Name: _____

Teacher's name: _____

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

Chemistry

Question and Answer Book

VCE Units 3&4 Trial Examination 2024 (Trial 2)

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

Approved materials

- One scientific calculator.

Materials supplied

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

Instructions

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

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

Contents page

Section A – Multiple-choice questions

Instructions

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

Question 1

Biofuels

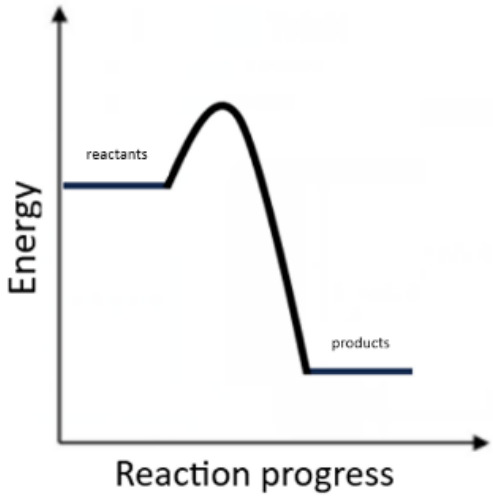
A. do not require energy to produce.
B. can be found trapped between rocks in gas reservoirs.
C. are unable to be replenished at a rate faster than they are consumed.
D. release carbon dioxide into the atmosphere during combustion.

Question 2

The energy released when food undergoes combustion in a lab is often higher than the energy it provides to the body after digestion. This could be due to

A. high levels of fat in the food sample.
B. incomplete digestion of food molecules.
C. the high degree of oxidation of carbohydrate molecules.
D. the loss of heat energy to the surroundings during combustion.

Use the following information to answer Questions 3 and 4.
The energy profile diagram for a particular chemical process is shown below.



Question 3
Looking at the energy profile diagram, the forward reaction is
A. endothermic because $E_a < H_r$
B. exothermic because $H_r > H_p$
C. exothermic because $\Delta H > E_a$
D. endothermic because $H_r < H_p$

Question 4
This process does not represent the energy changes associated with
A. fermentation of glucose.
B. cellular respiration.
C. steam reforming of methane.
D. a combustion reaction.

Question 5
17.5 mol of an unknown fuel undergoes complete combustion, releasing 15.60 MJ of energy. What is the likely identity of the fuel?
A. hydrogen
B. ethane
C. methanol
D. methane

Question 6
A spontaneous redox reaction occurs when solid zinc is placed in a beaker containing a 1.0 M solution of copper(II) ions at 25°C. Which of the following would NOT occur in the beaker?
A. the temperature of the solution would increase
B. a dark solid would be deposited at the surface of the zinc electrode
C. a potential difference of approximately 1.10 V would be recorded
D. the blue colour of the solution would gradually fade as $Cu^{2+}(aq)$ ions are reduced

Question 7

Which of the following statements about cellular respiration is incorrect?

A. cellular respiration provides energy for body processes
B. glucose is oxidised during cellular respiration
C. cellular respiration occurs in both plant and animal cells
D. the products of cellular respiration are usually glucose and oxygen gas

Question 8

Which flow chart shows a likely processing pathway for the production of bioethanol for use in E10 petrol?

A. glucose → fermentation → distillation → bioethanol
B. canola oil → fermentation → distillation → bioethanol
C. leaf litter → pre-treatment → distillation → fermentation → bioethanol
D. sugar cane → pre-treatment → distillation → fermentation → bioethanol

Question 9

Analysis of an unidentified organic substance shows that it has a low melting point range. This information suggests that the substance

A. has high purity.
B. starts to melt at a low temperature.
C. does not contain carbon-carbon double bonds.
D. has a disorganised arrangement of molecules.

Question 10

The balanced half equation for the reduction of permanganate(VII) ions to manganese(II) ions in alkaline conditions is

A. $MnO_4^-(aq) + 8OH^-(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$
B. $MnO_4^-(aq) + 8H_2O(l) + 5e^- \rightarrow Mn^{2+}(aq) + 4OH^-(aq)$
C. $MnO_4^-(aq) + 4H_2O(l) + 5e^- \rightarrow Mn^{2+}(aq) + 8OH^-(aq)$
D. $MnO_4^-(aq) + 4H_2O(l) + 8H^+(aq) \rightarrow Mn^{2+}(aq) + 8OH^-(aq)$

Question 11

A student constructs a series of galvanic cells as part of an investigation. Which combination of half cells would be expected to produce the greatest potential difference under standard conditions?

	Half-cell 1		Half-cell 2	
	Electrode	**Electrolyte**	**Electrode**	**Electrolyte**
A.	Fe(s)	$Fe^{2+}(aq)$	Pt(s)	$Pb^{2+}(aq)$
B.	Zn(s)	$Zn^{2+}(aq)$	Ni(s)	$Ni^{2+}(aq)$
C.	Ag(s)	$Ag^{+}(aq)$	inert electrode	$Mg^{2+}(aq)$
D.	inert electrode	$Mn^{2+}(aq)$	Al(s)	$Al^{3+}(aq)$

Question 12
Consider the thermochemical equation for the complete combustion of propane at SLC below:
$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l) \quad \Delta H = -2220$ kJ

Determine the theoretical ΔH value for the following reaction under the same conditions:
$6CO_2(g) + 8H_2O(l) \rightarrow 2C_3H_8(g) + 10O_2(g)$
A. $\Delta H = +1110$ kJ
B. $\Delta H = +4440$ kJ
C. $\Delta H = -1110$ kJ
D. $\Delta H = -4440$ kJ

Question 13
For which one of the following substances can energy content be expressed using both kJ g^{-1} and kJ mol^{-1}?
A. biogas
B. palmitic acid
C. E10 petrol
D. sugar cane

