Neap

Trial Examination 2022

VCE Chemistry Units 1&2

Written Examination

Question and Answer Booklet

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

Student's Name: _____

Teacher's Name: _____

Structure of booklet

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

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

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

Materials supplied

Question and answer booklet of 28 pages

Data booklet

Answer sheet for multiple-choice questions

Instructions

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

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

All written responses must be in English.

At the end of the examination

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

You may keep the data booklet.

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

SECTION A – MULTIPLE-CHOICE QUESTIONS

Instructions for Section A

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

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1; an incorrect answer scores 0.

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

No marks will be given if more than one answer is completed for any question.

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

Question 1

Which one of the following statements is **not** a feature of the quantum mechanical model of the atom proposed by Schrödinger?

A. Subshells contain orbitals, which are regions in which electrons may be found.

B. Within a particular atom, electrons may occupy electron clouds with a similar shape.

C. Electrons can be considered as moving in defined orbits around the nucleus.

D. The third shell of the atom has three different types of subshell, each of a different shape.

Use the following information to answer Questions 2 and 3.

The element carbon exists in various forms that have distinct arrangements of atoms.

Question 2

The elemental forms of carbon include:

I graphene

II diamond

III graphite

IV fullerenes.

Which of these elemental forms of carbon conduct electricity?

A. I and II only

B. II and IV only

C. II, III and IV only

D. I, III and IV only

Question 3

Some elemental forms of carbon conduct electricity due to the movement of

A. electrons only.

B. ions only.

C. both electrons and ions.

D. charged particles other than electrons or ions.

Question 4

Which one of the following groups of compounds is most likely to undergo addition polymerisation?

A. alkanes

B. alcohols

C. alkenes

D. esters

Question 5

An atom of a non-metallic element in period 3 of the periodic table has formed a stable ion with a double-negative charge.

What is the electron configuration of this ion?

A. $1s^2 2s^2 2p^6 3s^2 3p^6$

B. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$

C. $1s^2 2s^2 2p^6 3s^2 3p^2$

D. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$

Question 6

Which one of the following rows gives the correct molecule and shape?

	Molecule	Shape of molecule
A.	OF_2	V-shaped
B.	BF_3	pyramidal
C.	HCN	trigonal planar
D.	C_2H_2	tetrahedral

Question 7

The number of oxygen atoms contained in 2.0 mol of hydrated copper(II) sulfate, $CuSO_4.5H_2O$, is closest to

A. 2.4×10^{24}

B. 5.4×10^{24}

C. 6.0×10^{24}

D. 1.1×10^{25}

Question 8

Which one of the following statements about polymer materials is correct?

A. A thermoplastic polymer will soften when heated but will not burn at high temperatures.

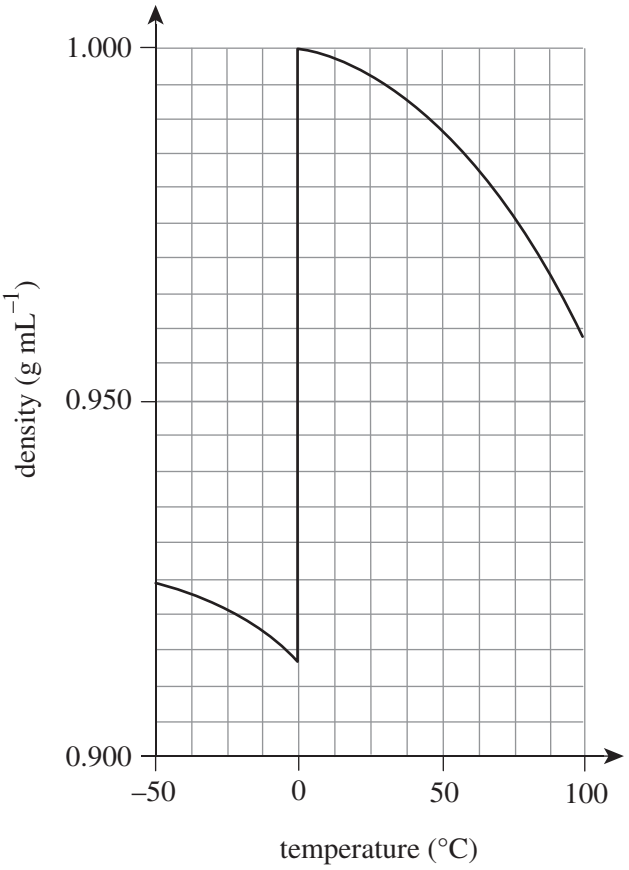
B. Both thermosetting polymers and thermoplastics are easily recycled.

C. A large amount of cross-linking allows a polymer to withstand high temperatures.

D. The strongest bonding between the polymer chains is identical for all types of polymers.

Use the following information to answer Questions 9 and 10.

The variation in the density of water with temperature is shown in the graph below.



Question 9

After analysing the graph, a student wrote the following statements.

I Evidence is provided to explain why ice will float on liquid water.

II As with other solids, heating ice will cause a consistent decrease in density.

III A layer of water at 95°C will float on a layer of water at 25°C.

Based on the graph, which of these statements are correct?

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Question 10

Below 0°C, the water molecules are held apart in an open structure in ice by

A. ion–dipole interaction.

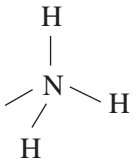
B. hydrogen bonding.

C. covalent bonds.

D. dispersion forces.

Question 11

Nitrogen and hydrogen have electronegativity values of 3.0 and 2.1, respectively. Ammonia is a compound of nitrogen and hydrogen. Its structure is shown below.



Which one of the following descriptions of ammonia is correct?

A. The molecule is slightly polar.

B. Nitrogen is the negative end of the molecule.

C. The shape of the molecule is tetrahedral.

D. The molecule has four bonding electron pairs.

Question 12

The structure of the linear molecules bromine (Br_2) and carbon dioxide (CO_2) are shown below.

$$Br—Br \quad O=C=O$$

Which one of the following statements about these molecules is correct?

