Neap

Trial Examination 2022

VCE Chemistry Unit 1

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	5	5	50
			Total 70

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

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

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

All written responses must be in English.

At the end of the examination

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

You may keep the data booklet.

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

SECTION A – MULTIPLE-CHOICE QUESTIONS

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1; an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.
Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

Question 1

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

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

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

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

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

Use the following information to answer Questions 2 and 3.

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

Question 2

The elemental forms of carbon include:

I graphene

II diamond

III graphite

IV fullerenes.

Which of these elemental forms of carbon conduct electricity?

A. I and II only

B. II and IV only

C. II, III and IV only

D. I, III and IV only

Question 3

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

A. electrons only.

B. ions only.

C. both electrons and ions.

D. charged particles other than electrons or ions.

Question 4

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

A. alkanes

B. alcohols

C. alkenes

D. esters

Question 5

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

What is the electron configuration of this ion?

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

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

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

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

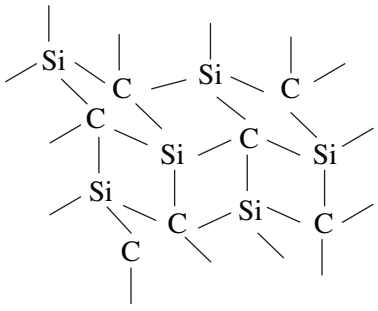
Question 6

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

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

Question 7

Part of the structure of a particular compound is shown in the diagram below.



The compound is likely used as

A. a plasticiser to make plastics more flexible.

B. the raw material for polymer production.

C. an abrasive to remove rust from metal.

D. a fuel used in camping stoves for cooking.

Question 8

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

A. 2.4×10^{24}

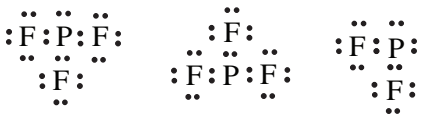
B. 5.4×10^{24}

C. 6.0×10^{24}

D. 1.1×10^{25}

Question 9

The following electron dot diagrams were drawn by students to represent molecules that are likely to form when phosphorus reacts with fluorine.



I II III

Which of these electron dot diagrams show possible molecules of phosphorus fluoride?

A. I only

B. II only

C. III only

D. none of I, II or III

Question 10

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

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

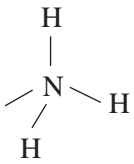
B. Both thermosetting polymers and thermoplastics are easily recycled.

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

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

Question 11

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



Which one of the following descriptions of ammonia is correct?

A. The molecule is slightly polar.

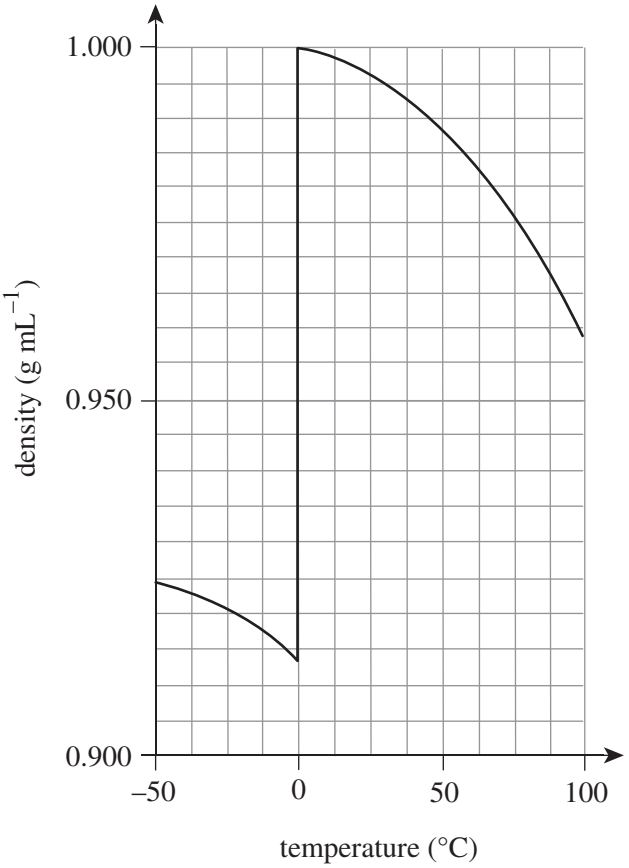
B. Nitrogen is the negative end of the molecule.

