Neap:

Trial Examination 2018

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	9	9	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 26 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 2018 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

Which one of the following lists contains only non-renewable energy sources?

A. coal seam gas, petrodiesel, methane gas generated in a digester
B. petroleum gas, coal, methane gas in sea-floor sediments
C. fossil fuels, biofuels, oil trapped in rock formations
D. biogas, bioethanol, diesel composed of methyl esters

Use the following information to answer Questions 2 and 3.

The manufacture of phenol (C_6H_5OH) uses the reaction shown by the overall chemical equation:

$$C_6H_6(l) + H_2SO_4(l) + 2NaOH(aq) \rightarrow C_6H_5OH(l) + Na_2SO_3(aq) + 2H_2O(l)$$

The molar mass of each compound is shown in the table below.

Compound	C_6H_6	H_2SO_4	NaOH	C_6H_5OH	Na_2SO_3	H_2O
Molar mass (g mol^{-1})	78.0	98.1	40.0	94.0	126.1	18.0

In one process, using 100.0 g of C_6H_6 produced 111.0 g of phenol.

Question 2

In what range is the yield of the reaction?

A. 60% or less
B. more than 60% and less than 75%
C. more than 75% and less than 90%
D. 90% or greater

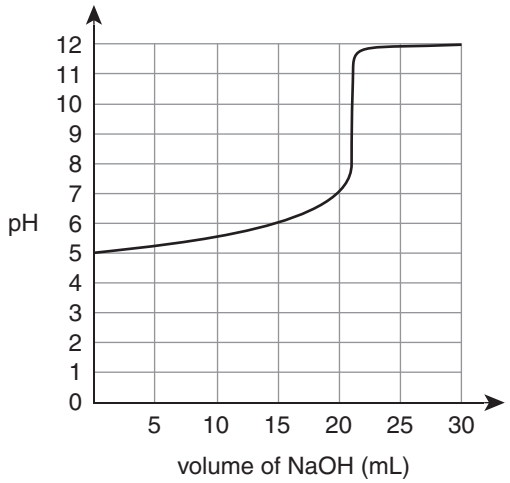
Question 3

The percentage atom economy for the reaction is closest to

A. 38%
B. 44%
C. 68%
D. 82%

Question 4

In order to determine the concentration of a solution of methanoic acid, a student titrated a 20.0 mL aliquot of methanoic acid solution with a 0.100 M sodium hydroxide solution. The titration curve shown below was generated.



Another student conducted the same titration, but used the indicator bromothymol blue to determine the endpoint of the titration.

Using bromothymol blue for the titration of methanoic acid solution with sodium hydroxide solution is an example of a

A. systematic error leading to an underestimate of the methanoic acid concentration.

B. random error leading to an underestimate of the methanoic acid concentration.

C. systematic error leading to an overestimate of the methanoic acid concentration.

D. random error leading to an overestimate of the methanoic acid concentration.

Use the following information to answer Questions 5 and 6.

A particular homologous series of organic compounds is used as fuels.

Question 5

Consider the following properties of these compounds:

I boiling point

II viscosity

III flashpoint

Which of these properties decrease with increasing relative molecular mass of the compounds?

A. I and II only

B. II and III only

C. I, II and III

D. none of I, II or III

Question 6

Which one of the following statements about the homologous series is correct?

A. The series must consist of compounds of hydrogen and carbon only.

B. The formulas of successive compounds in the series differ by a $-CH_3$ group.

C. The compounds must have a high energy content which is easily released.

D. Complete combustion of the compounds would generate CO as a product.

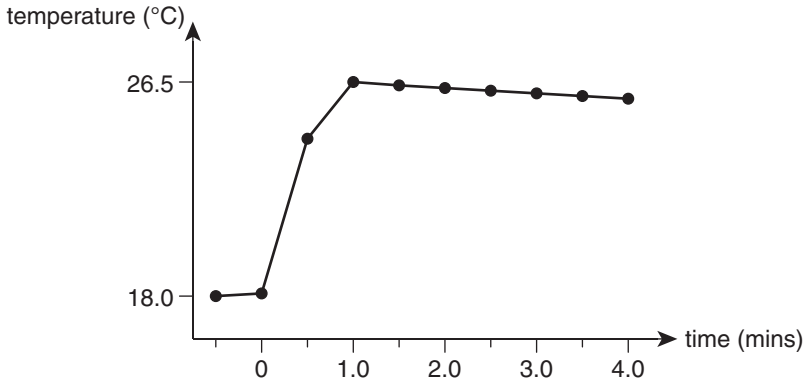
Question 7

Oxidative rancidity

A. will be increased by antioxidants.
B. occurs in unsaturated fats and oils.
C. can be prevented by use of coenzymes.
D. causes proteins to hydrolyse.