A. Only bromine is a non-polar molecule as it has a non-polar covalent bond.

B. Only carbon dioxide is a polar molecule as it has polar covalent bonds.

C. Both molecules are non-polar as linear molecules can never be polar.

D. Carbon dioxide is non-polar as it has no overall dipole.

Question 13

The methods used to isolate metals X, Y and Z from their ores are listed below.

- Metal X: Mix the ore with carbon and heat strongly.
- Metal Y: Melt the ore and remove metal ions using electricity.
- Metal Z: Decompose the ore using strong heating.

Another metal, Q, is found as a deposit in a native state and not as a compound combined with other elements.

What is the order of increasing reactivity of these metals?

A. X < Y < Z < Q

B. Q < Z < X < Y

C. Q < X < Z < Y

D. Y < Z < X < Q

Question 14

Which one of the following shows the semi-structural formula of the ester ethyl propanoate?

A. $CH_3CH_2COOCH_2CH_3$

B. $CH_3COOCH_2CH_2CH_3$

C. $CH_3CH_2CH_2COOCH_2CH_3$

D. $CH_3CH_2COCH_2CH_3$

Question 15

Which one of the following properties is typical for most transition group metals but **not** for main group metals?

A. soft, with a low boiling point

B. magnetic

C. able to be drawn into wires

D. hard, with a high melting point

Question 16

Phosphoric acid, H_3PO_4, is a triprotic acid.

The ion HPO_4^{2-} is best described as

A. diprotic but not amphiprotic.

B. diprotic and amphiprotic.

C. monoprotic but not amphiprotic.

D. monoprotic and amphiprotic.

Question 17

The following reaction occurs in a blast furnace, producing metallic iron.

$$Fe_2O_3(l) + 3CO(g) \rightarrow 2Fe(l) + 3CO_2(g)$$

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

A. Iron ions are the oxidant.

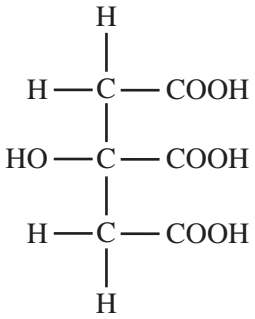
B. CO is the oxidant.

C. Carbon is reduced.

D. Oxygen atoms are oxidised.

Use the following information to answer Questions 18–20.

Citric acid is found naturally in many foods and is used in food preparation. Its structural formula is shown below.



Question 18

0.100 M citric acid is best described as a

A. concentrated solution of a weak acid.

B. dilute solution of a weak acid.

C. concentrated solution of a strong acid.

D. dilute solution of a strong acid.

Question 19

30.0 mL of 1.00 M nitric acid, HNO_3, reacts with exactly 10.0 mL of a sodium hydroxide, NaOH, solution.

What volume of 0.100 M citric acid will react with 10.0 mL of the same NaOH solution?

A. 10.0 mL

B. 30.0 mL

C. 100 mL

D. 300 mL

Question 20

What volume of water must be added to 150 mL of 0.100 M citric acid solution to produce a 0.0650 M solution?

A. 49.0 mL

B. 81.0 mL

C. 98.0 mL

D. 231 mL

Question 21

Which one of the following is **not** a property of water?

A. a very low specific heat capacity

B. a relatively high latent heat of vaporisation

C. a relatively high boiling point for the molecular size

D. the ability to dissolve many ionic and covalent substances

Question 22

To conduct a volumetric analysis, 250.0 mL of a 0.156 M sodium carbonate, Na_2CO_3, solution was required.

The mass of solid, anhydrous, Na_2CO_3 required to make this standard solution was

A. 2.72 g

B. 4.13 g

C. 10.9 g

D. 16.5 g

Question 23

The end point in any acid–base titration is reached when

A. equal volumes of the acid and base solutions have been mixed.

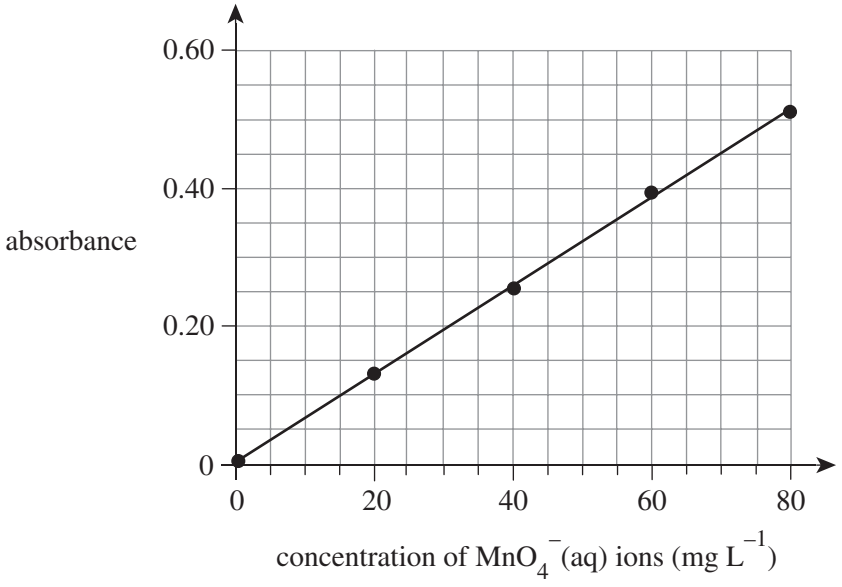
B. the reactants have been mixed in the mole ratio given in the balanced equation.

C. the pH of the solution in the reaction flask is 7.

D. the indicator shows a permanent colour change.

Use the following information to answer Questions 24–26.