C. The shape of the molecule is tetrahedral.

D. The molecule has four bonding electron pairs.

Use the following information to answer Questions 12 and 13.

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



Question 12

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

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

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

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

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

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Question 13

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

A. ion–dipole interaction.

B. hydrogen bonding.

C. covalent bonds.

D. dispersion forces.

Question 14

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

$$Br—Br \quad O=C=O$$

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

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

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

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

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

Question 15

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

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

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

What is the order of increasing reactivity of these metals?

A. X < Y < Z < Q

B. Q < Z < X < Y

C. Q < X < Z < Y

D. Y < Z < X < Q

Question 16

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

A. $CH_3CH_2COOCH_2CH_3$

B. $CH_3COOCH_2CH_2CH_3$

C. $CH_3CH_2CH_2COOCH_2CH_3$

D. $CH_3CH_2COCH_2CH_3$

Question 17

In an experiment, two identical pieces of copper were treated as follows.

- Piece 1: heated to red hot and plunged into cold water
- Piece 2: heated to red hot and allowed to cool in air over time

Which one of the following is most likely to be observed when the two pieces of copper are examined under a microscope after treatment?

A. No crystals would be seen in either piece of copper as the heating would have destroyed them.

B. Piece 1 would have larger crystals.

C. Piece 2 would have larger crystals.

D. Crystals in both pieces of copper would be identical in size.

Question 18

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

A. soft, with a low boiling point

B. magnetic

C. able to be drawn into wires

D. hard, with a high melting point

Use the following information to answer Questions 19 and 20.

In earlier times, cutlery such as knives, forks and spoons were made from a transition metal coated with a thin layer of silver. The transition metal used could react with gases in the air and corrode. When the cutlery was coated with silver, this corrosion was prevented as silver only reacts with gases in the air very slowly.

Question 19

Which of the following properties of the transition metal and silver were most relevant to their use in cutlery making?

	Transition metal	Silver
A.	malleability	strength
B.	strength	lustre
C.	electrical conductivity	malleability
D.	lustre	heat conductivity

Question 20

Scientists have used silver nanoparticles in a range of applications. They have found that it is almost impossible to obtain nanoparticles that are pure silver as the nanoparticles also frequently contain silver oxide particles.

This is likely to occur because

A. the metal cation array structures in silver metal are not present in silver nanoparticles.

B. silver nanoparticles are less reactive than silver metal.

C. silver is a highly reactive metal in both nanoparticle and bulk form.

D. there are many more silver atoms at the surface of silver nanoparticles to react with oxygen than in silver metal.

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

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

i. Describe how crude oil is formed. 3 marks

ii. During a process to produce C_2H_4, an alkane with 16 carbon atoms per molecule is broken apart. The products formed are one molecule of heptane, three molecules of C_2H_4 and one molecule of propene.
Write a balanced equation for this process. States are not required. 3 marks

b. Reacting C_2H_4 with water under suitable conditions produces ethanol.

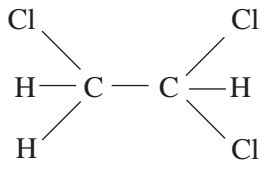
i. Name the family of compounds to which ethanol belongs. 1 mark

ii. Give the molecular formula of a member of the family of compounds from **part i.** that has nine carbon atoms per molecule. 1 mark

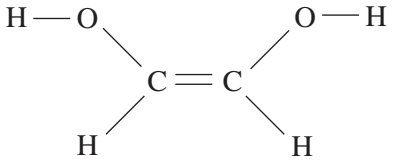
c. If ethanol is oxidised, a carboxylic acid is produced. The boiling points of carboxylic acids increase with the number of carbon atoms per molecule.

