2018 VCE Chemistry Trial Examination

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VICTORIAN CERTIFICATE OF EDUCATION
Year 2018

CHEMISTRY

Trial Written Examination
Reading time: 15 minutes
Writing time: 2 hours 30 minutes

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	12	12	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 white out liquid/tape.

Materials supplied
- Question and answer book of 38 pages.
- A data book
- Answer sheet for multiple-choice questions.

Instructions
- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- 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.

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VCE CHEMISTRY 2018
Trial Written Examination

MULTIPLE-CHOICE ANSWER SHEET

Student Name _____

Student Number _____

Signature _____

If your name or number on this sheet is incorrect, notify the Supervisor.
Use a **PENCIL** for **ALL** entries. For each question, shade the box that indicates your answer.
All answers must be completed like **THIS** example.

A		C	D
	▓		

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.

ONE ANSWER PER LINE　　　　ONE ANSWER PER LINE

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

SECTION A – Multiple-choice questions

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** for 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.

Question 1

In which one of the following sets of chromium-containing compounds do the chromium atoms all have the same oxidation number?

A. Cr_2O_3 $K_2Cr_2O_7$ Na_2CrO_4

B. $CrCl_2$ Cr_2O_3 $K_2Cr_2O_7$

C. Na_2CrO_4 CrO_3 $Cr(NO_3)_3$

D. Cr_2O_3 $CrCl_3$ $Cr(NO_3)_3$

Question 2

Which statement about petrodiesel and biodiesel is correct?

A. Petrodiesel is produced by distilling crude oil; biodiesel is produced by esterification of fatty acids.

B. Petrodiesel emits soot (small carbon particles) when burning is incomplete; biodiesel is pollutant- free

C. Petrodiesel consists of long-chain hydrocarbons; biodiesel contains benzene and its derivatives.

D. Petrodiesel has greater viscosity and hence flows more slowly along fuel lines than biodiesel.

Question 3

Justyna performs her tests in flasks that are placed in a water bath to keep the flasks and their contents at a constant temperature of 37° C.
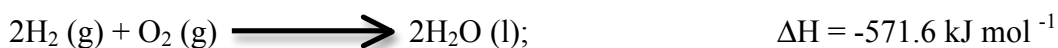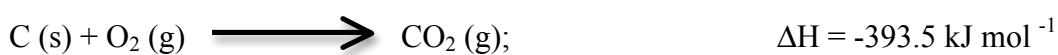
Under these conditions, the temperature at which the experiment is conducted is referred to as the

A.   control.

B.   dependent variable.

C.   independent variable.

D.   controlled variable.

Question 4

Which one of the following molecules contains a chiral carbon?

	Name	Semi-structural formula
A.	2-chlorobutane	$CH_3CHClCH_2CH_3$
B.	2-methylbut-1-ene	$CH_2C(CH_3)CH_2CH_3$
C.	Propanoic acid	CH_3CH_2COOH
D.	1,2-dichloroethene	$ClCHCHCl$

Question 5

$$C \text{ (s)} + O_2 \text{ (g)} \longrightarrow CO_2 \text{ (g)}; \qquad \Delta H = -393.5 \text{ kJ mol}^{-1}$$

$$2H_2 \text{ (g)} + O_2 \text{ (g)} \longrightarrow 2H_2O \text{ (l)}; \qquad \Delta H = -571.6 \text{ kJ mol}^{-1}$$

$$C \text{ (s)} + 2H_2O \text{ (l)} \longrightarrow CO_2 \text{ (g)} + 2H_2 \text{ (g)}$$

From the information supplied, the enthalpy change for the reaction above is

A.   -965.1 kJ mol^{-1}

B.   -107.7 kJ mol^{-1}

C.   +178.1 kJ mol^{-1}

D.   +679.3 kJ mol^{-1}

Question 6

Which one of the following energy sources of provides the highest quantity of energy per gram of fuel?

A.   Coal

B.   Natural gas

C.   Nuclear fission

D.   Biochemical fuels

Question 7

Use the information in the table below to answer this question.

Conjugate redox pair	E^0
Ag^+/ Ag	+ 0.80
Cu^{2+}/ Cu	+ 0.34
F_2/ F^-	+2.87
Br_2/ Br^-	+ 1.09
Zn^{2+}/ Zn	-0.76
Mg^{2+}/ Mg	-2.37

What is the correct order from strongest oxidant to weakest oxidant?

A. Ag^+, Cu, Br_2, F_2, Zn^{2+}, Mg

B. Mg^{2+}, Zn^{2+}, Cu^{2+}, Ag^+, Br_2, F_2

C. F_2, Br_2, Ag^+, Cu^{2+}, Zn^{2+}, Mg^{2+}

D.   Mg, Zn, Ag^+, Br^-, F^-, Cu

Question 8

Which one of the following best describes the anode in a galvanic cell?

	Polarity	**Electrode reaction**
A.	positive	oxidation
B.	positive	reduction
C.	negative	oxidation
D.	negative	reduction

Question 9

A reaction that might occur at the **cathode** of a fuel cell using hydrogen and oxygen as reactants is

A. $2H_2\,(g) + O_2\,(g) \quad \rightarrow \quad 2H_2O\,(g)$

B. $O_2\,(g) + 2H_2O\,(g) + 4e^- \quad \rightarrow \quad 4OH^-\,(aq)$

C. $H_2\,(g) \quad \rightarrow \quad 2H^+\,(aq) + 2e^-$

D. $H_2\,(g) + 2OH^-\,(aq) \quad \rightarrow \quad 2H_2O\,(g) + 2e^-$

Question 10

The types of bonding present in the tertiary structure of a protein are

A. covalent bonding, ionic bonding, hydrogen bonding

B. covalent bonding, ionic bonding, dispersion forces

C. covalent bonding, ionic bonding, hydrogen bonding, dispersion forces

D. ionic bonding, hydrogen bonding, dispersion forces
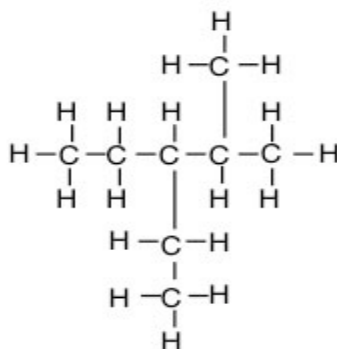
Question 11

The oxidation of sulfur dioxide to form sulfur trioxide is shown in the equation below. It is an exothermic reaction. The reaction is catalysed by vanadium (V) oxide.

$$2SO_2\,(g) + O_2\,(g) \rightleftharpoons 2SO_3\,(g) \qquad \Delta H = \text{negative}$$