Wastewater from an industrial manufacturing plant contains the purple-coloured permanganate ion, MnO_4^-. Colorimetry was used to determine the concentration of this ion in the wastewater. 20.00 mL samples of the wastewater were collected, and each sample was diluted to 250.0 mL. The absorbance of each diluted sample was read in the colorimeter with the wavelength set at 525 nm. The calibration curve used in the process is shown below.



Question 24

The main reason more than one sample of wastewater was taken is to

A. reduce uncertainty of the concentration determination by averaging results.

B. allow a larger volume to be taken when all the samples are pooled before use.

C. ensure that at least some samples can be used if there are accidental spillages.

D. enable the samples to be read at other wavelengths in the colorimeter.

Question 25

A wavelength of 525 nm was selected for this analysis because

A. MnO_4^- absorbs very weakly at this wavelength and so allows all light to pass through.

B. the water present in all the samples absorbs radiation of this wavelength.

C. only the substance under analysis has strong absorption at this wavelength.

D. it is set in the colorimeter as it is most effective for all colours.

Question 26

The absorbance of one diluted sample was 0.35.

Based on this absorbance reading, what is the concentration of MnO_4^- in the original wastewater?

A. 44 mg L^{-1}

B. 55 mg L^{-1}

C. 1.9×10^2 mg L^{-1}

D. 6.9×10^2 mg L^{-1}

Question 27

Rainwater is normally slightly acidic even when there is no air pollution present.

Which one of the following gases in the atmosphere is the main cause of this acidity?

A. carbon dioxide

B. nitrogen

C. oxygen

D. nitrogen dioxide

Question 28

A 200 mL sample of water contains 0.250 mg of fluoride ions.

The concentration of fluoride in the water sample is

A. 1.25×10^{-2} g L^{-1}

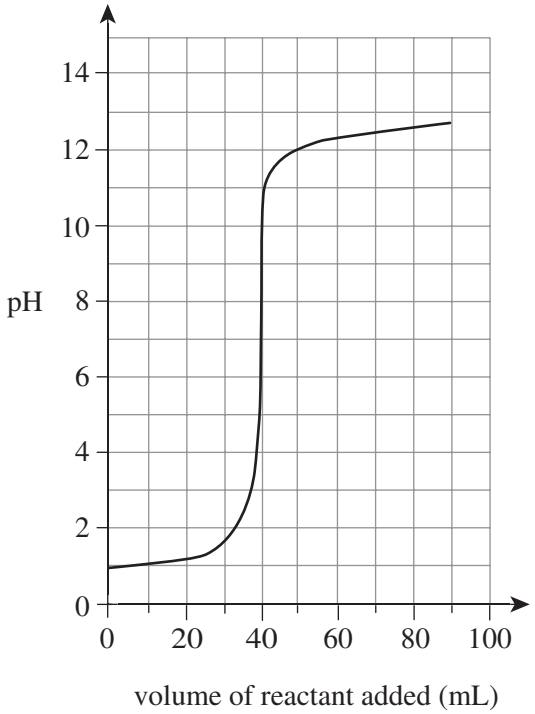
B. 1.25×10^{-3} %(m/v)

C. 1.25 ppm

D. 6.58×10^{-2} mol L^{-1}

Question 29

The changes in pH during a titration were recorded and plotted to produce the titration curve below.



Which reactants were used in the titration?

A. a weak acid and a weak base

B. a weak acid and a strong base

C. a strong acid and a weak base

D. a strong acid and a strong base

Question 30

A strip of zinc, Zn, is placed in a beaker containing a solution of 1.0 M nickel nitrate, $Ni(NO_3)_2$.

Which one of the following would be expected to occur?

A. The green colour of the $Ni(NO_3)_2$ solution would become darker.

B. No reaction would be observed because Zn is a weak reductant.

C. The mass of the strip of Zn would decrease.

D. Zinc nitrate would precipitate from the solution.

END OF SECTION A

SECTION B

Instructions for Section B

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

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

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

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

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

Question 1 (10 marks)

Ethene (C_2H_4) is widely used to produce other chemicals and consumer products.

a. C_2H_4 is made from compounds derived from crude oil.

i. Describe how crude oil is formed. 3 marks

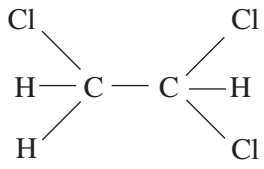
ii. During a process to produce C_2H_4, an alkane with 16 carbon atoms per molecule is broken apart. The products formed are one molecule of heptane, three molecules of C_2H_4 and one molecule of propene.

Write a balanced equation for this process. States are not required. 3 marks

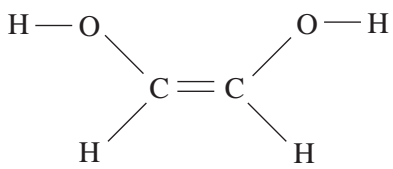
b. Reacting C_2H_4 with water under suitable conditions produces ethanol. If ethanol is oxidised, a carboxylic acid is produced. The boiling points of carboxylic acids increase with the number of carbon atoms per molecule.

In terms of structure and bonding, explain why the boiling points of carboxylic acids increase. 2 marks

c. C_2H_4 is used to produce a range of useful compounds. Two of these compounds are shown below.



compound I



compound II

i. Give the systematic name of compound I. 1 mark

ii. Draw a structural formula for an isomer of compound II. 1 mark

Question 2 (10 marks)
Period 3 of the periodic table consists of the elements from sodium to argon.

a. **i.** Circle the element below that has the lowest electronegativity. 1 mark

S Al Mg Cl P

ii. Circle the element below that has the highest first ionisation energy. 1 mark

P Ar S Al Mg

b. Magnesium readily forms a cation.

Using subshell notation, give the electron configuration of the magnesium cation. 1 mark

_____

c. Identical samples of sodium metal are placed separately in two sealed containers, one containing argon gas and the other containing chlorine gas.

i. There is no reaction between the sodium metal and argon gas.

Explain this observation with reference to electron configuration. 2 marks

_____

_____

_____

_____

ii. There is a violent reaction between the sodium metal and chlorine gas that produces a white, crystalline solid.

