Neap

Trial Examination 2021

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 characteristics applies to transition metals but **not** to the main group metals?

A. They have atoms with one, two or three electrons in their outer electron shell.

B. They form ions with variable charges.

C. They can be hammered into shapes without fracturing.

D. They conduct electricity in both the solid and molten states.

Question 2

A chemical particle has the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$.

This particle is most likely to be an

A. uncharged atom of an element located in the first transition series.

B. unreactive, noble gas that is from the third period.

C. ion of a metallic element that is positively charged.

D. atom of a non-metallic element that has lost electrons.

Question 3

Which two features of elements are used to formulate the modern periodic table?

A. mass number and metallic character

B. atomic number and mass number

C. electron configuration and atomic number

D. chemical reactivity and electron configuration

Question 4

Which one of the following is the valence shell electron-pair repulsion (VSEPR) model mainly used to predict?

A. electrical conductivity of substances

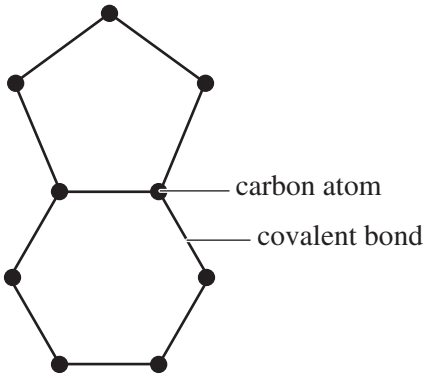
B. shapes of molecules

C. polar character of bonds within a molecule

D. electronegativity of elements

Use the following information to answer Questions 5 and 6.

The diagram below shows the arrangement of some of the atoms in a substance that is an elemental form of carbon.



Question 5

Which elemental form of carbon is shown?

A. graphite

B. fullerene

C. diamond

D. graphene

Question 6

The substance depicted in the diagram will

A. conduct electricity, as there are delocalised electrons in the structure.

B. conduct electricity, as carbon ions form and these carry the charge.

C. not conduct electricity, as all electrons are localised and so no charges move.

D. not conduct electricity, as only ions carry charge and no ions are present.

Question 7

Which one of the following rows correctly shows the details of the fourth shell of an atom, using the Schrödinger model?

	Number of subshells	Number of orbitals	Number of d-type orbitals
A.	4	32	1
B.	4	16	5
C.	16	32	1
D.	16	16	5

Question 8

Each of the isotopes ^{12}C, ^{13}C and ^{14}C have the same

A. number of neutrons and electrons.

B. ground state electron configuration and nuclear mass.

C. number of protons and mass number.

D. atomic number and number of outer-shell electrons.

Question 9

Which one of the following pairs of molecules have the same shape?

A. CO_2 and HCl

B. CH_4 and SF_6

C. NH_3 and H_2O

D. N_2 and H_2S

Question 10

An experiment was conducted to determine the order of reactivity of four metals: Q, R, X and Y.
The observations in the experiment include the following.

- All metals reacted with air and metal R reacted the fastest.
- There was no visible reaction of metal Q with water and metal Y reacted slowly.
- Metal X did not react with dilute hydrochloric acid, but all other metals produced bubbling.

What is the order of increasing reactivity of the metals?

A. R < Y < Q < X

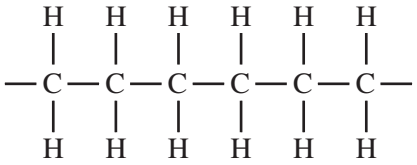
B. X < R < Y < Q

C. R < Q < X < Y

D. X < Q < Y < R

Use the following information to answer Questions 11 and 12.

Part of the structure of an addition polymer is shown in the diagram below.



Question 11

This polymer is best described as a

A. thermosetting plastic, as it will soften when heated to moderate temperatures.

B. thermosetting plastic, as it will char when heated to high temperatures.

C. thermosoftening plastic, as it will soften when heated to moderate temperatures.

D. thermosoftening plastic, as it will char when heated to high temperatures.

Question 12

What is the relative molecular mass of the monomer used to make this addition polymer?

A. 28

B. 30

C. 42

D. 44

Use the following information to answer Questions 13 and 14.

An experiment was conducted to investigate crystal formation using common table salt (NaCl). Different masses of NaCl were dissolved separately in 100 mL of water at the same temperature in numbered beakers. The water in each of the beakers was evaporated over different times until dryness was achieved. The table below shows the set-up of the experiment.

Beaker	1	2	3	4
Mass of NaCl dissolved in 100 mL of water	10 g	10 g	30 g	30 g
Time taken for evaporation to dryness	2 hours	12 hours	2 hours	12 hours

Question 13

Which beaker will contain crystals of the smallest size?