Which one of the following energy profile diagrams correctly represents both the catalysed and the uncatalysed reactions?
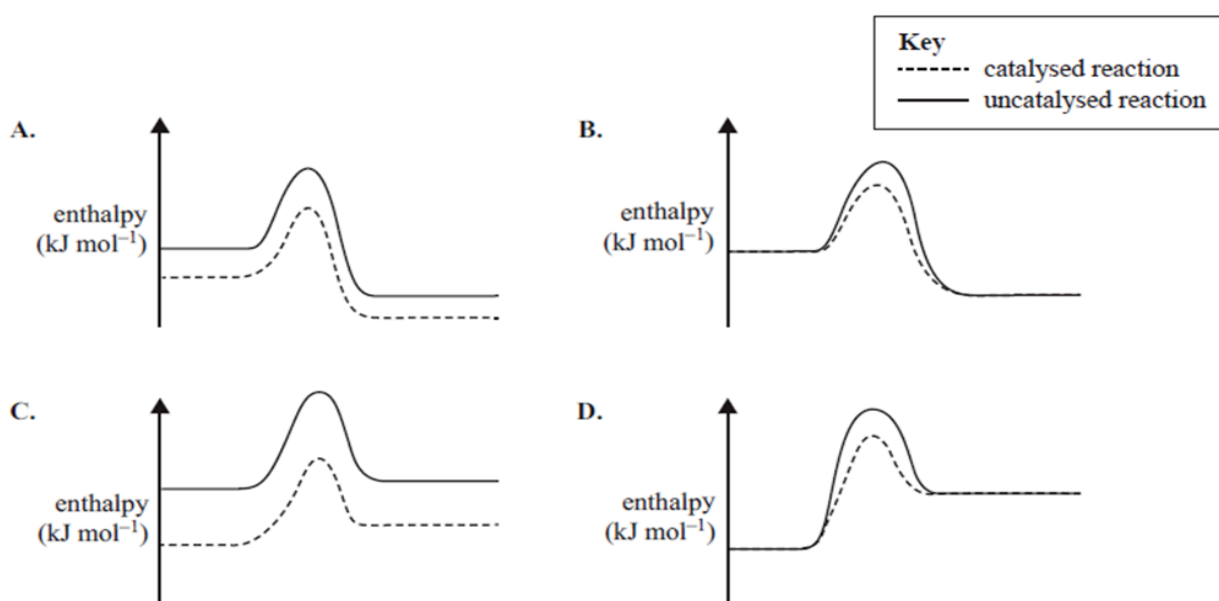
Use the following structure to answer Questions 12 and 13

```
                    H
                    |
                H—C—H
      H   H   H   |   H
      |   |   |   |   |
  H—C—C—C—C—C—H
      |   |   |   |   |
      H   H   |   H   H
                H—C—H
                    |
                H—C—H
                    |
                    H
```

Question 12

What is the correct IUPAC systematic name for this compound?

A.   2,3-dimethylheptane

B.   3,4-dimethylheptane

C.   4-methyl-5-ethylhexane

D.   2-methyl-3-ethylpentane

Question 13

How many structural isomers does this compound have?

A.   2

B.   3

C.   4

D.   more than 4

Question 14

To prepare the ester propyl methanoate, the two reagents needed are

A.   propan-1-ol and methanol.

B.   propan-1-ol and methanoic acid.

C.   methanol and propanoic acid.

D.   propanoic acid and methanoic acid.

Question 15

What are the three main materials required for the manufacture of a biodiesel fuel?

A.   petrol, an alkanol and an alkali solution

B.   tallow, an alkanol and an acidic solution

C.   a source of natural oil, an ester and an alkali solution

D.   tallow, an alkanol and an alkali solution

Question 16

Which one of the following molecules is **not** a primary amide?

A. $HCONH_2$

B. $C_6H_5CONH_2$

C. CH_3CONH_2

D. $C_6H_5CONHCH_3$

Question 17

The technique of proton nuclear magnetic resonance (^{1}H NMR) gives physical, chemical and structural information about a molecule. The principle behind ^{1}H NMR is

A.   the absorption of infrared radiation.

B.   the chemical shift, on the resonant frequencies of the nuclei present, as a result of nuclear spin.

C.   carbon-13 nuclear magnetic resonance.

D.   measuring the amount of light that the sample absorbs.

Question 18

A student decided to silver-plate a locker key using the apparatus shown.
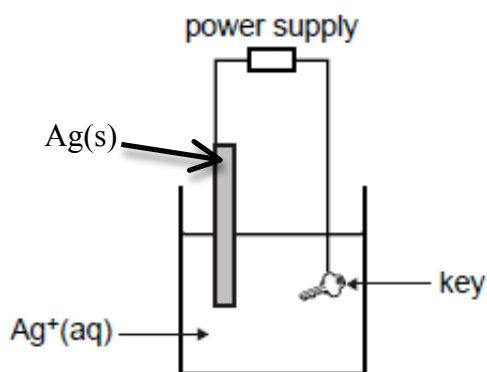
In this cell, the key is the

A.   cathode and is connected to the positive terminal of the power supply.

B.   cathode and is connected to the negative terminal of the power supply.

C.   anode and is connected to the positive terminal of the power supply.

D.   anode and is connected to the negative terminal of the power supply.

Question 19

Ethanoic acid reacts with ethanol to produce ethyl ethanoate and water. The equilibrium constant for this reaction with dioxane as a solvent is 4.0 at a fixed temperature. An equilibrium mixture at this temperature is created with $[CH_3COOH] = [C_2H_5OH] = 0.40$ M and $[H_2O] = 1.50$ M in enough dioxane to make 1.0 L of solution. What is the equilibrium concentration of ethyl ethanoate?

A.   0.43 M

B.   0.64 M

C.   0.96 M

D.   1.50 M

Question 20

For the reaction

$$H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq), \qquad K_w = 10^{-14} \text{ at } 25°C$$
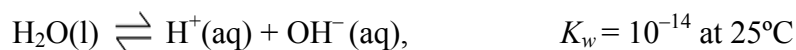
55.9 kJ mol^{-1} of heat is evolved when one mole of H^+(aq) reacts with one mole of OH^-(aq).
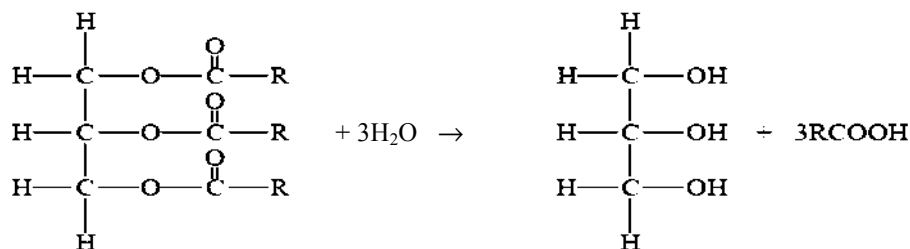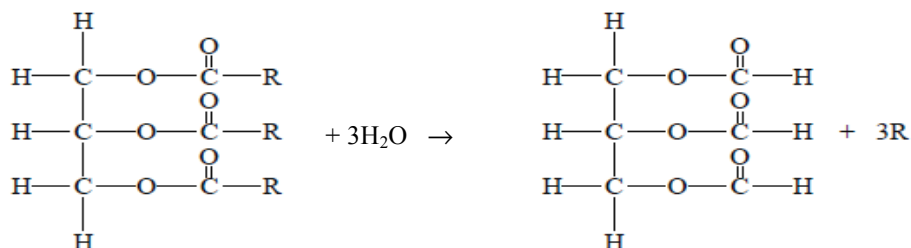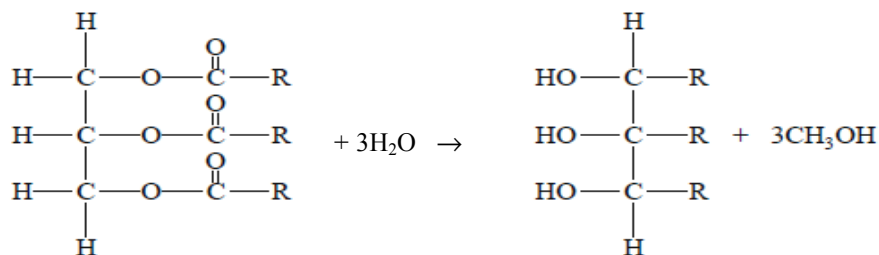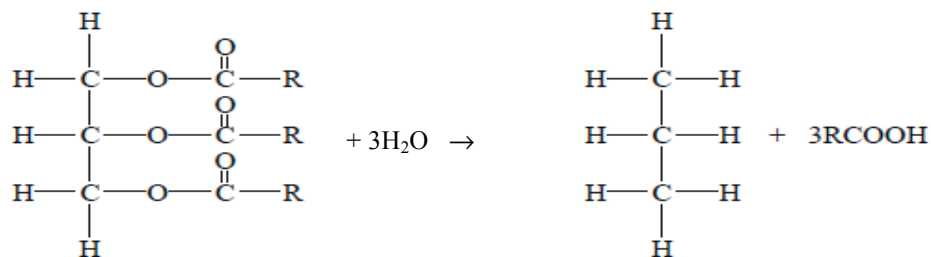
At 80°C, the K_w and pH for pure water are

	K_w	pH
A.	greater than 10^{-14}	less than 7
B.	greater than 10^{-14}	greater than 7
C.	less than 10^{-14}	less than 7
D.	less than 10^{-14}	greater than 7

Question 21

The general formula of a triglyceride can be represented as follows.
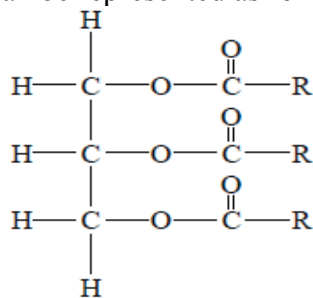
Which one of the following equations represents the hydrolysis of a triglyceride?

