



COMMONWEALTH SECONDARY SCHOOL
END OF YEAR EXAMINATION 2019
SECONDARY THREE EXPRESS

Name: _____ () Class: _____

CHEMISTRY

Paper 1 Multiple Choice

6092/01

Thur 10 Oct 2019

1 hour

Additional Materials: OTAS Sheet

0800 – 0900 h

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, index number and class on the question paper and the OTAS sheet.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers, **A, B, C** or **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the OTAS sheet.

Read the instructions on the question booklet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 18.

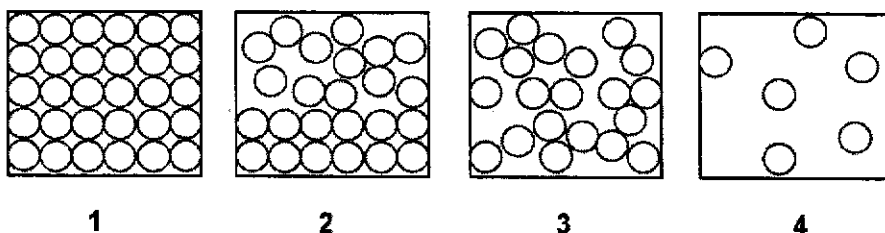
The use of an approved scientific calculator is expected, where appropriate.

This paper consists of <18> printed pages including the cover page.

[Turn over

- 1 Bromine melts at $-7\text{ }^{\circ}\text{C}$ and boils at $59\text{ }^{\circ}\text{C}$. A tank filled with bromine at $30\text{ }^{\circ}\text{C}$ is cooled to $-7\text{ }^{\circ}\text{C}$.

Which diagram below represents the arrangement of bromine particles at $-7\text{ }^{\circ}\text{C}$ and at $30\text{ }^{\circ}\text{C}$?



	At $-7\text{ }^{\circ}\text{C}$	At $30\text{ }^{\circ}\text{C}$
A	1	4
B	2	3
C	1	2
D	2	4

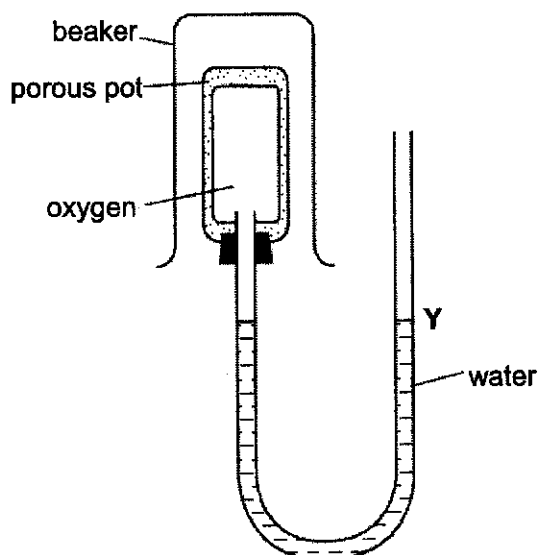
- 2 An inflated balloon will shrink if placed in a refrigerator. Which of the following explains this phenomenon?

- A The lower temperature causes the particles to move faster and become closer together.
 B The lower temperature causes the particles to move faster and become further apart.
 C The lower temperature causes the particles to move slower and become closer together.
 D The lower temperature causes the particles to move slower and become further apart.

- 3 Which statement about **impure** hexane, C_6H_{14} , is correct?

- A It boils over a range of temperatures.
 B It burns in excess oxygen to form carbon monoxide and water only.
 C It mixes with water.
 D It boils at a fixed temperature.

- 4 The diagram shows an experiment on diffusion.



Which gas, when present in the beaker over the porous pot, will cause the water level at Y to **fall first before rising**?

- A carbon dioxide, CO_2
- B hydrogen, H_2
- C methane, CH_4
- D nitrogen, N_2

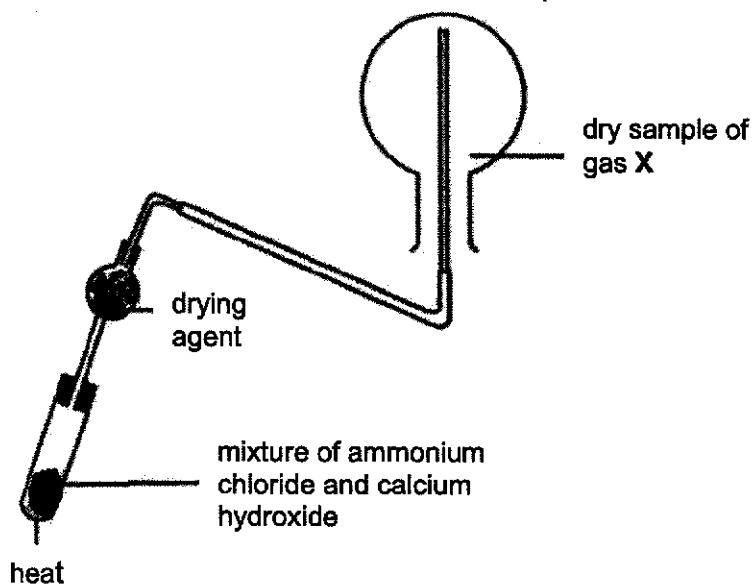
- 5 Some information on three solids is given below.

solid	solubility in water	solubility in ethanol	action of heat
X	soluble	insoluble	no effect
Y	insoluble	soluble	no effect
Z	soluble	soluble	sublimes

Which procedure could be carried out to obtain a pure sample of Z from a mixture of the three solids?

