Neap

Trial Examination 2023

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	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 correction fluid/tape.

Materials supplied

Question and answer booklet of 31 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

Relative isotopic mass is

A. the mass of an element's isotope measured in grams.

B. the sum of the number of isotopes of a particular element.

C. a value that does not have a unit of measurement and counts the number of atoms of an isotope.

D. a comparison of a particular isotope's mass with the mass of a standard isotope.

Question 2

Which one of the following gives the correct shape for each molecule?

	Carbon dioxide	Hydrogen chloride	Ammonia	Water
A.	bent	bent	linear	tetrahedral
B.	pyramidal	tetrahedral	bent	pyramidal
C.	linear	linear	pyramidal	bent
D.	tetrahedral	pyramidal	tetrahedral	linear

Question 3

Which one of the following properties of ionic compounds is **least** readily explained by the ionic bonding model?

A. Ionic compounds tend to shatter if a sideways force is applied.

B. There is great variation in the melting points of many ionic compounds.

C. A large amount of force is required to break a crystal of an ionic compound.

D. Solid ionic compounds have properties that are different to those of molten ionic compounds.

Use the following information to answer Questions 4 and 5.

Diamond and graphite are composed of carbon atoms only. Their different properties make them suitable for different applications.

Question 4

Which one of the following statements is correct?

A. The only bonding present in diamond and graphite is covalent bonding.

B. Diamond does not conduct electricity as it does not have delocalised electrons.

C. Each carbon atom in both diamond and graphite has four covalent bonds.

D. Both diamond and graphite have giant covalent network lattice structures.

Question 5

Which one of the following statements is most likely correct?

A. Diamond is used in rings and other jewellery as it can cut glass easily.

B. Graphite is used in small batteries as it can withstand high temperatures.

C. Diamond is used as a powder in locks as it lubricates metal surfaces well.

D. Graphite is used in 'lead' pencils as it is soft and slippery.

Use the following information to answer Questions 6 and 7.

The electronegativities of four elements are shown in the following table.

Hydrogen	Carbon	Sulfur	Oxygen
2.1	2.5	2.5	3.5

Question 6

A sample of hydrogen sulfide, H_2S, is dissolved in water.

The strongest bonding between H_2S molecules and water molecules is

A. dispersion forces.

B. covalent bonding.

C. dipole–dipole attraction.

D. hydrogen bonding.

Question 7

Which one of the following statements about methane, CH_4, is correct?

A. Although CH_4 has slightly polar covalent bonds, it is a non-polar molecule.

B. The carbon atom in a CH_4 molecule develops a very small, positive charge ($\delta+$).

C. CH_4 is a polar molecule because all alkane molecules are polar.

D. Due to its polar bonds, CH_4 readily dissolves in water.

Question 8

Green chemistry refers to the design of new chemical products and processes that are safer and more sustainable than those traditionally used.

Which one of the following statements is **not** one of the 12 principles that underpin green chemistry?

A. Chemical products should be designed to achieve their intended function safely, with minimal toxicity.

B. Whenever possible, feedstocks should be made from renewable materials, rather than fossil fuels.

C. Production pathways should be designed for maximum energy use and minimal environmental damage.

D. Prevention of waste is better than treatment of waste after it has been formed.

Use the following information to answer Questions 9 and 10.

Three metals – X, Y and Z – were each tested separately for their reactions with oxygen gas, cold water and hydrochloric acid under the same conditions. The results are shown in the following table.

Test	Metal X	Metal Y	Metal Z
heated in oxygen gas	does not burn but glows brightly	catches fire easily and burns brightly	does not burn but forms a powder coat
cold water	no reaction	gives off bubbles very slowly	no reaction
hydrochloric acid	gives off bubbles very slowly	gives off bubbles vigorously	no reaction

Question 9

Which one of the following lists the metals in order of increasing reactivity?

A. X, Y, Z

B. Y, X, Z

C. Z, X, Y

D. Z, Y, X

Question 10

Which of the metals is/are most likely to react vigorously with steam?

A. X only

B. Y only

C. X and Z only

D. X, Y and Z

Question 11

The periodic table is organised in such a way that trends in the structures and properties of elements can be identified.

For period 3 and group 13 elements, which one of the following describes the trends in atomic radii and electronegativity?