A.

$+ 3H_2O \rightarrow$

$3RCOOH$

B.

$+ 3H_2O \rightarrow$

$+ 3R$

C.

$+ 3H_2O \rightarrow$

$+ 3CH_3OH$

D.

$+ 3H_2O \rightarrow$

$+ 3RCOOH$

Question 22

When but-1-ene undergoes an addition reaction with chlorine gas, Cl_2, the molecular formula of the product is $C_4H_8Cl_2$. The semi-structural formula of this product is

A. $CH_3CHClCH_2ClCH_3$

B. $CH_3CCl_2CH_2CH_3$

C. $CH_2ClCHClCH_2CH_3$

D. $CH_3CH_2CH_2CHCl_2$

Question 23

Four half cells are constructed as follows.
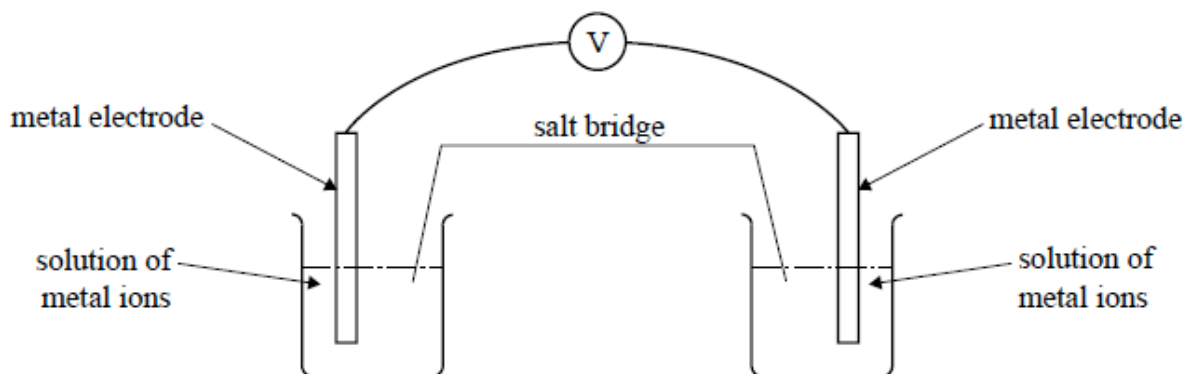
Half cell I: an electrode of metal P in a 1.0 M solution of P^+(aq) ions
Half cell II: an electrode of metal Q in a 1.0 M solution of Q^+(aq) ions
Half cell III: an electrode of metal R in a 1.0 M solution of R^+(aq) ions
Half cell IV: an electrode of Cu(s) metal in a 1.0 M solution of Cu^{2+}(aq) ions

The half cells are connected in pairs, as shown below, to form a series of galvanic cells.

For each cell, the polarity of the electrodes and the voltage generated are recorded.

| Half cells used	Positive electrode	Negative electrode	Voltage (V)
I and IV	P	Cu	0.46
II and IV	Cu	Q	0.57
III and IV	Cu	R	1.10
II and III	Q	R	0.53

Which one of the following lists the metals in order of increasing strength as reductants?

A.   R, Q, Cu, P

B.   Cu, P, Q, R

C.   P, Cu, R, Q
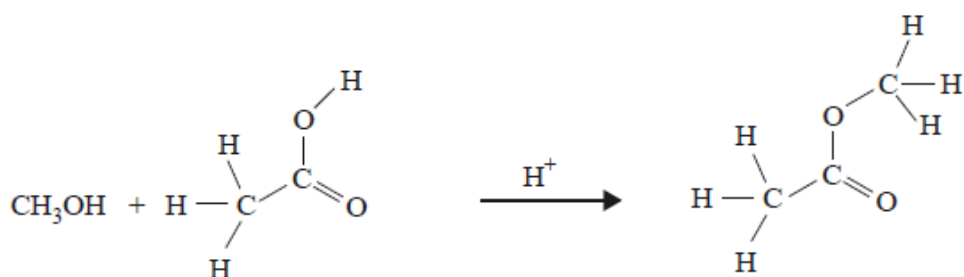
D.   P, Cu, Q, R

Question 24

Which one of the following organic reactions does **not** result in the product shown on the right-hand side of the reaction?

A.
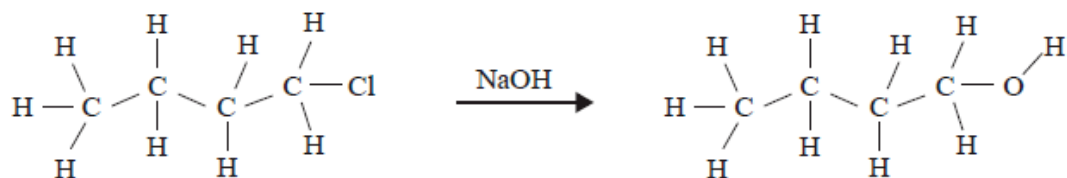
B.

C.
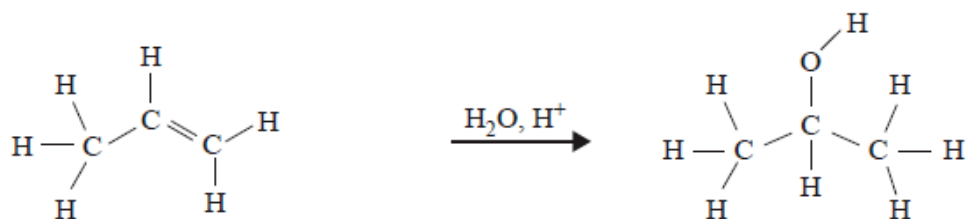
D.
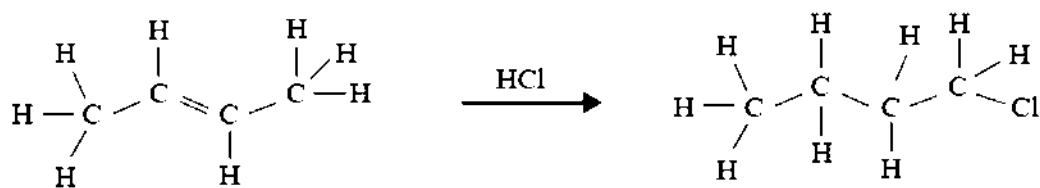
Question 25

In the low resolution ^{1}H NMR spectrum for ethyl ethanoate, the number of spectral lines is

A. 1

B. 2

C. 3

D. 4

Question 26

Consider the following hydrolysis reaction.

$$CH_3CH_2COOH(aq) + H_2O(l) \rightarrow CH_3CH_2COO^-(aq) + H_3O^+(aq)$$
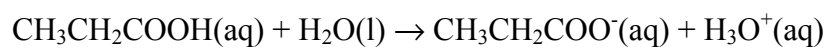
If a 0.184 M solution has a pH of 2.80, the acidity constant of propanoic acid is

