Neap

Trial Examination 2020

VCE Chemistry Unit 2

Written Examination

Question and Answer Booklet

Reading time: 15 minutes
Writing time: 1 hour 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	20	20	20
B	6	6	55
			Total 75

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 16 pages

Data booklet

Answer sheet for multiple-choice questions

Instructions

Please ensure that you write **your name** and your **teacher's name** in the space provided on this booklet and in the space provided 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

In a redox reaction, an oxidising agent causes

A. oxidation and in the process is reduced.
B. reduction and in the process is oxidised.
C. oxidation and in the process is oxidised.
D. reduction and in the process is reduced.

Question 2

Spectator ions

A. are always present in a redox reaction.
B. gain electrons in a chemical reaction.
C. lose a proton in an acid–base reaction.
D. are unchanged in a chemical reaction.

Question 3

In an experiment, 10 g each of water and cooking oil were heated separately from 20°C to 40°C.

Which one of the following statements is correct?

A. The water and cooking oil required equal amounts of heat to reach 40°C.
B. Water required a greater amount of heat to reach 40°C because it has a higher specific heat capacity.
C. Water required a greater amount of heat to reach 40°C because it has a lower specific heat capacity.
D. From the information given, it is not possible to conclude the comparative amounts of heat required to heat the substances to 40°C.

Question 4

Which one of the following conversions **cannot** be achieved?

A. a concentrated weak acid to a dilute weak acid
B. a dilute strong acid to a concentrated strong acid
C. a concentrated strong acid to a dilute weak acid
D. a concentrated weak base to a dilute weak base

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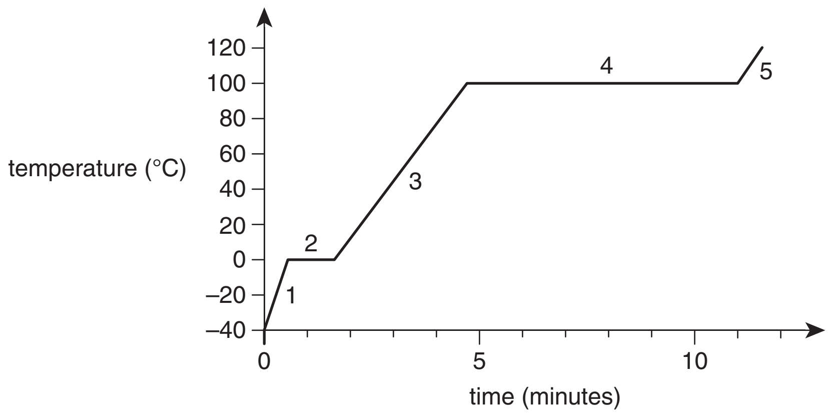
Use the following information to answer Questions 5 and 6.

Ice was heated continuously in a beaker with constant stirring. The temperature of the beaker's contents was recorded and the results were plotted as shown in the graph below. Five different sections of the graph are numbered.



Question 5

Which sections of the graph relate to the latent heat properties of water?

A. 1 and 2
B. 2 and 3
C. 2 and 4
D. 3 and 5

Question 6

Which types of bonding are being disrupted in section 3 of the graph?

A. dispersion forces and hydrogen bonding only
B. dispersion forces and covalent bonds only
C. hydrogen bonding and covalent bonds only
D. hydrogen bonding, covalent bonds and dispersion forces