Write a balanced equation for this reaction. 2 marks

_____

iii. Two conductivity experiments were performed on the compound produced by the reaction between sodium metal and chlorine gas.

In the table below, explain the results of these experiments in terms of structure and bonding. 3 marks

Result	Explanation
does not conduct electricity as a solid	
conducts electricity when dissolved in water	

Question 3 (7 marks)

a. Explain the meaning of the term 'isotope'. 1 mark

b. The relative atomic mass of boron is 10.8. Boron has two isotopes, with the heavier isotope having an abundance of 80.1%. The relative isotopic mass of the heavier isotope is larger than that of the lighter isotope by 0.996 atomic mass units.

i. Calculate the relative isotopic mass of the lighter isotope. 3 marks

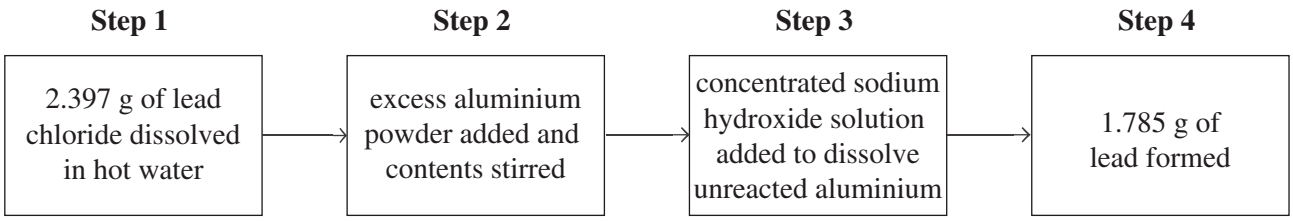
ii. Write the isotopic symbol of the heavier isotope. 1 mark

c. In the table below, draw **one** tick to identify the atomic entity that has the largest number of electrons and **one** tick to identify the atomic entity that has the largest number of neutrons. 2 marks

	^{58}Fe	^{58}Ni	^{59}Co	$^{60}Ni^{2+}$	$^{63}Cu^{2+}$
Atomic entity that has the largest number of electrons					
Atomic entity that has the largest number of neutrons					

Question 4 (8 marks)

The empirical formula of a sample of lead chloride is determined by an experiment using the method shown in the flowchart below.



a. Determine the empirical formula of lead chloride using the information provided. 3 marks

b. In step 2, aluminium atoms react with lead ions to form lead atoms.

Explain why it is important that aluminium powder is added in excess in step 2. 1 mark

c. In step 3, sodium hydroxide reacts with any unreacted aluminium powder to form the aluminate ion AlO_4^-, which is readily soluble in the solution.

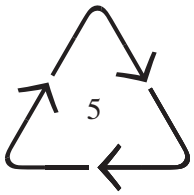
Explain the effect on the results of the experiment if step 3 was not performed. 2 marks

d. The melting point of lead chloride is 501°C.

In terms of structure and bonding, explain why the melting point of lead chloride is so high. 2 marks

Question 5 (10 marks)

The recycling symbol shown below can be found on items such as margarine tubs and disposable plates and cups. The 'PP' under the symbol stands for polypropene, which is an addition polymer produced from propene.



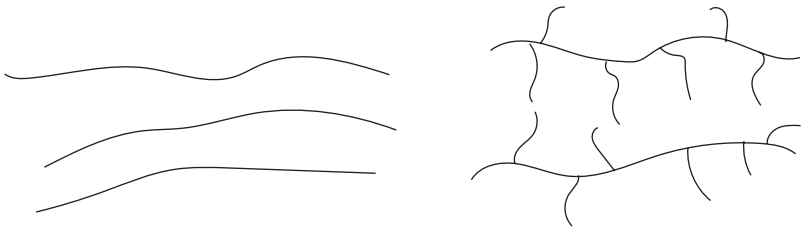
PP

a. Draw the structural formula of propene. 1 mark

b. A polypropene molecule has a molar mass of 290 000 g mol^{-1}.
Calculate the number of propene monomers used to form the polypropene molecule. 2 marks

c. In terms of structure and bonding, explain why polypropene softens when heated. 2 marks

d. Depending on the reaction conditions of temperature and pressure, polypropene can be manufactured in high-density and low-density forms, as illustrated below.



high-density PP low-density PP

Suggest **one** physical property (other than density) that would differ for the two forms of polypropene and explain this difference in terms of structure and bonding. 3 marks

e. **i.** Suggest **one** advantage of the recycling of polymers such as polypropene. 1 mark

ii. Suggest **one** disadvantage of the use of polymers such as polypropene. 1 mark

Question 6 (11 marks)

Chromium is a hard, shiny metal used widely in industrial applications such as electroplating (to prevent corrosion), stainless steel production and for decorative finishes.

An experiment was set up to determine the reactivity series of the metals chromium, lanthanum, palladium and barium. Samples of each metal were placed separately in aqueous solutions of each of the other metal ions. The results of the experiment are shown in the table below.