A. 1.37×10^{-5}

B. $10^{-2.8}$

C. 1×10^{-9}

D. 2.8

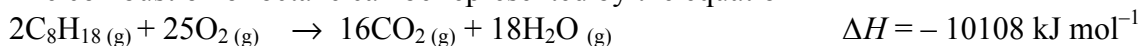**Question 27**

Tristearin is a saturated fat found in beef. The heat of combustion of tristearin, $(CH_3(CH_2)_{16}COO)_3C_3H_5$, is 38 kJg^{-1}. The amount of energy released by the combustion of 1 mole is

A.   890 MJ.

B.   33.8 MJ.

C.   3.38 MJ.

D.   46.5 MJ.

Question 28

The combustion of octane can be represented by the equation
$2C_8H_{18\ (g)} + 25O_{2\ (g)} \rightarrow 16CO_{2\ (g)} + 18H_2O_{\ (g)}$ $\Delta H = -10108$ kJ mol^{-1}

The energy produced by the complete oxidation of 45 kg of octane is

A. 2.0×10^3 kJ.

B. 4.0×10^3 kJ.

C. 2.0×10^6 kJ.

D. 4.0×10^6 kJ.

Question 29

Choose the clause that correctly completes the following sentence.

The dissolving of potassium nitrate in water is an endothermic process in which

_____.

A.   the temperature of the solution increases as the potassium nitrate dissolves.

B.   the molar heat of solution of potassium nitrate is positive.

C.   the molar heat of solution of potassium nitrate is negative.

D. ΔH is negative for dissolving potassium nitrate.

Question 30

The general formula for a saturated fatty acid is

A. $C_nH_{2n}O_2$

B. $C_nH_{2n-1}COOH$

C. $C_nH_{2n}COOH$

D. $C_nH_{2n+2}COOH$

END OF SECTION A

Instructions for Section B

Answer all questions in the spaces provided.

To obtain full marks for your responses you should

- give simplified answers with an appropriate number of significant figures for all numerical questions; unsimplified answers will not be given full marks.

- show all working in your answers to numerical questions. No credit will be given for an incorrect answer unless it is accompanied by details of the working.

- make sure all chemical equations are balanced and that the formulas for individual substances include an indication of state; for example, $H_2(g)$; $NaCl(s)$

Question 1 (8 marks)

a.   Draw a diagram of each level of a protein structure. Briefly describe each structure.

i.   Primary structure:

1 mark

ii.   Secondary structure:

1 mark

Question 1 (continued)

iii.   Tertiary structure:

1 mark

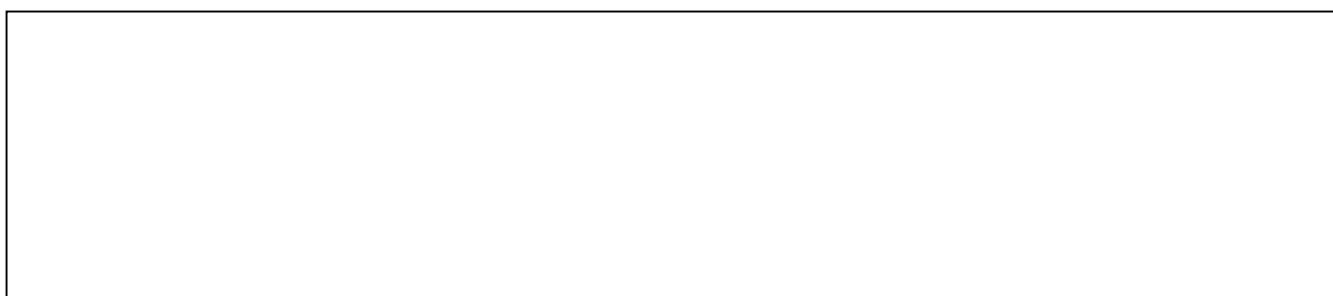**iv.**   Quaternary structure:

1 mark

b.   What kind of a reaction is responsible for the formation of a polypeptide?

_____
1 mark

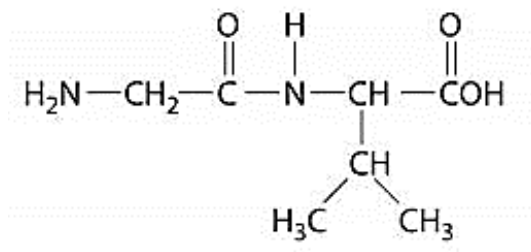**c.**   Use structural formulae to show the reaction between alanine and glycine to form a dipeptide.

1 mark

Question 1 (continued)

d.   Circle the peptide bond in the product of the reaction in **c.**

1 mark

e.   What is the name of the following polypeptide?

1 mark

Question 2 (13 marks)

You have learned in the course of year twelve chemistry that amino acids differ by the nature of their side chains (Z group).

a.   What is a Zwitterion group?

1 mark

b.   Give an example of each of the following amino acids:

i.	An amino acid with a polar side chain	
ii.	An amino acid with a non-polar side chain	
iii.	An amino acid that has an acidic side chain	
iv.	A cyclic amino acid	
v.	An amino acid with a basic side chain	

3 marks

c .   What is the difference between an omega-3 fatty acid and an omega-6 fatty acid?

1 mark

Question 2 (continued)

d.   Describe the bonding between carbon atoms in the hydrocarbon tails of the following fatty acids.

i.   Saturated fatty acids

_____

_____

_____

_____

1 mark

ii.   Monounsaturated fatty acids

_____

_____

_____

_____

1 mark

iii.   Polyunsaturated fatty acids

_____

_____

_____

_____

1 mark

e.   This is the structure of oleic acid.

$$CH_3(CH_2)_8CH \ = \ CH(CH_2)_7COOH$$
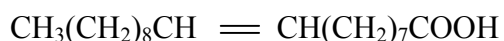
i.   Explain how a triglyceride will be made from oleic acid. Will the triglyceride that forms from oleic acid be a saturated or unsaturated fatty acid? Justify your answer.

_____

_____

_____

_____

2 marks

Question 2 e. (continued)

ii.   Draw a diagram to show the formation of a triglyceride.

2 marks

iii.   Name and circle the functional groups in the triglyceride molecule above.

1 mark

Question 3 (6 marks)

CO_2 is added to 1.00 L of pure water at 25°C in a pressurised bottle. The pressure of CO_2 above the water was raised to 3.00 atm and the gaseous CO_2 came to equilibrium with the CO_2 dissolved in the water. At equilibrium, the mass of CO_2 dissolved in the water was 5.00 g.

The equilibrium constant for this reaction, in atm M^{-1}, can be written as

$$K = \frac{p(CO_2, g)}{[CO_2(aq)]}$$

Where, $p(CO_2)$ represents the pressure of CO_2.

a.   Calculate the value of this equilibrium constant at 25°C.

_____

_____

_____

_____

2 marks

Question 3 (continued)

b.   500 mL of this aqueous solution of CO_2 is heated to 30°C and then opened to the atmosphere so that all the CO_2 in the aqueous solution goes into the gas phase. Calculate, in litre, the volume of CO_2 that would be evolved at 1.00 atm pressure and 30°C.

_____

_____

_____

_____

                                                                    2 marks

c.   Dissolved CO_2 acts as a weak acid in water according to the following equation,

$$CO_2\,(aq) + H_2O(l) \rightleftharpoons H^+(aq) + HCO_3^-\,(aq)$$
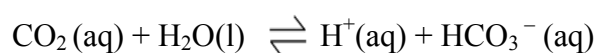
and the acidity constant of CO_2 in water at 25°C is given by

$$K_a = \frac{[H^+][HCO_3^-]}{[CO_2]} = 4.5 \times 10^{-7}\,M$$

Some CO_2 is added to a solution of $NaHCO_3$ at 25°C. In the solution, the concentration of the hydrogen carbonate ions (HCO_3^-) is 0.050 M and the CO_2 concentration is 0.0020 M.

