

**b.** The following flow chart shows reactions involving five different organic compounds (A to E). Compound A is an ester.




**i.** Draw the structural formula of compound A. 1 mark

**ii.** Write the semi-structural formula of compound B. 1 mark

**iii.** Identify the IUPAC name of compound D. 1 mark

**iv.** Write a balanced equation for the reaction of compound E with $Na_2CO_3$(aq). 2 marks

**Question 2** (10 marks)
Compound Q is a symmetrical molecule consisting of carbon, hydrogen and nitrogen.

**a.** The infrared spectrum of compound Q shows a signal at 3300–3400 $cm^{-1}$.

**i.** Identify the atom(s) and bond(s) that are consistent with this signal. 1 mark

**ii.** 1 mol of compound Q reacts with 2 mol of hydrochloric acid in an acid–base reaction.
What does this reveal about the structure of compound Q? 2 marks

**b.** Some of the peaks and mass-to-charge (m/z) values of the mass spectrum of compound Q are shown in the following table.

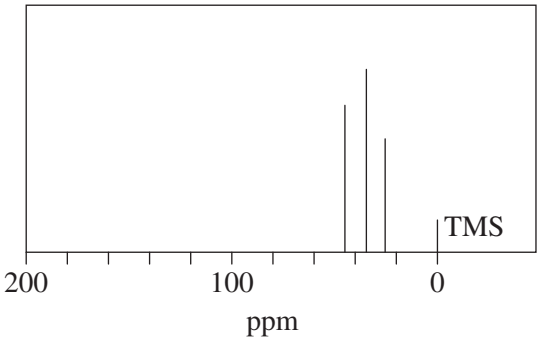
| Peak | m/z |
|---|---|
| base peak | 30 |
| molecular ion peak | 102 |

**i.** What information about compound Q can be derived from the molecular ion peak m/z value? 1 mark

**ii.** Identify the fragment responsible for the base peak. 1 mark

**iii.** In the mass spectrum, there are a number of very minor signals at m/z values beyond the molecular ion peak.
What is the likely cause of these minor signals? 1 mark

**c.** The $^{13}$C-NMR spectrum of compound Q is shown below.



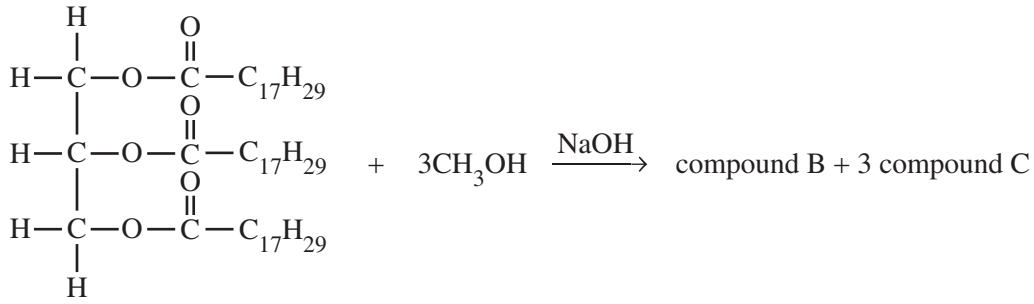

How many different carbon environments are present in compound Q? 1 mark

**d.** Based on the information provided, draw **one** possible structural formula of compound Q. 2 marks

**e.** Outline a type of evidence that would confirm that the structure drawn in **part d.** is correct. 1 mark

**Question 3** (9 marks)
Diesel and biodiesel fuels are used widely for transportation vehicles.

**a.** A chemical reaction for the production of a type of biodiesel (compound C) is shown below.




compound A

**i.** To which category of compounds does compound A belong? 1 mark

**ii.** Explain why compound B is highly soluble in water. 2 marks

**iii.** Draw the structural formula of one molecule of compound C. 1 mark

**iv.** In a separate reaction under suitable conditions, compound A will react with hydrogen gas, $H_2$.
What mass of $H_2$ will react with 1.5 mol of compound A? Justify your answer. 3 marks

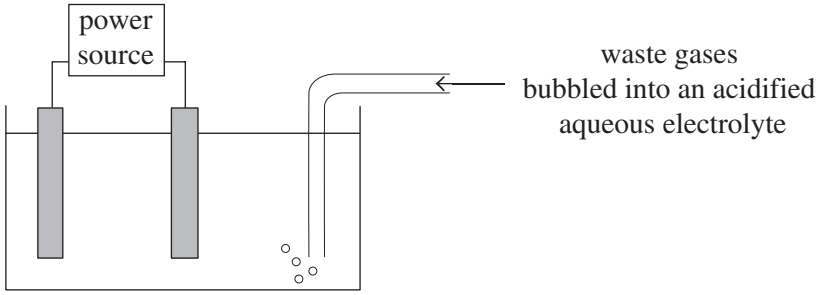
**b.** Compare the environmental impacts of sourcing biodiesel and diesel fuels. 2 marks