	Period 3 atomic radii	Group 13 electronegativity
A.	increase across the period	increases down the group
B.	increase across the period	decreases down the group
C.	decrease across the period	increases down the group
D.	decrease across the period	decreases down the group

Question 12

The electronic configurations of two elements – M and Q – are shown in the following table.

Element	Electronic configuration
M	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
Q	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^4$

If element M and element Q were reacted together, the compound that would most likely form is

A. an ionic compound with the formula MQ_2.

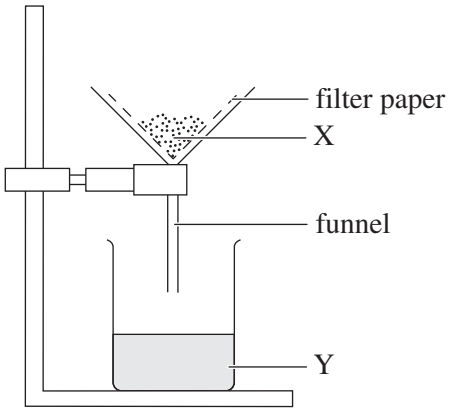
B. a molecular compound with the formula MQ_2.

C. an ionic compound with the formula M_2Q.

D. a molecular compound with the formula M_2Q.

Use the following information to answer Questions 13 and 14.

To prepare and isolate a sample of the insoluble salt barium sulfate, $BaSO_4$, a precipitation reaction between solutions of barium chloride, $BaCl_2$, and magnesium sulfate, $MgSO_4$, was performed. The equipment used during the preparation is illustrated in the diagram below.



Question 13

The ionic equation that best represents the precipitation reaction is

A. $BaCl_2(aq) + MgSO_4(aq) \rightarrow BaSO_4(s) + MgCl_2(s)$

B. $BaCl_2(aq) + MgSO_4(aq) \rightarrow BaSO_4(s) + MgCl_2(aq)$

C. $Ba^{2+}(s) + SO_4^{2-}(s) \rightarrow BaSO_4(s)$

D. $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$

Question 14

Which one of the following statements is correct?

A. Substance X should be washed with distilled water to remove soluble ions.

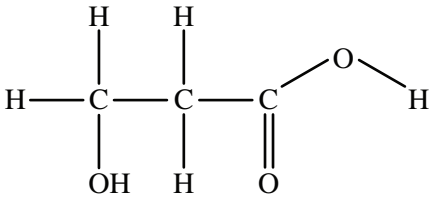
B. Substance X contains a large amount of solid $MgCl_2$.

C. Liquid Y contains large amounts of $BaSO_4$.

D. Liquid Y should be pure water that contains no ions.

Question 15

The structural formula of a compound is shown below.



Which one of the following statements about the compound is correct?

A. The C, O and H ions in the compound are in the ratio 1 : 1 : 2.

B. The relative molecular mass of the compound is 90.0 g mol^{-1}.

C. A sample of the compound that contains 7.22×10^{24} atoms would have a mass of 90.0 g.

D. In any sample of the compound, the mass of oxygen atoms equals the mass of carbon atoms.

Question 16

The high value for the specific heat capacity of water is due mainly to the presence of

A. hydrogen bonding.

B. ion–dipole attractions.

C. covalent bonds.

D. dispersion forces.

Question 17

What is the pH of a 0.100 M aqueous solution of barium hydroxide, $Ba(OH)_2$, at 25°C?

A. 0.70

B. 0.84

C. 13.3

D. 13.9

Use the following information to answer Questions 18 and 19.

Methanoic acid and sulfuric acid are compounds that contain two hydrogen atoms per molecule. The pH values of 1.0 M solutions of these acids are shown in the following table.

	Methanoic acid	**Sulfuric acid**
Chemical formula	HCOOH(aq)	H_2SO_4(aq)
pH	greater than 0	less than 0

Question 18

It can be concluded that

A. HCOOH is diprotic and H_2SO_4 is a strong acid.

B. HCOOH is a weak acid and H_2SO_4 is diprotic.

C. both HCOOH and H_2SO_4 are diprotic, strong acids.

D. neither HCOOH nor H_2SO_4 is a strong acid.

Question 19

In an experiment, equal sample volumes of each 1.0 M acid were placed in separate test tubes. Sodium hydrogen carbonate, $NaHCO_3$, powder was added to each test tube to neutralise the acids. 5.23 g of $NaHCO_3$ was needed to neutralise the HCOOH.