Calculate the pH of the solution.

_____

_____
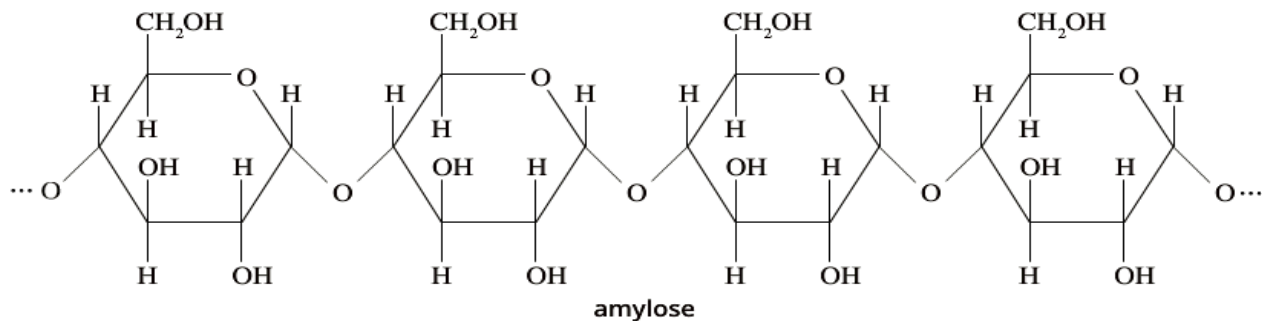
_____

_____

                                                                    2 marks

Question 4 (5 marks)

Below is part of the starch known as amylose.

a. Circle and label the glyocosidic link in the structure.
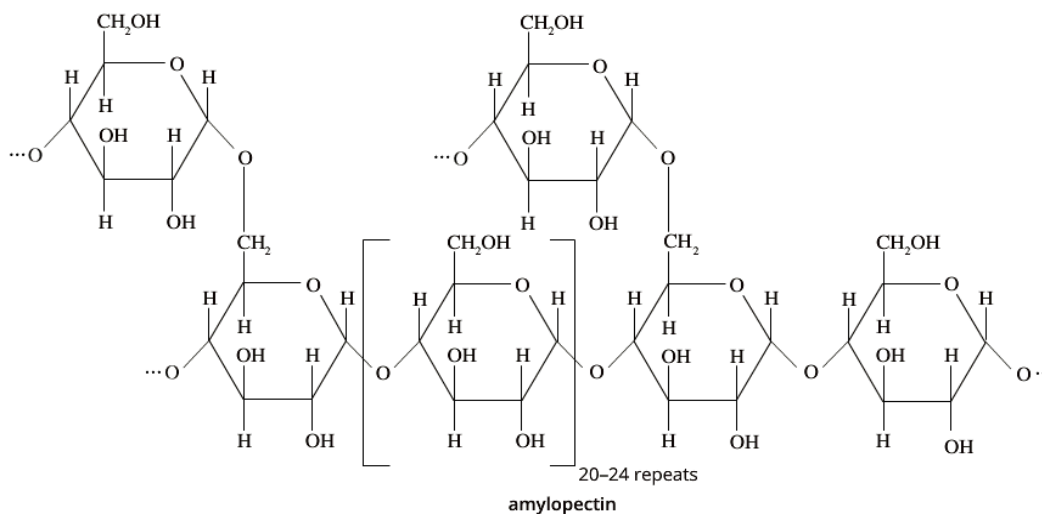

amylose

1 mark

b. Amylose is a straight chain polymer. Draw the structure of monomer that forms amylose.

1 mark

Question 4 (continued)

Amylopectin is a branched polymer with branches located alongside the chain of glucose units.

amylopectin

c.   Explain why amylose and amylopectin have different solubilities in water.

_____

_____

_____

_____

1 mark

d.   Although starch, glycogen and cellulose are all carbohydrates that contain glucose
monomers, the human digestive system can digest only glycogen and starch and not
cellulose. Explain.

_____

_____

_____

_____

1 mark

Question 4 (continued)

e.   Explain what causes lactose intolerance in some people.

_____

_____

_____

_____

1 mark

Question 5 (6 marks)

Magnesium is used in the production of magnesium-aluminium alloys. It is produced by the electrolysis of molten magnesium chloride. A schematic diagram of the electrolytic cell is shown below.
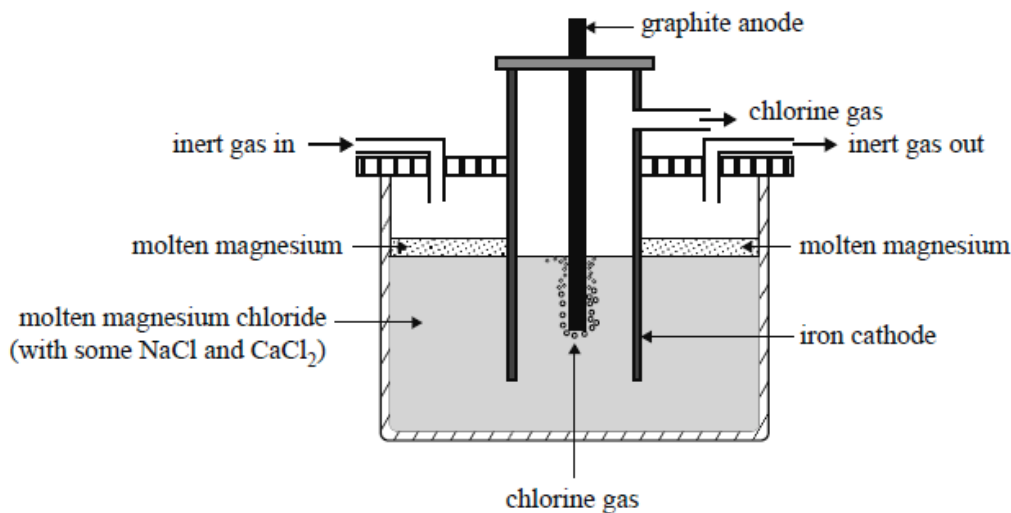
a.   Write a balanced half-equation for the reaction occurring at each of

i.   the cathode:

_____

ii.   the anode:

_____

2 marks

Question 5 (continued)

b.   In this cell, NaCl and $CaCl_2$ are used to lower the melting point of $MgCl_2$. Explain why NaCl and $CaCl_2$ can be used to lower the melting point of $MgCl_2$ but $ZnCl_2$ cannot be used?

_____

_____

_____

_____

                                                                    2 marks

c.   Explain what would happen if the graphite anode were replaced with an iron anode? Write the half-equation for the half-cell reaction. Explain your answer.

_____

_____

_____

_____

                                                                    2 marks

Question 6 (7 marks)

Consider the following reaction: $CO_{(g)} + 2H_{2\,(g)} \rightleftharpoons CH_3OH_{(g)}$ $\Delta H = -103$ kJ mol^{-1}

a.   Write the equilibrium expression for the above reaction.

_____

1 mark

b.   What pressure condition would be required to obtain a high equilibrium yield of methanol?
Explain your answer.

_____

_____

_____

_____

1 mark

c.   Would temperature condition would be required to obtain a high equilibrium yield of methanol?
Explain your answer.

_____

_____

_____

_____

1 mark

Question 6 (continued)

d.   Complete the graph below to show what would happen if the **temperature** of the system
          was increased at T_1.

                                                                                                      1 mark

e.   Complete the graph below to show what would happen if the **pressure** of the system
          was increased at T_2.