- A Add ethanol to the mixture, filter and collect the residue.
- B Add water to the mixture and filter to collect the residue.
- C Add ethanol to the mixture, filter and evaporate the filtrate.
- D Heat the mixture and condense the gas.

- 6 A student sets up the apparatus as shown to collect a sample of clean and dry gas X.



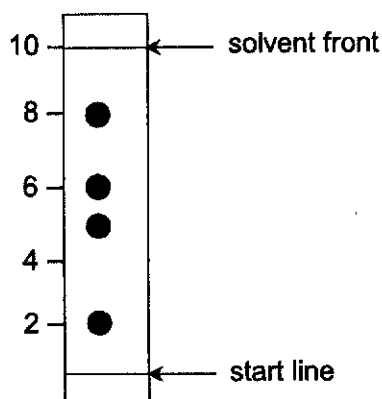
Which of the following are the identities of gas X and a suitable drying agent?

	gas X	drying agent
A	ammonia	calcium oxide
B	ammonia	concentrated sulfuric acid
C	hydrogen chloride	calcium oxide
D	hydrogen chloride	concentrated sulfuric acid

- 7 Propyl propanoate has the molecular formula, $C_2H_5COOC_3H_7$.
How many elements and atoms are present in **two** molecules of this compound?

	number of atoms	number of elements
A	20	3
B	20	4
C	40	3
D	40	6

- 8 The following shows a chromatogram of a pigment used to decorate a plate used for consuming food, to analyse if it contains any substances unsafe for consumption.



Common harmful substances used in such pigments have the following R_f values in the solvent:

substance	R_f value
cadmium red	0.15
cadmium yellow	0.20
chrome green	0.75
umber	0.80

Which substances do the pigment contain?

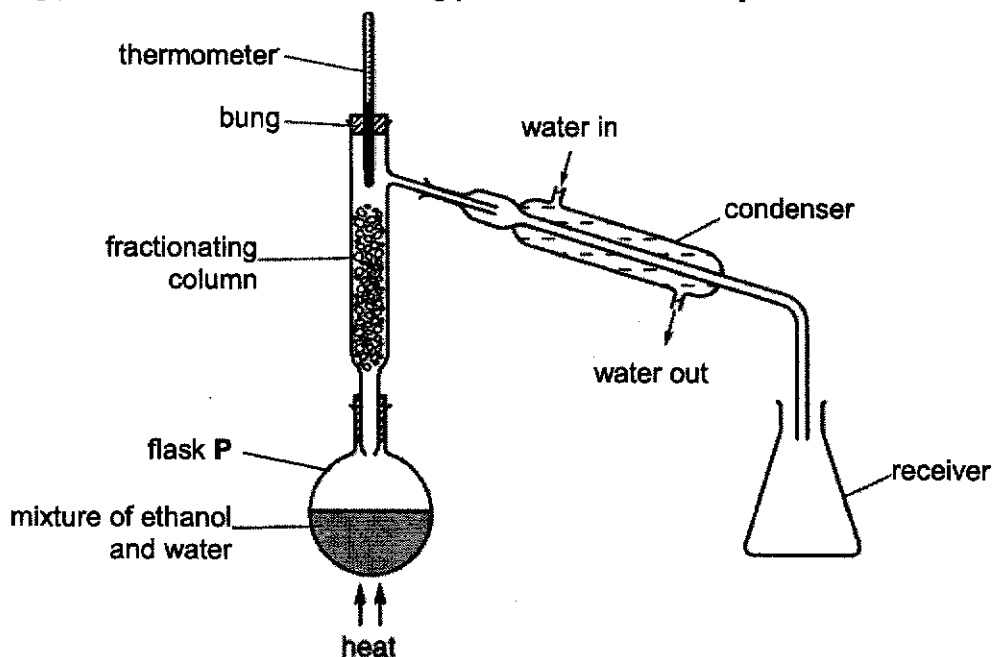
- A cadmium yellow only
 B cadmium yellow and umber
 C cadmium red and chrome green
 D chrome green and umber
- 9 An anion X^{2-} has a mass number of m and n electrons. What does the nucleus of an atom X contain?

	number of protons	number of neutrons
A	$n - 2$	$m - n$
B	n	$m - n$
C	$n - 2$	$m - (n - 2)$
D	$n + 2$	$m - (n + 2)$