The mass of $NaHCO_3$ required to neutralise the H_2SO_4 would have been

A. less than 5.23 g because H_2SO_4 has a lower pH than HCOOH.

B. more than 5.23 g because H_2SO_4 has a lower pH than HCOOH.

C. exactly 5.23 g because the acids have the same concentration.

D. more than 5.23 g because H_2SO_4 produces more hydrogen ions than HCOOH

Question 20

Consider the reaction represented by the following equation.

$$2Co^{3+}(aq) + 3Fe^{2+}(aq) \rightarrow 3Co^{2+}(aq) + 2Fe^{3+}(aq)$$

Which one of the following statements is true?

A. Co^{3+} acts as the oxidising agent when it is reduced to Co^{2+}.

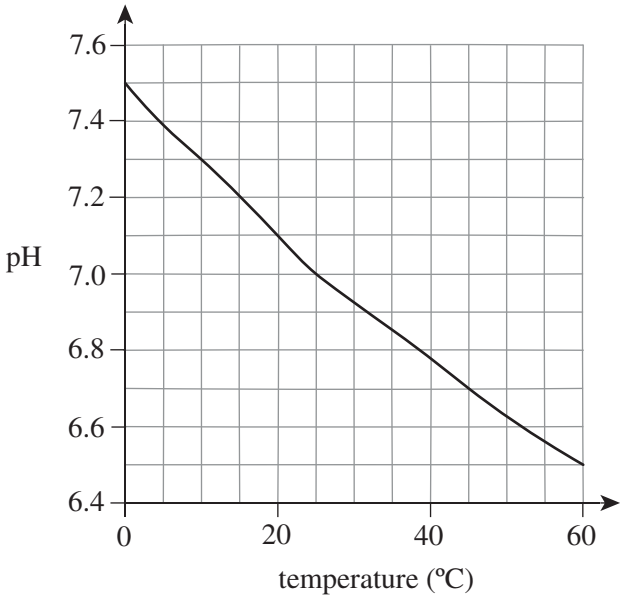
B. Co^{3+} accepts an electron and so acts as the reducing agent.

C. The overall charge stays the same and therefore the reaction is not a redox reaction.

D. Protons are transferred from the Co^{3+} to Fe^{2+}, which increases the charge to form the Fe^{3+} ion.

Use the following information to answer Questions 21–23.

The pH of pure water varies with temperature, as shown in the following graph.



Question 21

At 10°C, the value of the ionic product of water, K_w, is closest to

A. $10^{-14.6}$

B. $10^{-7.3}$

C. 7.3

D. $10^{7.3}$

Question 22

At 45°C, the concentration of hydroxide ions in pure water is

A. 5.0×10^{-8} M

B. $10^{-7.3}$ M

C. 2.0×10^{-7} M

D. 6.7 M

Question 23

Based on the information provided, which one the following statements is correct?

A. The pH of water decreases with increasing temperature, but the water remains neutral.

B. At 20°C, $[H_3O^+]$ is greater than $[OH^-]$ and so the water is acidic.

C. The concentration of hydroxide ions decreases with increasing temperature.

D. Cold water is more alkaline and less acidic than hot water.

Question 24

The molar volume of a gas at a temperature of 30°C and a pressure of 105 kPa is

A. less than 24.8 L.

B. equal to 24.8 L.

C. greater than 24.8 L.

D. unable to be estimated without knowing the identity of the gas.

Use the following information to answer Questions 25 and 26.

Two important qualities of reliable scientific measurement are accuracy and precision.

Question 25

Which one of the following defines accuracy and precision?

	Accuracy	Precision
A.	Measured values are close to each other under changed conditions of measurement.	Successive measured values are close to each other under the same conditions of measurement.
B.	Measured values are very close to the mean value.	Measured values are close to the true value.
C.	Successive measured values are close to each other under the same conditions of measurement.	Measured values are close to each other under changed conditions of measurement.
D.	Measured values are close to the true value.	Measured values are very close to the mean value.

Question 26

A natural acid–base indicator can be made by boiling red rose petals in water to produce a coloured solution. Universal indicator is a commercial product made by mixing numerous synthetic acid–base indicators. Electronic pH meters are also available commercially.