A. 1

B. 2

C. 3

D. 4

Question 14

In the experiment, the size of the crystals in each beaker was determined using a simple binocular microscope.

Which one of the following best describes what could be seen using the microscope?

A. protons, neutrons and electrons of the ions arranged in a lattice

B. individual sodium ions and chloride ions arranged in a regular array

C. crystals consisting of spheres stacked on top of each other

D. small, regular-shaped pieces with flat sides similar to small cubes

Question 15

An organic compound has the molecular formula $C_5H_{10}O_2$.

Which one of the following could **not** be the name of the compound?

A. ethyl propanoate

B. butyl methanoate

C. pentane-1,2-diol

D. pentanoic acid

Question 16

A gas is produced in the reaction of an acid with

A. either a metal or a metal carbonate.

B. either a metal hydroxide or a metal carbonate.

C. either a metal or a metal hydroxide.

D. any one of a metal, a metal carbonate or a metal hydroxide.

Question 17

What types of bonding are present in a solution of sodium chloride dissolved in water?

A. dispersion forces, hydrogen bonding and ion–dipole attraction only

B. hydrogen bonding, ion–dipole attraction and covalent bonds only

C. ion–dipole attraction, covalent bonds and dispersion forces only

D. covalent bonds, dispersion forces, hydrogen bonding and ion–dipole attraction

Question 18

Which one of the following properties or uses of water is **most** influenced by the value for the specific heat capacity of water?

A. Water dissolves many polar and ionic substances.

B. Water is used in car radiators as an engine coolant.

C. Water expands on freezing.

D. Water is sprayed onto skin in hot weather as a cooling mechanism.

Question 19

2.00 g of solid KNO_3 was dissolved in 350 mL of pure water.

What is the molarity of the solution?

A. 0.0198 M

B. 0.0565 M

C. 1.32 M

D. 5.78 M

Use the following information to answer Questions 20 and 21.

In a 0.50 M solution of a particular acid, six molecules in every thousand react with water molecules to produce hydrogen ions.

Question 20

This solution is best described as a

A. concentrated strong acid.

B. dilute strong acid.

C. concentrated weak acid.

D. dilute weak acid.

Question 21

What is the pH of this acidic solution?

A. 0.30

B. 0.78

C. 2.5

D. 6.0

Question 22

Which one of the following species is amphiprotic?

A. HCO_3^-

B. S^{2-}

C. H_3O^+

D. H_2SO_4

Use the following information to answer Questions 23–25.

An accidental spill at a food manufacturing industry released vinegar into stormwater drains. Volumetric analysis was used to determine the concentration of the monoprotic ethanoic acid present in the vinegar so that it could be neutralised. A 20.0 mL sample of the vinegar reacted with 23.45 mL of 0.945 M sodium hydroxide solution using a phenolphthalein indicator. The chemical equation for the analysis is as follows.

$$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$$

Question 23

During the titration experiment the following glassware was used.

I 20.0 mL pipette

II 50.0 mL burette

III 150 mL conical flask

Which glassware may be given a final rinse with water prior to use without affecting the outcome of the titration?

A. I and II only

B. I, II and III

C. III only

D. none of I, II or III as all glassware must be dry before use

Question 24

Phenolphthalein was chosen as the indicator in this analysis because it gives a sharp endpoint when a

A. strong base reacts with a strong acid.

B. weak base reacts with a weak acid.

C. weak base reacts a strong acid.

D. strong base reacts with a weak acid.

Question 25

What is the concentration of ethanoic acid in the vinegar?

A. 0.0222 M

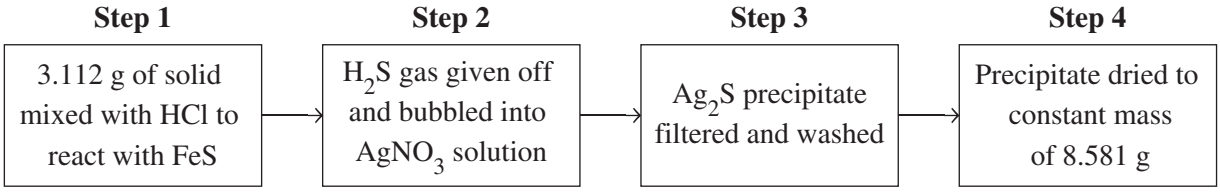
B. 0.443 M

C. 0.903 M

D. 1.11 M

Use the following information to answer Questions 26 and 27.

Gravimetric analysis was used to check the percentage purity of a sample of iron(II) sulfide (FeS) using the method shown in the flow chart below.