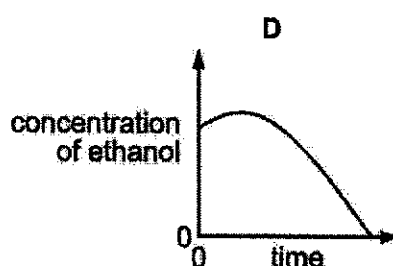
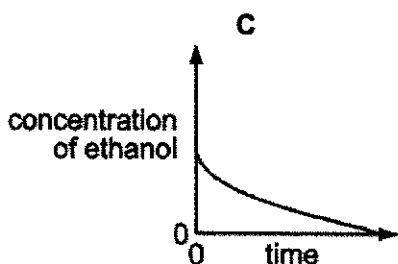
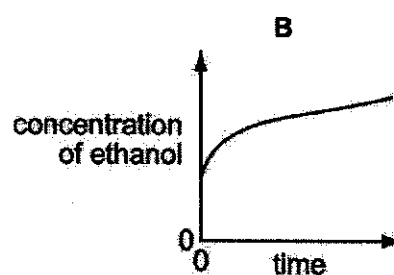
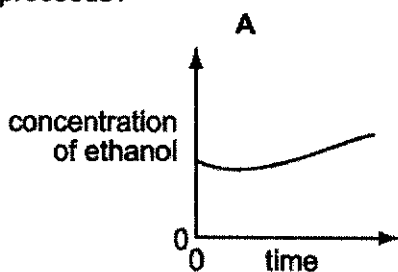
Use the diagram below to answer question 10 and 11.

The apparatus shown is used to distil a dilute solution of ethanol in water.

[Boiling point of ethanol = 78 °C, Boiling point of water = 100 °C]



- 10 What error is the student making in setting up the apparatus?
- A The thermometer is in the wrong position.
 B There should not be a bung in the top of the fractionating column.
 C Water enters and leaves the condenser in the wrong place.
 D There should be a bung in the top of the receiver.
- 11 Which graph shows the change in concentration of ethanol in flask P as the distillation proceeds?

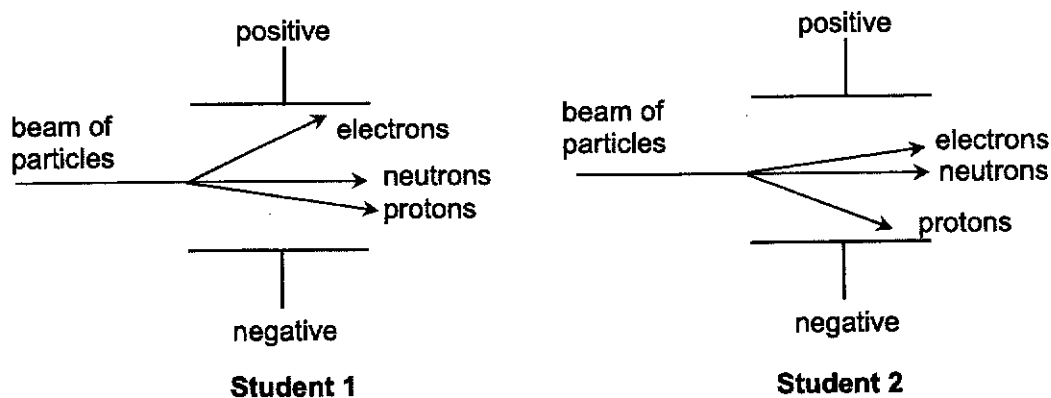


- 12 Strontium is used in fireworks to produce crimson flames. Naturally occurring strontium has three isotopes, ^{86}Sr (10%), ^{87}Sr (7%) and ^{88}Sr (83%).

What is the relative atomic mass of naturally occurring strontium?

- A 86.0
- B 87.0
- C 87.7
- D 88.0

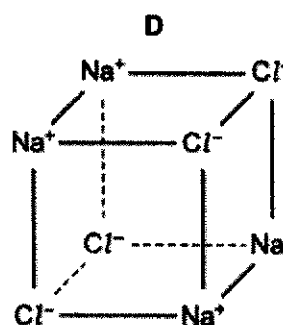
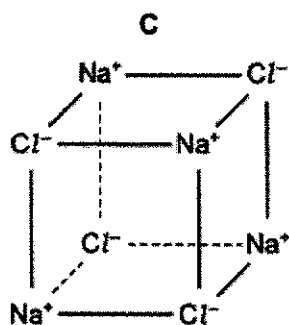
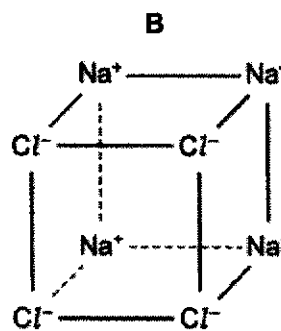
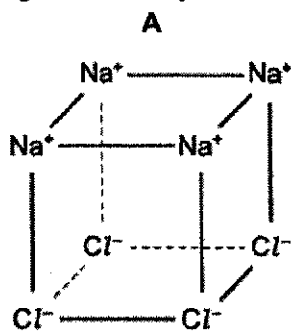
- 13 A beam of all three subatomic particles was passed through a pair of electrically charged plates at constant speed. Two students drew their predictions of the effect of the charged plates on the particles, as shown below.