Question 7

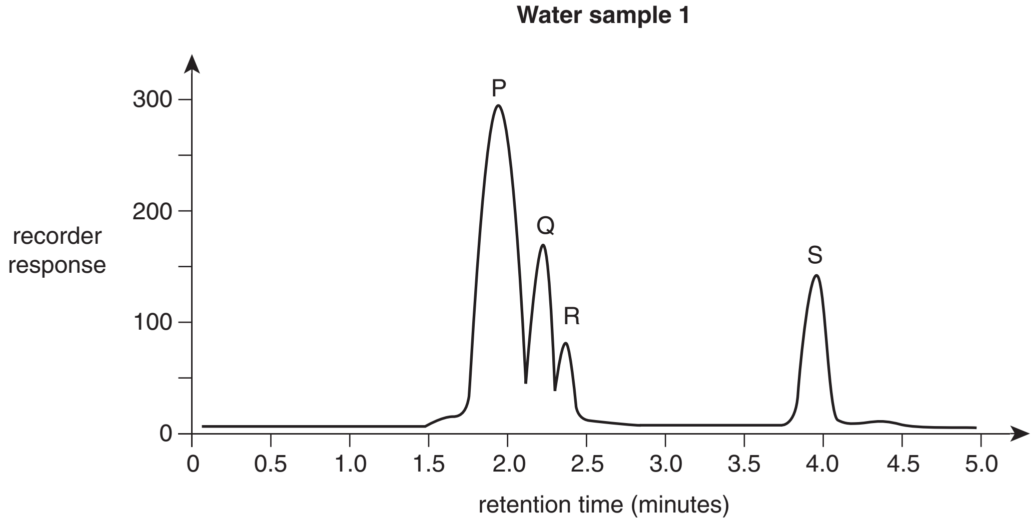
The specific heat capacity of water is 4.18 J g^{-1} $°C^{-1}$. Heat was added to 8.0 g of water to raise its temperature from 25°C to 60°C.

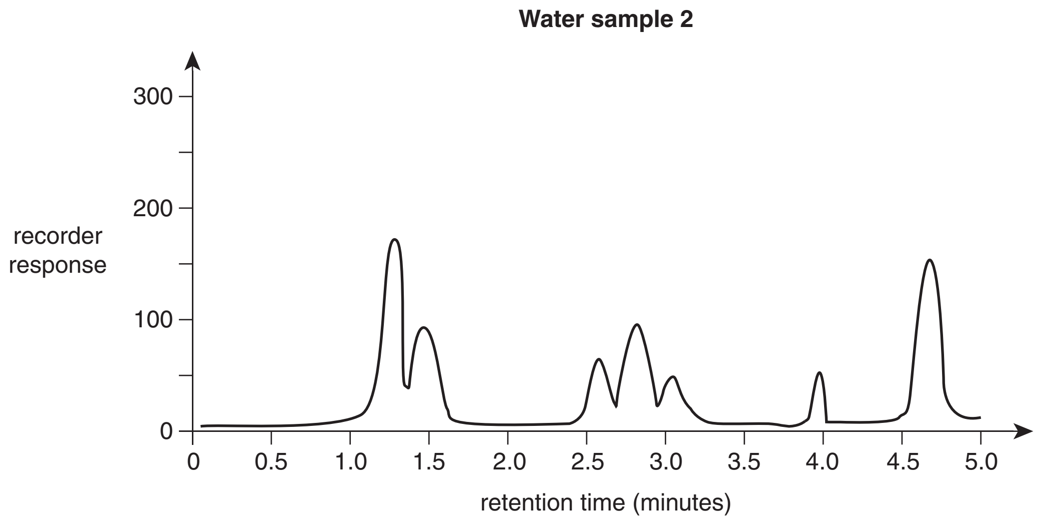
If the same amount of heat was added to 40 g of lead, which has a specific heat capacity of 0.13 J g^{-1} $°C^{-1}$, the expected temperature change in the metal would be closest to

A. 35°C
B. 175°C
C. 225°C
D. 2250°C

Use the following information to answer Questions 8–10.

Water samples taken from two different rivers were analysed by high-performance liquid chromatography (HPLC) using the same column under identical conditions. The recorded output is shown below. The peaks in one water sample are marked with the letters P, Q, R and S, representing the components of the sample that produce each peak.





Question 8

Which one of the following statements about water sample 1 is correct?

A. Component S has the strongest attraction to the mobile phase.

B. Component P will be removed from the column last.

C. Component P is twice the concentration of component S.

D. Component R has the lowest concentration of any component.

Question 9

Which of the components present in water sample 1 are **not** likely to be present in water sample 2?

A. P and Q only

B. R and S only

C. P, Q and R only

D. Q, R and S only

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Question 10

Which one of the following steps is **not** required to find the concentration of component S in water sample 1?

A. Construct a calibration curve of peak area of standard solutions of component S against concentration.

B. Record the absorbance at many different wavelengths of the standard solutions of component S as they elute from the HLPC column.