                                                                                                      1 mark

f.   Would the graph from T_1 to T_3 have looked **exactly** the same if a catalyst had been added at T_1?
          Give a reason for your answer

                                                                                                      1 mark
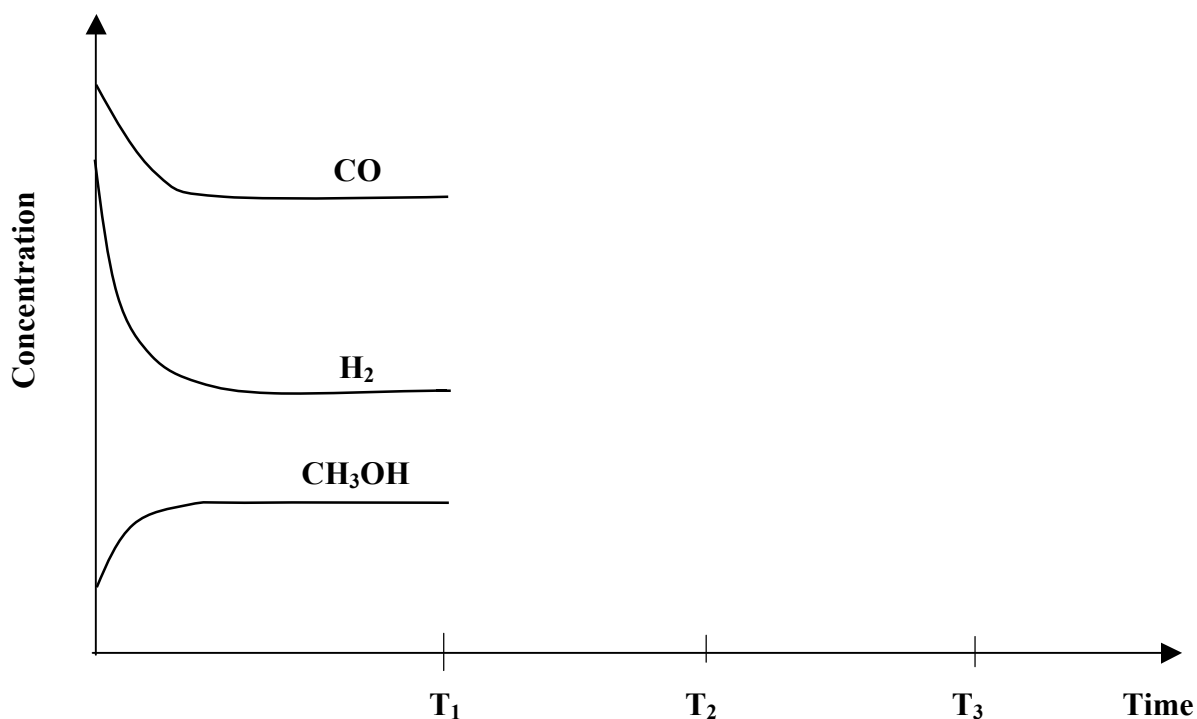
g.   Calculate the equilibrium constant K at T_1, given the concentration of species were:

          $[CO] = 0.5$ M, $[H_2] = 0.3$ M, $[CH_3OH] = 0.2$ M

_____

_____

_____

_____

                                                                                                      1 mark

Question 7 (12 marks)

Some alkenes exist as *cis-trans* isomers.

a.   What is meant by a *cis-trans* isomer?

_____

_____

_____

_____

2 marks

b.   Draw the *cis-trans* isomers for each compound.

i.   1,2-dichloroethene

2 marks

ii.   1,2-dimethylcyclopropane

2 marks

Question 7 (continued)

c. Which of the following compounds exist as *cis-trans* isomers? Write **YES** or **NO** and name each compound.

i. $CH_2 = CBrCH_3$ _____ _____

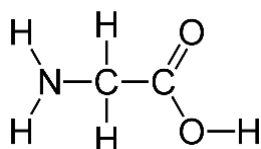**ii.** $CH_3CH = CHCH_2CH_3$ _____ _____

iii. $CHCl = CHBr$ _____ _____

$3 \times 1 = 3$ marks

d.

i. Draw a section of the polymer formed from this monomer.

1 mark

ii. Draw the structure of the dipeptide formed from the amino acids glycine and valine.

1 mark

**iii.** What type of polymerisation reaction are **i** and **ii**?

_____

_____

1 mark

Question 8 (10 marks)

The following is a simple diagram of a galvanic cell.

Use the following chemicals to design your galvanic cell.

$Zn(NO_3)_2(aq)$, $Zn(s)$, $Cu(NO_3)_2(aq)$, $Cu(s)$, $KNO_3(aq)$

a.   On the diagram of galvanic cell below, label the following:

      i.   The anode and the cathode and the charges on each
      ii.   The reduction half-cell side and the oxidation half-cell side
      iii.   Direction of electron flow
      iv.   The salt bridge electrolyte
      v.   The direction of movement of ions in the salt bridge
      vi.   The electrolytes formed in each of the two half-cells
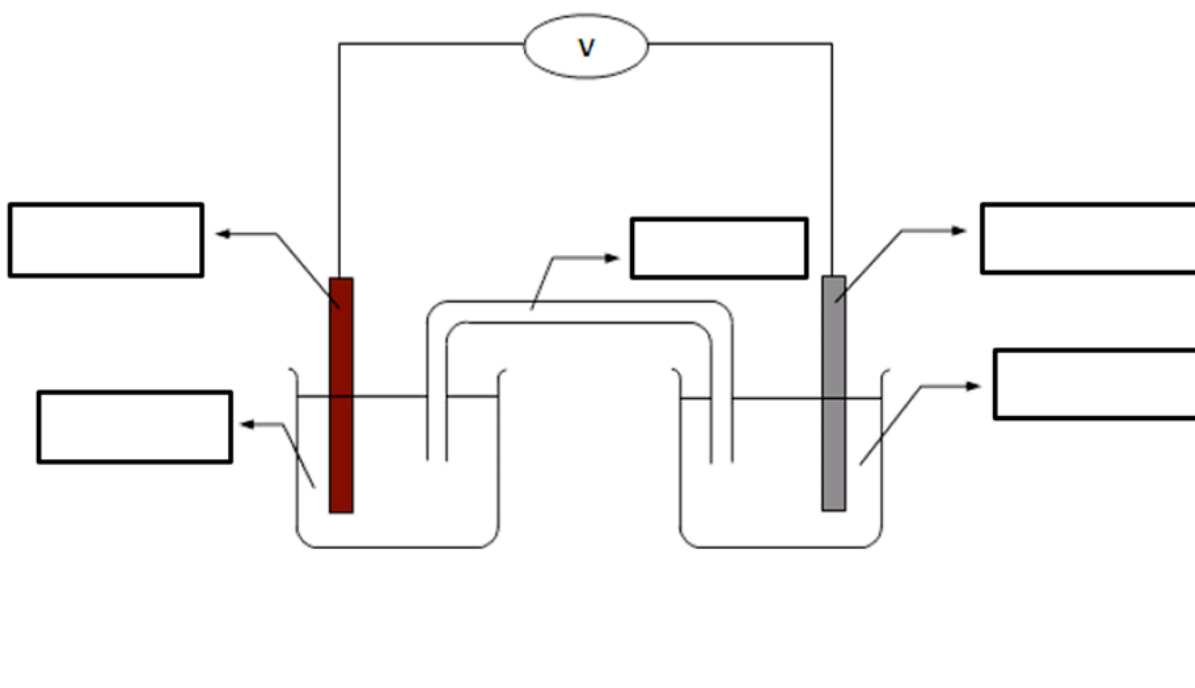
Overall galvanic cell equation: _____

$(6 \times \frac{1}{2} = 3 \text{ marks})$

b.   Write the half-equations for the oxidation reaction and the reduction reaction underneath
      each corresponding half of the cell.

$(2 \times 1 = 2 \text{ marks})$

c.   Write the net cell equation for the reaction underneath the cell

1 mark

Question 8 (continued)

d.   The reductant in this galvanic cell is   _____

1 mark

e.   The oxidant in this galvanic cell is   _____

1 mark

f.   Explain the purpose of having a salt bridge in galvanic cell.