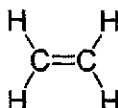
Which statement explains which student is correct?

- A Student 1 is correct as protons have lower mass than electrons.
- B Student 1 is correct as electrons have lower mass than protons.
- C Student 2 is correct as protons have lower mass than electrons.
- D Student 2 is correct as electrons have lower mass than protons.

- 14 Which diagram correctly shows the arrangement of the ions in solid sodium chloride?



- 15 Ethene exists as a gas at room temperature.
The structural formula of ethene is given below.



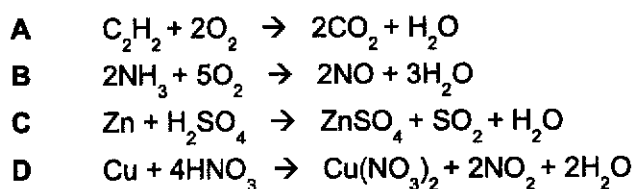
Which statement describes the ethene?

- A** It is insoluble in organic solvent.
B It has a high boiling point.
C It has a simple molecular structure.
D It has weak covalent bonds that break easily.
- 16 A student thinks that element R is a metal because it has a high melting point and a high boiling point. What other properties below could element R have if it is a metal?
- 1 R is malleable.
 2 R forms an acidic oxide RO_2 .
 3 R conducts electricity in solid state.
- A** 1, 2 and 3
B 1 and 2
C 1 and 3
D 2 and 3

- 17 Which correctly describes the structures of the following substances?

	Graphite	iodine	magnesium oxide
A	simple molecular	simple molecular	giant metallic
B	giant molecular	simple molecular	giant ionic
C	giant metallic	giant molecular	giant molecular
D	giant molecular	giant metallic	simple molecular

- 18 Which of the following chemical equations is balanced?



- 19 Element P reacts with element Q to form a compound. The electronic configurations of P and Q are 2,2 and 2,7 respectively.

What is the formula of the compound formed?

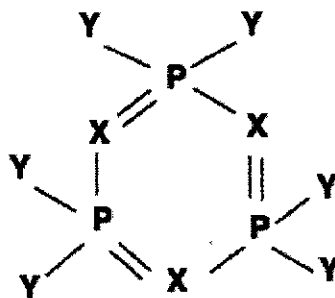
- A PQ
 B P₂Q
 C PQ₂
 D P₂Q₂

- 20 Arsenic oxide has the formula As₂O₃, while sodium phosphate has the formula Na₃PO₄.

What is the formula of arsenic phosphate?

- A AsPO₄
 B As₂PO₄
 C As₂(PO₄)₃
 D As₃PO₄

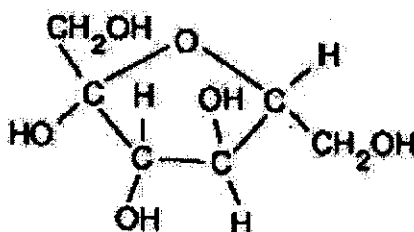
- 21 A molecule consists of three types of atoms, P, X and Y.



If P is phosphorus, what could X and Y be?

	X	Y
A	Al	H
B	N	Cl
C	O	H
D	Si	Cl

- 22 Fructose has the following structural formula.



What is the empirical formula of fructose?

- A CHO
 B CH₂O
 C $\text{C}_6\text{H}_{12}\text{O}_5$
 D $\text{C}_6\text{H}_{12}\text{O}_6$
- 23 Which substance contains the **most** number of molecules in 1 g?
- A O₂
 B CO
 C NO₂
 D SO₂

- 24 The reaction between hydrochloric acid and calcium carbonate is shown.



Which volume of 1.0 mol/dm^3 hydrochloric acid is needed to react **completely** with 1.0 g of calcium carbonate?

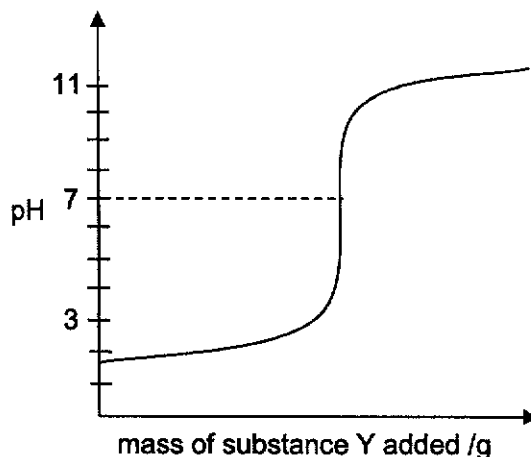
- A 10 cm^3
 B 20 cm^3
 C 100 cm^3
 D 200 cm^3
- 25 The formula for hydrated copper(II) nitrate is $\text{Cu}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$. It contains 36.5% water of crystallisation by mass.
- What is the value of x ?
- A 4
 B 5
 C 6
 D 7
- 26 Which statement is true for **all** aqueous solutions of acids?
- A They give off hydrogen when added to all metals.
 B They have a pH greater than 7.
 C They react with ammonium salts to give ammonia gas.
 D They react with magnesium carbonate to give carbon dioxide.
- 27 A student titrated 25.0 cm^3 of dilute nitric acid with sodium hydroxide solution a few times. The results he obtained are shown in the table below.

titration number	1	2	3	4
volume of NaOH / cm^3	19.45	19.35	18.80	19.40

What could he have done **wrongly** for titration 3?