The reaction in step 1 is shown by the following ionic equation.

$$FeS(s) + 2H_3O^+(aq) \rightarrow Fe^{2+}(aq) + H_2S(g) + 2H_2O(l)$$

Question 26

Why is it important that $AgNO_3$ is used in excess in step 2?

A. to lower the mass of the precipitate so that filtration is quicker

B. to ensure that some unreacted $AgNO_3$ can be removed in step 3

C. to ensure that none of the gas remains unreacted

D. to prevent some precipitate being lost in filtration

Question 27

What percentage of the 3.112 g of solid in step 1 was impurities?

A. 2.2%

B. 4.4%

C. 8.8%

D. greater than 8.8%

Question 28

Which one of the following solutions would be expected to show the highest electrical conductivity at 25°C?

A. 0.20 M $Ca(NO_3)_2$

B. 0.25 M NaCl

C. 0.30 M NH_3

D. 0.40 M CH_3OH

Use the following information to answer Questions 29 and 30.

The solubility (in g per 100 g of water) of two substances at different temperatures is shown in the table below.

	0°C	**20°C**	**60°C**
Substance X	90	53	17
Substance Y	77	82	110

Question 29

Substance X is most likely to be a

A. group 18 gas.

B. compound composed of positive and negative ions.

C. non-polar covalent compound.

D. gas composed of polar molecules.

Question 30

Substance Y is most likely to be a

A. group 18 gas.

B. compound composed of positive and negative ions.

C. non-polar covalent compound.

D. gas composed of polar molecules.

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.

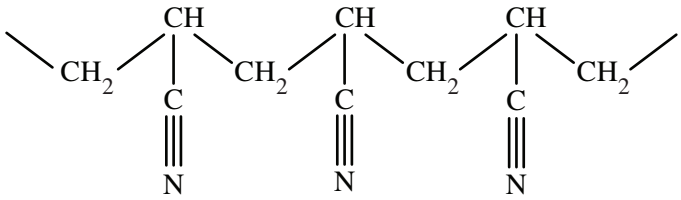
Show all working in your answers to numerical questions; no marks will be given for an incorrect answer unless it is accompanied by details of the working.

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 (5 marks)

a. The addition polymer polyacrylonitrile (PAN) is used in the production of carpets and fibres. A section of the polymer is shown in the diagram below.



Draw a structural diagram for the monomer used to form PAN. 1 mark

b. **i.** Draw a structural diagram of a five-carbon alcohol molecule. 1 mark

ii. Name the molecule drawn in **part b.i.** 1 mark

_____

c. A metal ion with a +2 charge has 23 protons in its nucleus. It forms a compound with a halogen ion containing 17 protons.

Give the name and formula of the compound. 2 marks

Name _____

Formula _____

Question 2 (12 marks)

The element hydrogen has three isotopes as shown in the table below.

Isotope	Isotopic symbol	Relative isotopic mass
protium	^{1}H	1.008
deuterium	^{2}H	2.014
tritium	^{3}H	3.016

a. The relative atomic mass of hydrogen is 1.0. Using information from the table above, it might appear that the value should be closer to 2.0.

Explain this apparent contradiction. 2 marks

b. In some versions of the modern periodic table, hydrogen is placed at the top of the group 1 elements, whereas in other versions it is not placed at the top of any group.

i. Give **one** reason that supports placing hydrogen at the top of group 1. 1 mark

ii. Give **one** reason that does **not** support placing hydrogen at the top of group 1. 1 mark

c. Hydrogen gas consists of diatomic molecules, H_2, whereas helium gas consists of single atoms, He.

i. Explain the difference in the composition of the two gases. 2 marks

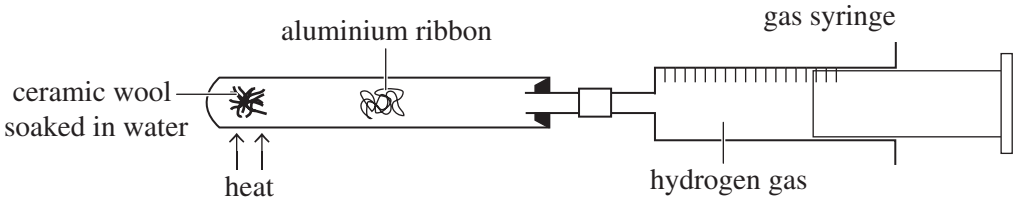
ii. The interaction between the particles of each gas at very low temperatures is of the same type.

Name this type of intermolecular attraction. 1 mark

d. Hydrogen gas is produced during the reaction of aluminium metal with steam. The relevant reaction is represented by the following equation.

$$\text{aluminium} + \text{water (as steam)} \rightarrow \text{aluminium oxide} + \text{hydrogen gas}$$

This chemical reaction was used in the experiment shown below.