Which of the following methods could measure the pH of a solution with high levels of accuracy and precision?

A. natural indicator

B. electronic pH meter

C. universal indicator

D. electronic pH meter and universal indicator

Question 27

A number of steps involved in various analytical techniques are listed below.

1. making solutions of known concentration of a compound
2. using a precipitation reaction of an ion under analysis
3. constructing a calibration curve
4. determining the conductivity of a solution under investigation
5. reading the absorbance of a solution using a UV-visible spectrometer
6. finding the conductivity of solutions of known concentration

Which of these steps would be involved when using electrical conductivity to assess the salinity of a water sample?

A. 1, 2, 3, 5

B. 1, 3, 4, 6

C. 2, 3, 4, 5

D. 2, 4, 5, 6

Question 28

10.0 g of chlorine gas, Cl_2, is dissolved in 2500 L of water.

What is the concentration of the solution?

A. 4.00×10^{-2} g L^{-1}

B. 40.0 ppm

C. 4.00×10^{-4} %(m/v)

D. 5.63×10^{-4} mol L^{-1}

Use the following information to answer Questions 29 and 30.

A 50 L tank of water was contaminated with dissolved magnesium sulfate, $MgSO_4$ (M = 120.4 g mol^{-1}). 20.0 mL samples of the water were treated with 0.10 M barium chloride, $BaCl_2$, solution to precipitate all the sulfate ions. The reaction occurs according to the following ionic equation.

$$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$$

For each sample, the precipitate of barium sulfate, $BaSO_4$, (M = 233.4 g mol^{-1}) was isolated by filtration, washed with distilled water and then dried. The average mass of precipitate was 0.153 g.

Question 29

How many grams of $MgSO_4$ were dissolved in the water in the 50 L tank?

A. 0.0789 g

B. 158 g

C. 197 g

D. 383 g

Question 30

The mass of the precipitate from one of the 20.0 mL samples of the water was recorded as 0.179 g. This value was not included in the calculation to find the average mass of precipitate.

Which one of the following statements could explain the unusually high value of 0.179 g?

A. An excess of $BaCl_2$ solution was used for precipitation of this sample.

B. During filtration, some of the precipitate was lost in the filtrate.

C. Too much distilled water was used to wash the precipitate.

D. The precipitate on the filter paper was not sufficiently dry.

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 (8 marks)

The metal magnesium, Mg, reacts readily with chlorine gas, Cl_2, to produce magnesium chloride, $MgCl_2$, according to the following equation.

$$Mg(s) + Cl_2(g) \rightarrow MgCl_2(s)$$

a. i. Using the metallic bonding model, outline the structure of Mg. 2 marks

ii. The properties of Mg include:

- malleability
- ductility
- heat conductivity.

With reference to the structure of Mg, explain why the metal exhibits **one** of the properties listed. 2 marks

b. Explain why a Cl_2 molecule is non-polar. 2 marks

c. Two samples of $MgCl_2$ are to be treated in different ways.

In **one** box in each row of the table below, explain why each sample will or will not conduct electricity. 2 marks

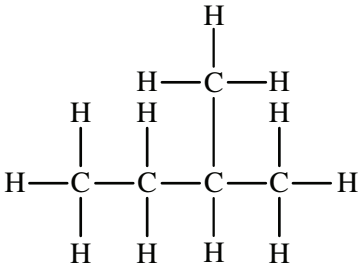
Sample	Will conduct electricity	Will not conduct electricity
solid $MgCl_2$		
an aqueous solution of $MgCl_2$		

Question 2 (7 marks)

The hydrocarbon C_5H_{12} has three structural isomers. One of the isomers is unbranched and the other two isomers are branched.

a. Write the systematic IUPAC name for the unbranched isomer of C_5H_{12}. 1 mark

b. The structural formula of one of the branched isomers of C_5H_{12} is shown below.



i. Write the systematic IUPAC name for this isomer. 1 mark

ii. Explain whether the unbranched isomer of C_5H_{12} or the branched isomer from **part b.i.** has the higher boiling point. 2 marks

iii. Draw the structural formula of the other branched isomer of C_5H_{12}.
Show all bonding. 1 mark

c. Explain why C_5H_{12} does not conduct electricity. 2 marks

Question 3 (8 marks)

Copper has many uses such as in electrical cables, plumbing and coinage. It is found in different mineral forms; the most common are known as copper pyrites in which copper has a charge of +1.

a. The composition by mass of a particular copper pyrite mineral is 34.6% copper, 30.4% iron and 35.0% sulfur.