- A washing the conical flask with nitric acid
 B not adding drop by drop towards the end of the titration
 C diluting nitric acid with deionised water after adding to conical flask
 D diluting nitric acid with water before pipette measurement

- 28 Substance Y was added a little at a time, with stirring to aqueous solution Z. The changes in pH of the mixture are shown in the graph below.



What could Y and Z be?

	substance Y	substance Z
A	zinc oxide	ethanoic acid
B	iron(II) oxide	ethanoic acid
C	aluminium oxide	sulfuric acid
D	sodium oxide	sulfuric acid

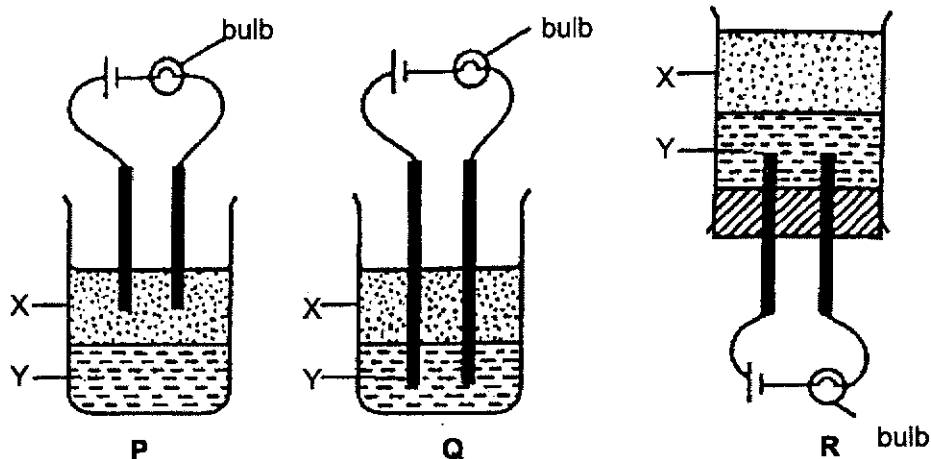
- 29 The colour of an indicator in solutions of different pH is shown below. A student wants to use the indicator to distinguish two solutions.



Which pair of solutions can be distinguished by the indicator?

- A aqueous ammonia and aqueous sodium hydroxide
- B dilute hydrochloric acid and water
- C aqueous sodium chloride and aqueous sodium hydroxide
- D aqueous sodium chloride and dilute ethanoic acid

- 30 Three experiments, P, Q and R, were set up to test the conductivity of two solutions as shown.



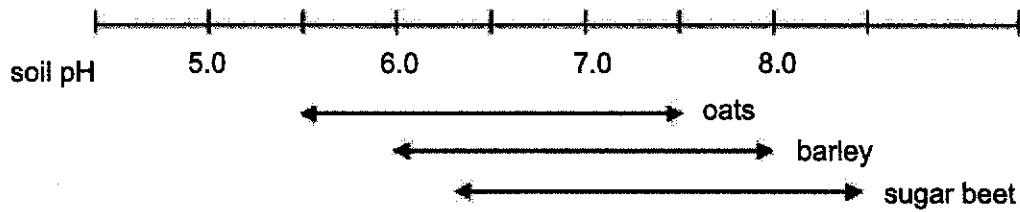
In which of the above experiments will the bulb light up?

- A P only
 B Q only
 C P and Q
 D Q and R
- 31 Joanne tried to prepare copper(II) sulfate crystals by adding copper(II) oxide solid to dilute sulfuric acid, but she ended up with white powder instead.

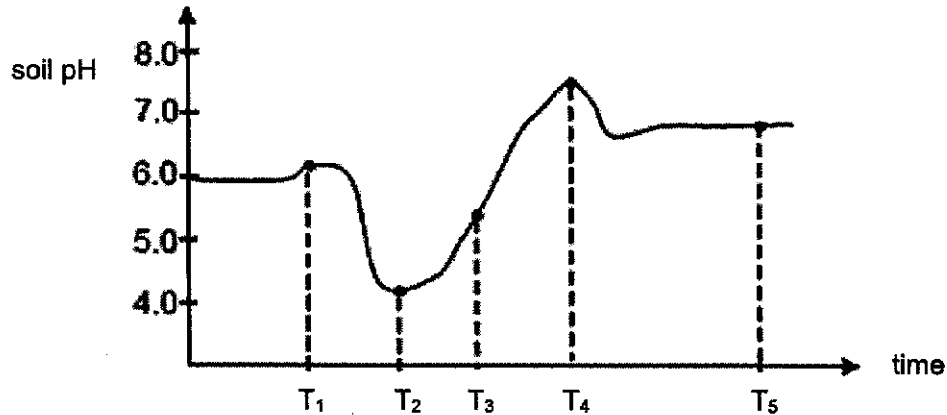
What mistake could she have made?