Mass of aluminium ribbon reacted in the experiment 0.859 g

Mass of hydrogen gas formed in the experiment 0.0954 g

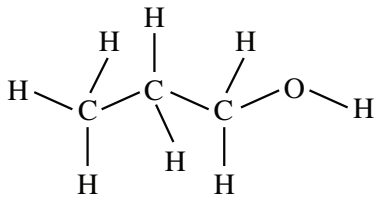
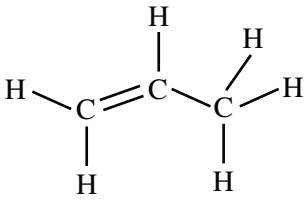
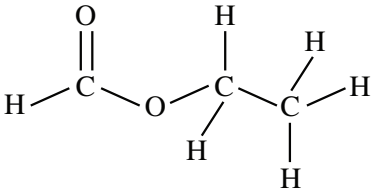
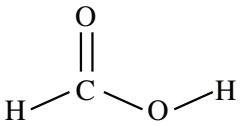
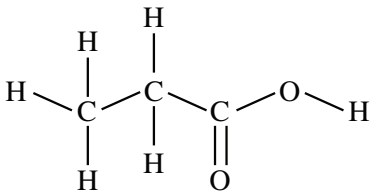
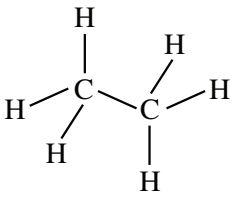
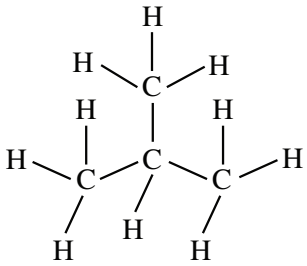
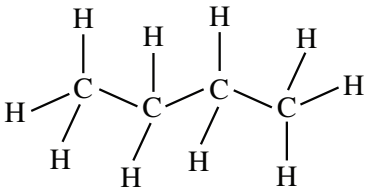
i. Based on its chemical formula, calculate the percentage by mass of hydrogen in water. 1 mark

ii. Using the information in **part d.i.** and the mass of hydrogen gas formed in the experiment above, calculate the mass of oxygen atoms that reacted with the aluminium to produce aluminium oxide. 2 marks

iii. By calculation, show that the empirical formula of aluminium oxide is Al_2O_3. 2 marks

Question 3 (12 marks)

The structural formulas of a range of carbon-based compounds are shown in the table below.

A. 	**B.** 	**C.** 
D. 	**E.** 	**F.** 
G. 	**H.** 	**I.** 

a. Use the letters (A to I) from the table to identify the compounds in the following questions. The letters may be used once, more than once or not at all.

i. Identify the alkyne in the table. 1 mark

_____

ii. Identify **one** carboxylic acid in the table. 1 mark

_____

iii. Which compound has a relative molecular mass of 46? 1 mark

_____

iv. Which **two** compounds are isomers but are not alkanes? 1 mark

_____

v. Identify **one** compound that has the molecular formula identical to its empirical formula. 1 mark

_____

vi. Identify the compound with all of the features listed below. 1 mark

- unbranched molecule
- component of crude oil with molar mass greater than 30 g mol^{-1}
- used primarily as a fuel

vii. Of the compounds with three carbon atoms per molecule, which one has the lowest boiling point? 1 mark

b. Compounds G and I have the same molar mass.

Explain which compound, if either, has the higher boiling point. 2 marks

c. Compound E has a relative molecular mass of 74.0.

What is the total number of atoms in 0.935 g of this compound? 3 marks

Question 4 (10 marks)

Magnesium is an industrially important metal that is found in deposits only as an ore. Magnesium ore is a compound of magnesium.

a. Explain why magnesium is only found as an ore and never in deposits as a pure metal, in the way that gold is found. 2 marks

b. One method used to extract magnesium from its ore involves converting magnesium hydroxide to magnesium chloride. This is then melted and, using electricity, magnesium is isolated according to the following equation:

$$MgCl_2 \rightarrow Mg + Cl_2$$

i. Magnesium chloride must be molten to conduct electricity because solid magnesium chloride is not conductive.

In terms of structure and bonding, explain why the molten compound conducts, but the solid compound does not. 2 marks

ii. A temperature of 700°C is used to melt solid magnesium chloride.