Determine the empirical formula of this mineral. 2 marks

b. Copper has two stable isotopes. Their relative isotopic masses are shown in the following table.

Copper isotope	Relative isotopic mass
isotope 1	62.93
isotope 2	64.93

i. Write the isotope notation for isotope 1. Include its mass number and atomic number. 1 mark

ii. The abundance of one of the isotopes is more than twice the abundance of the other isotope.

Given that the relative atomic mass of copper is 63.54, explain which isotope (1 or 2) has the greater abundance. 2 marks

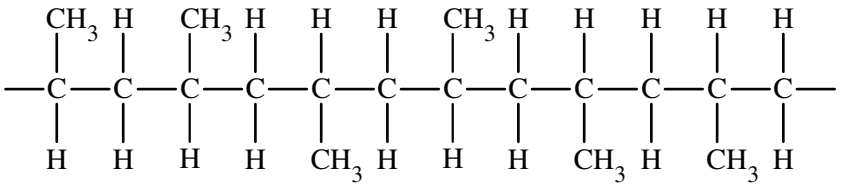
c. The electronic configuration of copper is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$. This indicates that there are 29 protons in the nucleus of a copper atom and 29 electrons in an uncharged copper atom.

State **one** other piece of information about copper that is indicated by its electronic configuration. 1 mark

d. Explain why copper recycling is an example of a circular economy rather than a linear economy. 2 marks

Question 4 (6 marks)

The structural formula of an addition polymer is shown below.



a. Explain the meaning of the term 'addition polymer'. 1 mark

b. Draw the structural formula of the monomer of this polymer. 1 mark

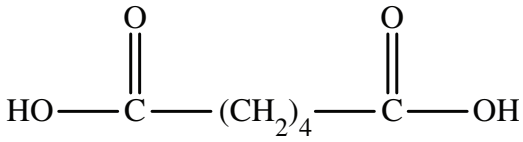
c. This polymer is a thermoplastic polymer.

With reference to structure and bonding, explain how a thermoplastic polymer differs from a thermosetting polymer. 2 marks

d. In a laboratory, how can a polymer sample be determined to be a thermoplastic or a thermosetting polymer? 2 marks

Question 5 (9 marks)

Adipic acid is widely used in the manufacture of polymers, in medical products and as an ingredient in food and drinks. The structural formula of adipic acid is as follows.



Some information about adipic acid is provided in the table below.

		Solubility in water (g L^{-1}) at various temperatures		
Formula	**Molar mass (g mol^{-1})**	**10°C**	**25°C**	**100°C**
$C_6H_{10}O_4$	146.1	14	24	1600

a. Calculate the number of hydrogen atoms in 23.6 g of $C_6H_{10}O_4$. 3 marks

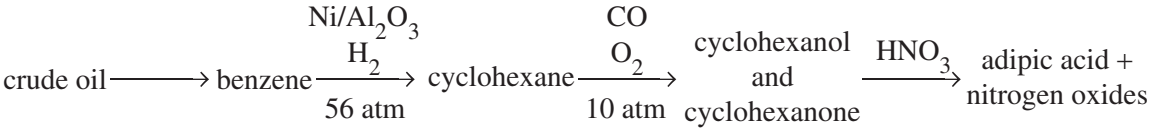
b. Heating solid $C_6H_{10}O_4$ to around 152°C causes melting but not the decomposition of the molecule.

Explain why melting occurs but decomposition of the molecule does not. 2 marks

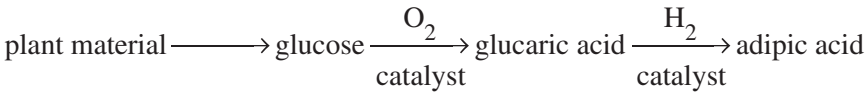
c. In terms of structure and bonding, explain the solubility of $C_6H_{10}O_4$ in water. 2 marks

d. The two main processes – A and B – used to manufacture adipic acid are shown in the following flow charts.