- A adding excess copper(II) oxide
 B adding excess dilute sulfuric acid
 C overheating the filtrate to dryness
 D poking a hole in the filter paper

- 32 The diagram shows the optimal pH ranges required by different crops for growth.



The graph shows how the pH value of the soil in a farmer's field changes over time.



The farmer wants to grow oats, barley and sugar beet.
In which period of time would all three crops grow well?

- A between T₁ and T₂
 B between T₂ and T₃
 C between T₃ and T₄
 D between T₄ and T₅
- 33 Which of the following does **not** show the appropriate reagents used for preparation of the named salt?

	salt	reagent 1	reagent 2
A	barium sulfate	aqueous barium nitrate	dilute sulfuric acid
B	lead(II) chloride	lead(II) carbonate	dilute hydrochloric acid
C	magnesium chloride	magnesium	dilute hydrochloric acid
D	sodium nitrate	aqueous sodium hydroxide	dilute nitric acid

- 34 A salt has the chemical formula $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$. Excess aqueous sodium hydroxide was added slowly, with shaking to a hot solution of the salt in a boiling tube until there is no further reaction. The boiling tube was then left to stand for some time.

Which of the following observations would **not** be made?

- A A green precipitate was produced.
 B A pungent gas which turned damp red litmus blue was produced.
 C On standing, the precipitate turned brown.
 D The precipitate dissolved in excess sodium hydroxide.
- 35 A colourless solution Y reacts with a blue solution X to give a blue precipitate, which is insoluble in excess Y.

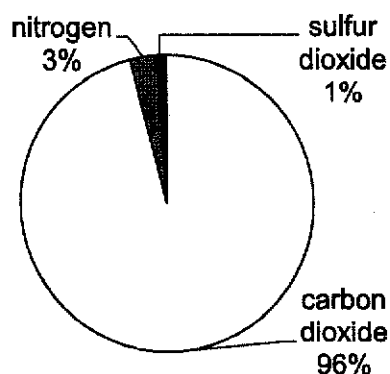
What ions are present in X and Y?

	X	Y
A	Fe^{2+}	OH^-
B	Cu^{2+}	OH^-
C	Fe^{2+}	SO_4^{2-}
D	Cu^{2+}	SO_4^{2-}

- 36 An aqueous solution of zinc chloride is tested by adding reagents. Which observation is correct?

	reagent added to zinc chloride (aq)	observations
A	acidified aqueous barium nitrate	forms a white precipitate
B	aqueous ammonia	forms a white precipitate, soluble in excess of the reagent
C	aqueous sodium hydroxide	forms a white precipitate, insoluble in excess of the reagent
D	powdered copper	forms a grey precipitate

- 37 The diagram below shows the composition of the planet Venus.



Which statements are likely to be true of Venus?

- I Any rain on Venus would be acidic.
- II Venus has active volcanoes on its surface.
- III The temperature on Venus is higher than on Earth.

- A III only
 - B I and II only
 - C II and III only
 - D all of the above
- 38 The table below gives the concentration, in parts of pollutant per billion parts of air, of polluting gases in four different industrialised cities.

In which city are limestone buildings under the **greatest** threat from pollution?

city	nitrogen monoxide /ppb	ozone /ppb	sulfur dioxide /ppb
A	17	23	28
B	26	32	26
C	28	29	19
D	33	35	21

- 39 Sodium sulfate and potassium carbonate are similar white powders which are very soluble in water.

Which reagent could be added to distinguish between the two?

- A barium nitrate
- B lead(II) nitrate
- C hydrochloric acid
- D aqueous ammonia

- 40** A catalytic converter in a car exhaust system changes pollutants into less harmful products.

Which change does **not** occur in a catalytic converter?

- A** carbon dioxide → carbon
- B** carbon monoxide → carbon dioxide
- C** nitrogen oxides → nitrogen
- D** unburnt hydrocarbons → carbon dioxide and water