In terms of structure and bonding, explain why such a high temperature is required to melt the magnesium chloride. 2 marks

iii. Apart from electrical conductivity and high melting point, name **one** other property that magnesium chloride is likely to exhibit. 1 mark

c. Magnesium is located in period 3 of the periodic table.

i. Which metallic element in period 3 is least reactive? 1 mark

ii. Which element in period 3 has the largest atomic radius? 1 mark

iii. Which element in period 3 has the lowest first ionisation energy? 1 mark

Question 5 (9 marks)

a. Using relevant chemical concepts, explain why ice floats on liquid water. 3 marks

b. The following list contains statements about water, its properties and its uses. There are a number of incorrect statements in the list.

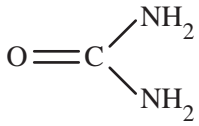
1. The high specific heat capacity of water is mainly due to hydrogen bonding.
2. Pure water has a pH of 7 irrespective of the temperature of the water.
3. Compared to other liquids, water has a low latent heat of vaporisation.
4. Constantly heating ice at 0°C results in an immediate temperature increase.
5. $[H_3O^+] = [OH^-]$ for all neutral solutions, regardless of the temperature.
6. Twenty percent of the freshwater on Earth can be used for drinking, watering crops and other similar uses.

In the table below, identify three incorrect statements, and explain why each statement is incorrect. 6 marks

Incorrect statement	Why the statement is incorrect

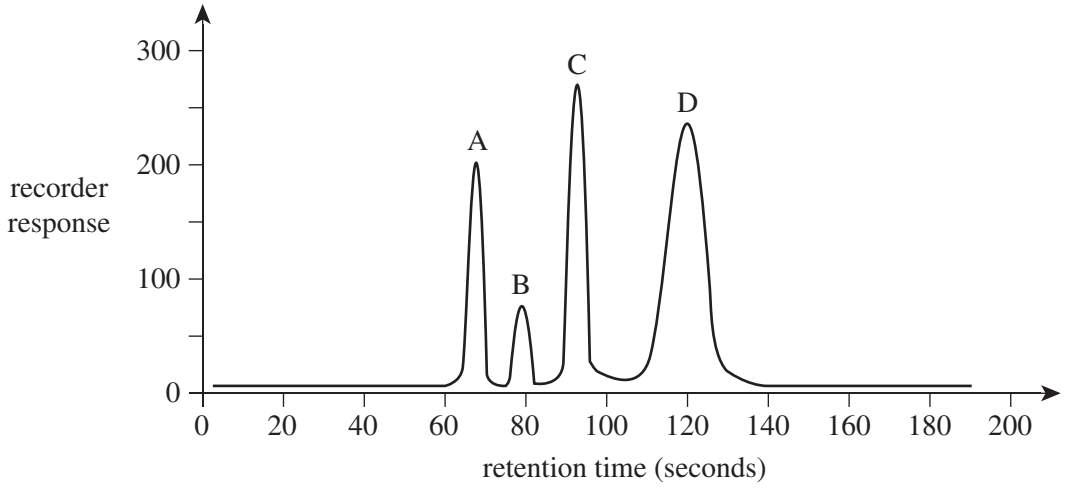
Question 6 (7 marks)

Urea is an important compound used in industry to manufacture other chemicals, and is also used by farmers as a fertiliser because it contains a high proportion of nitrogen. Urea has a very high solubility of over 1000 g per litre of water. The structure of urea is shown below.



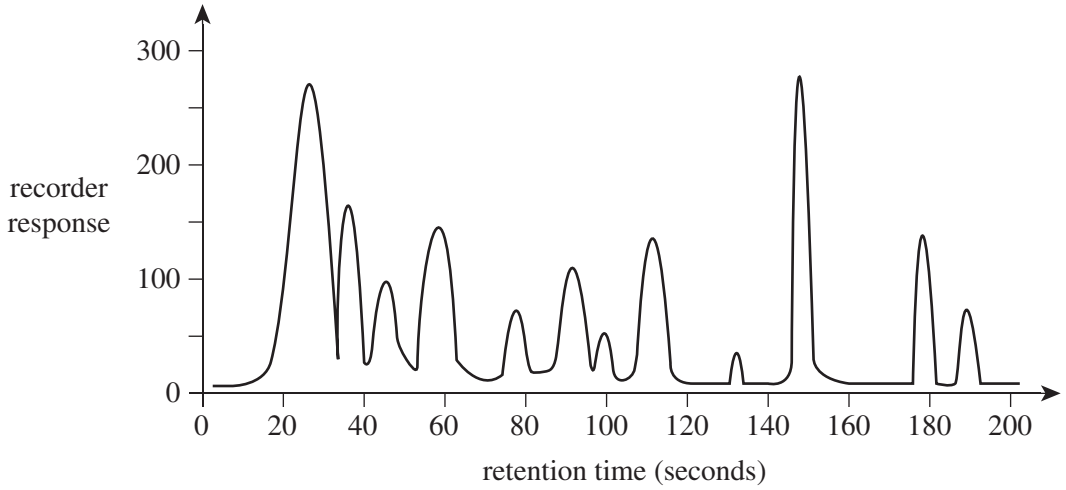
a. With reference to structure and bonding, explain why urea is highly soluble in water. In your answer, include a diagram of water molecules interacting with a urea molecule and label this interaction. 3 marks

