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YEAR 12 *Trial Exam Paper*
2020
CHEMISTRY
Written examination

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

STUDENT NAME:

QUESTION AND ANSWER BOOK

Structure of book

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 book of 35 pages
- Data book
- Answer sheet for multiple-choice questions

Instructions
- Write your **name** in the box provided above on this page and on the multiple-choice answer sheet.
- Unless otherwise indicated, the diagrams in this book 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 book.
- You may keep the data book.

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

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 book are **not** drawn to scale.

Question 1

Which one of the following alternatives releases the greatest amount of energy during complete combustion?

A. 50 g of methane gas

B. 99.2 L of methane gas stored at standard laboratory conditions (SLC)

C. 3.4 mol of methane gas

D. 99.2 L of methane gas stored at 25 °C and 50 kPa pressure

Question 2

Which one of the following statements about the use of canola crops to make biodiesel is the **most** correct?

A. The largescale growing of canola crops in Australia presents environmental challenges.

B. The whole canola plant is used in the production of biodiesel.

C. The canola oil undergoes a condensation reaction with methanol to form an ester.

D. Each triglyceride molecule produces one biodiesel molecule.

Question 3

The properties of a particular fuel are listed in the following table.

Property	
Boiling point	97.2 °C
Heat of combustion	33.7 kJ g^{-1}
Solubility in water	high

The fuel is **most** likely

A. pentane.

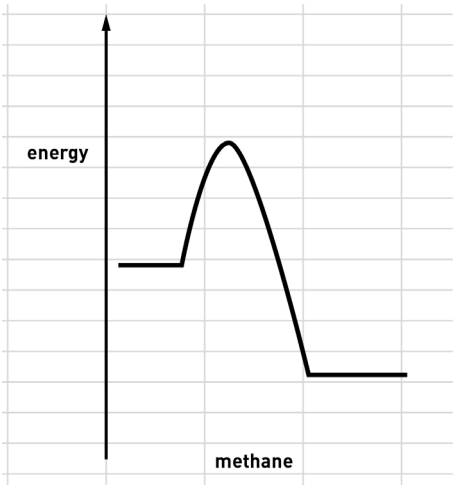
B. propan-1-ol.

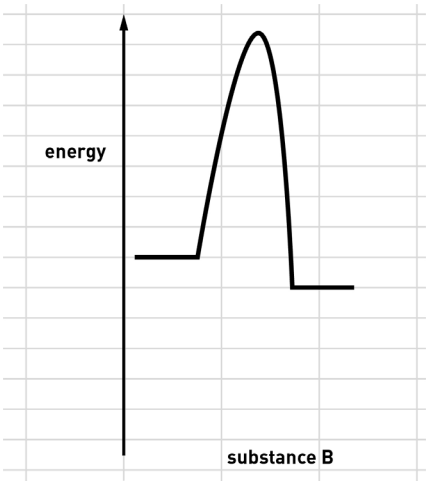
C. cyclohexane.

D. stearic acid.

Question 4

The energy profile diagrams below provide a comparison between the combustion of methane and the combustion of substance B.





It is likely that substance B

A. could be a viable fuel because its combustion is exothermic.

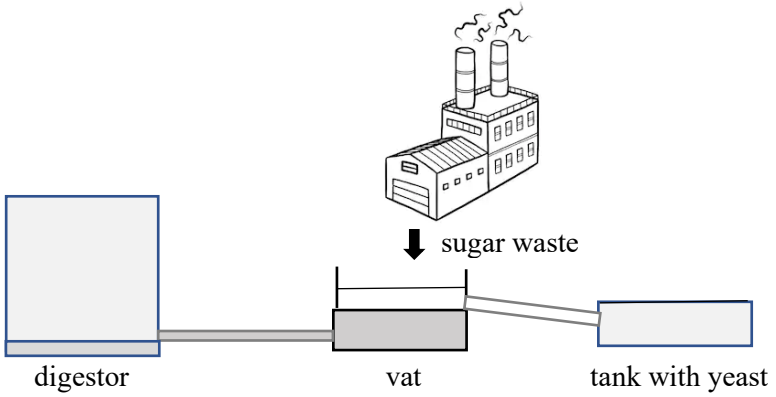
B. would not be suitable as a fuel because its low activation energy will make it unstable and dangerous.

C. would not be viable as a fuel because the heat of combustion is too low.

D. would not be suitable as a fuel because its combustion reaction is endothermic.

Question 5

The waste from a sugar refinery is collected and allowed to settle in large vats.



The liquid is tapped from the vats and added to a tank that contains yeast. The solid slurry from the vat is added to an anaerobic digestor that contains bacteria.

As a result of this processing, the refinery is able to produce

A. supplies of biogas from both tanks.

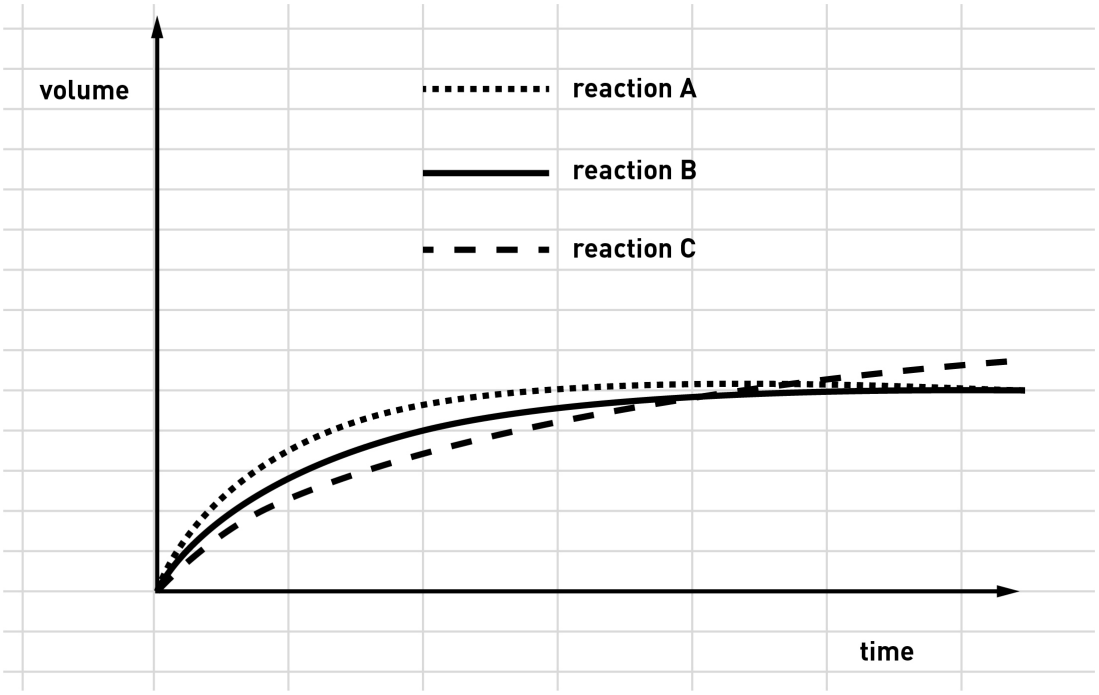
B. bioethanol from both tanks.