Question 8

A temperature–time graph from a solution calorimetry experiment is show below.



Which one of the following statements related to the graph is **incorrect**?

A. The calorimeter is poorly insulated and lost heat to the surroundings.
B. The graph depicts a reaction which has a negative enthalpy change.
C. After 4.0 minutes the graph will plateau at a constant value.
D. Before mixing, the temperature of the reactant solutions was 18.0°C.

Question 9

Each compound in a particular selection of a primary alcohol, a secondary alcohol and a tertiary alcohol has the same number of carbon atoms per molecule.

The tertiary alcohol

A. has a different molecular formula to the primary alcohol.
B. has a different empirical formula to the secondary alcohol.
C. can be oxidised partially to give an aldehyde or ketone.
D. has three C atoms and an –OH group bonded to one carbon atom.

Question 10

Which one of the following compounds usually produces glucose following hydrolysis in the human body?

A. amylopectin
B. cellulose
C. cysteine
D. amylase

Question 11

Aspartame is used as a sweetener in place of sucrose.

Compared to 1 gram of sucrose, 1 gram of aspartame contains

A. double the amount of energy and has much greater sweetness.
B. about the same amount of energy and has much greater sweetness.
C. double the amount of energy and about the same sweetness.
D. about the same amount of energy and about the same sweetness.

Use the following information to answer Questions 12–14.

Methane gas reacts with water according to the following equation:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$$

Some variables for the reaction are shown in the table below.

ΔH	Activation energy (E_a)	K_c at 1000°C
+206 kJ mol^{-1}	250 kJ mol^{-1}	4.68×10^{-2}

Question 12

Which one of the following correctly shows the changes, if any, in the variables if the reaction occurred at 800°C?

	ΔH	E_a	K_c
A.	increased	unchanged	decreased
B.	unchanged	unchanged	increased
C.	unchanged	unchanged	decreased
D.	decreased	increased	increased

Question 13

What is the value of the activation energy (in kJ mol^{-1}) of the reverse reaction?

A. 44
B. 206
C. 250
D. 456

Question 14

CO is a dangerous gas which can cause rapid death in victims who breathe in the gas.

This occurs because

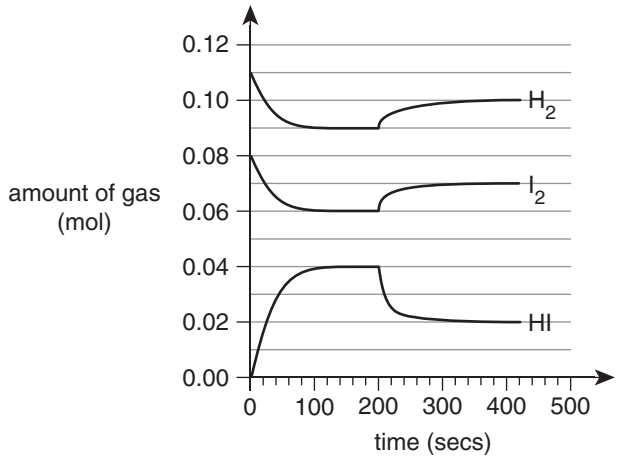
A. cell respiration stops as the enzymes required for the reaction are denatured.
B. CO gas and oxygen gas in the blood react to produce carbon dioxide gas.
C. oxygen gas is prevented from being carried to the cells and this impedes respiration.
D. haemoglobin molecules are destroyed by CO gas and no oxygen transport can occur.

Use the following information to answer Questions 15–17.

The gases H_2 and I_2 react according to the following chemical equation:

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

An experiment was conducted by placing set amounts of the reactant gases in a sealed vessel and allowing the system to reach equilibrium, as shown in the graph below.



Question 15

What change was made to the system at 200 seconds?

A. More reactant gases were added.
B. Some HI gas was removed.
C. The temperature was altered.
D. A catalyst for the forward reaction was introduced.

Question 16

How many values of the equilibrium constant for the reaction are evident from 0 to 400 seconds?

A. 1
B. 2
C. 3
D. more than 3

Question 17

Consider the following possibilities:

I The H_2 graph would rise instantaneously but gradually decrease over time and then plateau.

II The HI graph would rise instantaneously, gradually increase over time and then plateau.

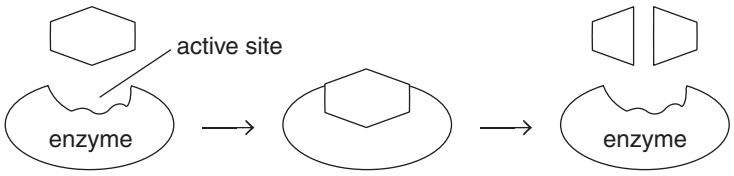
III The value of the equilibrium constant when equilibrium is reached would be lower than the previous value.