Process A



Process B

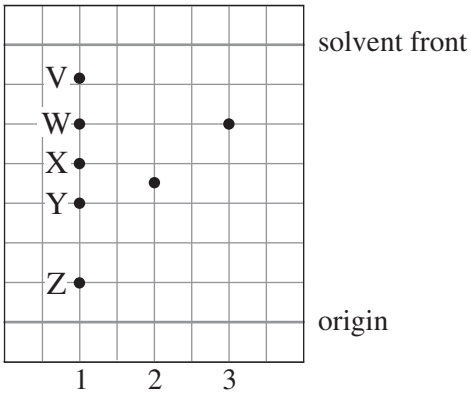


Process B is an example of plant-based biomass being used as an alternative source of organic chemicals.

Explain **two** reasons why process B is greatly preferred over process A in modern times. 2 marks

Question 6 (6 marks)

Paper chromatography was used to try to identify the components of a mixture. The results of this analysis are shown in the following diagram.



The mixture was run in lane 1, and standards were run in lanes 2 and 3.

a. Explain how many of the components (V–Z) of the mixture may possibly be identified using the results shown. 1 mark

b. What is the R_f value of the standard in lane 3? 1 mark

c. A non-polar solvent was used as the mobile phase for the analysis.
Explain which component (V–Z) has the lowest overall polarity. 2 marks

d. Explain why the components of the mixture were able to be separated in lane 1. 2 marks

Question 7 (9 marks)
Hydrochloric acid, HCl, is produced when hydrogen chloride gas is dissolved in water.

a. In industry processes, hydrogen chloride gas is produced by burning hydrogen gas in chlorine gas. This reaction occurs according to the following equation.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

Calculate the volume of hydrogen chloride gas produced at 20°C and 1.0 atm pressure when 100 kg of hydrogen gas is burnt completely. 3 marks

b. Hydrogen chloride gas is very soluble in water but will also dissolve in the organic solvent methylbenzene, $C_6H_5CH_3$. Some of the properties of the solution formed are shown in the following table.

Electrical conductivity	Effect on colour of indicators	Reaction with metals	Reaction with carbonates
none	no colour change	no reaction	no reaction

Explain why hydrogen chloride gas dissolved in methylbenzene shows none of the properties expected of an acid. 2 marks

c. Write balanced equations for the following reactions involving acids.

i. a complete chemical equation for the reaction between hydrochloric acid and zinc metal 2 marks

ii. an ionic half-equation for the reduction of the nitrate ion, NO_3^-, to gaseous N_2O in an acidified solution 2 marks

Question 8 (5 marks)
Water has unique properties that allow the existence of life on Earth.

a. Water is a group 16 hydride and boils at 100°C.

i. Outline the trend in the boiling points of the other group 16 hydrides: H_2S, H_2Se and H_2Te. 1 mark

ii. In terms of structure and bonding, explain the trend in boiling points outlined in **part a.i.** 2 marks

b. The mass of 1000 mL of water at various temperatures is shown in the following table.

Temperature (°C)	–50	–20	–10	0	10	20	50
Mass (g)	924.5	920.0	917.5	999.9	999.7	998.1	987.2

At a molecular level, explain the sharp change at 0°C. 2 marks

Question 9 (9 marks)

A bottle of sodium carbonate was left open to the air for a long period of time, and moisture from the atmosphere was absorbed by the crystals. The formula of the compound formed can be shown as $Na_2CO_3 \cdot xH_2O$. The value of x can be determined from a volumetric analysis using the data in the following table.

Mass of crystals used to make sodium carbonate solution	1.585 g
Volume of sodium carbonate solution	250.0 mL
Volume of sodium carbonate solution used in titration	20.00 mL
Average volume of 0.1000 M HCl(aq) used to reach endpoint	20.45 mL

a. Write a balanced chemical equation for the reaction used in the titration. 2 marks

b. **i.** Calculate the number of moles of HCl needed to reach the endpoint. 1 mark

ii. Determine the number of moles of sodium carbonate that reacted with the HCl in the titration. 1 mark

iii. Calculate the total number of moles of sodium carbonate in the 250.0 mL solution. 1 mark

iv. Calculate the mass of sodium carbonate in the 250.0 mL solution. 1 mark

v. Determine the mass of water in the 1.585 g of crystals that were used to make the sodium carbonate solution. 1 mark

vi. Using the answers to **parts b.iii.** and **b.v.**, calculate the mole ratio of sodium carbonate to water and, hence, find the value of x. 2 marks

Question 10 (8 marks)

Redox reactions are used widely and have a diverse range of applications. The metal aluminium is involved in numerous redox reactions that are important to society.

a. Aluminium metal was first isolated when a scientist heated solid aluminium chloride, $AlCl_3$, with sodium metal in a platinum dish.