C. biogas in one tank and bioethanol in the other.

D. both bioethanol and biogas fuels in each tank.

Use the following information to answer Questions 6 and 7.

A student performed a series of experiments during which they added hydrochloric acid to calcium carbonate, $CaCO_3$ (M_r = 100.1 g mol^{-1}). With each experiment, the student monitored the volume of carbon dioxide gas released. The results of the experiment are shown on the graphs below.



Reaction B involved 1.0 g of small marble chips being added to 100 mL of 1.0 M HCl.

Question 6

Which one of the following statements is consistent with the graph for reaction A?

A. The only change made to the procedure of reaction B was to lower the temperature of the HCl.

B. The mass of calcium carbonate used in reaction A was greater than that used in reaction B.

C. The concentration of the HCl in reaction A was higher than that of reaction B.

D. The shape of the beaker used in reaction A was different from that used in reaction B.

Question 7

Which one of the following statements is consistent with the graph for reaction C?

A. A catalyst was added to reaction C along with the calcium carbonate.

B. A single marble chip of mass 1.2 g was added to the HCl in reaction C.

C. The 1.0 g of calcium carbonate was added as a single marble chip in reaction C.

D. The concentration of the HCl was slightly lower in reaction C than in reaction B.

Use the following information to answer Questions 8 and 9.

A wide variety of lithium cells exist, as manufacturers attempt to find substances that are compatible with lithium metal. One commercial version uses the reaction between lithium metal and sulfur to produce electrical energy. The reaction can be represented by the following equation.

$$16Li + S_8 \rightarrow 8Li_2S$$

Question 8

The half-equation for the reaction of sulfur in this cell is

A. $S \rightarrow S^{2-} + 2e^-$

B. $S_8 + 2e^- \rightarrow 8S^{2-}$

C. $S_8 \rightarrow 8S^{2-} + 8e^-$

D. $S_8 + 16e^- \rightarrow 8S^{2-}$

Question 9

If 0.69 g of lithium reacts during discharge in this cell, the mass of sulfur reacting will be, in g,

A. 0.20

B. 0.40

C. 0.80

D. 1.6

Question 10

The half-equation for the reaction at the cathode of an ethane–oxygen alkaline fuel cell is

A. $O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$

B. $O_2(g) + 4H^+(aq) + 4e^- \rightarrow 2H_2O(l)$

C. $C_2H_6(g) + 14OH^-(aq) \rightarrow 2CO_2(g) + 10H_2O(l) + 14e^-$

D. $C_2H_6(g) + 4H_2O(l) \rightarrow 2CO_2(g) + 14H^+(aq) + 14e^-$

Use the following information to answer Questions 11 and 12.

One of the steps in the manufacture of nitric acid is the reaction between ammonia and oxygen. The reaction can be represented by the following equation.

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g) \qquad \Delta H = -ve$$

Question 11

The units for the equilibrium constant, K_c, for this reaction is

A. M^{-2}

B. M^{-1}

C. M

D. M^2

Question 12

The volume of an equilibrium mixture of the above gases is halved at time t_1 and the mixture regains equilibrium at time t_2.

A. The concentration of NO at t_2 will be higher than it was at t_1.

B. The amount of NO at t_2 will be higher than it was at t_1.

C. The amount of NO will not change between t_1 and t_2 because temperature is constant.

D. The value of K_c will be lower at t_2 than it was at t_1.

Question 13

A reversible reaction occurs when solutions of Fe^{3+} ions are added to solutions containing thiocyanate, SCN^-, ions. The product formed is red in colour.

$$Fe^{3+}(aq) + SCN^-(aq) \rightleftharpoons \underset{\text{red}}{FeSCN^{2+}(aq)}$$

20 mL of water is added to an equilibrium mixture of the species above. When equilibrium is re-established, the impact of this addition has led to the following possible responses.

Consider the following statements.

Statement number	Statement
1	a decrease in red intensity
2	a decrease in value of K_c
3	an increase in concentration of SCN^-
4	an increase in the amount of SCN^-

Which one of the following sets of statements is correct?

A. statement numbers 1, 2 and 4

B. statement numbers 1, 3 and 4

C. statement numbers 1 and 3

D. statement numbers 1 and 4

Question 14

Which one of the following electrolytic cells will produce the highest number of mole of metal?

A. a current of 9650 A running for 1000 seconds through $AlCl_3(aq)$

B. a current of 9650 A running for 100 seconds through $CuCl_2(aq)$

C. a current of 9650 A running for 90 seconds through $AgNO_3(aq)$

D. a current of 965 A running for 1000 seconds through $AlCl_3(l)$

Use the following information to answer Questions 15 and 16.

Magnesium metal is produced commercially from the electrolysis of molten $MgCl_2$. This process is known as the Dow process. The magnesium chloride required is obtained from seawater.