If the volume of the vessel was halved (with the temperature unchanged) at 450 seconds, which of the above possibilities would be evident in the graphs?

A. I and II only
B. III only
C. I, II and III
D. none of I, II or III

Use the following information to answer Questions 18 and 19.

A student drew the simple diagram below to represent a reaction, catalysed by an enzyme, which produces two organic products.



Question 18

Which one of the following is correct for the reaction shown?

	Model of enzyme action	Type of reaction
A.	induced fit	hydrolysis
B.	lock-and-key	condensation
C.	induced fit	condensation
D.	lock-and-key	hydrolysis

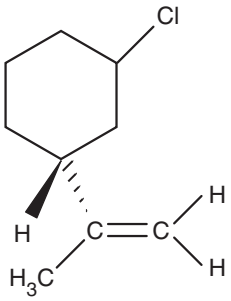
Question 19

Which one of the following is **least** likely to affect the configuration of the active site?

A. low pH
B. high pH
C. low temperature
D. high temperature

Question 20

The structure of one isomer of a compound is shown below.



This compound could show

A. optical isomerism only.
B. geometric isomerism only.
C. both optical and geometric isomerism.
D. neither optical nor geometric isomerism.

Use the following information to answer Questions 21–23.

The energy content of peanuts in a particular sample was investigated using two different methods.

- Method 1: A peanut was weighed and set alight. The burning peanut was then held close to a flask containing 25.0 g of water. The temperature of the water increased by 14.2°C by burning 0.113 g of the peanut.
- Method 2: 0.238 g of crushed peanuts were burnt in a bomb calorimeter to produce an increase in temperature of 6.35°C. The energy content of the peanuts was calculated to be 23.1 kJ g^{-1}.

Question 21

How many joules of energy were used to heat the water in method 1?

A. 8.49

B. 1.67×10^2

C. 1.06×10^3

D. 1.48×10^3

Question 22

What is the calibration factor (in J $°C^{-1}$) of the bomb calorimeter used in method 2?

A. 86.6

B. 616

C. 866

D. 925

Question 23

Method 2 produced a much higher value for the energy content per gram of peanuts than method 1.

What is the main reason for this discrepancy?

A. The peanut used in method 1 was not crushed.

B. Method 2 used different peanuts to method 1.

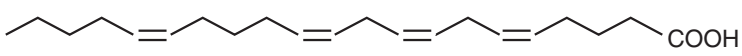
C. A greater mass of peanuts was used in method 2.

D. Method 1 did not use any calibration.

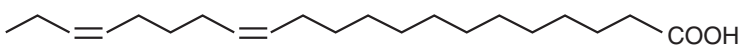
Question 24

The skeletal structures of two fatty acids are shown below.

fatty acid P



fatty acid Q



Which one of the following statements relating to these fatty acids is correct?

A. Fatty acid P is an omega-6 fatty acid.

B. Neither fatty acid has a trans configuration.

C. Fatty acid Q melts at a lower temperature than fatty acid P.

D. Fatty acid Q could be used to generate biodiesel, while fatty acid P could not.

Use the following information to answer Questions 25 and 26.

Various reagents were mixed in separate flasks as shown in the table below.

Flask 1	Flask 2	Flask 3	Flask 4
$Cu(NO_3)_2(aq) + Sn$	$Ag^+(aq) + Cd$	$Fe^{3+}(aq) + NaCl(aq)$	I_2 solution + Cu

Question 25

A reaction is likely to occur in

A. flasks 1 and 2 but not in flask 3.
B. flasks 1 and 3 but not in flask 2.
C. flask 2 but not in flasks 1 and 3.
D. flask 3 but not in flasks 1 and 2.

Question 26

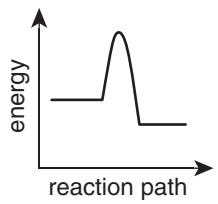
Using the electrochemical series, a reaction is predicted to occur in flask 4. However, no reaction had occurred by the time any reactions took place in the other flasks.

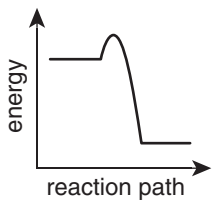
Which one of the following is the most likely reason to explain this?

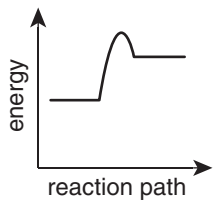
A. The iodine was in a different state to that shown in the electrochemical series.
B. The enthalpy change for the reaction has a positive value.
C. An alloy of copper and zinc was used mistakenly in place of the pure copper metal.
D. The products are formed much more slowly than products in the other reactions.