	$Cr^{3+}(aq)$	**$La^{3+}(aq)$**	**$Pd^{2+}(aq)$**	**$Ba^{2+}(aq)$**
Cr		no reaction	reaction	no reaction
La	reaction		reaction	no reaction
Pd	no reaction	no reaction		no reaction
Ba	reaction	reaction	reaction	

a. Using the element symbols for the four metals, write the metals in order of increasing reactivity. 1 mark

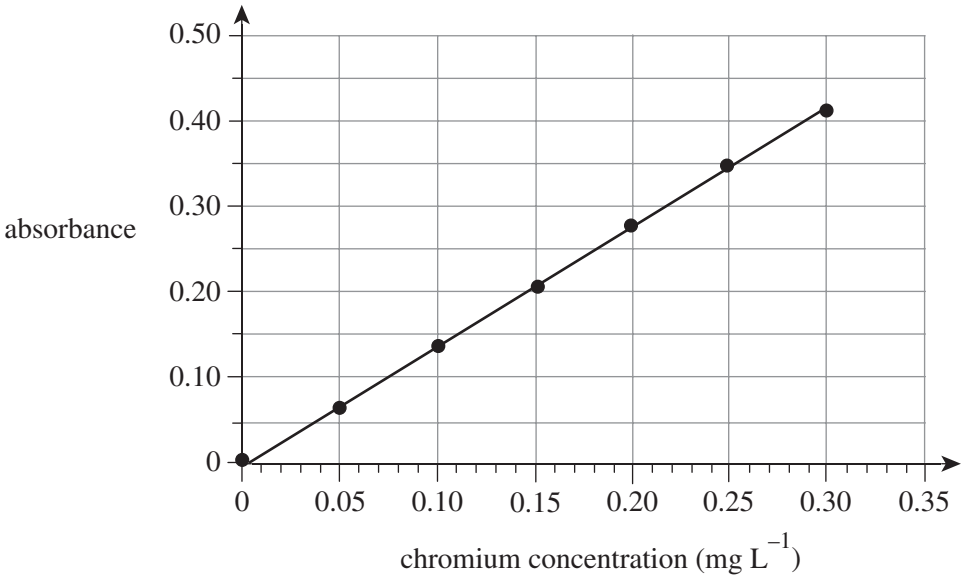
b. **i.** Write the balanced ionic equation for the reaction of Cr with Pd^{2+}. 2 marks

ii. Ba also reacts with Pd^{2+}.
Write the oxidation half-equation for this reaction. 1 mark

c. An electroplating factory has 500 L of waste liquid containing chromium as $Cr^{3+}(aq)$. Before the liquid can be safely discharged, Cr^{3+} is removed from the liquid using a precipitation reaction represented by the following ionic equation.

$$Cr^{3+}(aq) + 3OH^{-}(aq) \rightarrow Cr(OH)_3(s)$$

Atomic absorption spectroscopy (AAS) was used to determine the concentration of Cr^{3+} in the waste liquid so that the ions could be removed efficiently. The chromium AAS calibration curve that was used in the analysis is shown below.



1.00 mL of the waste liquid was diluted to 100.0 mL. A sample of this diluted liquid recorded an absorbance of 0.25 using the AAS analysis.

i. Determine the concentration, in mol L^{-1}, of chromium in the undiluted waste liquid. 3 marks

ii. Calculate the mass, in grams, of chromium in the 500 L of waste liquid. 1 mark

iii. Another 500 L batch of waste liquid was found to contain 10.0 g of chromium.

Calculate the mass of solid $Cr(OH)_3$, in grams, that will be produced when this 500 L of waste liquid undergoes the precipitation reaction. 3 marks

Question 7 (8 marks)

a. A solution of 1.0×10^{-3} M ethanoic acid, CH_3COOH, a monoprotic acid, has a pH of 3.9.

i. Determine the hydrogen ion concentration in a 1.0×10^{-3} M CH_3COOH solution at 25°C. 1 mark

ii. State the pH of a 1.0×10^{-3} M hydrochloric acid solution, HCl. 1 mark

b. **i.** Write the balanced ionic equation for the reaction of zinc with dilute HCl. 2 marks

ii. Write the balanced chemical equation for the reaction of CH_3COOH with solid potassium carbonate. 2 marks

iii. Write the balanced chemical equation for the reaction of dilute HCl with solid magnesium oxide. 2 marks

Question 8 (9 marks)
The water from a drain located near an industrial manufacturing complex was investigated for contaminants.

a. Explain the meaning of the term 'contaminant'. 1 mark

b. The drain water was analysed to determine the levels of sodium chloride, NaCl.

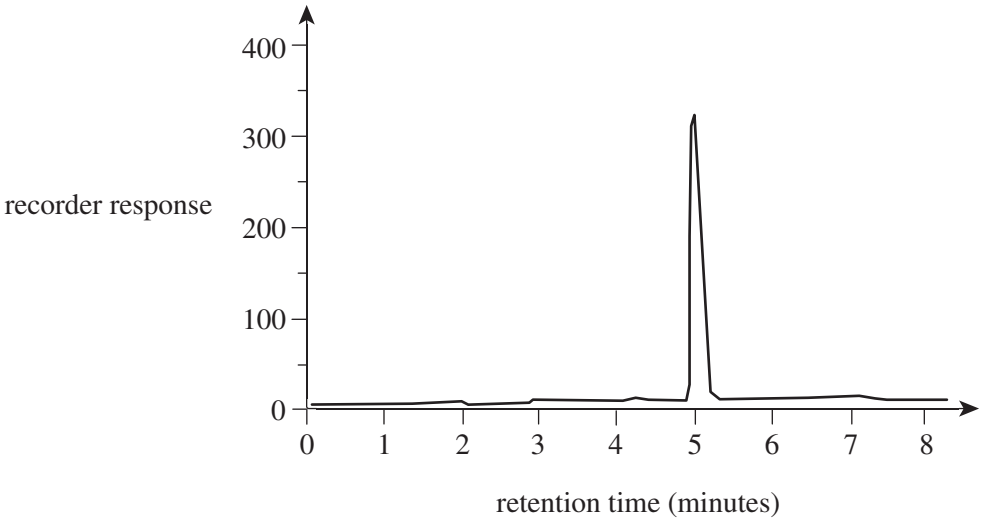
i. Using gravimetric analysis, a 10.0 L sample of drain water was treated with silver nitrate solution. 0.0126 g of silver chloride, AgCl, precipitate was obtained.
Calculate the concentration of NaCl, in g L^{-1}, in the water. 3 marks

ii. State **one** important assumption that was made in the gravimetric analysis in **part b.i.** 1 mark

iii. Suggest **one** analytical method other than gravimetric analysis that could be used to determine the level of NaCl in the drain water. 1 mark