Question 15

The half-equation occurring at the cathode in this cell is

A. $Mg^{2+}(l) + 2e^- \rightarrow Mg(l)$

B. $2Cl^-(l) + 2e^- \rightarrow Cl_2(g)$

C. $2Cl^-(l) \rightarrow Cl_2(g) + 2e^-$

D. $2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$

Question 16

A large current of 12 600 A is used in this process.

The volume of gas at SLC obtained from this cell in 1.0 hour will be, in litres,

A. 2900

B. 5800

C. 11 700

D. 23 300

Question 17

The semi-structural formula of an ester is $CH_3CH_2OCOCH_3$.

This molecule could be formed from the reaction between

A. ethanol and methanoic acid.

B. ethanoic acid and methanol.

C. propan-1-ol and methanoic acid.

D. ethanoic acid and ethanol.

Question 18

Which one of the following molecules is a structural isomer of butanoic acid?

A. $CH_3CH_2CH_2CHO$

B. $CH_3CH_2\,COOCH_3$

C. $CH_3CH_2COCH_3$

D. $CH_2OHCH_2\,CH_2CH_2OH$

Question 19

Which one of the following molecules will have the lowest flashpoint?

A. ethanol

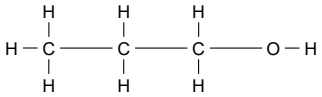
B. butane

C. hexane

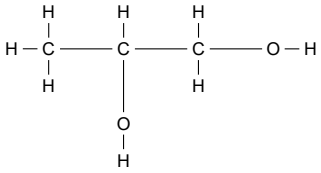
D. diesel

Use the following information to answer Questions 20 and 21.

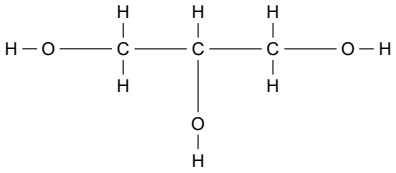
A mixture containing the three molecules below is injected into a high-performance liquid chromatography (HPLC) column that uses a polar stationary phase and hexane as the mobile phase.



alcohol 1

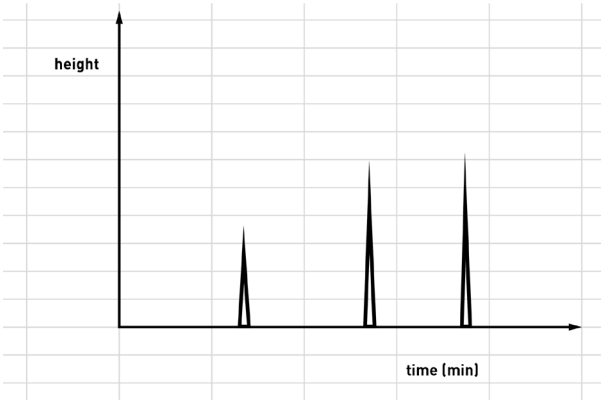


alcohol 2

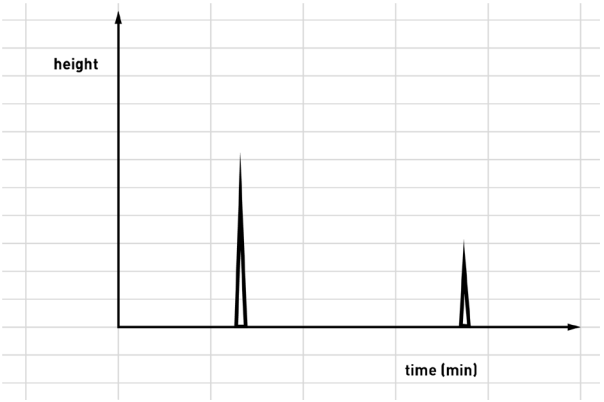


alcohol 3

The chromatogram obtained is shown on the left, and a chromatogram of a related sample is shown on the right (assume the scales of both graphs are the same).



run 1: mixture of three alcohols



run 2: related mixture

Question 20

It is likely that alcohol 3 will have the

A. shortest retention time because it is the most polar of the molecules shown.

B. longest retention time because it will adsorb more readily to the stationary phase.

C. shortest retention time because it has the highest relative molecular mass.

D. shortest retention time because it is the most soluble in the mobile phase.

Question 21

In run 2, it is likely that

A. the temperature has been changed, affecting the retention times of the alcohols.

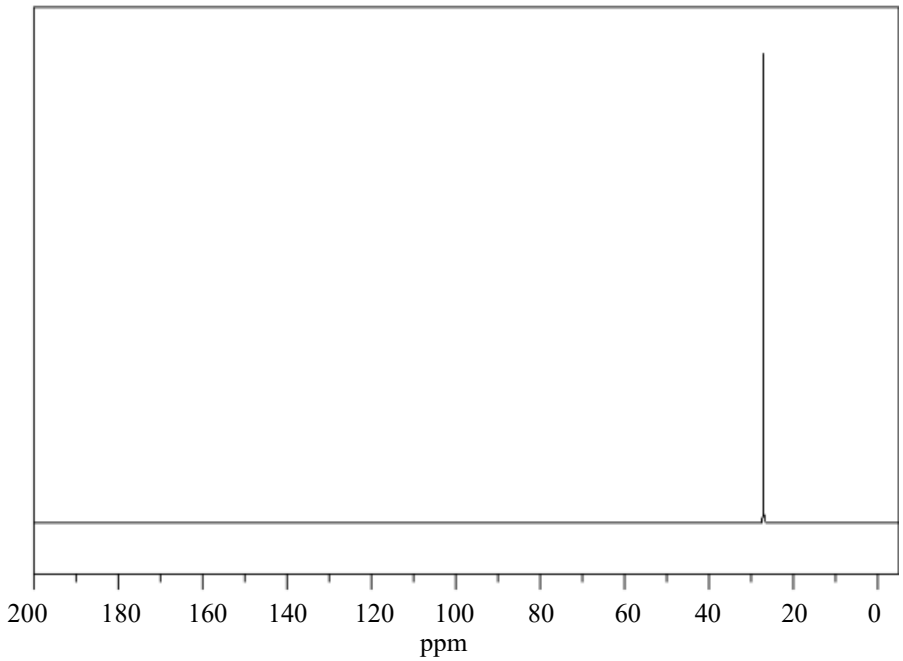
B. the alcohols are the same, but the solvent has been changed to a polar solvent.