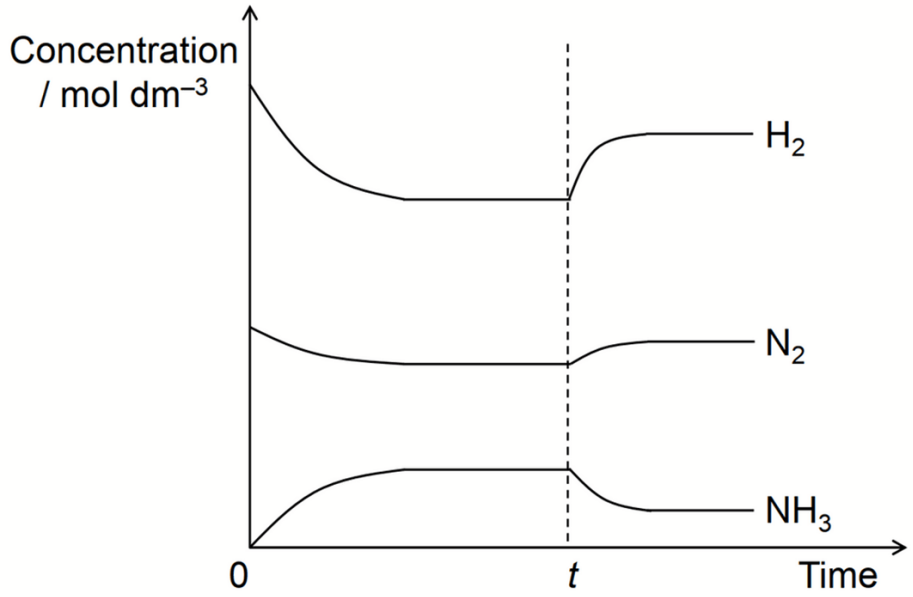
Question 14
A hydrogen production facility at Bell Bay, Tasmania, is aiming to be one of the world's largest producers of renewable hydrogen. The hydrogen will be used in fuel cell technology, drastically reducing carbon emissions in the transport industry.

According to green chemistry principles, raw materials and feedstocks should be renewable, rather than depleting. The hydrogen that will be produced at the Tasmanian facility is considered renewable because
A. a hydrogen fuel cell does not produce carbon emissions.
B. porous electrodes will allow for increased energy efficiency.
C. the energy source for hydrogen production will be hydroelectric and wind-based power.
D. electrolysis of water to produce hydrogen does not require the input of energy.

Question 15
According to collision theory, which of the following changes will not lead to an increase in the rate of reaction?
A. increasing the particle size of solid reactants
B. decreasing the volume of the vessel for gaseous systems
C. lowering the activation energy of the reaction
D. increasing the temperature of the system

Question 16

The concentration-time graph below shows that a change was made to a system in equilibrium at time, t.



$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H < 0$$

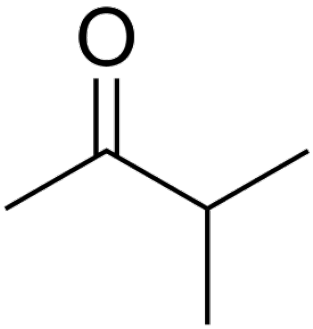
Source: Le Chatelier Principle and Concentration Time Graph

Which option correctly identifies the change that was made to the system at time, t, with the corresponding effect on the equilibrium constant?

A. increase in volume of the vessel, decrease K
B. increase in volume of the vessel, no change to K
C. increase in temperature, decrease K
D. increase in temperature, no change to K

Question 17

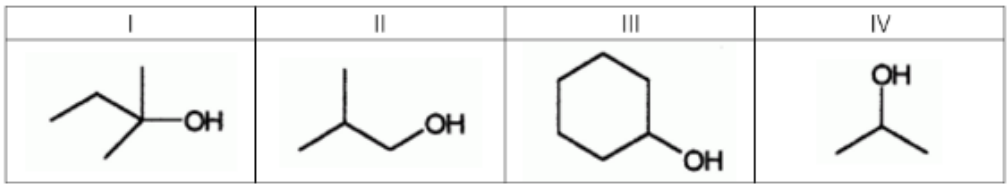
State the IUPAC systematic name of the organic molecule shown in the diagram below.



A. 2-methylpropan-3-one
B. 3-methylpropan-2-one
C. 3,3-dimethylpropan-2-one
D. 3-methylbutan-2-one

Question 18

The images below show the structures of various primary, secondary and tertiary alcohols.



Source: https://commons.wikimedia.org/wiki/File:Alcohol_examples.png

Which structure(s) are classified as secondary alcohols?

A. I only
B. I and III only
C. III and IV only
D. II, III and IV only

Question 19

Which straight chain, hydrocarbon molecule has a degree of unsaturation equal to 2?

A. C_2H_6
B. C_3H_6
C. C_4H_6
D. C_5H_{10}

Question 20

Water can be electrolysed to produce hydrogen gas in an electrolytic cell at a rate of 1.8 litres per minute at SLC. Calculate the current required to produce this volume of hydrogen gas.

A. 58 A
B. 117 A
C. 233 A
D. 840 A

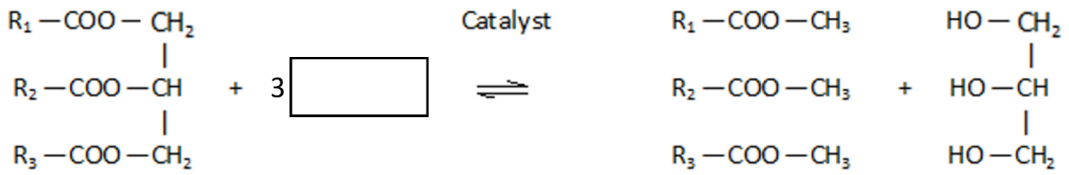
Question 21

For a secondary cell, such as a lead-acid battery, to be recharged, the products of the discharge reaction should

A. remain in contact with the electrodes.
B. be kept separate to avoid a spontaneous reaction.
C. be supplied with electrical energy, equal to the potential difference of the cell.
D. react spontaneously to reverse the discharge reaction.