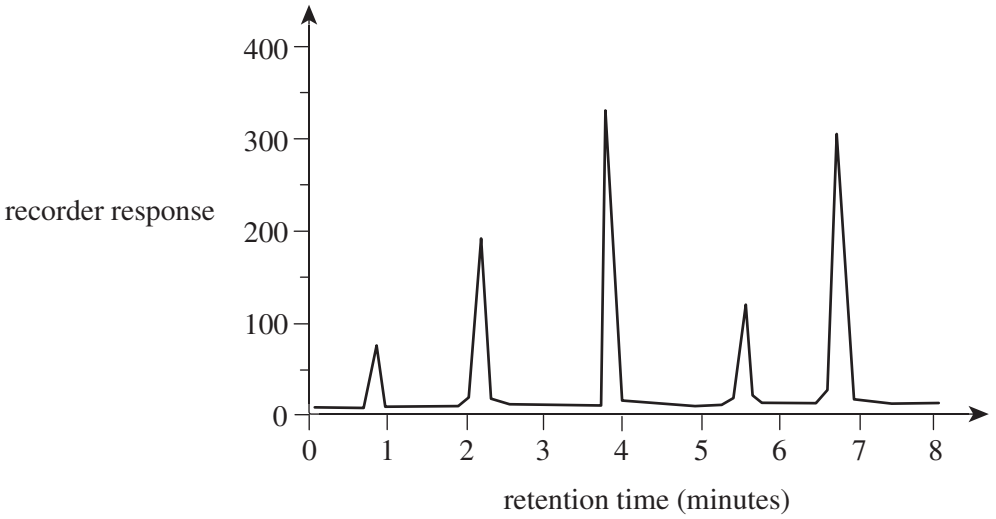
c. High-performance liquid chromatography (HPLC) was used to analyse the drain water for the presence of the pesticide alpha-Naphthylthiourea (ANTU). The output of the HPLC analysis of a pure sample of ANTU is shown in Graph 1 below.

Graph 1



A water sample from the drain was analysed using the same HPLC column under identical conditions and produced the output shown in Graph 2 below.

Graph 2



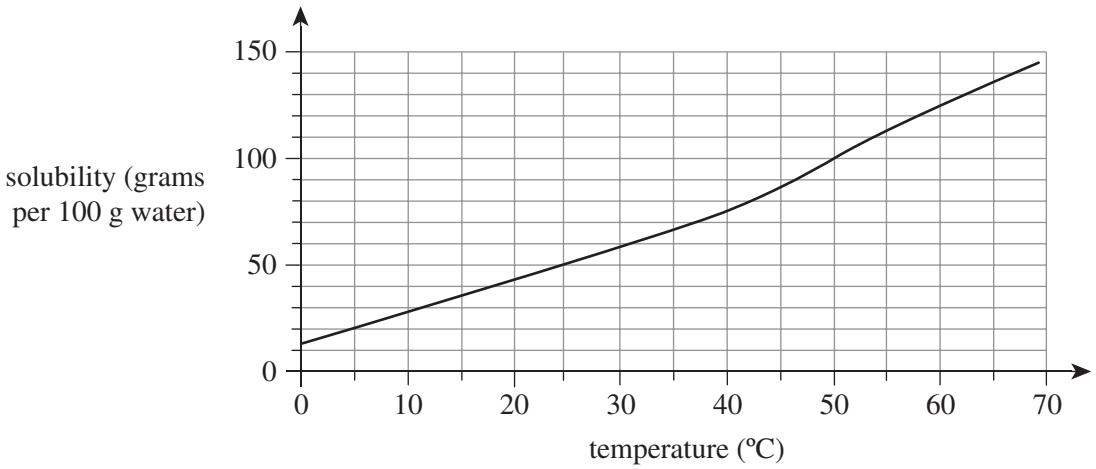
i. Explain whether the drain water does or does not contain ANTU. 2 marks

ii. State **one** conclusion other than your answer for **part c.i.** that can be drawn from the HPLC output in Graph 2. 1 mark

Question 9 (11 marks)

Water is known as the universal solvent because it dissolves many solids, liquids and gases.

a. The solubility of soluble solids generally increases as temperature increases. The solubility curve of the ionic compound potassium nitrate is shown below.



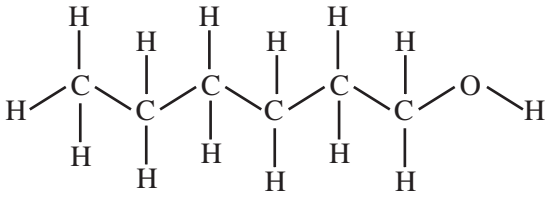
i. When solid potassium nitrate dissolves in water, bonds are broken and other bonds are formed.

Explain the dissolving process by naming the bond types broken and the bond types formed. 3 marks

ii. 40 mL of a saturated solution of potassium nitrate at 50°C was placed in a beaker. The temperature was then lowered to 40°C.

How many grams of potassium nitrate will crystallise in the beaker? 3 marks

b. The molecular structure of hexanol is shown below.



Explain why hexanol is insoluble in water. 2 marks

c. The solubility of gases in water decreases when temperature is increased. The solubilities of the gases oxygen and ammonia in water at different temperatures are shown in the following table. The solubilities are given in grams of gas per 100 grams of water.

	0°C	**20°C**	**60°C**
Oxygen (O_2)	0.0069	0.0043	0.0023
Ammonia (NH_3)	89.7	52.9	16.8

With reference to structure and bonding, and using a labelled diagram, explain why NH_3 gas is very soluble in water at all the temperatures shown in the table. 3 marks

Question 10 (6 marks)

a. Write the equation for the self-ionisation reaction of water. 2 marks

b. The values for the ionic product of water (K_w) at various temperatures are shown in the following table.