The Periodic Table of Elements

I		Group										VII		0																													
II												VI		V		IV		III																									
3 Li lithium 7	4 Be beryllium 9	11 Na sodium 23	12 Mg magnesium 24	19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84	53 I iodine 127	54 Xe xenon 131	85 At astatine 127	86 Rn radon 222	87 Fr francium 223	88 Ra radium 226	89-103 actinoids	104 Rf rutherfordium 261	105 Db dubnium 262	106 Sg seaborgium 263	107 Bh bohrium 264	108 Hs hassium 265	109 Mt meitnerium 266	110 Ds darmstadtium 267	111 Rg roentgenium 268	112 Cn copernicium 269	113 Nh nihonium 270	114 Fl flerovium 271	115 Mc moscovium 272	116 Lv livermorium 273	117 Ts tennessium 274	118 Og oganesson 276
5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20	13 Al aluminum 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40																																
Key		proton (atomic) number		atomic symbol		name		relative atomic mass																																			
1 H hydrogen 1		2 He helium 4		3 Li lithium 7		4 Be beryllium 9		5 B boron 11		6 C carbon 12		7 N nitrogen 14		8 O oxygen 16		9 F fluorine 19		10 Ne neon 20																									

lanthanoids

actinoids

57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium 145	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
89 Ac actinium 227	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium 237	94 Pu plutonium 244	95 Am americium 243	96 Cm curium 247	97 Bk berkelium 247	98 Cf californium 251	99 Es einsteinium 252	100 Fm fermium 257	101 Md mendelevium 258	102 No nobelium 259	103 Lr lawrencium 260

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).



COMMONWEALTH SECONDARY SCHOOL

END OF YEAR EXAMINATION 2019

SECONDARY THREE EXPRESS

Name: _____ ()

Class: _____

CHEMISTRY

Paper 2

6092/02

Tuesday 1 Oct 2019

1 h 45 min

Candidates answer on the Question Paper.

No Additional Materials are required.

1100 – 1245 h

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the question paper and any separate answer sheets used.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough work.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer all questions in the spaces provided on the Question Paper.

Section B

Answer all **three** questions, the last question is in the form of either/or and only one of the alternatives should be attempted.

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

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

A copy of the Periodic Table is printed on page 18.

The use of an approved scientific calculator is expected, where appropriate.

For Examiner's Use	
Section A	/ 50
B9	/ 10
B10	/ 10
B11 E / O	/ 10
Total	/ 80

Parent's / Guardian's Signature

This paper consists of <18> printed pages including the cover page.

[Turn over

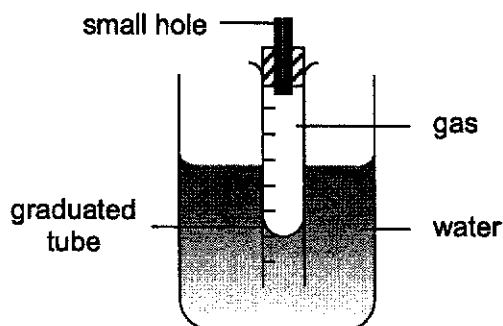
Section A (50 marks)

Answer all the questions in the spaces provided.

For
examiner's
use

- A1 A student set up an apparatus (as shown below) to measure the rates of diffusion of gases through a small hole. The time taken for 100 cm³ of some gases (measured at room temperature and pressure) to diffuse from the apparatus were recorded as follows:

gas	CO	CH ₄	Cl ₂	N ₂	O ₂
time/s	264	199	420	?	280



- (a) Using the information given, state which gas diffuses at the slowest rate?
..... [1]
- (b) Explain why this gas in (a) diffuse at the slowest rate.
..... [1]
- (c) Suggest the time taken for nitrogen to diffuse through the small hole.
..... [1]
- (d) Name a gas that will diffuse faster than any of the gases shown in the table.
..... [1]
- (e) Why is this method above **not** suitable for measuring diffusion rate of gases such as ammonia and sulfur dioxide?
..... [1]

[Total: 5]

A2 The table gives the composition of three particles of an element **M**.

particle	number of protons	number of electrons	number of neutrons
M₁	15	15	16
M₂	15	18	16
M₃	15	15	17

For
examiner's
use

(a) A student makes three statements about the particles.

Statement 1: Particle **M₁** is an atom.

Statement 2: Particle **M₂** is a positive ion.

Statement 3: Particles **M₂** and **M₃** are isotopes.

Use evidence from the table to explain whether each of the statements is correct.

Statement 1:

.....

.....

Statement 2:

.....

.....

Statement 3:

.....

.....

[3]

(b) Draw a 'dot-and-cross' diagram to show the arrangement of outer shell electrons in the compound formed between this element **M** with hydrogen.

[2]

[Total: 5]

A3 Elements **W**, **X**, **Y** and **Z** belong to Period 3 of the Periodic Table.

The table below gives information regarding the oxides of these elements.

For
examiner's
use

element	formula of oxide	reaction of oxide with	
		aqueous sodium hydroxide	dilute nitric acid
W	W₂O	yes	no
X	XO₂	yes	no
Y	Y₂O₃	yes	yes
Z	ZO	no	yes

(a) Write down the Group in which elements **W**, **X**, **Y** and **Z** belong to in the Periodic Table.

element	Group
W	
X	
Y	
Z	

[2]

(b) Use the information in the table above to predict the state of **ZO** at room temperature.

Explain your answers in terms of bonding.

.....

.....

.....

.....

.....

.....

[3]

(c) Write the chemical formulae of the sulfate and nitrate of **Z**.

sulfate of **Z**:

nitrate of **Z**:

[2]

[Total: 7]

A4 Neon, argon, krypton and xenon are four of the noble gases. They are monatomic elements.