Use the following information to answer Questions 22 and 23.

The equation below represents the production of a common biofuel via transesterification of plant triglycerides.



R 1, R 2, R 3 = Hydrocarbon chain of 15 to 21 carbon atoms

Source: Adapted from https://commons.wikimedia.org/wiki/File:Transesterification_reaction.png

Question 22

What is the identity of the reactant that is missing from the equation?

A. $C_3H_8O_3$
B. CH_3OH
C. C_2H_5OH
D. fatty acids

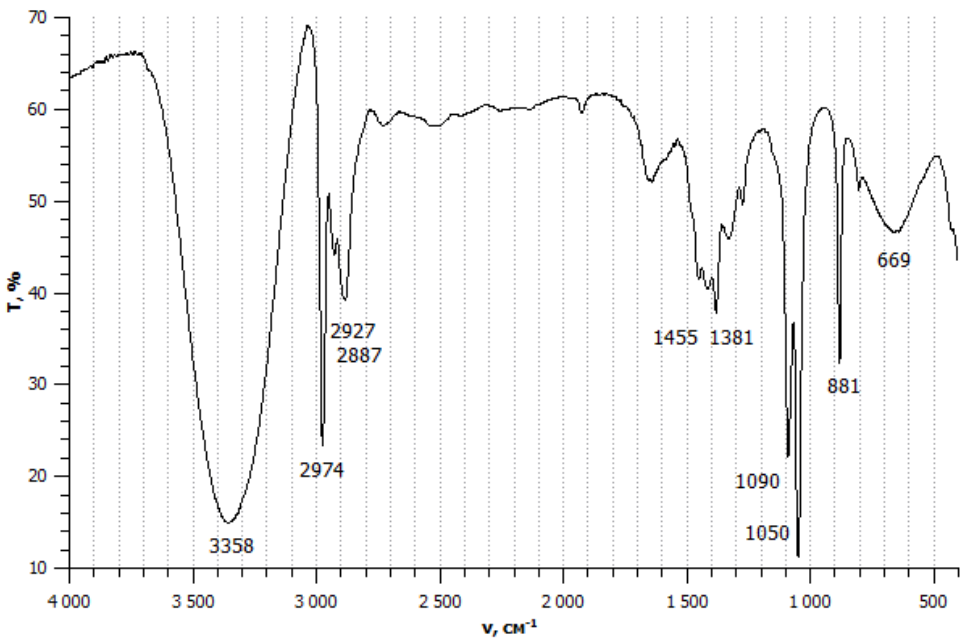
Question 23

The methyl esters that are produced during this reaction

A. are non-renewable.
B. can be added to petrol to make E10 fuel.
C. are commonly used as a biofuel in the transport industry.
D. do not produce carbon dioxide emissions during combustion.

Question 24

The IR spectrum of a simple organic compound is shown below.



Source: File IR Spectrum.png

The likely identity of the molecule is

A. ethanol
B. ethanal
C. ethanoic acid
D. ethanamide

Question 25

What is the correct oxidation number for chromium in $Cr_2O_7^{2-}$?

A. +6
B. +7
C. +12
D. +14

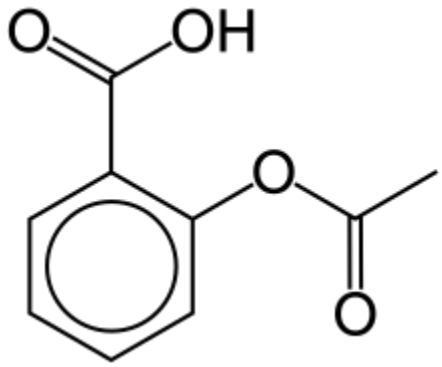
Question 26

Low-resolution ^{1}H-NMR analysis can provide information about the

A. presence of carbon-13 isotopes in a molecule.
B. number of unique carbon environments in a molecule.
C. ratio of hydrogen atoms in each hydrogen environment.
D. number of neighbouring hydrogen atoms adjacent to each hydrogen environment.

Question 27

The skeletal formula of an aspirin molecule is shown below.



Source: https://commons.wikimedia.org/wiki/File:Aspirin-skeletal_benzene-circle.svg

Which of the following would NOT be observed when conducting laboratory and instrumental analysis of aspirin?

A. a mass spectrum peak at m/z 15
B. a ^{1}H-NMR spectrum with 8 clear signals
C. an IR spectrum showing a broad absorption band at approximately 3000cm^{-1}
D. it is colourless in the presence of phenolphthalein indicator

Question 28

Consider the following statements regarding the production of green hydrogen via electrolysis of water in acidic conditions.

I The reaction occurring at the negative electrode is $2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$
II Hydrogen ions are reduced to $H_2(g)$ during electrolysis
III The process produces green hydrogen when the electrical energy required is obtained from renewable sources
IV Electrical energy is not required for this process, so the hydrogen is classified as a green fuel

Which of the statements above are correct?

A. I and IV only
B. II and III only
C. I, II and IV only
D. I, II and III only

Question 29

Hydrogen iodide is produced from a reversible reaction between hydrogen gas and iodine gas according to the equation:

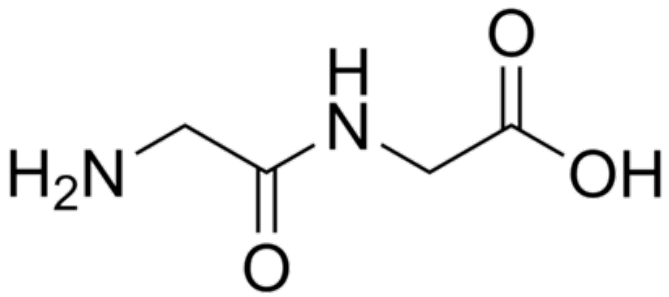
$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

At a particular temperature, 1.0 mol of H_2 and 1.0 mol of I_2 are present at equilibrium in a 2.0 L, closed vessel. If the equilibrium constant, K, is 50 at this temperature, the equilibrium concentration of hydrogen iodide would be closest to

A. 3.5 M.
B. 3.5 no units.
C. 12.5 M.
D. 12.5 no units.

Question 30

Consider the structure of the dipeptide shown below.