_____

_____

1 mark
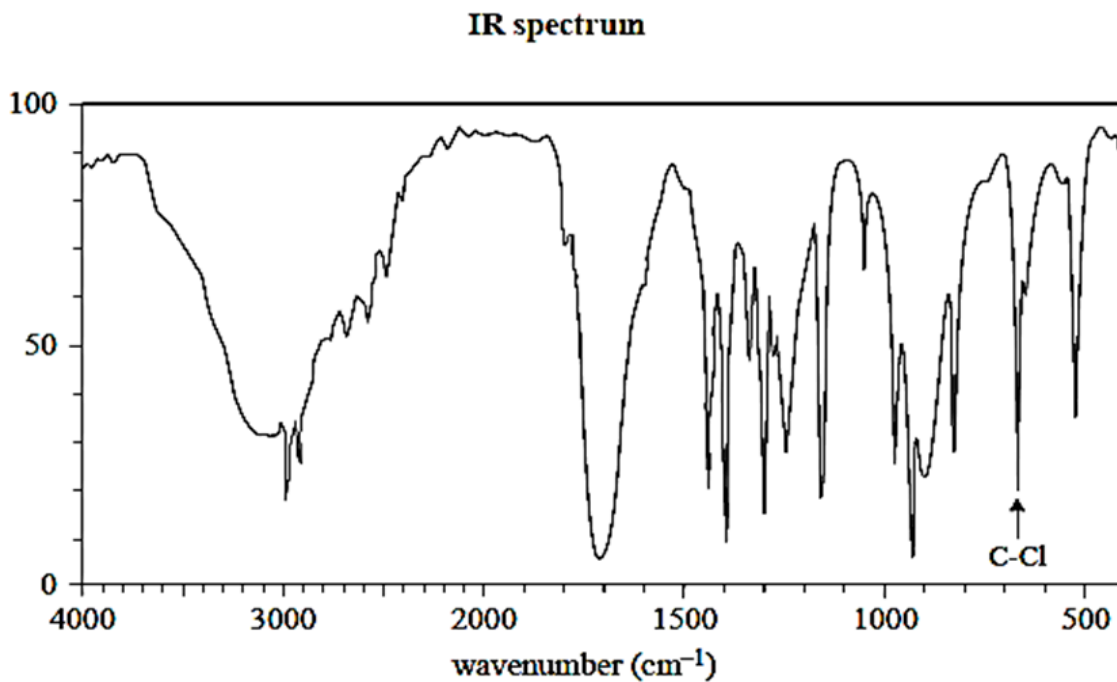
g.   Calculate the theoretical voltage of the cell.

_____

_____

_____

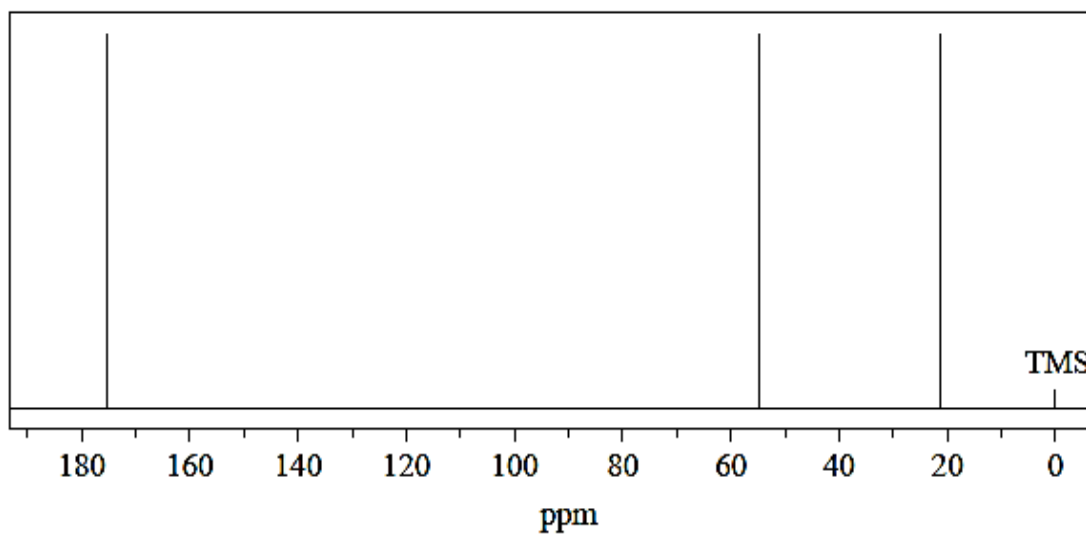_____

1 mark

Question 9 (7 marks)

A small organic molecule has the molecular formula $CxHyO_2Cl$.

The pH of the molecule is 4.5.

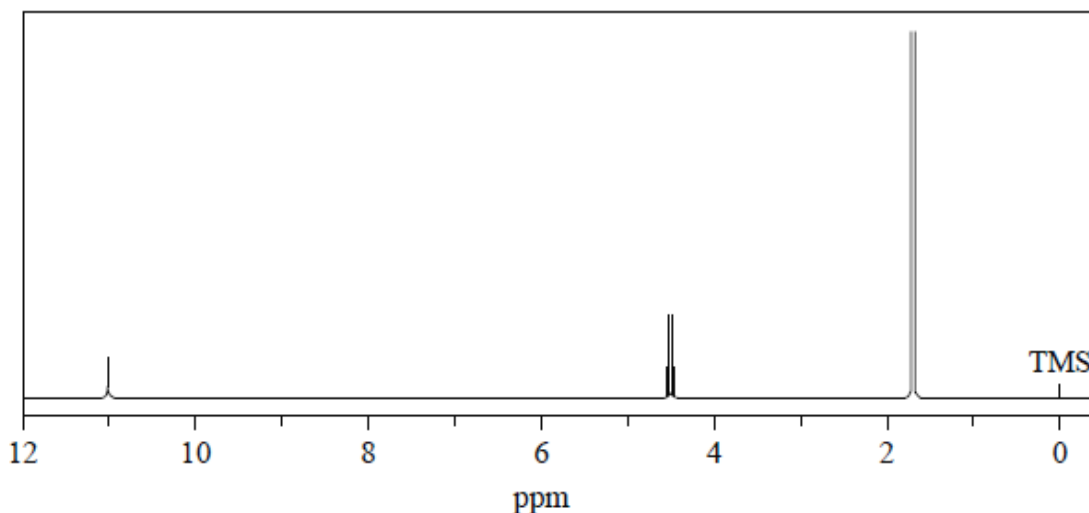*The IR spectrum, ^{13}C NMR, ^1H NMR data and mass spectrum for this molecule are shown below.*