b. Urea is used to manufacture pesticides for use by farmers to control unwanted insects. High-performance liquid chromatography (HPLC) was used to analyse a mixture of four such pesticides, labelled A, B, C and D. The output of the analysis is shown below.



i. Which pesticide has the strongest attraction to the stationary phase in the HPLC column? Explain your choice. 2 marks

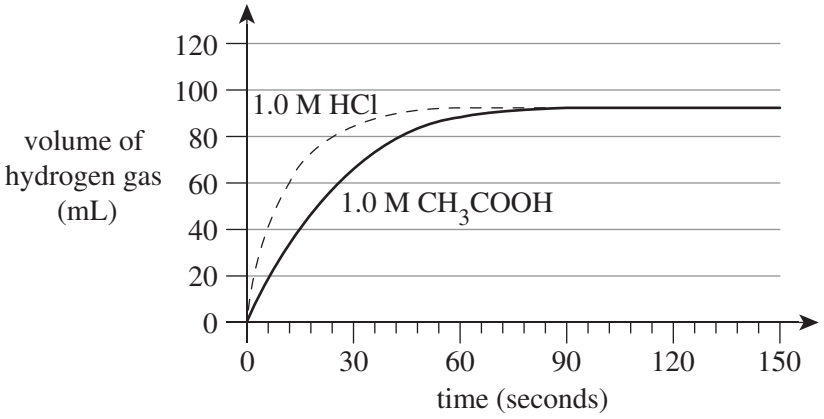
ii. A certain farmer uses urea-based pesticides. After dead fish were found in a dam on the farmer's property, water samples were taken and analysed by HPLC using the same column under identical conditions. The output of the analysis is shown below.



Based on the HPLC results, explain which of the pesticides could **not** be implicated in the deaths of the fish. 2 marks

Question 7 (9 marks)

An experiment was set up by placing 20.0 mL of 1.0 M hydrochloric acid and 20.0 mL of 1.0 M ethanoic acid separately in two test tubes. Under the same conditions, identical pieces of pure magnesium ribbon were added to each test tube, and the volume of hydrogen gas produced was collected and recorded at regular intervals. The results of the experiment are shown in the graph below.



At the end of the experiment, no magnesium ribbon remained in the test tubes.

a. **i.** Explain the difference in the graphs during the initial 30 seconds of the experiment. 2 marks

ii. Explain why both graphs reached the same constant value for volume of hydrogen gas towards the end of the experiment. 2 marks

b. The 1.0 M hydrochloric acid used in the experiment was taken from a 500.0 mL stock solution. The stock solution was made using concentrated 5.75 M acid.

Explain how the stock solution of 1.0 M acid was prepared. Include the relevant calculation in your explanation. 3 marks

c. Write the balanced formula equation for the reaction that occurred between ethanoic acid and magnesium. 2 marks

Question 8 (9 marks)
Chromium is a metal in the first transition series of the d-block of the periodic table.

a. Chromium may be extracted from chromium oxide (Cr_2O_3). After the oxide is dissolved in hydrochloric acid to produce an aqueous solution, aluminium metal is added, and chromium metal is formed.

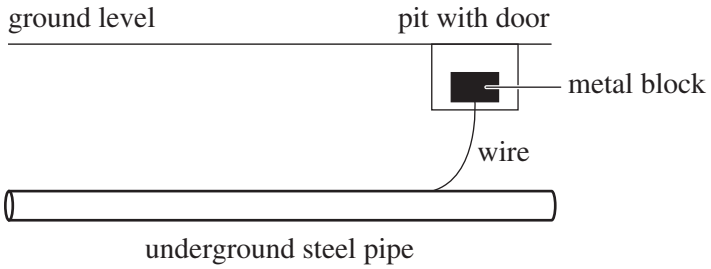
i. Write the balanced formula equation for the reaction of Cr_2O_3 with hydrochloric acid. 2 marks

ii. Write the balanced ionic equation for the production of chromium using the addition of aluminium. 1 mark

b. One important use of the hard, shiny metal chromium is protecting another transition metal, iron, from corrosion. Iron is the main component of steel, which corrodes extensively when water and oxygen are present, forming rust.

i. How does coating steel with chromium prevent rusting? 1 mark

ii. When steel pipes are placed underground, it is impractical and too expensive to coat them with chromium to prevent rusting. A method to stop steel pipes from rusting is shown in the diagram below.