Source: https://commons.wikimedia.org/wiki/File:Glycylglycine.png

Which statement is correct regarding the hydrolysis of the dipeptide during digestion?

A. two different amino acids are produced and water is lost during the reaction
B. two of the same amino acids are produced and water is required for the reaction
C. two different amino acids are produced and water is required for the reaction
D. two of the same amino acids are produced and water is lost during the reaction

End of Section A

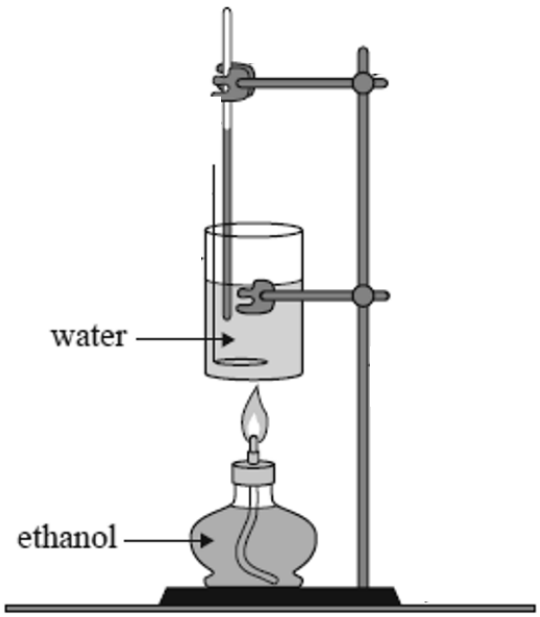
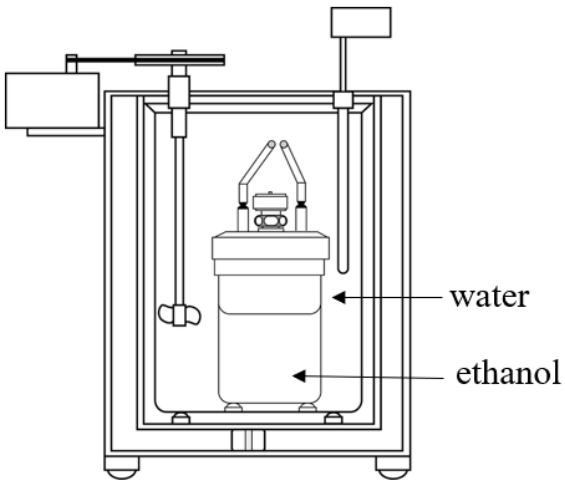
Section B

Instructions

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

Question 1 (13 marks)

The amount of energy absorbed or released during a reaction can be estimated using calorimetric processes in a laboratory. The table below shows two different methods for recording the change in temperature of water as a known mass of ethanol combusts.

Method 1: spirit burner and metal can	Method 2: bomb calorimeter
 Source: http://www.dynamicscience.com.au/tester/solutions1/chemistry/pastexamquestion/2014enthalpy.html	 Source: https://commons.wikimedia.org/wiki/File:Bomb_calorimeter_scheme.png

A student designs an investigation to compare the two processes. The results, taken at SLC, are shown in the tables below.

Method 1: spirit burner results

Mass of ethanol combusted (g)	**Mass of water in can (g)**	**ΔT water (°C)**	**Energy transferred to water (kJ)**	**ΔH_c ethanol (kJ g^{-1})**
1.48	100	9.5		

Method 2: bomb calorimeter results

Mass of ethanol combusted (g)	**Calorimeter calibration factor (kJ $°C^{-1}$)**	**ΔT water (°C)**	**Energy transferred to water (kJ)**	**ΔH_c ethanol (kJ g^{-1})**
10.6	5.60	58.5	328	30.9

a. State the independent variable in this investigation. 1 mark

b. Calculate the amount of energy, in kJ, that was transferred to the water using the spirit burner method. Record your answer in the results table. 2 marks

c. Calculate the ΔH_c of ethanol, in kJ g^{-1}, using results from the spirit burner method. Record your answer in the results table. 1 mark

d. Calculate the theoretical heat of combustion for ethanol in kJ g^{-1}. Compare the results of the two methods with the calculated, theoretical value. 3 marks