Write a balanced chemical equation for this reaction. 2 marks

b. Aluminium can be used to extract some metals from their oxides. For example, chromium is isolated in the metal displacement reaction represented by the following equation.

$$Cr_2O_3(s) + 2Al(s) \rightarrow Al_2O_3(s) + 2Cr(s)$$

i. Explain why every metal displacement reaction is a redox reaction. 1 mark

ii. Write the balanced half-equation for the oxidation reaction. 1 mark

iii. Write the balanced half-equation for the reduction reaction. 1 mark

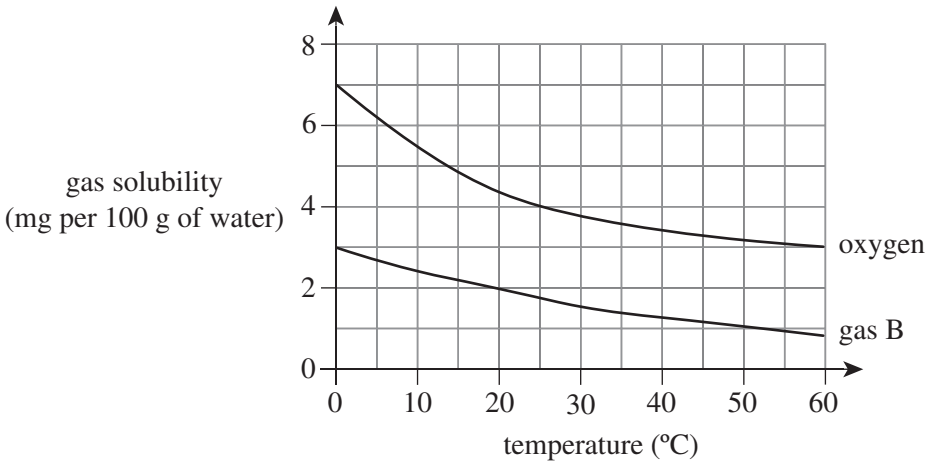
c. Aluminium is produced industrially using electrical energy. The reaction occurs according to the following equation.

$$2Al_2O_3 + 3C \rightarrow 4Al + 3CO_2$$

Calculate the mass of CO_2 produced by this reaction for each tonne of aluminium formed. (1.0 tonne = 1000 kg) 3 marks

Question 11 (6 marks)

a. The following graph shows the variation in the solubilities of two gases, oxygen and gas B, with increasing temperature.

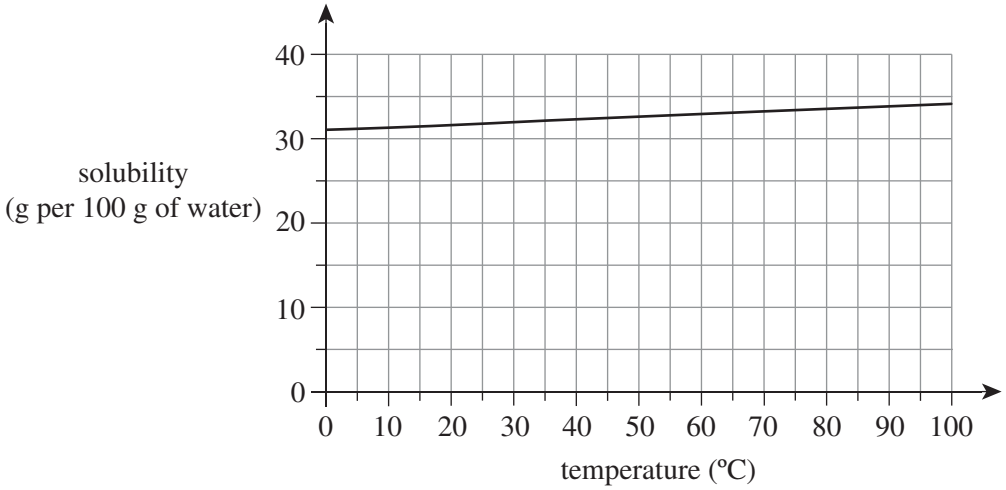


Gas B is one of the gases shown in the table below.