C. two alcohols are present, but the stationary phase is now non-polar.

D. there are two alcohols, one twice as concentrated as run 1 and the other half as concentrated.

Question 22

A ^{13}C NMR spectrum is shown below.



Data: SDBS Web, <http://sdbs.db.aist.go.jp>,
National Institute of Advanced Industrial Science and Technology

The ^{13}C NMR shown could be that of

A. propane.

B. butane.

C. cyclohexene.

D. cyclohexane.

Question 23

A titration is conducted to determine the concentration of a solution of iron(II) sulfate.

The standard used is a solution of 0.260 M potassium permanganate. The reaction can be represented by the following equation.

$$5Fe^{2+}(aq) + MnO_4^-(aq) + 8H^+(aq) \rightarrow 5Fe^{3+}(aq) + Mn^{2+}(aq) + 4H_2O(l)$$

20.0 mL aliquots of potassium permanganate solution are used and the mean titre of iron solution is 25.0 mL.

The concentration of the iron solution is, in M,

A. 1.04

B. 0.42

C. 0.21

D. 0.042

Question 24

The molecular formula of a food molecule is determined to be $C_{65}H_{102}N_{18}O_{21}$.

The molecule could be the

A. protein collagen.

B. triglyceride formed from stearic acid and glycerol.

C. polysaccharide glycogen.

D. polysaccharide amylose.

Question 25

Which one of the following statements about lactose and sucrose is correct?

A. Lactose is sweeter than sucrose.

B. The same enzyme can hydrolyse both because they are disaccharides.

C. The molar mass of lactose is greater than that of sucrose.

D. Glucose is produced from the hydrolysis of both.

Question 26

A fatty acid has the empirical formula $C_9H_{16}O$.

How many carbon-to-carbon double bonds (C=C) will the fatty acid contain?

A. 0

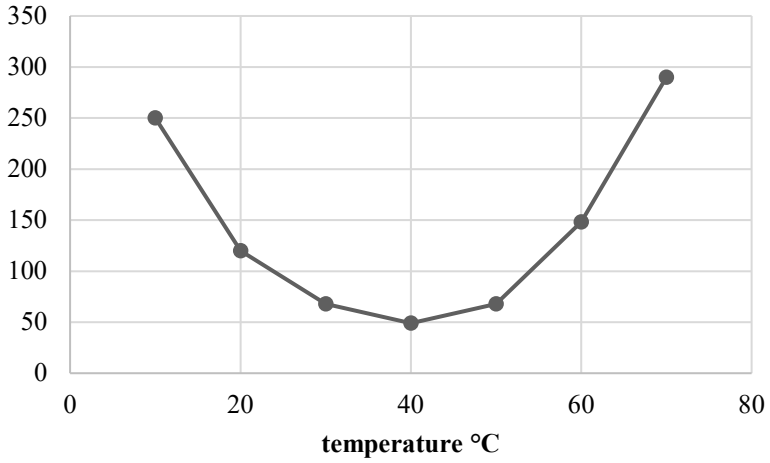
B. 1

C. 2

D. 3

Question 27

The following graph represents the results from an experiment investigating the action of an enzyme, where temperature is the independent variable.



The dependent variable in this experiment could be the

A. number of collisions occurring per minute.

B. time taken for a positive result.

C. rate of the reaction.

D. number of successful collisions occurring per minute

Question 28

What mass of triglyceride is needed to produce the same amount of energy as 1.00 g of starch?

A. 0.200 g

B. 0.432 g

C. 1.00 g

D. 2.31 g

Question 29

The food label below is taken from a packet of muesli bars.

Nutrition information			
Servings per package: 6		Serving Size: 35 g	
	Average Quantity Per Serve (35 g)	**% DI** Per Serve**	**Average Quantity Per 100 g**
Energy	555 kJ 133 Cal	6%	1590 kJ 379 Cal
Protein	3.8 g	8%	10.8 g
Fat, Total	4.9 g	7%	14.0 g
-Saturated	0.6 g	3%	1.8 g
Carbohydrate	12.8 g	4%	36.6 g

1.0 g of muesli bar is burnt under a can containing 500 g of water.

Assuming that the energy transfer from the muesli bar to the water is 100% efficient, the temperature change of the water will be

A. 2.7 °C.

B. 7.6 °C.

C. 15 °C.

D. 38 °C.

Question 30

Which one of the following statements about errors is the **most** correct?

A. Repeated trials can serve to minimise the impact of random errors.

B. Selecting an inappropriate indicator for a titration is an example of a random error.

C. A balance that has not been calibrated will cause random errors.

D. Repeated trials can serve to minimise the impact of systematic errors.

END OF SECTION A
TURN OVER

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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 book are **not** drawn to scale.

Question 1 (5 marks)

The following is an example of a balanced chemical equation.