The metal block in the diagram is commonly magnesium, zinc or aluminium.
Explain why these metals are used. 2 marks

c. The two half-equations for a chemical reaction involved in the rusting of steel are as follows.

I $Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$

II $O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$

i. Which of the half-equations (I or II) is the reduction reaction? 1 mark

_____

ii. Give the symbol of the oxidising agent in this reaction. 1 mark

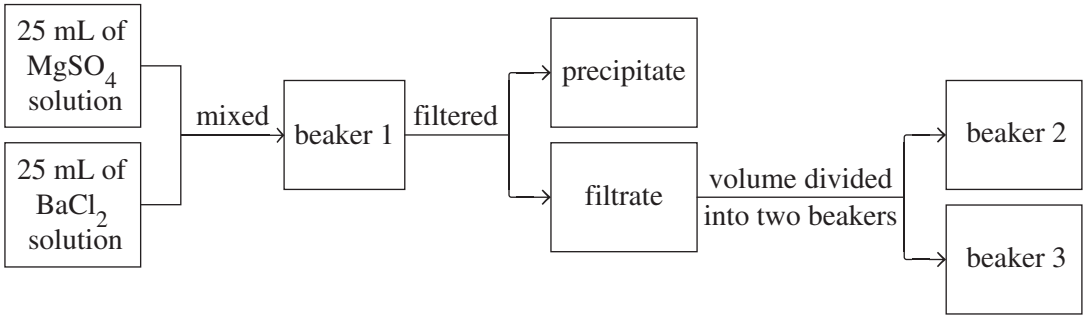
_____

iii. Write the overall redox equation for this reaction. 1 mark

_____

Question 9 (10 marks)

a. Two solutions were used in the investigation shown in the flow chart below.



i. Write the ionic equation for the reaction in beaker 1. 1 mark

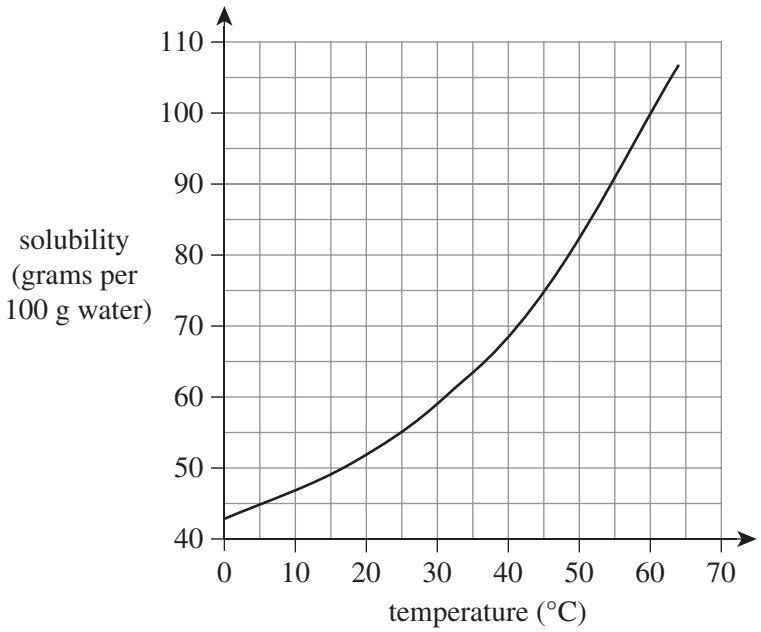
ii. 1 mL of $MgSO_4$ solution was added to the contents of beaker 2 and the clear solution went cloudy.

Explain why this cloudiness occurred. 2 marks

iii. A sample of the contents of beaker 3 could be analysed by atomic absorption spectroscopy (AAS).

Give **two** pieces of information about the contents of beaker 3 that the AAS analysis could provide. 2 marks

b. The solubility curve of a compound is shown below.