State whether each gas could or could not be gas B and provide an explanation for each. 3 marks

Gas	Could this gas be gas B?	Explanation
N_2		
NH_3		
CO_2		

b. The solubility curve of sodium chloride is shown below.



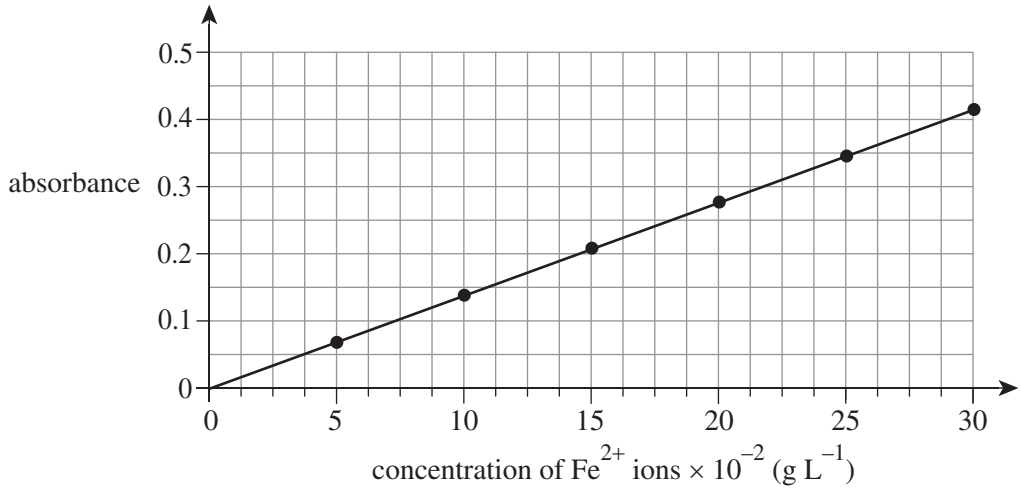
i. What is unusual about the solubility of sodium chloride in water compared to the solubility of most other ionic salts? 1 mark

ii. 30 g of sodium chloride crystals were placed in a beaker containing 50 g of water at 100°C and stirred until no more solid would dissolve. The temperature was then lowered to 20°C and the contents of the beaker was filtered.

What mass of sodium chloride crystals would have been expected to be isolated? Explain your answer. 2 marks

Question 12 (9 marks)

UV-visible spectroscopy was used to determine the concentration of iron(II) ions (Fe^{2+}) in wastewater from an industrial manufacturing process. Fe^{2+} reacts with *o*-phenanthroline, $C_{12}H_2N_2$, to produce an orange–red complex that can be analysed by spectroscopy. The following calibration curve was produced using standard solutions of Fe^{2+} of known concentration after reaction with *o*-phenanthroline.



A flow chart of how the sample of wastewater was treated is shown below.

Step 1	Step 2	Step 3	Step 4	Step 5
A 2.0 mL sample of wastewater was taken.	The sample was diluted to 50.0 mL by adding water.	A 10 mL sample was taken and diluted to 50.0 mL.	A sample was treated with *o*-phenanthroline.	The treated sample recorded an **absorbance of 0.35** in the UV-visible spectrometer.

All absorbance readings in the UV-visible spectrometer were made at a wavelength of 510 nm.

a. Outline why the wavelength of 510 nm was chosen for the absorbance readings. 1 mark

b. What piece of glassware should have been used to take the original sample in step 1? 1 mark

c. Calculate the molarity of Fe^{2+} in the original sample taken in step 1. 3 marks

d. This experiment generated primary quantitative data but contained sources of random error.

i. Why is the data classified as both primary and quantitative? 2 marks

ii. Describe **one** possible source of random error in this experiment. 1 mark

iii. Outline how the effect of the random error from **part d.ii.** could be minimised in the experiment. 1 mark

END OF QUESTION AND ANSWER BOOKLET

Neap

Trial Examination 2023

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