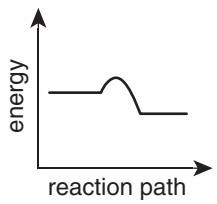
Use the following information to answer Questions 27 and 28.

Using the same scale, the energy profiles of four different reactions are shown below.

1.


2.


3.


4.


Question 27

Which diagram shows the most likely energy profile for a fuel?

A. 1
B. 2
C. 3
D. 4

Question 28

In which of the diagrams is the activation energy for the forward reaction greater than the magnitude of the enthalpy change for the reverse reaction?

A. 1 only
B. 1 and 3 only
C. 2 and 4 only
D. 4 only

Question 29

Vitamin D

A. will dissolve in oil but not in water.

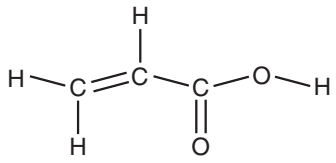
B. has an active site like all proteins.

C. is an essential dietary requirement.

D. has the same functional groups as vitamin C.

Question 30

The structural formula of a particular compound is shown below.



What mass of bromine molecules would react with 0.150 mole of this compound?

A. 12.0 g

B. 24.0 g

C. 36.0 g

D. 47.9 g

END OF SECTION A

SECTION B

Instructions for Section B

Answer **all** questions in the spaces provided. Write using blue or black pen.

Give simplified answers to all numerical questions, with an appropriate number of significant figures; unsimplified answers will not be given full marks.

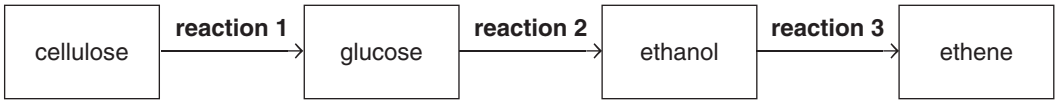
Show all working in your answers to numerical questions; no marks will be given for an incorrect answer unless it is accompanied by details of the working.

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 (13 marks)

The flowchart below shows a pathway for the production of the widely used compound ethene.



a. **i.** What is a likely source of cellulose? 1 mark

_____

ii. What type of linkages are broken in cellulose by reaction 1? 1 mark

_____

b. Reaction 2 is known as fermentation and occurs in the presence of yeast enzymes. The reaction is shown by the following chemical equation:

$$C_6H_{12}O_6(aq) \rightarrow 2C_2H_5OH(aq) + 2CO_2(g)$$

i. Fermentation will cease when the ethanol concentration rises to a certain level.

Explain why this occurs with reference to the effect of ethanol on the structure of the enzymes required for the reaction. 2 marks

_____

_____

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ii. In one process, 75.9 L of carbon dioxide was produced at SLC.

Calculate the mass of glucose (M = 180 g mol^{-1}) used. 3 marks

_____

_____

_____

_____

c. Ethene is used extensively in industry for the manufacture of a vast range of products. One compound which is produced from ethene is chloroethane.

i. Write a balanced chemical equation for the reaction of ethene which produces chloroethane. 1 mark

_____

ii. The thermochemical equation for the combustion of chloroethane is shown below.

$$CH_3CH_2Cl(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(g) + HCl(g) \quad \Delta H = -1430 \text{ kJ mol}^{-1}$$

150.0 g of CH_3CH_2Cl and 250.0 g of O_2 were injected into an empty, sealed container and ignited.

Calculate the energy produced from the combustion reaction. 3 marks

_____

_____

_____

_____

_____

d. Most ethene is produced from crude oil.

Compare the long-term viability of ethene production from crude oil with the method used in the flowchart on page 11. 2 marks

_____

_____

_____

_____

Question 2 (7 marks)

Ammonia gas reacts with oxygen gas according to the following chemical equation:

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g) \qquad \Delta H = -900 \text{ kJ mol}^{-1}$$

a. In one experiment at a particular temperature (T_1), 0.300 mol of ammonia gas was mixed with 0.400 mol of oxygen gas in a sealed 2.00 L container and was allowed to reach equilibrium. 0.200 mol of nitrogen oxide gas was present in the equilibrium mixture.

i. Determine the amount (in mol) of each component in the equilibrium mixture. 3 marks

_____

_____

_____

_____

_____

ii. Calculate the value of the equilibrium constant (K_c) at T_1. 2 marks

_____

_____

_____

_____

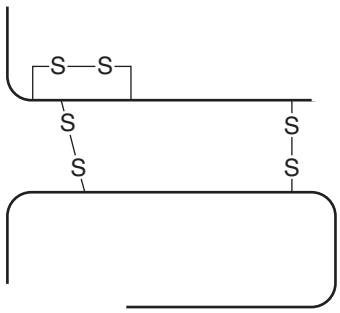
b. In another experiment, changes were made to the system at equilibrium. Each change was made separately and the system returned to equilibrium before another change was made.