Temperature (°C)	0	15	35	45	55
K_w **(M^2)**	1.14×10^{-15}	4.51×10^{-15}	2.09×10^{-14}	4.01×10^{-14}	7.29×10^{-14}

At 55°C, the pH of a solution of nitric acid (HNO_3), which is a strong acid, is 3.7.

Calculate the hydroxide ion concentration in the solution. 2 marks

c. A sample of pure water at 30°C was heated until the temperature reached 50°C.

How does the pH of the water change as the water is heated? 2 marks

END OF QUESTION AND ANSWER BOOKLET

Neap

Trial Examination 2022

VCE Chemistry Units 1&2

Written Examination

Data Booklet

Instructions

This data booklet is provided for your reference.
A question and answer booklet is provided with this data booklet.

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

1. Periodic table of the elements

1 **H** 1.0 hydrogen																	2 **He** 4.0 helium
3 **Li** 6.9 lithium	4 **Be** 9.0 beryllium											5 **B** 10.8 boron	6 **C** 12.0 carbon	7 **N** 14.0 nitrogen	8 **O** 16.0 oxygen	9 **F** 19.0 fluorine	10 **Ne** 20.2 neon
11 **Na** 23.0 sodium	12 **Mg** 24.3 magnesium											13 **Al** 27.0 aluminium	14 **Si** 28.1 silicon	15 **P** 30.1 phosphorus	16 **S** 32.1 sulfur	17 **Cl** 35.5 chlorine	18 **Ar** 39.9 argon
19 **K** 39.1 potassium	20 **Ca** 40.1 calcium	21 **Sc** 45.0 scandium	22 **Ti** 47.9 titanium	23 **V** 50.9 vanadium	24 **Cr** 52.0 chromium	25 **Mn** 54.9 manganese	26 **Fe** 55.8 iron	27 **Co** 58.9 cobalt	28 **Ni** 58.7 nickel	29 **Cu** 63.5 copper	30 **Zn** 65.4 zinc	31 **Ga** 69.7 gallium	32 **Ge** 72.6 germanium	33 **As** 74.9 arsenic	34 **Se** 79.0 selenium	35 **Br** 79.9 bromine	36 **Kr** 83.8 krypton
37 **Rb** 85.5 rubidium	38 **Sr** 87.6 strontium	39 **Y** 88.9 yttrium	40 **Zr** 91.2 zirconium	41 **Nb** 92.9 niobium	42 **Mo** 96.0 molybdenum	43 **Tc** (98) technetium	44 **Ru** 101.1 ruthenium	45 **Rh** 102.9 rhodium	46 **Pd** 106.4 palladium	47 **Ag** 107.9 silver	48 **Cd** 112.4 cadmium	49 **In** 114.8 indium	50 **Sn** 118.7 tin	51 **Sb** 121.8 antimony	52 **Te** 127.6 tellurium	53 **I** 126.9 iodine	54 **Xe** 131.3 xenon
55 **Cs** 132.9 caesium	56 **Ba** 137.3 barium	57–71 lanthanoids	72 **Hf** 178.5 hafnium	73 **Ta** 180.9 tantalum	74 **W** 183.8 tungsten	75 **Re** 186.2 rhenium	76 **Os** 190.2 osmium	77 **Ir** 192.2 iridium	78 **Pt** 195.1 platinum	79 **Au** 197.0 gold	80 **Hg** 200.6 mercury	81 **Tl** 204.4 thallium	82 **Pb** 207.2 lead	83 **Bi** 209.0 bismuth	84 **Po** (210) polonium	85 **At** (210) astatine	86 **Rn** (222) radon
87 **Fr** (223) francium	88 **Ra** (226) radium	89–103 actinoids	104 **Rf** (261) rutherfordium	105 **Db** (262) dubnium	106 **Sg** (266) seaborgium	107 **Bh** (264) bohrium	108 **Hs** (267) hassium	109 **Mt** (268) meitnerium	110 **Ds** (271) darmstadtium	111 **Rg** (272) roentgenium	112 **Cn** (285) copernicium	113 **Nh** (280) nihonium	114 **Fl** (289) flerovium	115 **Mc** (289) moscovium	116 **Lv** (292) livermorium	117 **Ts** (294) tennessine	118 **Og** (294) oganesson

Key:

79	atomic number
Au	symbol of element
197.0	relative atomic mass
gold	name of elecment

57 **La** 138.9 lanthanum	58 **Ce** 140.1 cerium	59 **Pr** 140.9 praseodymium	60 **Nd** 144.2 neodymium	61 **Pm** (145) promethium	62 **Sm** 150.4 samarium	63 **Eu** 152.0 europium	64 **Gd** 157.3 gadolinium	65 **Tb** 158.9 terbium	66 **Dy** 162.5 dysprosium	67 **Ho** 164.9 homium	68 **Er** 167.3 erbium	69 **Tm** 168.9 thulium	70 **Yb** 173.1 ytterbium	71 **Lu** 175.0 lutetium
89 **Ac** (227) actinium	90 **Th** 232.0 thorium	91 **Pa** 231.0 protactinium	92 **U** 238.0 uranium	93 **Np** (237) neptunium	94 **Pu** (244) plutonium	95 **Am** (243) americium	96 **Cm** (247) curium	97 **Bk** (247) berkelium	98 **Cf** (251) californium	99 **Es** (252) einsteinium	100 **Fm** (257) fermium	101 **Md** (258) mendelevium	102 **No** (259) nobelium	103 **Lr** (262) lawrencium

The value in the brackets indicates the mass number of the longest-lived isotope.