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

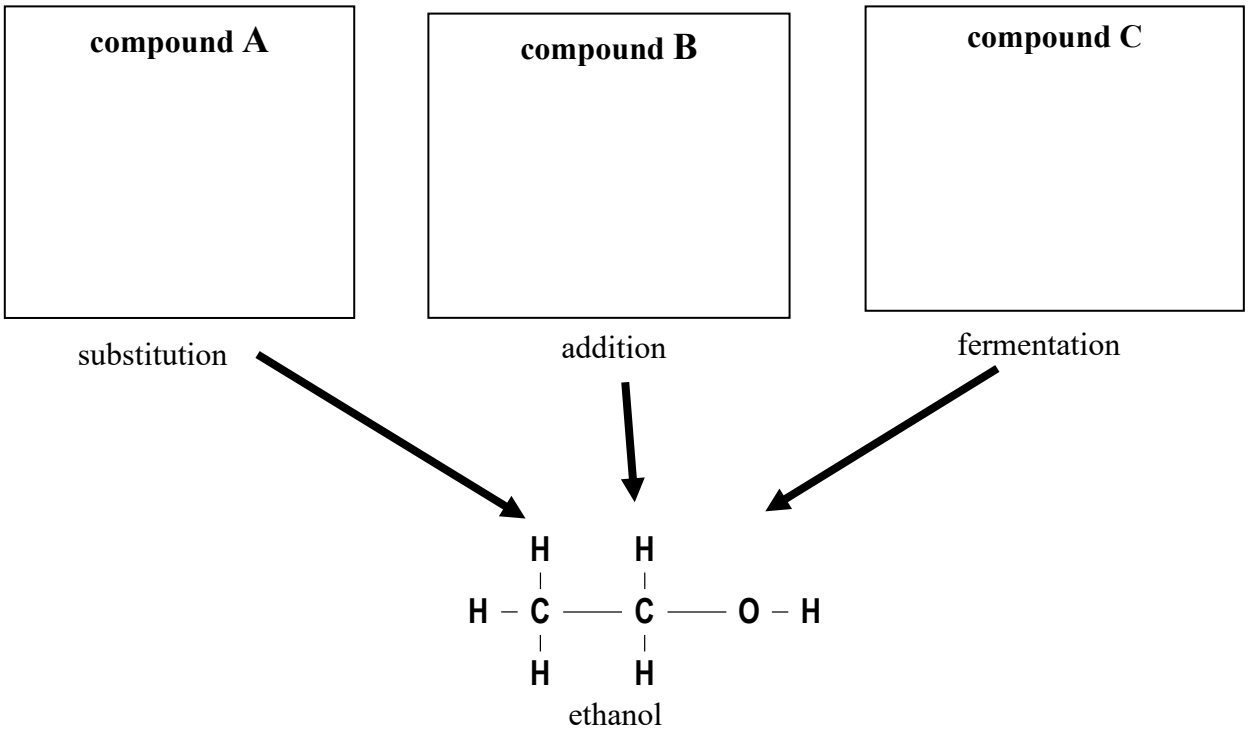
The state of each reactant and product is usually shown in an equation to convey a better picture of the reaction occurring. Some reactions will not occur if the reactants are not present in the correct state.

Complete the following table by writing the state each chemical should be in for the reaction to occur successfully. Choose from the following four states: (s), (l), (g), (aq)

Chemical	State
glucose in fermentation	
sulfuric acid as an esterification catalyst	
H_2O reacting with ethene to form ethanol	
biodiesel in combustion	
potassium metal produced in electrolysis	

Question 2 (8 marks)

Ethanol is an important chemical, with world production exceeding 40 billion litres in 2019. A variety of production processes are used to meet this demand for ethanol, some of which are outlined below.



a. Ethanol can be produced through substitution reactions.

i. Draw an example of a molecule that could be used to manufacture ethanol by substitution in the box provided (compound A).

1 mark

ii. Write a balanced equation for the formation of ethanol from compound A. States are not required.

1 mark

_____

b. Ethanol can be produced through addition reactions.

i. Draw an example of a molecule that could be used to manufacture ethanol by addition in the box provided (compound B).

1 mark

ii. Write a balanced equation for the formation of ethanol from compound B. States are not required.

1 mark

_____

c. Ethanol can be produced by fermentation.

i. Draw an example of a molecule that could be used to manufacture ethanol by fermentation in the box provided (compound C).

1 mark

ii. Write a balanced equation for the formation of ethanol from compound C. States are not required.

1 mark

---

d. Ethanol can be oxidised by dichromate ions in acidic conditions. The oxidation process occurs in two stages.

i. Draw the initial product that forms when ethanol is oxidised.

1 mark

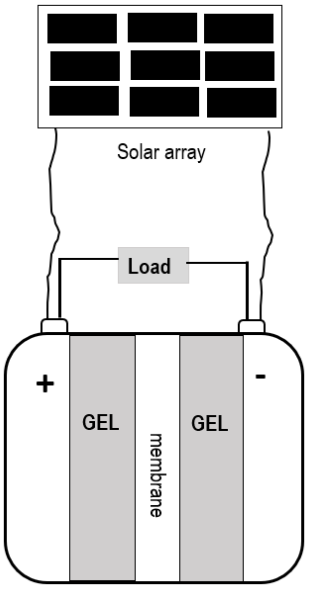
ii. Draw the product that will form if the initial product is heated further.

1 mark

Question 3 (12 marks)

Zinc–bromine flow batteries have been available for several years. These batteries use an electrolyte of zinc bromide solution, which is connected to tanks to store the reactants. The flow batteries perform well, but the need for separate tanks of liquid makes them unsuitable for many applications.

A Sydney company is trialling a modification to the design using a gel. The gel holds reactants without the need for separate tanks and it can be used in moving objects because it does not splash. In the trial, the zinc–bromine gel-ion batteries will power street lights at night as they discharge. During the day, a solar array is used to recharge the battery, re-forming the reactants. A representation of this arrangement is shown below. One electrode is made from zinc and the other is graphite. The electrolyte is a gel containing zinc bromide, $ZnBr_2$. The gel also stores the bromine liquid needed for the reaction.



a. **i.** Write the half-equations occurring when the cell is discharging. States are not required.

3 marks

	Half-equation	**Polarity**
Anode		
Cathode		

ii. Write the overall discharge equation.

1 mark

_____

iii. Write the half-equations for the recharge process. States are not required.

3 marks

	Equation	**Polarity**
Anode		
Cathode		

b. The voltage produced in the cell is 1.6 V, which is lower than the value expected from use of the electrochemical series.

i. What is the predicted voltage of this cell?

1 mark

_____

ii. Suggest one reason why the voltage obtained is lower than the predicted value.

1 mark

_____

_____

c. The mass of zinc in the electrode of each cell is 520 g. The current required to run the street light is 4.8 A.

Calculate the theoretical maximum time the light can run before a recharge is necessary.

3 marks

_____

_____

_____

_____

Question 4 (12 marks)

A chemist isolates a molecule found as a contaminant in a sample of vinegar. To identify the molecule, the chemist tests the molecule in a series of instruments. The empirical formula is determined as C_2H_4O.

a. The relative molecular mass of the molecule is found to be 88.

i. What is the molecular formula of the molecule? Explain how you arrived at your answer.