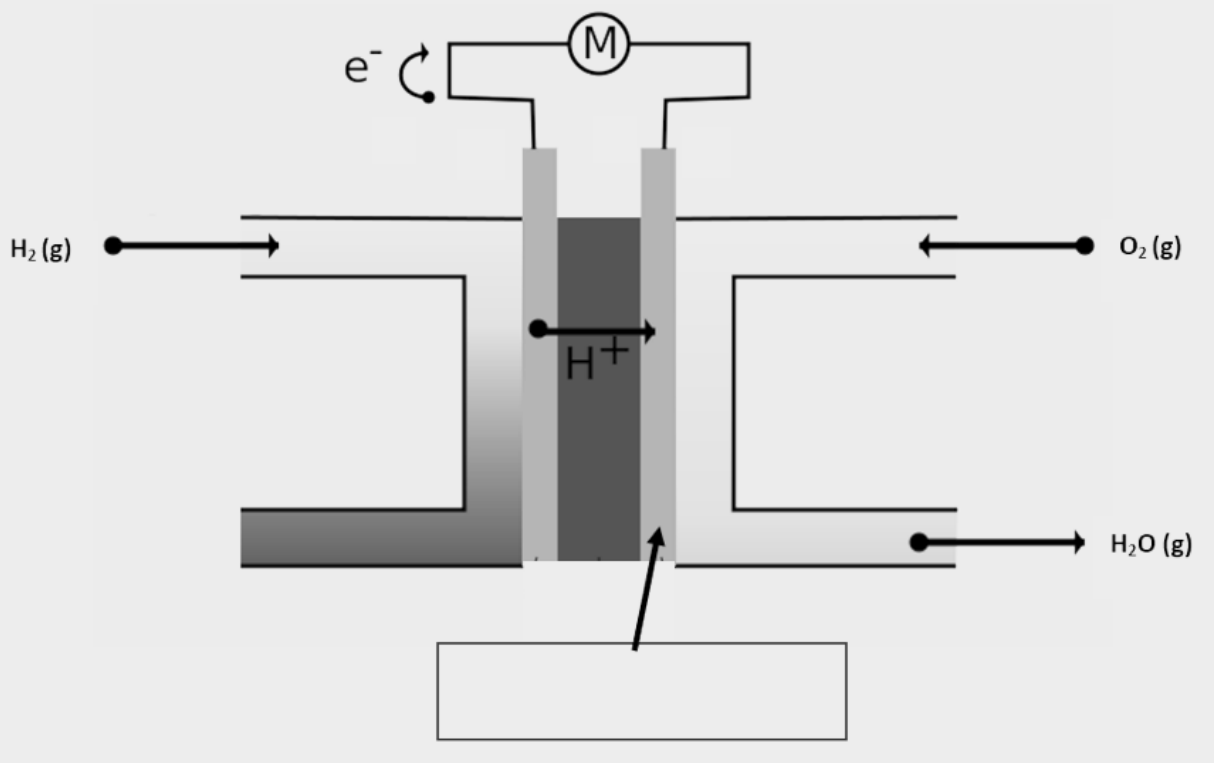
e. A bomb calorimeter is similar to a solution calorimeter as they both insulate against heat loss. Both types of calorimeter measure the temperature change of a known mass of water in order to determine energy changes. 2 marks

Assuming that the calorimeter was calibrated correctly, describe one source of error for each method that could have affected the accuracy of results obtained by the student.

f. The thermometer used for the spirit burner method was labelled as having a resolution of 0.5°C. Explain how this could affect the student's ability to check for the precision of data. 1 mark

g. Solution and bomb calorimeters are both calibrated before use. The bomb calorimeter was initially calibrated using a known quantity of thermal energy supplied by an electric heater. A current of 4.50 A was passed through the heater for 5 minutes with a potential difference of 8.00 V. If the temperature of the water was 22.0°C before calibration, calculate the highest temperature the water reached during calibration. Assume the calorimeter is well insulated. 3 marks

Question 2 (10 marks)
The diagram below shows the set-up of a hydrogen fuel cell.



Source: https://commons.wikimedia.org/wiki/File:Fuel_cell_EN.svg

a. The diagram shows a box with an arrow, pointing to one of the electrodes. Identify this electrode as either the anode or the cathode and write your answer in the box. 1 mark

b. Write the equation for the half-cell reaction occurring at the negative electrode in the fuel cell. 1 mark

c. The reactions occurring in the acidic fuel cell were replicated in a lab at SLC. Predict the potential difference of the replicated cell, in volts. 1 mark

Do not write in this area.

d. Hydrogen fuel cells can also be constructed with an alkaline electrolyte, such as potassium hydroxide, KOH. 2 marks

State two differences between acidic and alkaline hydrogen fuel cells with reference to the reactions occurring at the anode and cathode.

e. To increase the electrical energy output of fuel cells, individual cells can be linked together, forming a stack. A particular stack of acidic hydrogen fuel cells can generate a current of 250 A. 3 marks

Calculate the mass of hydrogen gas that would be consumed by the fuel cell stack over a 5-hour period.

f. Fuel cell electrodes are both porous and conductive. Explain how these electrode properties improve the overall function of the cell. 2 marks

Question 3 (10 marks)

Sulfuric acid is a very useful chemical. It can be used as an electrolyte in batteries, as a cleaning agent, or as a precursor in the production of other chemicals. One of the key stages in the commercial production of sulfuric acid is the reaction of sulfur dioxide with oxygen in the air. The reaction is reversible and exothermic in the forward direction.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

a. With the use of oxidation numbers, show that sulfur, in sulfur dioxide, undergoes oxidation during this process. 1 mark

b. It is common for oxygen to be mixed with sulfur dioxide in a 1:1 ratio during industrial manufacturing processes. However, the molar coefficients suggest that only one mole of oxygen is required for every two moles of sulfur dioxide. Suggest a likely reason for the 1:1 mixing ratio. 1 mark

c. The optimum temperature for the production of sulfur trioxide is 450°C. With reference to yield and rate of reaction, explain the factors involved in this choice of temperature. 2 marks

Do not write in this area.

d. A vanadium catalyst is used for this reaction. Explain how a catalyst increases the rate of reaction. 1 mark

e. Explain how the use of catalysts supports the green chemistry principle of designing processes for greater energy efficiency. 2 marks

f. Analysis of the composition of reacting gases shows that, at a particular point in time, the following molar concentrations are present at 450°C: 3 marks