**Question 4** (11 marks)

Sulfur is a component of particular types of coal and metal ores. When this coal undergoes combustion or metal is extracted from these metal ores, sulfur is oxidised, producing sulfur dioxide, which is a common air pollutant. Sulfur dioxide can be removed from waste gases by electrolysis. This reaction occurs according to the following equation.

$$2SO_2(g) + 2H_2O(l) \rightarrow S_2O_6^{2-}(aq) + 2H^+(aq) + H_2(g)$$

A simplified diagram of the electrolytic cell used is shown below. The electrodes are inert.




**a.** What is the oxidation number of sulfur in the dithionate ion ($S_2O_6^{2-}$)? 1 mark

**b.** Write the balanced half-equation for the reaction that occurs at each of the following.

**i.** anode 1 mark

**ii.** cathode 1 mark

**c.** Platinum is sometimes used for inert electrodes but it is very expensive.

**i.** Name **one** other substance that could be used for inert electrodes. 1 mark

**ii.** Iron electrodes are inexpensive.
Suggest why they are **not** used in this cell. 1 mark

**d.** **i.** Explain what happens to the pH of the electrolyte as the cell reaction proceeds. 2 marks

**ii.** An electrolyte consisting of the hydrogen phosphate ion, $HPO_4^{2-}$, and dihydrogen phosphate ion, $H_2PO_4^-$, produced the following equilibrium.

$$HPO_4^{2-}(aq) + H_3O^+(aq) \rightleftharpoons H_2PO_4^- + H_2O(l)$$

When this electrolyte was used, its pH remained reasonably constant.

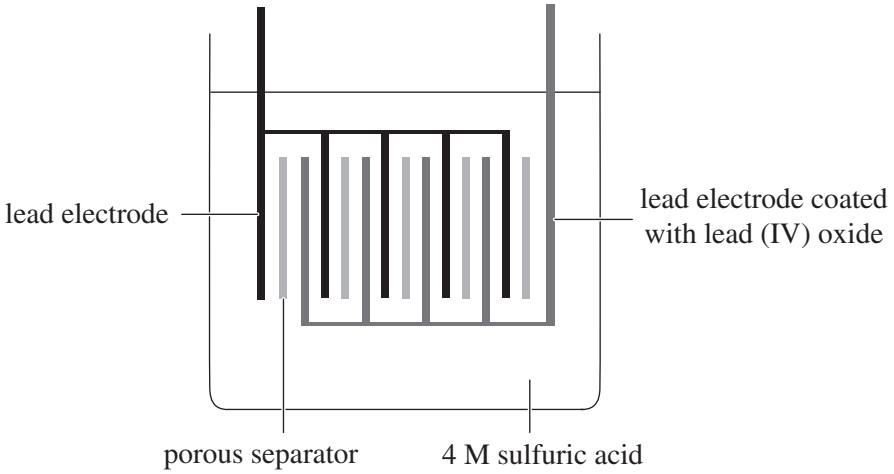
Using Le Chatelier's principle, explain why the electrolyte's pH did not change significantly. 2 marks

**e.** Hydrogen gas is produced in the cell reaction.

Explain whether hydrogen gas from this source could be classified as renewable. 2 marks

**Question 5** (6 marks)

The lead–acid battery is composed of a series of six secondary cells as shown in the following diagram.




The following half-reactions are used in the cells.

$$PbSO_4(s) + 2e^- \rightleftharpoons Pb(s) + SO_4^{2-}(aq) \qquad E^0 = -0.36 \text{ V}$$

$$PbO_2(s) + 4H^+(aq) + SO_4^{2-}(aq) + 2e^- \rightleftharpoons PbSO_4(s) + 2H_2O(l) \qquad E^0 = +1.69 \text{ V}$$

**a.** **i.** Write the balanced equation for the overall reaction when the battery is discharging. 1 mark

**ii.** State the expected voltage delivered by each cell based on the standard electrode potential values, $E^0$, provided. 1 mark

**b.** This battery operates at approximately 14 V, which is different to the expected battery voltage that can be calculated using the value obtained in **part a.ii**.