2 marks

ii. Draw **three** possible structures for the molecule that are consistent with the molecular formula identified in **part a.i.**

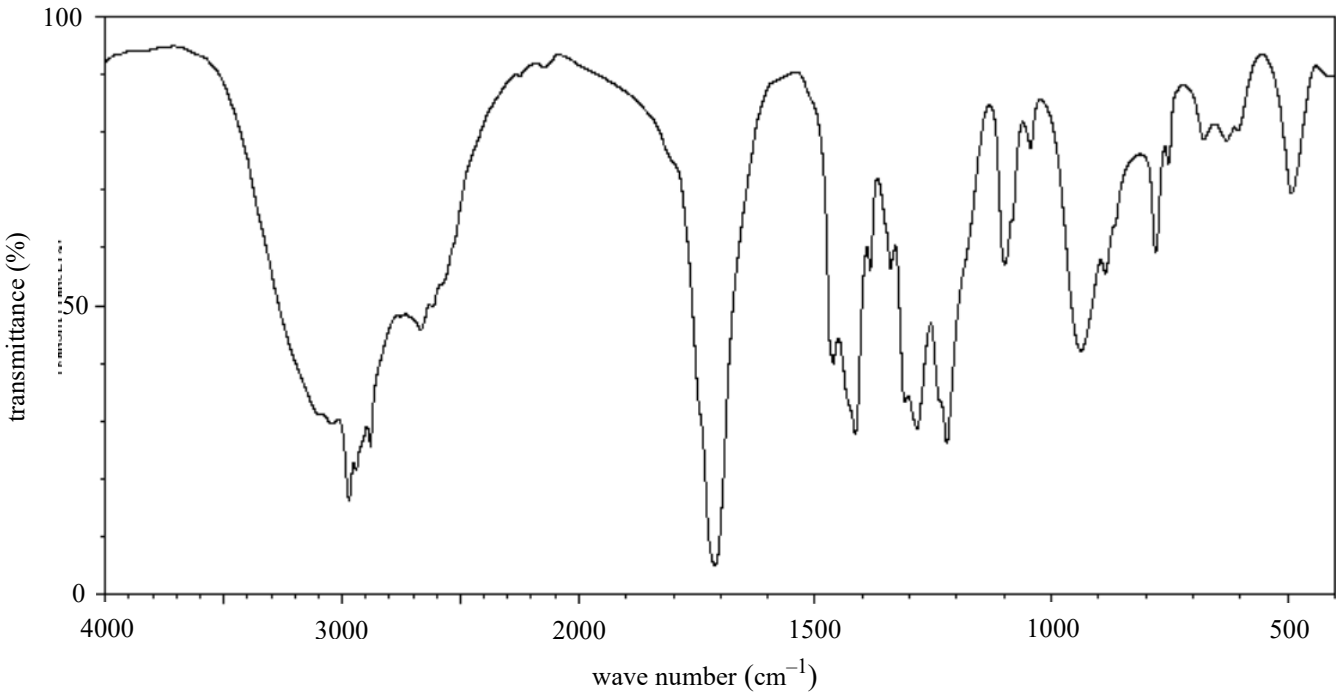
3 marks

iii. The pH of a solution of this molecule is tested.

Explain how the pH might help distinguish between the possible structures.

1 mark

b. The infra-red (IR) spectrum of the molecule is shown below.



Data: SDBS Web, <http://sdbs.db.aist.go.jp>,
National Institute of Advanced Industrial Science and Technology

Using the spectrum, identify the structure of the contaminant molecule. Justify your answer.

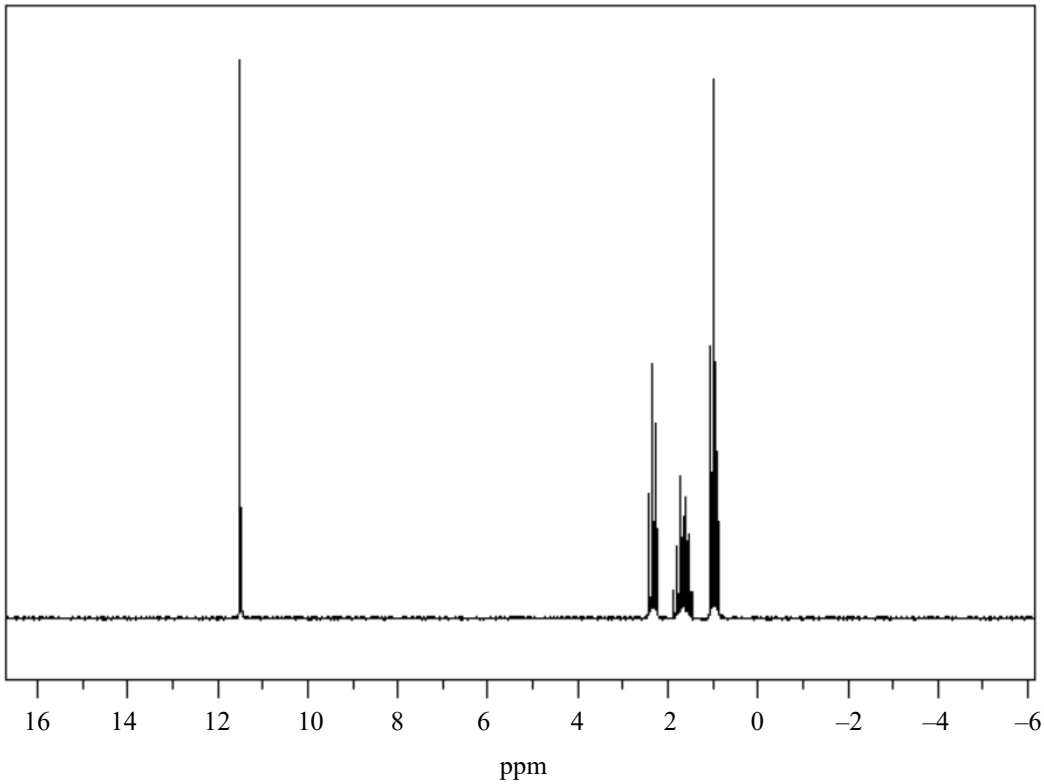
2 marks

_____

_____

_____

c. The ^{1}H NMR of the molecule is shown below.