C. Make up standard solutions of component S and analyse these by HPLC.

D. Find the peak area of component S in water sample 1 from the HPLC output.

Question 11

A conjugate redox pair is

A. two chemical species that react with each other in a redox reaction.

B. two related chemical species where one is an oxidising agent and one is a reducing agent.

C. two related chemical species that differ from each other by one or more protons.

D. always present in redox reactions as well as in acid–base reactions.

Use the following information to answer Questions 12 and 13.

Sodium reacts with chlorine gas according to the following equation:

$$2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$$

Question 12

The reduction half-equation for this reaction is

A. $Na(s) \rightarrow Na^+(s) + e^-$

B. $Na(s) + e^- \rightarrow Na^+(s)$

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

D. $Cl_2(g) \rightarrow 2Cl^-(s) + 2e^-$

Question 13

If 55 g of sodium is reacted with 80 g of chlorine gas in a closed vessel, what chemicals will remain in the vessel after reaction is complete?

A. NaCl(s) only

B. Na(s) and NaCl(s) only

C. $Cl_2(g)$ and NaCl(s) only

D. $Cl_2(g)$, Na(s) and NaCl(s)

Question 14

At 25°C, the pH of solution X is 3 and the pH of solution Y is 6.

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

A. Solution X has more than twice the hydrogen ion concentration of solution Y.

B. The hydroxide ion concentration in solution Y is lower than that in solution X.

C. Solution X is acidic and so has no hydroxide ions present.

D. Solution X must be a strong acid and solution Y must be a weak acid.

Question 15

The reactivity series for metals M, N, O and P is as follows:

M < N < O < P

Which one of the following statements is a valid conclusion that can be drawn from this information?

A. P would displace any of the metals from a solution of their ions.

B. M would displace O from a solution of O^{2+} ions.

C. N would react readily with a solution of P^{2+} ions.

D. N^{2+} ions would react with M^{2+} ions to produce metal N.

Use the following information to answer Questions 16 and 17.

The ionic product (K_w) of pure water varies with temperature as shown in the table below.

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

Question 16

The pH of pure water at 35°C is

A. 6.57

B. 6.83

C. 7.00

D. 7.17

Question 17

Which one of the following statements about pure water at different temperatures is correct?

A. As the temperature of pure water increases, the pH increases.

B. For pure water at 15°C, $[OH^-]$ is greater than $[H_3O^+]$.

C. The hydrogen ion concentration of pure water is greater at 0°C than at 25°C.

D. Regardless of the temperature, pure water is always neutral.

Question 18

The concentration of an aqueous solution of ethanol (C_2H_5OH) was expressed using a number of different units.

Which one of the following is **not** equivalent to the other stated concentrations of ethanol?

A. 0.246 mol L^{-1}

B. 11.3 g L^{-1}

C. 1.13% m/v

D. 1.13×10^3 ppm

Question 19

20.0 mL of a 0.10 M solution of the weak base ammonia, NH_3, is titrated with a 0.10 M solution of hydrochloric acid, HCl, using methyl red as an indicator.

It would be expected that the endpoint would occur with a colour change of

A. yellow to red, and a titre of 20.0 mL.

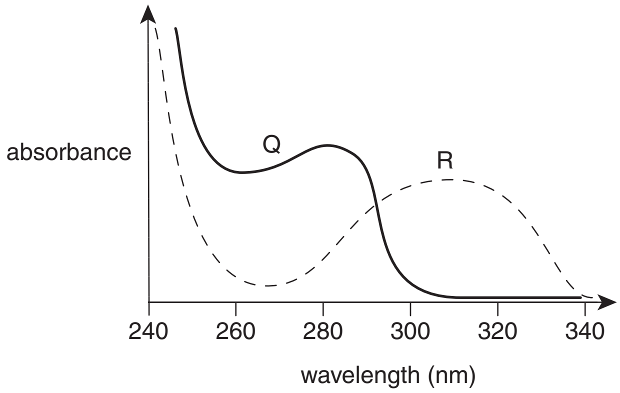
B. yellow to red, and a titre of less than 20.0 mL.

C. red to yellow, and a titre of 20.0 mL.

D. red to yellow, and a titre of more than 20.0 mL.

Question 20

A water sample under analysis contains two substances, Q and R. The concentration of both substances is to be determined by UV-visible spectroscopy. The absorption spectra of Q and R are shown below.



Which wavelength should be used for the absorbance measurements to determine the concentration of substance R in the water sample?