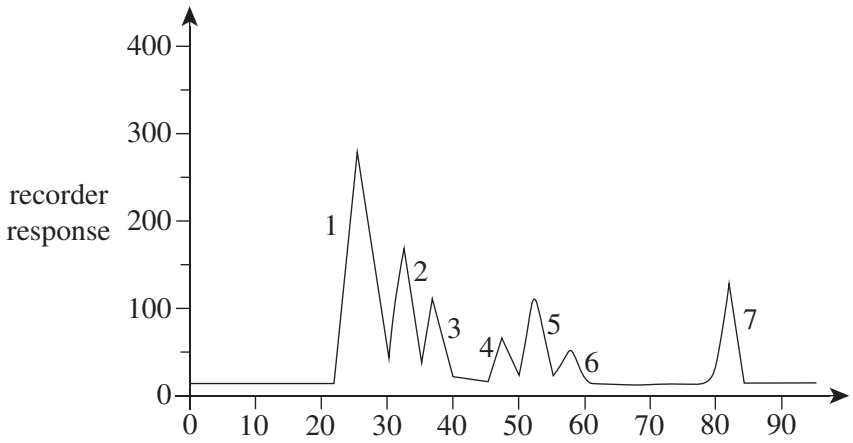
Explain this difference. 1 mark

**c.** Write the half-equation for the reaction that occurs at a positive electrode when the battery is recharging. 1 mark

**d.** The lead–acid battery cannot be charged and recharged indefinitely.
Explain **one** factor that could limit the life of the battery. 2 marks

**Question 6** (6 marks)

Following the fermentation of a sample of plant waste material, the resultant products were analysed using high-performance liquid chromatography (HPLC). The output is shown below.




**Key**

| | |
|---|---|
| 1 | dextrin |
| 2 | maltose |
| 3 | glucose |
| 4 | lactic acid |
| 5 | glycerol |
| 6 | ethanoic acid |
| 7 | ethanol |

**a.** Dextrins are short chains of monosaccharide monomers bonded together.

Name the type of link formed between the monomer molecules. 1 mark

**b.** With reference to the HPLC output, explain which compound has the weakest attraction to the stationary phase. 2 marks

**c.** With reference to the HPLC output, explain which compound has the lowest concentration. 2 marks

**d.** A component of plant waste material is cellulose.

Why was cellulose not present in the HPLC analysis? 1 mark

**Question 7** (9 marks)

A section of nutritional information displayed on the packaging of a loaf of bread is shown in the following table.

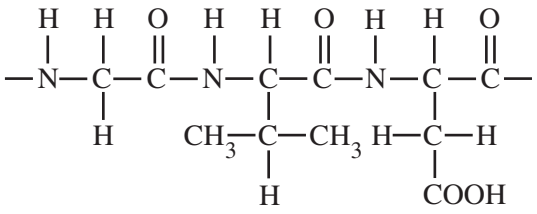
| | **Quantity per 100 g** |
|---|---|
| Energy | 1.08 MJ |
| Protein | 8.40 g |
| Total Fat | 2.20 g |
| – saturated | 1.00 g |
| Total Carbohydrate | 48.70 g |
| – sugars | 1.00 g |

**a.** What percentage of the energy in the bread comes from carbohydrates? 2 marks

**b.** An ingredient of the bread is palm oil, which is produced from palmitic acid and palmitoleic acid.

How could samples of palmitic acid and palmitoleic acid be distinguished from each other in a simple laboratory test? 2 marks

**c.** A short sequence of the structure of a protein in the bread is shown in the following structural formula.



**i.** Using the three-letter symbols for amino acids, write the sequence of amino acids that compose this section of the protein. 1 mark

_____

**ii.** Consider the amino acid component indentified in **part c.i.** that has the highest molar mass.

Draw the structural formula of this isolated amino acid in a high pH environment. 2 marks

**d.** Another type of bread is advertised as 'low G.I.', referring to the glycaemic index.

Explain how the ingredients of low G.I. bread are likely to be different to the ingredients of the bread whose nutritional information is shown in the table on page 25. 2 marks

_____

_____

_____

_____

**Question 8** (10 marks)

When placed in a sealed container, the brown-coloured gas nitrogen dioxide, $NO_2$, will react to produce the colourless gas dinitrogen tetroxide, $N_2O_4$. This equilibrium reaction occurs according to the following equation.