In the table below, tick **one** box in each row to show the effect on the stated quantity (when equilibrium is established) with each change to the system. 2 marks

Change	Quantity	Effect of change on the quantity		
		Increase	No difference	Decrease
1. Add NO(g).	K_c			
2. Increase pressure by adding an inert gas.	pressure of O_2 in container			

Question 3 (12 marks)

Insulin is a protein involved in controlling glucose levels in the blood in the human body. Insulin consists of two polypeptide chains which are shown below in a simplified diagram of the structure.



a. Using insulin as an example, describe the levels of protein structure listed in the table below. 3 marks

Level of protein structure	Description
primary	
tertiary	
quaternary	

b. One of the amino acids which is used to make insulin in the body is tyrosine.

Draw the structure of tyrosine in a solution of low pH. 2 marks

c. For certain medical conditions, insulin is available in small, sealed containers for injection into the body. Insulin can only be injected into the body and not taken by mouth as a tablet.

Explain the likely reason for this situation. 2 marks

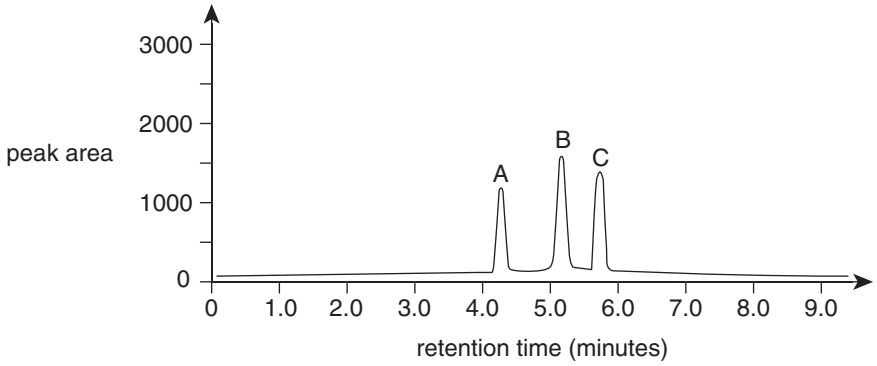
_____

_____

_____

_____

d. Insulin is present in different animal species. A mixture of insulin from three different sources was analysed by high-performance liquid chromatography (HPLC) and produced the results below. Peak B is human insulin.



i. What conclusion can be made about the insulin molecules from the three different sources? 1 mark

_____

_____

ii. The HPLC analysis was conducted at 30°C and a flow rate of the mobile phase of 0.3 mL per minute.

What effect, if any, would lowering the value of either of these variables have on the areas of the peaks in the HPLC output? 2 marks

_____

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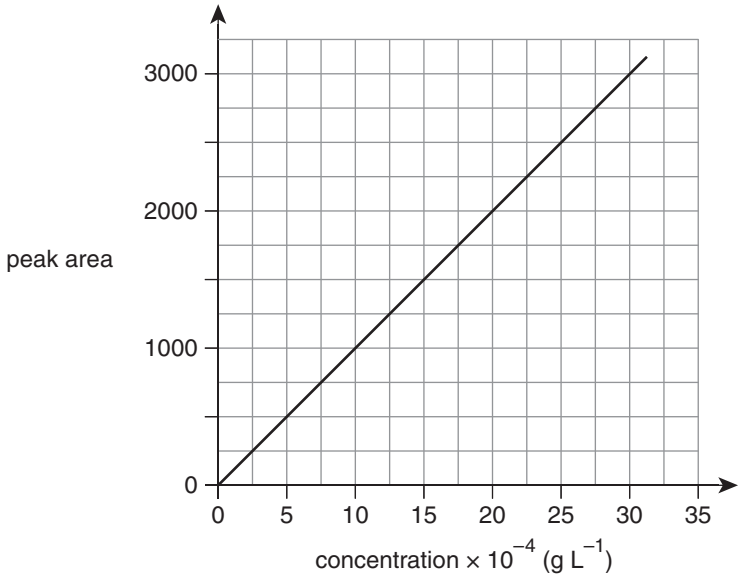
_____

iii. Standard solutions of human insulin of known concentration were analysed by HPLC on the same column under identical conditions to the initial analysis. The calibration graph below was produced.



The area of peak B in the initial HPLC analysis is 1750 units.