A. 260 nm

B. 285 nm

C. 295 nm

D. 310 nm

END OF SECTION A

SECTION B

Instructions for Section B

Answer **all** questions in the spaces provided. Write using blue or black pen.

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

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

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

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

Question 1 (12 marks)

Sulfuric acid, H_2SO_4, is a strong acid and is one of the most widely manufactured chemicals in the world.

a. Sulfuric acid reacts with water in two stages. The first stage is represented by the following equation:

$$H_2SO_4(l) + H_2O(l) \rightarrow HSO_4^-(aq) + H_3O^+(aq)$$

i. Write the equation for the second stage. 1 mark

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ii. Why is sulfuric acid classed as a strong acid? 1 mark

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b. When manufactured, sulfuric acid is a viscous liquid with a concentration of approximately 18 M.

What volume of 18 M sulfuric acid would be diluted to make 125 L of 1.5 M sulfuric acid? 2 marks

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c. Sulfuric acid can be used to prepare the volatile hydrochloric acid, HCl. The reaction is shown by the following equation:

$$H_2SO_4(l) + NaCl(s) \rightarrow HCl(g) + NaHSO_4(s)$$

The pH of 1.0 M hydrochloric acid is 0, whereas the pH of 1.0 M sulfuric acid is less than 0.

Explain why the two acids have different pH values. 2 marks

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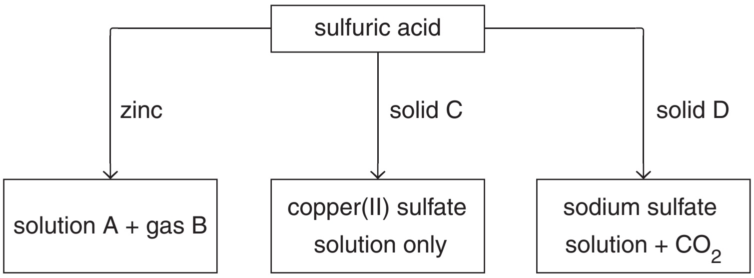
d. A number of chemical reactions involving dilute sulfuric acid are shown in the diagram below.



i. Name each of the substances shown in the table below. 3 marks

Solution A	**Gas B**	**Solid D**

ii. Write a balanced equation for a possible chemical reaction of sulfuric acid with solid C. 2 marks

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iii. Circle **one** of the terms below to identify the type of reaction that occurs when sulfuric acid reacts with zinc. 1 mark

acid–base   redox   precipitation

Question 2 (8 marks)

The preparation of insoluble salts by precipitation is a standard laboratory procedure. To prepare a sample of the insoluble compound lead(II) sulfate, the steps below were followed.

1. Prepare 50 mL of 0.100 M K_2SO_4 solution and 50 mL of 0.100 M $Pb(NO_3)_2$ solution by dissolving the solids separately in water.
2. Mix the prepared aqueous solutions in a beaker.
3. Filter the contents of the beaker and, after washing the beaker with a small amount of water, pour the washings onto the filter paper.
4. Pour a small amount of cold distilled water onto the solid trapped on the filter paper.
5. Dry the filter paper and determine the mass of the solid.

a. Calculate the mass of solid potassium sulfate required to make the K_2SO_4 solution in step 1. 2 marks

b. Write a balanced ionic equation for the reaction in step 2. 1 mark

c. What was the purpose of filtering the washings in step 3? 1 mark

d. In step 3, the filtrate is the material that passed through the filter paper.

List the ions present in the filtrate. 1 mark

e. One aim of the preparation of an insoluble salt is to maximise the yield of the salt.

i. If the yield was 100%, 1.52 g of lead(II) sulfate would have been produced in this preparation. The actual mass produced was 1.38 g.

Calculate the percentage yield for this preparation of lead(II) sulfate. 1 mark

ii. Suggest **two** reasons why the yield was not 100%. 2 marks

Question 3 (11 marks)

There is wide variation in the solubility of substances in water.

a. The solubility of solid sodium sulfate, Na_2SO_4, in water (in grams of solute per 100 g of water) at various temperatures is shown in the table below.