$$2NO_2(g) \rightleftharpoons N_2O_4(g)$$

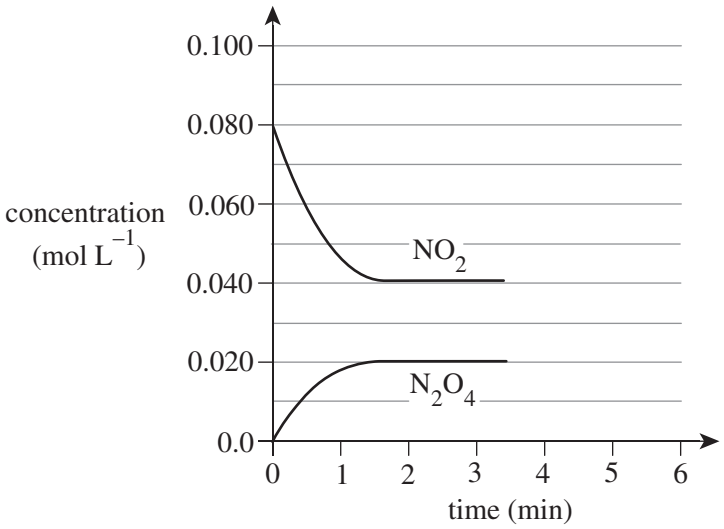
**a.** An equilibrium mixture of the two gases was placed in a gas syringe with a moveable plunger. The initial volume was halved.

Explain the colour changes that would have occurred at the following times.

**i.** immediately after the volume was halved 2 marks

**ii.** several minutes after the volume was halved 2 marks

**b.** In a different experiment, the variation in the concentrations of the two gases at temperature $T_1$ was recorded in the following graph.




**i.** Calculate the equilibrium constant, $K_c$, for the reaction at $T_1$. 2 marks

**ii.** At a lower temperature, $T_2$, the equilibrium constant for the reaction is 16.0 M$^{-1}$.
Deduce whether the formation of $N_2O_4$ from $NO_2$ is exothermic or endothermic. 2 marks

**c.** 3.5 minutes into the reaction at $T_1$, the concentration of $N_2O_4$ was instantaneously increased by 50%.

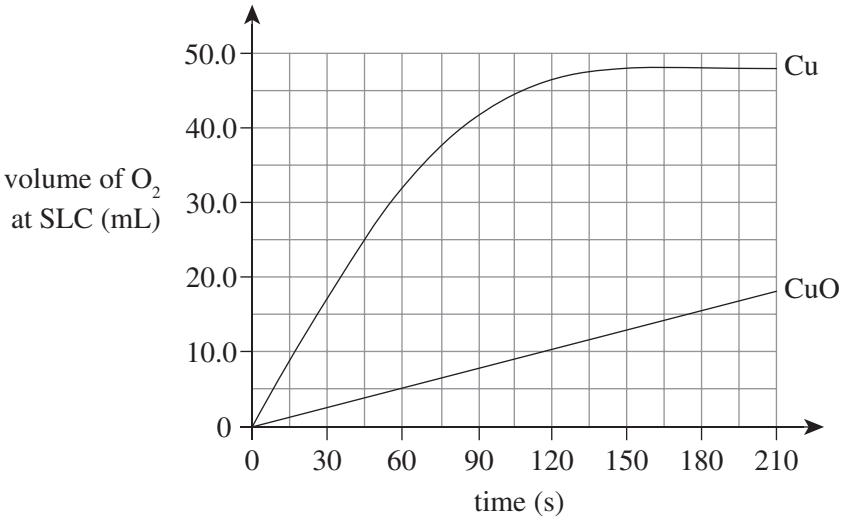
On the graph above, draw the subsequent changes in the concentrations of both gases, assuming that equilibrium was reached again before $t = 6$ minutes. 2 marks

**Question 9** (11 marks)

A Chemistry student conducted an experiment to determine whether the transition metal copper, Cu, or copper(II) oxide, CuO, is the more effective catalyst for the decomposition reaction of hydrogen peroxide. This is represented by the following equation.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

Using identical conditions, 1.0 g of each catalyst was added to 50.0 mL of $H_2O_2$ solution in separate flasks and the volume of $O_2$ produced at standard laboratory conditions (SLC) was measured at 30 second intervals. The student used the data collected to draw the following graph.