A 120 g sample of a saturated solution of the compound at 60°C was taken.

i. Define the term 'saturated solution'. 1 mark

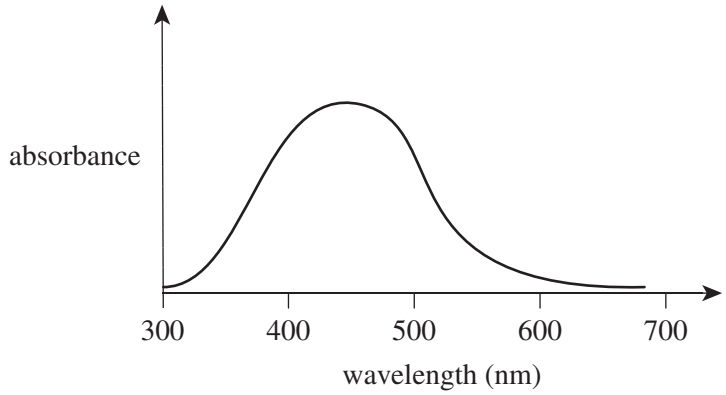
ii. What is the mass of solute in the 120 g sample? 1 mark

iii. What is the mass of water in the sample? 1 mark

iv. If the sample was cooled to 25°C, what mass of crystals would come out of solution at this temperature? 2 marks

Question 10 (7 marks)

There are strict controls on industries discharging wastes into the environment. One industry uses a food colouring in the manufacture of certain foodstuffs, and so must store the wastewater that is contaminated with the colouring so that it can be treated before release. The absorption spectrum of the colouring compound is shown below.

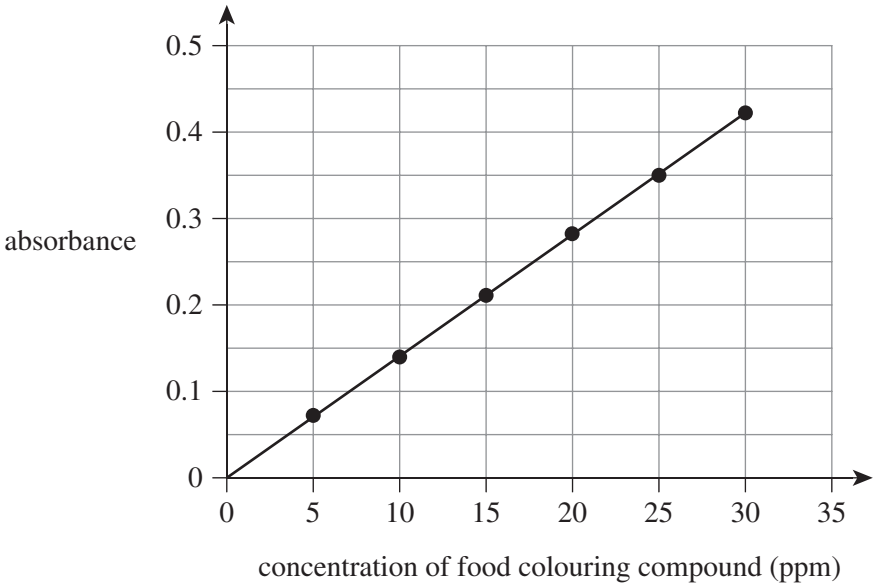


UV-visible spectroscopy is to be used to determine the concentration of the colouring in the wastewater.

a. i. Based on the spectrum shown, which wavelength should be used in the analysis? 1 mark

ii. State **one** assumption that has been made in selecting the wavelength given in **part a.i.** 1 mark

b. The calibration curve shown below was constructed for the analysis.



i. Outline the steps needed to construct a calibration curve. 3 marks

ii. A 10.0 mL sample of the contaminated wastewater was made up to 1.0 L and the absorbance of this diluted solution was found to be 0.35.

Calculate the concentration of the food-colouring compound in the 10.0 mL sample of contaminated water in parts per million. 2 marks

END OF QUESTION AND ANSWER BOOKLET

Neap

Trial Examination 2021

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

Key: atomic number 79; symbol of element Au; relative atomic mass 197.0; name of elecment 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 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

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 thulmium	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

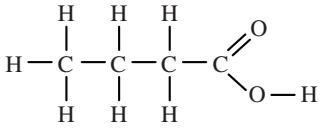
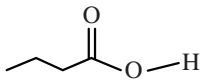
Metric (including SI) prefixes	Scientific notation	Multiplying factor
giga (G)	10^9	1 000 000 000
mega (M)	10^6	1 000 000
kilo (k)	10^3	1000
deci (d)	10^{-1}	0.1
centi (c)	10^{-2}	0.01
milli (m)	10^{-3}	0.001
micro (μ)	10^{-6}	0.000001
nano (n)	10^{-9}	0.000000001
pico (p)	10^{-12}	0.000000000001

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 2021

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
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

21	A	B	C	D
22	A	B	C	D
23	A	B	C	D
24	A	B	C	D
25	A	B	C	D
26	A	B	C	D
27	A	B	C	D
28	A	B	C	D
29	A	B	C	D
30	A	B	C	D