Data: SDBS Web, <http://sdbs.db.aist.go.jp>,
National Institute of Advanced Industrial Science and Technology

The splitting pattern on this spectrum is difficult to read.

Referring to the structure of the molecule, explain which part of the molecule caused each set of peaks and what the splitting pattern might be.

4 marks

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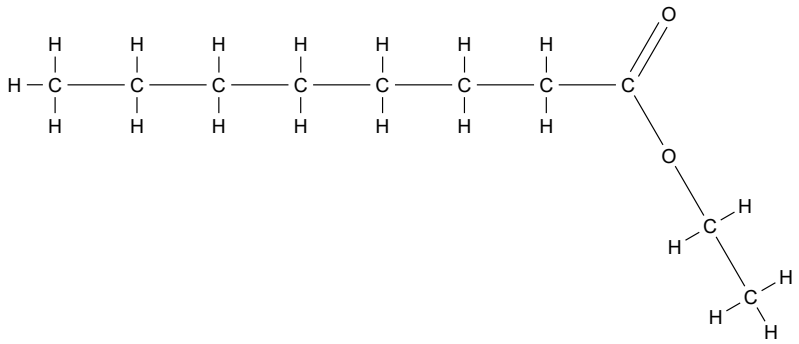
Question 5 (11 marks)

An Australian company is researching the production of a biodiesel molecule which is shown below.



biodiesel A

Interest in biodiesel A stems from the fact that the fatty acid required is caprylic acid, a component of cow's milk that is present in waste from cheese-making processes.

a. **i.** Give the IUPAC name for caprylic acid.

1 mark

_____

ii. Draw the structural formula of the triglyceride formed from glycerol and caprylic acid.

2 marks

b. The alcohol molecule used to make biodiesel A is not the usual choice of alcohol when making biodiesel.

Explain how the choice of the alcohol used could reduce the environmental impact of making this form of biodiesel.

2 marks

c. Write a balanced equation for the complete combustion of this biodiesel molecule.

2 marks

d. Determine the volume of CO_2 that would be produced, at 355 °C and 160 kPa, from the complete combustion of 1.00 kg of this biodiesel.

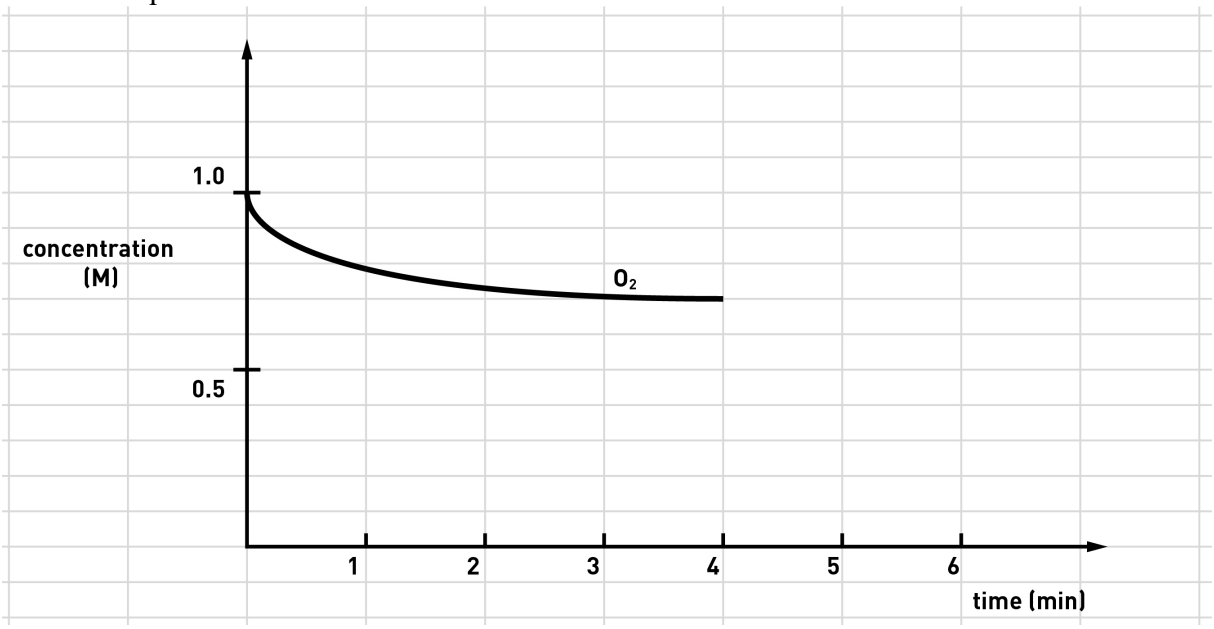
4 marks

Question 6 (10 marks)

The equation for the formation of sulfur trioxide from sulfur dioxide and oxygen gases is

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H = -ve$$

In one particular experiment, equal amounts of SO_2 and O_2 gases are added to an empty reactor at 100 °C. The graph below shows how the concentration of O_2 changes as the system moves to equilibrium.



a. **i.** Using the graph provided, draw the concentrations of both SO_2 and SO_3 gases for the first four minutes of the experiment.

2 marks

ii. Determine the value of K_c at 100 °C for this reaction.

2 marks

_____

_____

_____

b. At the four-minute mark, a sample of oxygen is injected into the reactor, increasing the immediate concentration of O_2 to 0.8 M.

Show this increase on the graph above and draw how the concentrations of all three species will respond as the system moves to re-establish equilibrium.

3 marks

c. The temperature of an equilibrium mixture of the three gases is increased from 100 °C to 200 °C.

Identify the impact of this temperature change on the following.

i. the value of K_c

1 mark

_____

ii. the amount of SO_3 gas

1 mark

_____

iii. the total amount of gas

1 mark

_____

Question 7 (7 marks)

Methanamine is a gas at room temperature. It is used as a raw material in the production of a range of pharmaceuticals, pesticides and explosives. It is highly soluble in water and often sold as a solution.

a. **i.** Draw methanamine.