**a.** Calculate the concentration of the $H_2O_2$ solution in mol $L^{-1}$. 3 marks

**b.** The independent variable in the experiment is the nature of the catalyst.
Identify the dependent variable in the experiment. 1 mark

**c.** **i.** The CuO catalyst was in powder form and consisted of small crystals.

How can the validity of the experiment be affected by the form of the Cu catalyst used in the experiment? 2 marks

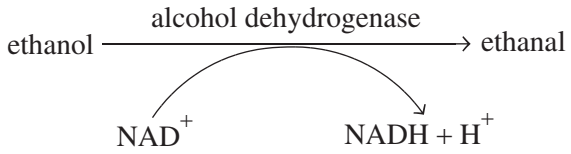
**ii.** Identify **one** way in which the reliability of the results could be improved by the student. 1 mark

**d.** **i.** Using collision theory, explain why the rate of a reaction generally decreases as it proceeds. 2 marks

**ii.** Explain why the rate of reaction using the CuO catalyst does not appear to decrease as the reaction proceeds. 2 marks

**Question 10** (11 marks)

Enzymes are catalysts that play a key role in metabolic function. Coenzymes play important roles in enabling certain enzymes to function. In the human body, the enzyme alcohol dehydrogenase catalyses the conversion of ethanol to ethanal. A coenzyme, usually referred to as NAD, must be present for the enzyme to function, as illustrated in the diagram below.

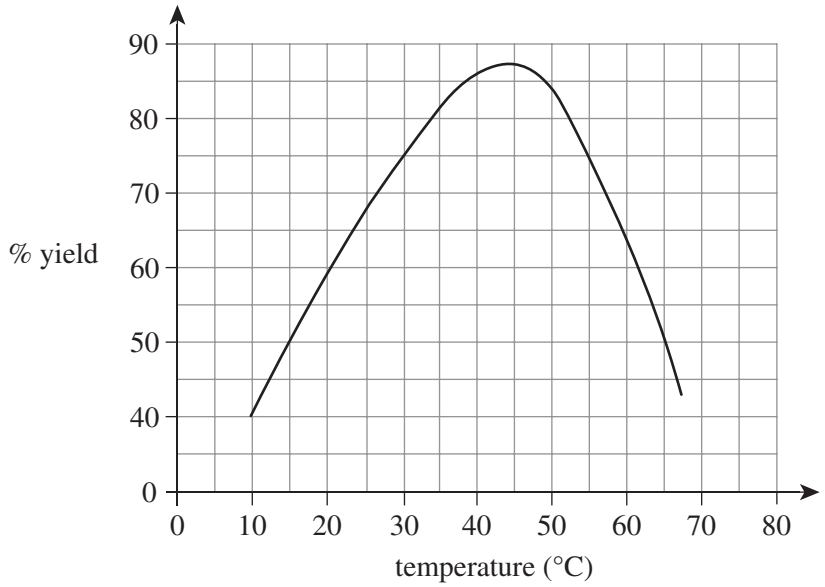



Vitamin C has many roles in the human body. In one role, it acts as a coenzyme by activating a particular inactive enzyme so that the enzyme can interact with the substrate.

**a.** Outline the induced fit model to explain enzyme activity, and explain how **one** specific coenzyme aids an enzyme's catalytic function. 5 marks

**b.** State **two** differences between enzymes and coenzymes. 2 marks

**c.** The graph below shows the variation in the percentage yield in a chemical reaction catalysed by an enzyme with changes in temperature.




**i.** On a molecular level, explain why the yield is so low at 15°C. 2 marks

**ii.** On a molecular level, explain why the yield is so low at 65°C. 2 marks

**END OF QUESTION AND ANSWER BOOKLET**

Neap

Trial Examination 2023

# VCE Chemistry Units 3&4

## Written Examination

## Multiple-choice Answer Sheet

Student's Name: _____

Teacher's Name: _____

**Instructions**

Use a **pencil** for **all** entries. If you make a mistake, **erase** the incorrect answer – **do not** cross it out. Marks will **not** be deducted for incorrect answers.
**No** mark will be given if more than **one** answer is completed for any question.

All answers must be completed like this example: **A** B C D

Use pencil only

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | A | B | C | D | 11 | A | B | C | D | 21 | A | B | C | D |
| 2 | A | B | C | D | 12 | A | B | C | D | 22 | A | B | C | D |
| 3 | A | B | C | D | 13 | A | B | C | D | 23 | A | B | C | D |
| 4 | A | B | C | D | 14 | A | B | C | D | 24 | A | B | C | D |
| 5 | A | B | C | D | 15 | A | B | C | D | 25 | A | B | C | D |
| 6 | A | B | C | D | 16 | A | B | C | D | 26 | A | B | C | D |
| 7 | A | B | C | D | 17 | A | B | C | D | 27 | A | B | C | D |
| 8 | A | B | C | D | 18 | A | B | C | D | 28 | A | B | C | D |
| 9 | A | B | C | D | 19 | A | B | C | D | 29 | A | B | C | D |
| 10 | A | B | C | D | 20 | A | B | C | D | 30 | A | B | C | D |