IR spectrum

Data: National Institute of Advanced Industrial Science and Technology

^{13} C NMR Spectrum

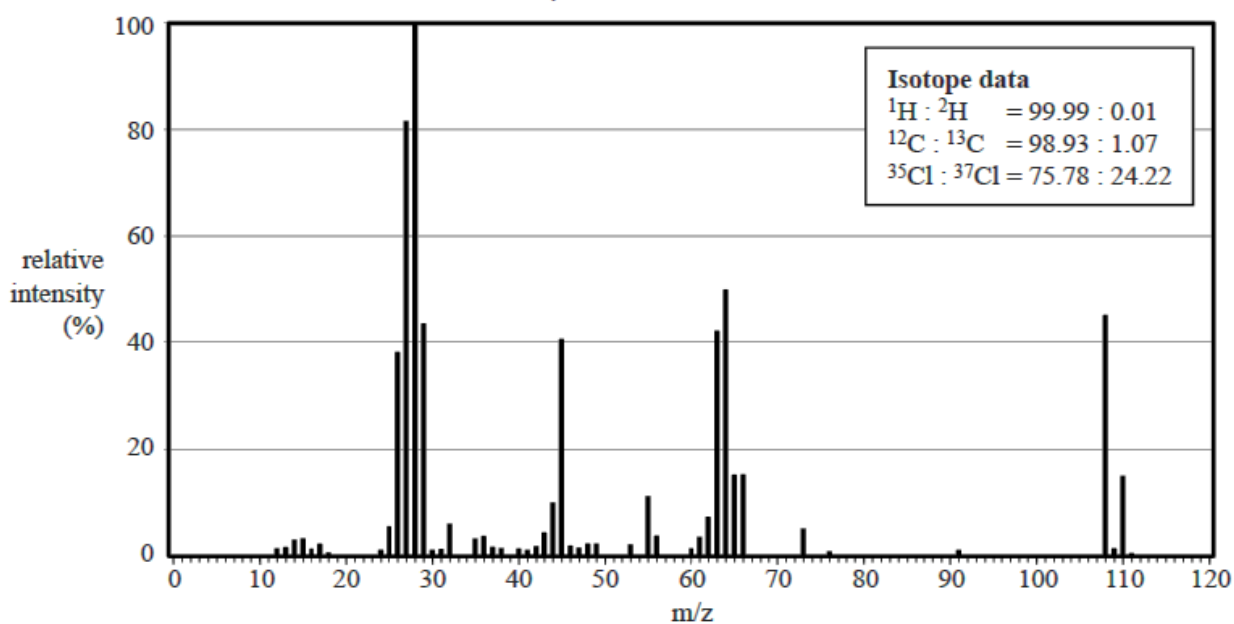*Data: National Institute of Advanced Industrial Science and Technology*

Question 9 (continued)

^{1}H NMR spectrum

Data: National Institute of Advanced Industrial Science and Technology

^{1}H NMR data

Chemical shift (ppm)	Peak splitting	Relative peak area
1.7	Doublet (2 peaks)	3
4.5	Quartet (4 peaks)	1
11.2	Singlet (1 peak)	1

Data: National Institute of Advanced Industrial Science and Technology

$C_xH_yO_2Cl$ mass spectrum

Isotope data
^{1}H : ^{2}H   = 99.99 : 0.01
^{12}C : ^{13}C   = 98.93 : 1.07
^{35}Cl : ^{37}Cl = 75.78 : 24.22

Data: National Institute of Advanced Industrial Science and Technology

Question 9 (continued)

a.   On the infrared spectrum, label the peaks that correspond to the presence of two functional groups in this compound.

2 marks

b.   What does the splitting pattern in the ^{1}H NMR spectrum tell you about the structure of this compound?

_____

_____

_____

_____

1 mark

c.   Use the data provided to determine the values of x and y in $CxHyO_2Cl$.

_____

_____

_____

_____

         $x =$ _____ $y =$ _____

2 marks

d.   Draw the structural formula of this compound.

1 mark

Question 9 (continued)

e.   The mass spectrum is showing two molecular ion peaks at $m/z = 108$ and 110.

What is the reason for this?

_____

_____

_____

_____

<div align="right">1 mark</div>

Question 10 (6 marks)

When ethanol (C_2H_5OH) undergoes complete combustion, it produces carbon dioxide and water.

a.   Write the balanced chemical equation for this reaction.

_____

_____

<div align="right">1 mark</div>

b.   Calculate the mass of carbon dioxide formed when 2.00 kg of ethanol undergoes combustion.

_____

_____

_____

_____

<div align="right">1 mark</div>

c.   Calculate the volume of carbon dioxide that would form from the combustion
of 2.00 kg of ethanol at SLC?

_____

_____

<div align="right">1 mark</div>

Question 10 (continued)

d. Calculate the mass of ethanol in 70.0 L.
(the density of ethanol is 0.785 g mL^{-1})

_____

_____

1 mark

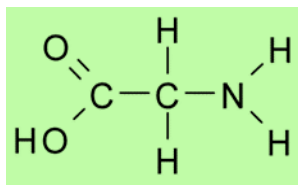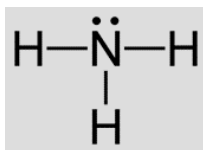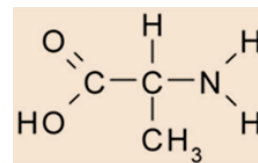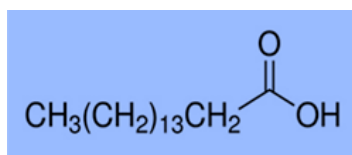**e.** Calculate the mass of CO_2 formed in this reaction when 3.00 kJ of energy is released.

_____

_____

_____

_____

1 mark

f. Calculate the energy in MJ obtained from the combustion of 50.0 L of ethanol.
(the density of ethanol is 0.785 g mL^{-1})

_____

_____

_____

_____

1 mark

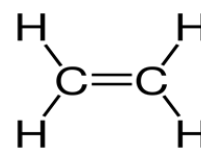**Question 11 (5 marks)**

Use the below molecules **(A- H)** to answer the following questions.
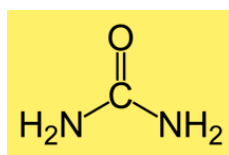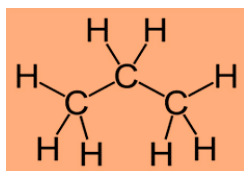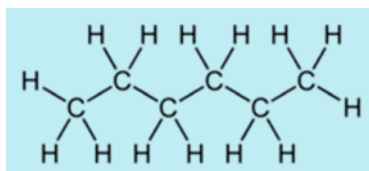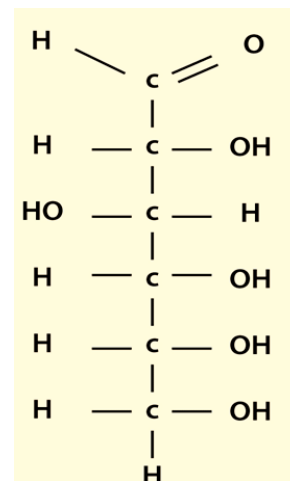
a. Which two molecules can interact to form a dipeptide?

_____

_____

1 mark

b. Which molecule is the end product of the breakdown of protein in the human body?

_____

1 mark

Question 11 (continued)

c.   Which molecule can polymerise to form starch?

_____
                                                                                                        1 mark

d.   Which molecule can be formed as a result of the hydrolysis of a triglyceride?

_____
                                                                                                        1 mark

e.   Which two saturated hydrocarbons will burn in excess oxygen to produce CO_2 and H_2O?

_____

_____
                                                                                                        1 mark

Question 12 (5 marks)

Petrodiesel and biodiesel have different properties. Both forms of diesel have higher densities than petrol and so the energy released per litre of diesel fuel is higher than per litre of petrol.

Use the table below to answer these questions.

property	petrodiesel	biodiesel
density (kg L^{-1})	0.84	0.87
viscosity (cSt)	2.5	4.9
energy density (kJ L^{-1})	40	36
energy content (kJ g^{-1})	48	41
cloud point (^{o}C)	-15 to 5	-3 to 12

a.   Explain why biodiesel has a higher viscosity than petrodiesel by describing the chemical structures of the two molecules.

_____

_____

_____

_____
                                                                                                        2 marks

Question 12 (continued)

b.   Biodiesel cannot be stored for as long as petrodiesel. Explain.

_____

_____

_____

                                                                    1 mark

c.   A substance that can absorb and store water easily is said to be hygroscopic. Explain why
          biodiesel has a higher hygroscopic tendency than petrodiesel.

_____

_____

_____

                                                                    1 mark

d.   In very cold climates, biodiesel can lose its ability to flow and it can also solidify
          completely. Explain the reason for this and compare this feature with that of petrodiesel.

_____

_____

_____

                                                                    1 mark

End of question and answer book for the 2018 Kilbaha VCE Chemistry Trial Examination