1 mark

ii. Write a balanced equation for the reaction between solutions of methanamine and hydrochloric acid.

1 mark

_____

b. The concentration of a commercial solution of methanamine is determined by titration against a HCl solution.

The following data is recorded during the experiment.

Methanamine dilution: 20 mL of commercial methanamine added to a 250 mL volumetric flask.
Flask is made up to the mark with deionised water.
20.0 mL aliquots of diluted methanamine added to flasks.
HCl concentration: 0.360 M
Mean titre: 12.2 mL

i. Determine the concentration of the diluted methanamine solution.

2 marks

_____

_____

_____

ii. What is the concentration of the commercial methanamine solution?

1 mark

_____

c. It is noted that the burette was rinsed with deionised water before it was filled with HCl.

i. Explain the impact, if any, of this step on the titre obtained

1 mark

_____

ii. Explain the impact, if any, of this step on the concentration determined for the diluted methanamine solution.

1 mark

_____

Question 8 (10 marks)

a. Amylase and maltase enzymes are used in digestion to reduce starch to a monosaccharide.

i. Draw the disaccharide that can be formed from this monosaccharide.

1 mark

(Use the same format for carbohydrates as that found in the data book.)

ii. Name the most common functional group on the disaccharide.

1 mark

_____

b. A sample of threonine is dissolved in a dilute solution of NaOH.

i. Draw the structure of threonine as it will exist in an alkaline solution.

1 mark

ii. How does the relative molecular mass of the ion that threonine forms in acidic solutions compare to the relative molecular mass of the ion that it forms in alkaline solutions?

1 mark

_____

c. Lactase is an enzyme produced by most humans.

Students conduct two tests on a lactase solution.

Test 1: Dilute HCl is added to the solution. Lactase loses its ability to function as an enzyme but analysis shows that the molecular formula has not changed.

Test 2: Concentrated HCl is added and the solution is heated gently. Many smaller molecules are formed from the lactase. The lactase no longer functions as an enzyme.

One of these tests is an example of hydrolysis and the other is an example of denaturation.

Use the headings provided to identify each test as being either hydrolysis or denaturation and to explain the main bonding change that is occurring in each.

i. Test 1

2 marks

ii. Test 2

2 marks

d. A 0.60 g sample of a triglyceride formed from stearic acid is burnt under a beaker containing 200 g of water. The initial temperature of the water is 22.6 °C.

Calculate the final temperature of the water, assuming all energy released is transferred to the water.

2 marks

Question 9 (8 marks)

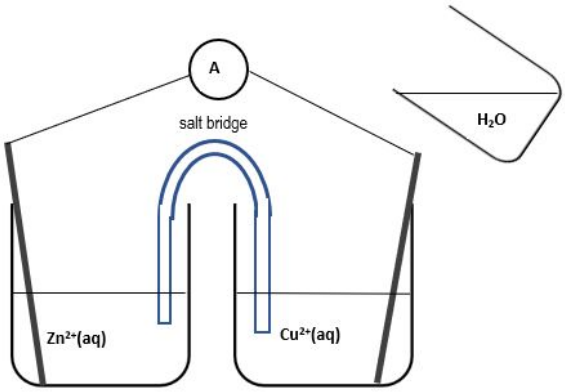
A student set up a galvanic cell to investigate the relationship between the current in a cell and the concentration of the solution. A representation of the cell is shown below. The student's notes are also shown.

Hypothesis: The current in a cell is proportional to the concentration of the solution.

Cell: $Zn^{2+}(aq)$, Zn(s) half-cell connected to a $Cu^{2+}(aq)$, Cu(s) half-cell.

Initial: 50 mL of 1.0 M solution used in both beakers.

Water to be added in 5 mL increments to the copper half-cell to change the concentration. Current recorded after each increment.



Volume of water added (mL)	Current (A)
0	0.78
5.0	0.82
10	0.86
15	0.89
20	0.91

Conclusion: The hypothesis is proven because the current has increased as the water is added.

a. **i.** Identify the independent variable.

1 mark

_____

ii. Identify the dependent variable.

1 mark

_____

iii. Identify a controlled variable.

1 mark

_____

b. Is the student's conclusion consistent with the experimental data? Justify your answer.

2 marks

c. The student's teacher suggests that the experimental design needs to be modified in order to produce more valid data.

Identify a flaw with the experiment design and discuss how the student might address this issue.

3 marks

Question 10 (7 marks)

Oats are a whole grain cereal and are very popular in Europe and North America. They are most commonly rolled or crushed and consumed as oatmeal or porridge.

Oats have gained considerable attention as a health food because of the many benefits they offer, such as lowering blood sugar levels and cholesterol levels. They are also high in vitamins, minerals and antioxidants.

The nutritional breakdown of a 40 g sample of oats is shown below.

- Protein 6.9 g
- Carbohydrate, total 22.7 g
  - sugars 0.4 g
  - fibre 3.7 g
- Fat 3.7 g
- Other (water, sodium etc) 6.7 g

a. Consider a person consuming a bowl of porridge with added milk for breakfast. Demonstrate your understanding of the chemistry and metabolism of the carbohydrates that will be in both the porridge and the milk. In your answer:

- Identify the carbohydrates that are likely to be present and comment on their composition.
- Describe how each carbohydrate is likely to be metabolised in the body.

5 marks

b. Oats contain many different fatty acids, but the main fatty acids components are listed below.

Fatty acid	Percentage composition by mass
C18.2	44.8
C18.1	36.2
C16.0	16.1
C18.0	1.7
C18.3	1.2

The notation used indicates the number of C atoms, then the number of C=C double bonds. For example, C18.2 = 18 carbon atoms in the fatty acid with two C=C bonds.

i. Identify the most common fatty acid on this table.

1 mark

ii. Calculate the percentage of unsaturated fatty acid in this sample.

1 mark

END OF QUESTION AND ANSWER BOOK