2. Electrochemical series

Reaction	Standard electrode potential (E^0) in volts at 25°C
$F_2(g) + 2e^- \rightleftharpoons 2F^-(aq)$	+2.87
$H_2O_2(aq) + 2H^+(aq) + 2e^- \rightleftharpoons 2H_2O(l)$	+1.77
$Au^+(aq) + e^- \rightleftharpoons Au(s)$	+1.68
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-(aq)$	+1.36
$O_2(g) + 4H^+(aq) + 4e^- \rightleftharpoons 2H_2O(l)$	+1.23
$Br_2(l) + 2e^- \rightleftharpoons 2Br^-(aq)$	+1.09
$Ag^+(aq) + e^- \rightleftharpoons Ag(s)$	+0.80
$Fe^{3+}(aq) + e^- \rightleftharpoons Fe^{2+}(aq)$	+0.77
$O_2(g) + 2H^+(aq) + 2e^- \rightleftharpoons H_2O_2(aq)$	+0.68
$I_2(s) + 2e^- \rightleftharpoons 2I^-(aq)$	+0.54
$O_2(g) + 2H_2O(l) + 4e^- \rightleftharpoons 4OH^-(aq)$	+0.40
$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$	+0.34
$Sn^{4+}(aq) + 2e^- \rightleftharpoons Sn^{2+}(aq)$	+0.15
$S(s) + 2H^+(aq) + 2e^- \rightleftharpoons H_2S(g)$	+0.14
$2H^+(aq) + 2e^- \rightleftharpoons H_2(g)$	0.00
$Pb^{2+}(aq) + 2e^- \rightleftharpoons Pb(s)$	– 0.13
$Sn^{2+}(aq) + 2e^- \rightleftharpoons Sn(s)$	– 0.14
$Ni^{2+}(aq) + 2e^- \rightleftharpoons Ni(s)$	– 0.25
$Co^{2+}(aq) + 2e^- \rightleftharpoons Co(s)$	– 0.28
$Cd^{2+}(aq) + 2e^- \rightleftharpoons Cd(s)$	– 0.40
$Fe^{2+}(aq) + 2e^- \rightleftharpoons Fe(s)$	– 0.44
$Zn^{2+}(aq) + 2e^- \rightleftharpoons Zn(s)$	– 0.76
$2H_2O(l) + 2e^- \rightleftharpoons H_2(g) + 2OH^-(aq)$	– 0.83
$Mn^{2+}(aq) + 2e^- \rightleftharpoons Mn(s)$	–1.18
$Al^{3+}(aq) + 3e^- \rightleftharpoons Al(s)$	–1.66
$Mg^{2+}(aq) + 2e^- \rightleftharpoons Mg(s)$	–2.37
$Na^+(aq) + e^- \rightleftharpoons Na(s)$	–2.71
$Ca^{2+}(aq) + 2e^- \rightleftharpoons Ca(s)$	–2.87
$K^+(aq) + e^- \rightleftharpoons K(s)$	–2.93
$Li^+(aq) + e^- \rightleftharpoons Li(s)$	–3.04

3. Chemical relationships

Name	Formula
number of moles of a substance	$n = \frac{m}{M}; \quad n = cV$

4. Physical constants and standard values

Name	Symbol	Value
Avogadro constant	N_A or L	6.02×10^{23} mol^{-1}
specific heat capacity of water	c	4.18 kJ kg^{-1} K^{-1} or 4.18 J g^{-1} K^{-1}
density of water at 25°C	d	997 kg m^{-3} or 0.997 g mL^{-1}
ionic product for water	K_W	1.00×10^{-14} mol^2 L^{-2} at 298 K (self-ionisation constant)

5. Unit conversions

Measured value	Conversion
1 litre (L)	1 dm^3 or 1×10^{-3} m^3 or 1×10^3 cm^3 or 1×10^3 mL

6. Metric (including SI) prefixes

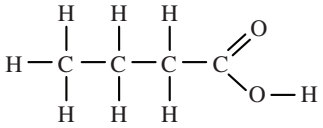
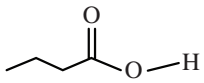
Metric (including SI) prefixes	Scientific notation	Multiplying factor
giga (G)	10^9	1 000 000 000
mega (M)	10^6	1 000 000
kilo (k)	10^3	1000
deci (d)	10^{-1}	0.1
centi (c)	10^{-2}	0.01
milli (m)	10^{-3}	0.001
micro (μ)	10^{-6}	0.000001
nano (n)	10^{-9}	0.000000001
pico (p)	10^{-12}	0.000000000001

7. Acid–base indicators

Name	pH range	Colour change from lower pH to higher pH in range
thymol blue (1st change)	1.2–2.8	red → yellow
methyl orange	3.1– 4.4	red → yellow
bromophenol blue	3.0– 4.6	yellow → blue
methyl red	4.4–6.2	red → yellow
bromothymol blue	6.0–7.6	yellow → blue
phenol red	6.8–8.4	yellow → red
thymol blue (2nd change)	8.0–9.6	yellow → blue
phenolphthalein	8.3–10.0	colourless → pink

8. Representations of organic molecules

The following table shows different representations of organic molecules, using butanoic acid as an example.

Formula	Representation
molecular formula	$C_4H_8O_2$
structural formula	
semi-structural (condensed) formula	$CH_3CH_2CH_2COOH$ or $CH_3(CH_2)_2COOH$
skeletal structure	

9. A solubility table

High solubility	Low solubility
Compounds containing the following ions are soluble in water. • Na^+, K^+, NH_4^+, NO_3^-, CH_3COO^- • Cl^-, Br^-, I^- (unless combined with Ag^+ or Pb^{2+}) • SO_4^{2-} (however $PbSO_4$ and $BaSO_4$ are not soluble, Ag_2SO_4 and $CaSO_4$ are slightly soluble)	Compounds containing the following ions are generally insoluble, unless combined with Na^+, K^+ or NH_4^+. • CO_3^{2-}, PO_4^{3-}, S^{2-} • OH^- ($Ba(OH)_2$ and $Sr(OH)_2$ are soluble, $Ca(OH)_2$ is slightly soluble)

END OF DATA BOOKLET

Neap

Trial Examination 2022

VCE Chemistry Units 1&2

Written Examination

Multiple-choice Answer Sheet

Student's Name: _____

Teacher's Name: _____

Instructions

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

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

Use pencil only

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