If the sample volume injected into the HPLC instrument was 5.0×10^{-4} mL, how many grams of human insulin were present in this sample? 2 marks

_____

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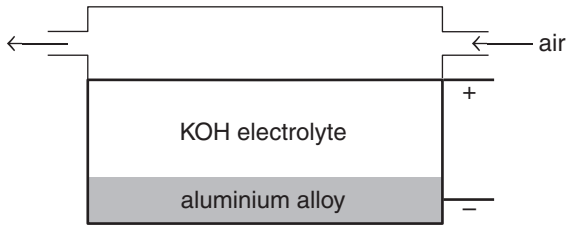
Question 4 (10 marks)

The aluminium–air battery provides a portable source of electrical energy and uses a special alloy of aluminium as one electrode. The basic design of the device is shown in the diagram below.



a. The overall **unbalanced** reaction in the battery is:

$$\_\_\_\_\_Al(s) + \_\_\_\_\_O_2(g) + \_\_\_\_\_H_2O(l) \rightarrow \_\_\_\_\_Al(OH)_3(s)$$

i. Balance the overall reaction by placing the correct coefficients in the spaces provided. 1 mark

ii. In **one** box below, write the half-equation for the reaction which occurs at the cathode to show its polarity. Do **not** write in the other box. 1 mark

Positive electrode	Negative electrode

iii. Outline why the positive electrode must be porous. 1 mark

_____

_____

b. In theory, this battery could be recharged using electrical energy to reverse the overall reaction.

i. What feature of the battery should allow it to be recharged by this method? 1 mark

_____

_____

ii. Assuming it could be recharged by this method, write the half-reaction which would occur at the positive electrode during recharging. 1 mark

_____

c. The negative electrode consists of a special alloy of aluminium which prevents an impervious layer from forming on the surface of the aluminium.

Why would the efficiency of the battery be affected if this layer formed on the electrode? 2 marks

_____

_____

_____

_____

d. The maximum cell voltage of the battery is 1.7 V, but it usually operates at 1.3 V.

i. Suggest **one** reason why the battery operates at less than maximum voltage. 1 mark

_____

_____

ii. When the battery operates, 3 mol of electrons are produced for each 1 mol of aluminium used.

Calculate the energy delivered for each mole of aluminium consumed in the battery. 2 marks

_____

_____

_____

_____

_____

Question 5 (13 marks)

The boiling points of three colourless liquid compounds are shown in the table below.

Compound	ethanoic acid	butan-1-ol	butyl ethanoate
Boiling point (°C)	118	117	116

a. Outline simple physical and/or chemical tests which would distinguish between ethanoic acid, butan-1-ol and the ester in a laboratory. 3 marks

_____

_____

_____

_____

_____

_____

b. Explain how mass spectrometry could be used to distinguish between samples of the three compounds. 2 marks

_____

_____

_____

_____

c. Showing all bonds, draw the structure of the ester. 1 mark

d. Even though the molar mass of butyl ethanoate is much larger than the molar mass of either of the other two compounds, the boiling points are very similar.

Using structure and bonding, explain this observation. 2 marks

_____

_____

_____

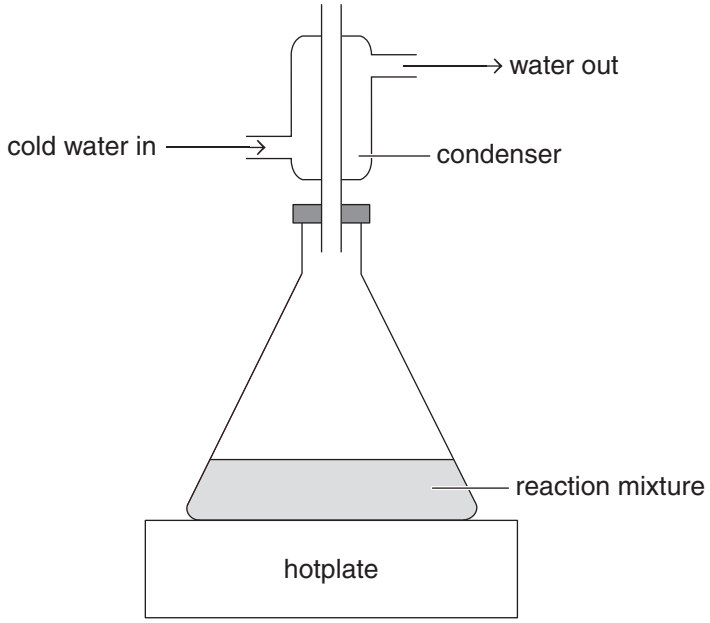
_____

_____

e. Butyl ethanoate is produced by reacting the other two compounds according to the following equation:

$$C_2H_4O_2(l) + C_4H_{10}O(l) \rightleftharpoons C_6H_{12}O_2(l) + H_2O(l)$$

Heating the reaction mixture increases the rate of reaction and the yield. The reaction is usually performed under reflux using the equipment set-up shown below. The condenser is a cooling device around the outlet tube which causes any vapour to liquefy.