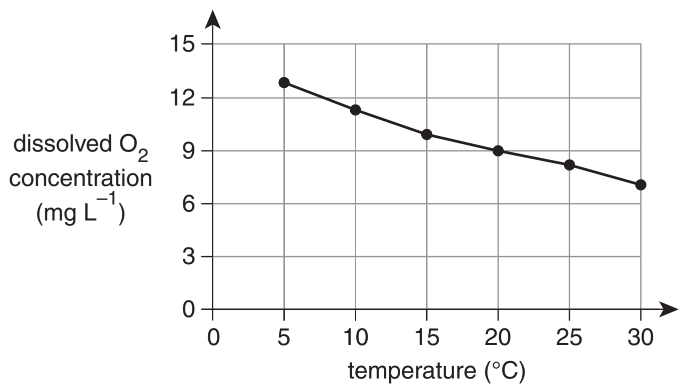
Solubility (g per 100 g)	58	56	52	50	47	45
Temperature (°C)	10	20	30	40	50	60

i. What is unusual about the trend in the solubility of the solid shown in the table? 1 mark

ii. Describe how 50 mL of pure water at 30°C could be used to make a **saturated** solution of sodium sulfate. 2 marks

iii. How could it be easily shown that the solution described in **part a.ii.** is saturated? 1 mark

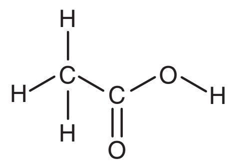
b. The variation in the solubility of oxygen gas in water is shown in the graph below.



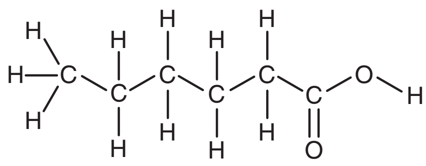
With reference to the graph shown above, explain why environmental laws prevent industries from returning heated wastewater into natural waterways such as rivers. 2 marks

c. The solubility of two liquids, compound A and compound B, at 20°C is shown below.

Compound A



Compound B



Compound A is soluble in all proportions in water, while the solubility of compound B is 1.0 g per 100 g of water.

i. With the aid of an appropriate drawing of the molecular interactions and labelling of relevant bond types, explain the solubility of compound A in water. 3 marks

ii. Why is the solubility of compound B so low in comparison to compound A? 2 marks

Question 4 (11 marks)

Samples from the wastewater storage on an industrial site were taken and analysed by atomic absorption spectroscopy (AAS) to find the cadmium, Cd, concentration.

a. **i.** When wastewater samples were taken, sampling protocols were followed to ensure that the analysis was accurate, reliable and valid.

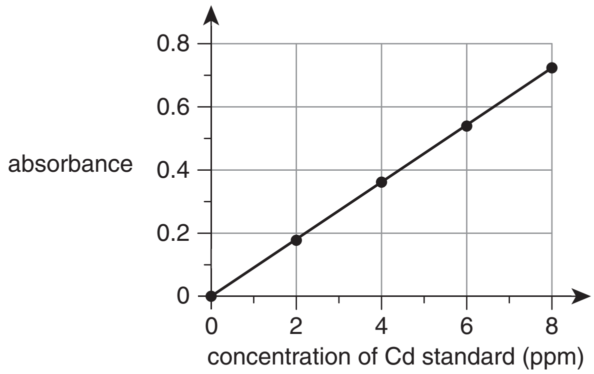
In the table below, describe the procedures that should be used in sampling to satisfy each stated requirement. 2 marks

Requirement for valid sampling	**Procedure**
Samples are representative of all the wastewater	
Samples are kept securely and safely for transport and storage	

ii. In this situation, the cadmium could be classed as a chemical contaminant.

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

b. A set of standard solutions was prepared and the absorbance of each solution was measured using an appropriately set atomic absorption spectrophotometer. The calibration graph shown below was generated.



The samples of wastewater were diluted by a factor of five before the absorbance of each could be determined.

i. Suggest why the dilution was necessary. 1 mark

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ii. The absorbance of one diluted sample was 0.45.