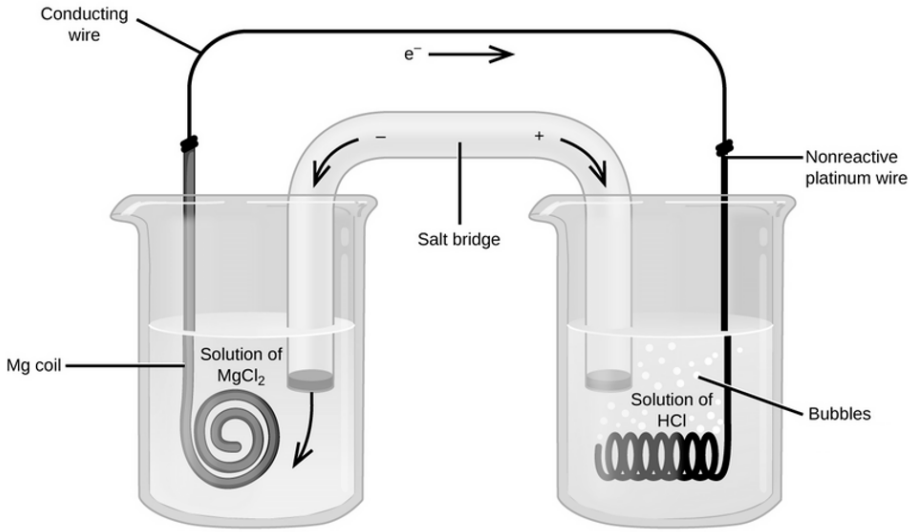
1.20 M $SO_2(g)$
2.40 M O_2 (g)
2.95 M $SO_3(g)$

The equilibrium constant, K, for the reaction at the same temperature, is 24.8 M^{-1}.

Explain how the reaction will proceed from this point in time, with reference to the reaction quotient (Q) and the rate of both forward and reverse pathways.

Question 4 (6 marks)

The diagram below shows the laboratory set-up of a simple galvanic cell.



Source: https://commons.wikimedia.org/wiki/File:CNX_Chem_17_02_Oxidareduc.png

ai. Write the half equation for the reaction occurring at the anode. 1 mark

aii. State the identity of the gas bubbles forming in the half cell containing the platinum wire. 1 mark

b. State one safety hazard that would need to be controlled during the operation of this cell. 1 mark

c. Explain the likely outcome of replacing the magnesium coil with an inert carbon electrode. 3 marks

Do not write in this area.

Question 5 (13 marks)

The chemical equation below represents the process of photosynthesis in plant cells, where atmospheric carbon dioxide is converted into biomass.

$$6CO_2(g) + 6H_2O(l) \rightarrow C_6H_{12}O_6(aq) + 6O_2(g) \qquad \Delta H = +2803 \text{ kJ}$$

a. Calculate the amount of energy, in kJ, required to convert 10.0 g of atmospheric carbon dioxide into glucose. 3 marks

b. The glucose produced during photosynthesis can be stored as starch in plant cells. State the type of reaction that occurs to form starch from glucose. 1 mark

c. Calculate the molar mass of a starch polymer consisting of 50 glucose monomers. The molar mass of glucose is 180.0 g mol^{-1}. 1 mark

Do not write in this area.

di. Plants that contain a high percentage of starch and cellulose are used as biomass for the production of bioethanol. 1 mark
The equation for this reaction is shown below.

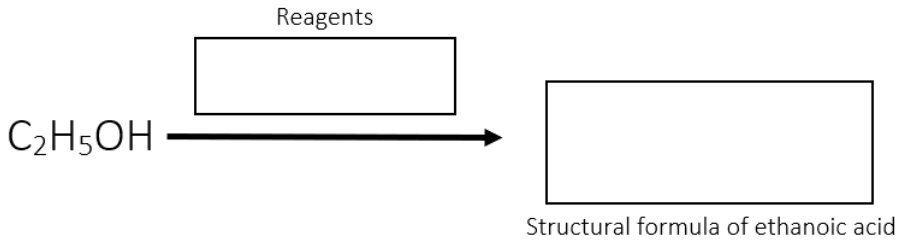
$$C_6H_{12}O_6(aq) \rightarrow 2C_2H_5OH(l) + 2CO_2(g)$$

Calculate the atom economy of the reaction to form bioethanol from glucose.

dii. Explain whether the value calculated in Question 5di supports the green chemistry principle for atom economy. 1 mark

e. State one reason why it is more sustainable for industrial processes to have a high atom economy. 1 mark

f. Ethanol can also be used as a reactant in the commercial production of ethanoic acid. Complete the equation below, identifying the reagents required for the reaction and the structural formula of ethanoic acid. Write your responses into the boxes. 2 marks

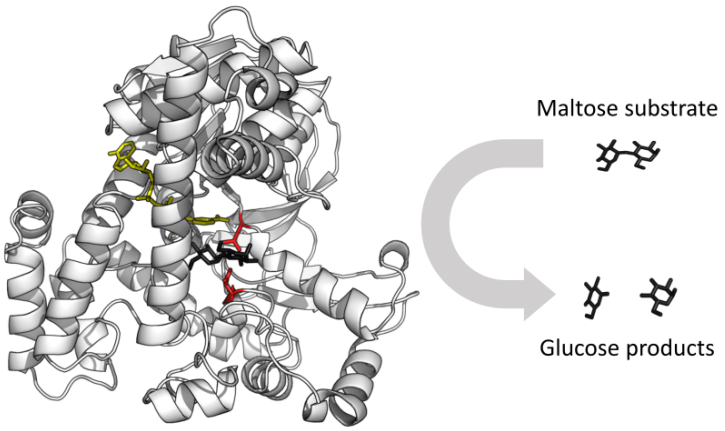


g. The process of esterification between an alcohol and a carboxylic acid produces molecules that can be used as artificial flavours and scents. Draw the skeletal formula of the ester formed from the reaction between ethanol and ethanoic acid. 1 mark

h. Scientists are developing methods of fuel production through artificial photosynthesis. Compare the processes of natural photosynthesis and artificial photosynthesis. 2 marks

Question 6 (9 marks)
Enzymes are biological catalysts that speed up the rate of many important biological reactions.

The diagram below shows the folded structure of maltase, an enzyme that catalyses the breakdown of maltose into glucose during the hydrolysis of carbohydrates.