i. Name the type of reaction occurring when butyl ethanoate is produced from ethanoic acid and butan-1-ol. 1 mark

_____

ii. Suggest **one** reason why a condenser is used during the reaction process. 1 mark

_____

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iii. Suggest why a hotplate is used for heating rather than a Bunsen burner. 1 mark

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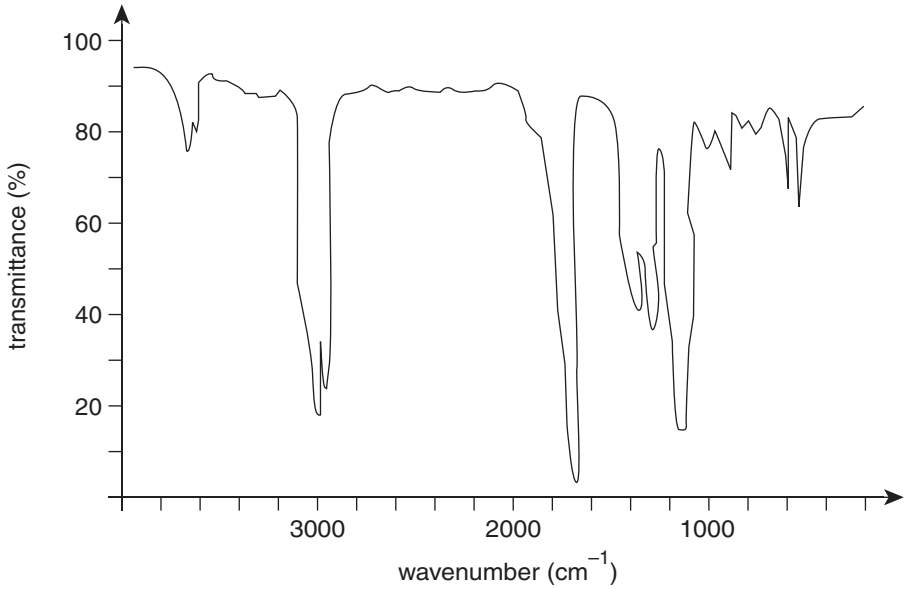
f. Using separation techniques, a sample of butyl ethanoate was isolated from the reaction mixture and analysed by infrared (IR) spectroscopy. The IR spectrum of the sample is shown below.



What evidence is provided by the IR spectrum to show that the sample is **not** contaminated by either of the reactants? 2 marks

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Question 6 (8 marks)

An aqueous solution of 1.0 M vanadium chloride and 1.0 M magnesium chloride was electrolysed using a current of 0.627 A for 30.0 minutes. It was found that 0.201 g of pure vanadium metal was deposited on one electrode.

a. Determine the charge on the vanadium ion. 3 marks

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b. At the other electrode, the pH of the electrolyte near the electrode decreased as the electrolysis proceeded.

Using a balanced chemical equation, explain why this happened. 2 marks

_____

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_____

c. **i.** No magnesium metal was deposited during the electrolysis.

Explain why magnesium metal could **not** be deposited in this type of electrolysis experiment. 2 marks

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ii. Magnesium metal is produced industrially by electrolysis.

Explain how magnesium metal can be produced from magnesium chloride by electrolysis. 1 mark

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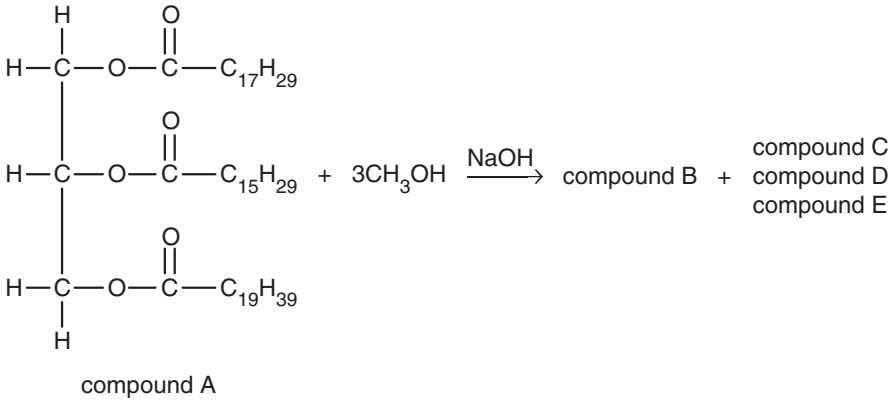
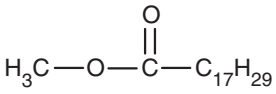
Question 7 (8 marks)

In the presence of a sodium hydroxide catalyst, a transesterification reaction will occur between methanol and compound A to produce compound B and a mixture of methyl esters.