Determine the concentration, in ppm, of the **undiluted** sample. 2 marks

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iii. Calculate the mass of cadmium, in kg, in 5000 litres of the wastewater. 2 marks

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c. The concentration of cadmium in the wastewater could have also been determined using gravimetric analysis.

i. Outline **one** advantage of using gravimetric analysis instead of AAS. 1 mark

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ii. Outline **two** advantages of using AAS instead of gravimetric analysis. 2 marks

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Question 5 (8 marks)

A large quantity of water that had been used in the extraction of minerals in mining was stored so that it could be treated before being released into the environment. One treatment involved the low pH of the water being returned to neutral. Samples of the water were taken and titrated with standardised sodium hydroxide, NaOH, solution. The following results were obtained:

Volume of water samples analysed:	20.00 mL
Concentration of NaOH solution:	0.127 M
Average titre of NaOH solution required to reach endpoint:	22.35 mL
Stoichiometric ratio between H^+ ions and OH^- ions:	1 : 1

a. **i.** Calculate the average number of moles of NaOH used in each titration. 1 mark

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ii. Determine the number of moles of H^+ ions in each 20.00 mL sample of the water. 1 mark

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iii. Calculate the concentration of H^+ ions, in mol L^{-1}, in the stored water. 1 mark

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iv. Calculate the pH of the stored water. 1 mark

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b. Explain **one** reason why it is necessary to return the stored water to a close to neutral pH before it is released into local waterways or rivers. 2 marks

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c. A standard solution of NaOH cannot be prepared by weighing a mass of solid NaOH and dissolving it in a set volume of water.

Suggest **one** reason why this is the case. 2 marks

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Question 6 (5 marks)

A number of contaminants may be found in water from wells. These include arsenic, As, a highly toxic species, and hydrogen sulfide gas, H_2S, known as 'rotten egg gas'. Various water treatment processes involving both acid–base and redox reactions are employed to remove these contaminants to produce drinkable water.

a. Arsenic may be removed by adsorption to solid iron compounds to create particles large enough to be filtered from the water. The following reaction occurs when iron(III) chloride solution is added to well water:

$$3H_2O(l) + FeCl_3(aq) \rightarrow Fe(OH)_3(s) + 3HCl(aq)$$

The $Fe(OH)_3(s)$ strongly adsorbs arsenic species, providing the pH is low.

i. Circle **one** of the terms below to identify how water is acting during the reaction between water and iron(III) chloride. 1 mark

acid base oxidising agent reducing agent

ii. How does the reaction between water and iron(III) chloride ensure that the pH is low? 1 mark

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b. A second water treatment removes hydrogen sulfide gas by reaction with manganese dioxide, MnO_2, which is coated on to the surface of a filtering medium made from naturally occurring glauconite greensand. The hydrogen sulfide is oxidised to solid sulfur, which can be filtered from the water. The manganese dioxide is reduced to $Mn^{2+}(aq)$.

i. Write a balanced half-equation for the oxidation of hydrogen sulfide to sulfur. 1 mark

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ii. Write a balanced half-equation for the reduction of $MnO_2(s)$ to $Mn^{2+}(aq)$. 1 mark

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iii. In various situations MnO_2 is able to act as an oxidising agent and a reducing agent. Give the chemical symbol or formula for another species that can act as both an oxidising agent and a reducing agent. 1 mark

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END OF QUESTION AND ANSWER BOOKLET

Neap

Trial Examination 2020

VCE Chemistry Unit 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.

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1. Periodic table of the elements

Key: atomic number **79**, symbol of element **Au**, relative atomic mass 197.0, name of element gold

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** 31.0 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

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 holmium	**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 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	$n = \frac{m}{M}$; $n = cV$

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

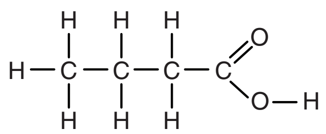
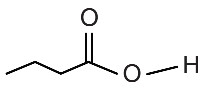
Metric (including SI) prefixes	Scientific notation	Multiplying factor
giga (G)	10^9	1 000 000 000
mega (M)	10^6	1 000 000
kilo (k)	10^3	1000
deci (d)	10^{-1}	0.1
centi (c)	10^{-2}	0.01
milli (m)	10^{-3}	0.001
micro (μ)	10^{-6}	0.000001
nano (n)	10^{-9}	0.000000001
pico (p)	10^{-12}	0.000000000001

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 2020

VCE Chemistry Unit 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
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D

11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D
16	A	B	C	D
17	A	B	C	D
18	A	B	C	D
19	A	B	C	D
20	A	B	C	D