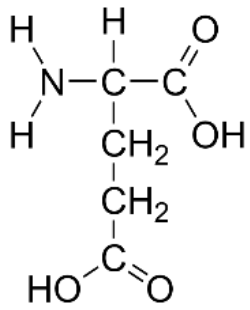


Source: File:Galactosidase enzyme 2.svg

a. The coiled structures in the folded enzyme represent alpha helices. Describe the bonding that occurs in the enzyme to produce these coiled sections. 1 mark

b. Explain why people who suffer from maltase deficiency are likely to experience a feeling of tiredness, lack of energy and motivation. 2 marks

c. Maltase has an optimum pH range of 6.5-7.5. The structural formula of glutamic acid, one of the amino acids found in maltase, is shown below. 4 marks



Source: File:Glutamic Acid.svg

Explain how the presence of glutamic acid in the peptide chain could affect the tertiary structure and function of the enzyme if the pH drops below the optimum range.

d. Tangzhiqing (TZQ) is a Chinese herbal medicine that is sometimes used to treat high blood glucose levels associated with Type II diabetes. It works to inhibit the action of enzymes, like maltase, that break down carbohydrates. 2 marks
Explain the likely function of TZQ to inhibit the enzyme.

Question 7 (9 marks)

Terminalia ferdinandiana, or gubinge, is a native plum found in the Kimberley region of Western Australia. The fruit is known to be very high in Vitamin C (ascorbic acid). Laboratory analysis of the native fruit was conducted to compare its ascorbic acid content with that of an orange. Oranges have been found to contain approximately 53 mg of ascorbic acid per 100 g.

A redox titration was performed and a summary of the procedure is given below.

- A 20.0 g sample of gubinge was crushed and juiced, then filtered to remove solids.
- The juice was diluted to 250 mL in a volumetric flask.
- A 25.0 mL aliquot of the diluted juice was added to a conical flask with a few drops of HCl and 10 drops of starch indicator.
- The aliquot was titrated with a standardised solution of 0.050 M I_2 and the average titre was found to be 6.63 mL.

The chemical equation for the reaction is:

$$C_6H_8O_6(aq) + I_2(aq) \rightarrow C_6H_6O_6(aq) + 2I^-(aq) + 2H^+(aq)$$

a. The half equation for the reduction of iodine during the analysis is 1 mark

$$I_2(aq) + 2e^- \rightarrow + 2I^-(aq)$$

Write the half equation for the oxidation of ascorbic acid to show that the use of a redox titration is justified.

b. Calculate the amount of I_2, in mol, required to reach the end point of the reaction. 1 mark

Do not write in this area.

c. Assuming all the ascorbic acid in the fruit was present in the diluted juice, use the balanced equation to calculate the mass of ascorbic acid, in mg, present in the 20.0 g sample of gubinge. 3 marks

d. Referring to the results of the analysis, compare the ascorbic acid content of oranges and gubinge. 2 marks

e. The investigation was reproduced by scientists in a different laboratory. The scientists followed the method correctly, under the same conditions, however their results were much lower than those achieved in the original analysis. State two possible reasons for this difference. 2 marks

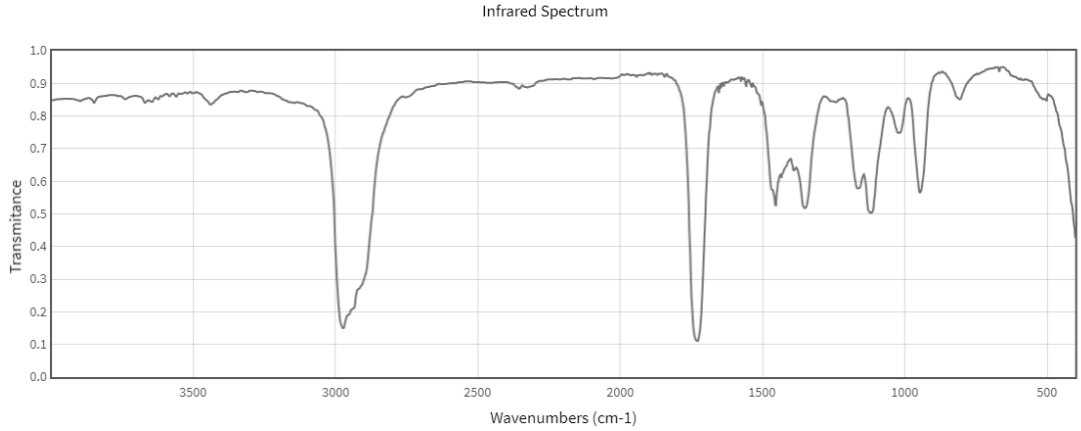
Question 8 (13 marks)
An unknown organic compound found in a sample of cat food is tested to determine its identity. A range of laboratory and instrumental analysis techniques are used to determine whether the organic compound could be harmful to cats if it is consumed.

Test 1: Laboratory analysis

Test	Result
Boiling point	102°C
Bromine test	Brown colour observed
Test for ester formation	No smell or odour was detected when the sample was heated with ethanoic acid and sulfuric acid
Test for acids	No reaction with Na_2CO_3

a. The laboratory tests provide initial information about the structure and properties of the unknown compound. Looking at the results of the laboratory experiments, state three inferences that can be made about the compound. 3 marks

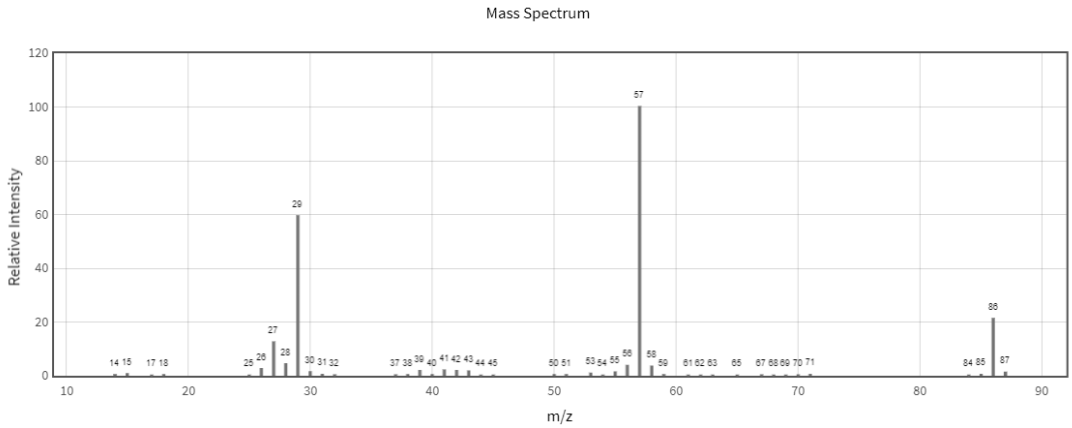
b. Test 2: IR Spectroscopy 2 marks



Source: nist.gov

Identify the bonds responsible for the two strongest transmittance bands shown on the IR spectrum that are also consistent with the laboratory analysis results.