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

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



compound I



compound II

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

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

iii. Calculate the percentage by mass of oxygen in compound II. 1 mark

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

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

S Al Mg Cl P

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

P Ar S Al Mg

b. Magnesium readily forms a cation.
Using subshell notation, give the electron configuration of the magnesium cation. 1 mark

_____

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

i. There is no reaction between the sodium metal and argon gas.
Explain this observation with reference to electron configuration. 2 marks

_____

_____

_____

_____

ii. There is a violent reaction between the sodium metal and chlorine gas that produces a white, crystalline solid.
Write a balanced equation for this reaction. 2 marks

_____

iii. Two conductivity experiments were performed on the compound produced by the reaction between sodium metal and chlorine gas.
In the table below, explain the results of these experiments in terms of structure and bonding. 3 marks

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

Question 3 (9 marks)

Atoms of all the elements have the same fundamental structure. Although iodine has only one naturally occurring isotope, other elements have various isotopic forms.

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

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

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

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

c. The abundances of the naturally occurring isotopes of the element tellurium are shown in the following table.

^{130}Te	^{128}Te	^{126}Te	^{125}Te	^{124}Te	^{123}Te	^{122}Te	^{120}Te
34.5%	31.8%	18.7%	combined total of 15%				

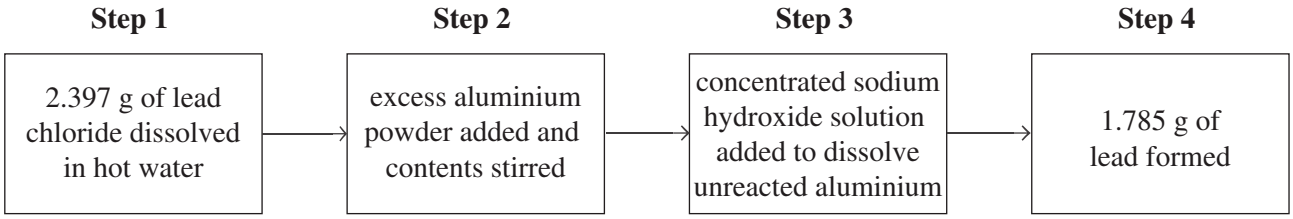
Use the information provided to explain why tellurium has a higher relative atomic mass than iodine but is placed **before** iodine in period 5 of the periodic table. 2 marks

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

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

Question 4 (8 marks)

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



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

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

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

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

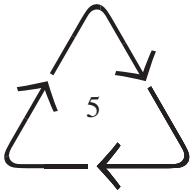
Explain the effect on the results of the experiment if step 3 was not performed. 2 marks

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

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

Question 5 (10 marks)

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



PP

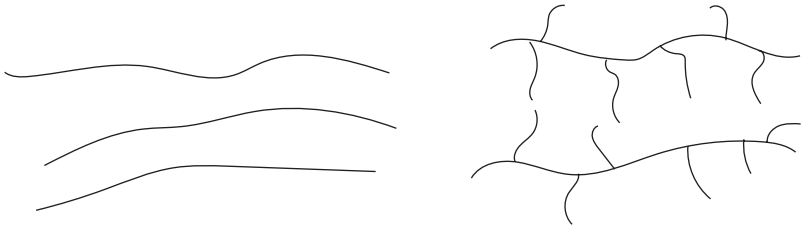
a. Draw the structural formula of propene. 1 mark

b. A polypropene molecule has a molar mass of 290 000 g mol^{-1}.

Calculate the number of propene monomers used to form the polypropene molecule. 2 marks

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

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



high-density PP low-density PP

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

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

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

END OF QUESTION AND ANSWER BOOKLET

Neap

Trial Examination 2022

VCE Chemistry Unit 1

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	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
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 thulium	70 Yb 173.1 ytterbium	71 Lu 175.0 lutetium
89 Ac (227) actinium	90 Th 232.0 thorium	91 Pa 231.0 protactinium	92 U 238.0 uranium	93 Np (237) neptunium	94 Pu (244) plutonium	95 Am (243) americium	96 Cm (247) curium	97 Bk (247) berkelium	98 Cf (251) californium	99 Es (252) einsteinium	100 Fm (257) fermium	101 Md (258) mendelevium	102 No (259) nobelium	103 Lr (262) lawrencium

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

2. Chemical relationships

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

3. Physical constants and standard values

Name	Symbol	Value
Avogadro constant	N_A or L	6.02×10^{23} mol^{-1}

4. 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

END OF DATA BOOKLET

Neap

Trial Examination 2022

VCE Chemistry Unit 1

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