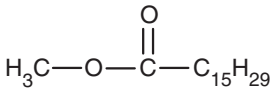


compound A

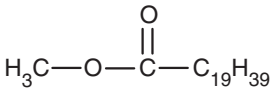
The semi-structural formulas of the methyl esters are shown below.



compound C



compound D



compound E

a. **i.** What type of compound is compound A? 1 mark

_____

ii. Give the molecular formula of compound B. 1 mark

_____

b. **i.** Which of the methyl esters is derived from a polyunsaturated fatty acid? 1 mark

_____

ii. Write a balanced equation for the complete combustion of the methyl ester derived from a saturated fatty acid. 2 marks

_____

iii. Explain why the methyl esters will absorb some moisture from the atmosphere. 2 marks

_____

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_____

c. The mixture of methyl esters is known as biodiesel and can be used as a transport fuel. Petrodiesel is another common transport fuel which is a mixture of compounds.

Give the molecular formula of a compound present in petrodiesel which has twelve carbon atoms per molecule. 1 mark

_____

Question 8 (7 marks)

A compound with empirical formula $C_3H_6O_2$ has a number of isomers. When vaporised, 1.37 g of the compound occupies 566 mL at 100°C and 100 kPa pressure.

a. Show that the molecular formula of the compound is $C_3H_6O_2$. 2 marks

_____

_____

_____

_____

b. Isomer I of the compound is produced by the complete oxidation of an alcohol.

i. Suggest a suitable oxidising agent which would be used in the laboratory for this oxidation reaction. 1 mark

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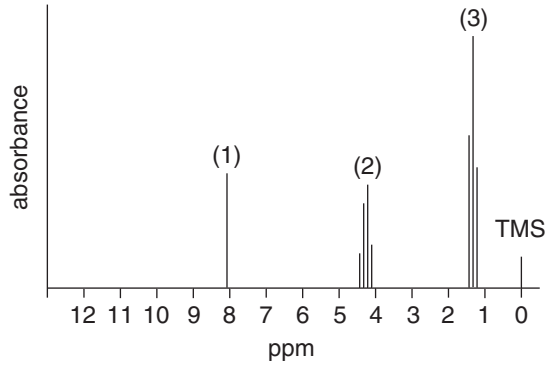
ii. Partial oxidation of the alcohol produces an aldehyde.

Draw the skeletal structure of this aldehyde. 1 mark

c. The proton NMR spectrum of isomer II of the compound is shown below. The relative area under each peak is indicated in brackets.



State **three** pieces of information about the structure of isomer II which are revealed by the proton NMR spectrum. 3 marks

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Question 9 (12 marks)

The polysaccharide starch can be hydrolysed to produce glucose by heating with hydrochloric acid. An experiment was conducted to investigate the effect of temperature on the rate of acid hydrolysis of starch using the following steps:

1. 25.0 mL of 1.0 M hydrochloric acid was heated in a 50 mL beaker to a set temperature which was maintained throughout the experiment.
2. 0.50 g of granulated starch was added to the beaker while stirring.
3. At 1 minute intervals, a 0.10 mL sample was removed from the beaker and tested for the presence of glucose.
4. Steps 1 to 3 were repeated using a range of temperatures as shown in the results table below.

Temperature of hydrochloric acid (°C)	60	70	80	90
Time for glucose to be produced (mins)	12	7	5	4

a. **i.** Identify the dependent variable in the experiment. 1 mark

_____

ii. Identify the independent variable in the experiment. 1 mark

_____

iii. Identify **one** controlled variable in the experiment. 1 mark

_____

b. Identify the temperature which produced the highest rate of reaction. 1 mark

_____

c. **i.** State **two** possible sources of random error in the experiment. 2 marks

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ii. What is the usual way to minimise the effect of random error on the results of an experiment? 1 mark

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d. After considering the results of the experiment above, a student proposed the following hypothesis:

If the concentration of hydrochloric acid is increased, then the time for glucose to be produced will decrease.

i. In terms of interactions of reactant particles, explain the reasoning which supports this hypothesis. 2 marks

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ii. Outline an experiment that is similar to the original investigation which would test this hypothesis. Sufficient detail should be given so that the experiment could be conducted by another student using the outline. 3 marks

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END OF QUESTION AND ANSWER BOOKLET