c. Test 3: Mass Spectrometry 1 mark

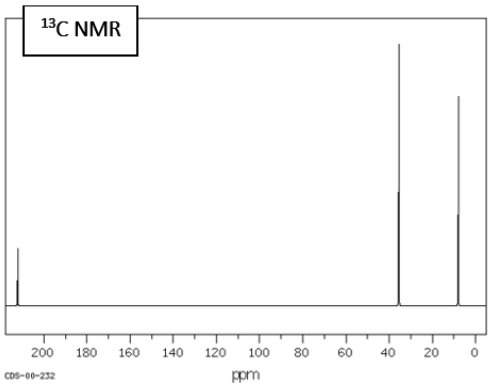


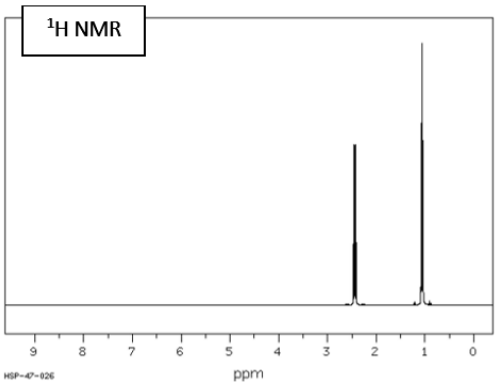
Source: nist.gov

The mass spectrum shows a base peak at m/z 57. Identify a possible fragment that could have produced this peak.

d. State the two classes of compounds that match the laboratory test results, the IR spectrum and mass spectrum of the unknown compound. 2 marks

e. Test 4: ^{13}C NMR and low resolution ^{1}H NMR Spectroscopy 2 marks





Source:chemicalbook.com

Complete the tables below to summarise the information provided in the two NMR spectra.

Number of unique hydrogen environments	
Number of unique carbon environments	

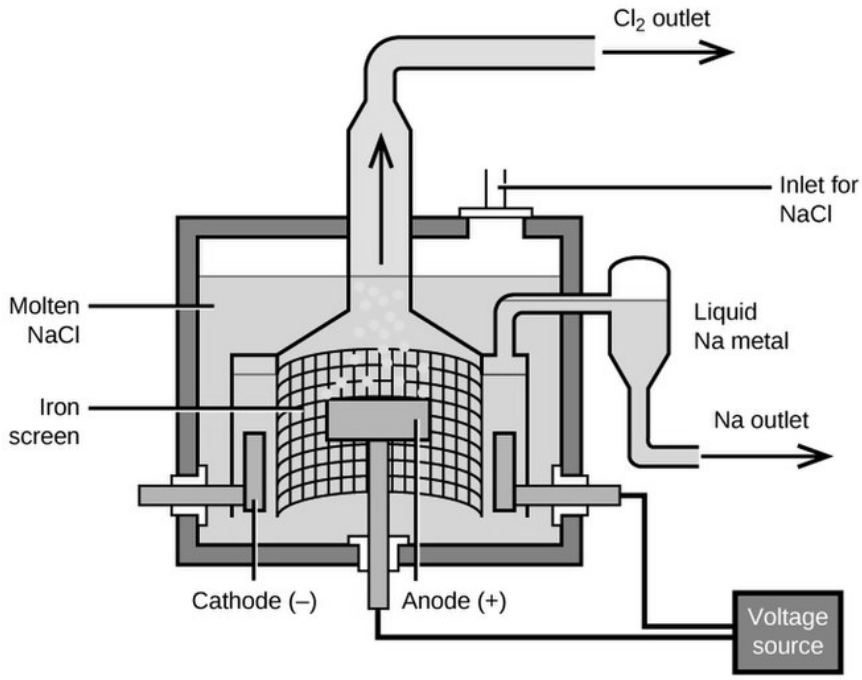
Chemical shift (ppm) and likely identity of one carbon in the unknown structure	

f. Considering the evidence provided by the laboratory and instrumental analysis of the molecules in the unknown organic compound, draw the skeletal structure of one molecule in the space below. 2 marks

g. State the IUPAC, systematic name for the molecule drawn in Question 8f. 1 mark

Question 9 (7 marks)

The diagram below shows the operation of the Downs cell to produce sodium metal and chlorine gas.



Source: File:Downs cell diagram.jpg

a. Describe three of the operating features, shown in the diagram of the cell, that are required for the production of sodium metal and chlorine gas in the Downs cell. 3 marks

b. Chemists are challenged to modify the operating conditions and energy requirements of commercial cells to help reduce environmental damage and improve safety. The two green chemistry principles that outline these requirements are: 4 marks

- Use of renewable feedstocks
- Designing safer chemicals

Explain how modifications could be made to the Downs cell to help the commercial production of sodium align with these green chemistry principles.

End of examination questions

Extra space for responses

Clearly number all responses in this space.

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

VCE UNITS 3&4 CHEMISTRY

Written Examination

ANSWER SHEET – 2024

Student name:	

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

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

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

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

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

11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
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15	A	B	C	D
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26	A	B	C	D
27	A	B	C	D
28	A	B	C	D
29	A	B	C	D
30	A	B	C	D