For
examiner's
use

(a) What is meant by the term *monatomic* ?

..... [1]

(b) Explain why the noble gases are very **unreactive**.

..... [1]

(c) Chemists have discovered that some noble gases can form compounds.
A 1.00 g sample of one of these compounds contains 0.55 g of xenon, 0.13 g of oxygen and 0.32 g of fluorine.

Calculate the empirical formula of this compound.

empirical formula [3]

(d) Describe and explain how fractional distillation can be used to separate a mixture of neon, argon, krypton and xenon.

.....
.....
.....
..... [3]

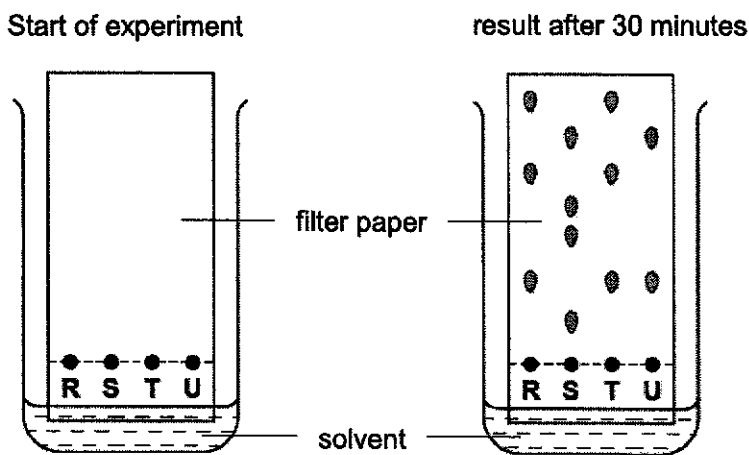
[Total: 8]

A5 Plants make a variety of coloured pigments. A student extracted red colouring from four different plants, **R, S, T** and **U**.

For
examiner's
use

A student put a spot of each colouring on a piece of filter paper. The filter paper was dipped into a solvent and left for 30 minutes.

The results are shown below.



(a) Name the method of separation and explain why the pigments can be separated.

.....

[2]

(b) Explain why the base line **cannot** be drawn using a pen.

.....

[1]

(c) Which two plants contained the same pigments?

.....

[1]

(d) This method can also be used to separate and identify sugars obtained through the breakdown of carbohydrates. Sugars are colourless substances.

Suggest a modification necessary for this method to work.

.....

[1]

[Total: 5]

A6 Sulfuric acid is one of the world's most important chemical. Over 100 million tonnes of sulfuric acid are produced throughout the world every year.

For
examiner's
use

(a) (i) Name the ion in sulfuric acid that give it its acidic properties.

..... [1]

(ii) Describe **one** similarity and **one** difference when pieces of iron metal and a spatula of copper(II) carbonate powder are added to different test tubes of sulfuric acid.

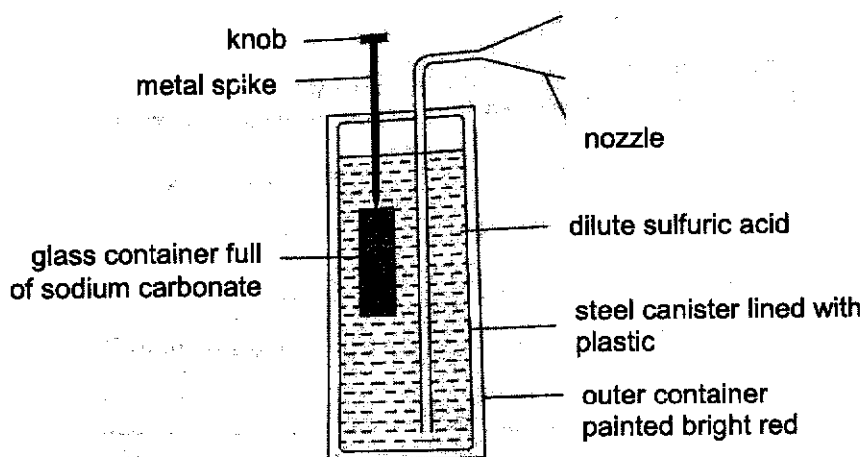
Similarity:

.....
.....

Difference:

.....
..... [2]

(b) A common type of fire extinguisher commonly used is shown in the diagram below.



(i) The instructions on the fire extinguishers say: "Push down the knob to use the extinguisher. Point nozzle at flames". Use the chemicals provided in the diagram to outline how the extinguisher works.

.....
.....
.....
.....
..... [2]

(ii) Construct a balanced equation for the chemical reaction in the steel canister when the extinguisher is being used.

..... [1]

[Total: 6]

For
examiner's
use

A7 Chlorofluorocarbons (CFCs) are air pollutants that cause 'holes' in the ozone layer.

(a) (i) State the atom in CFCs that is responsible for these 'holes'.

..... [1]

(ii) Explain why these 'holes' cause harm to humans.

.....
.....
..... [2]

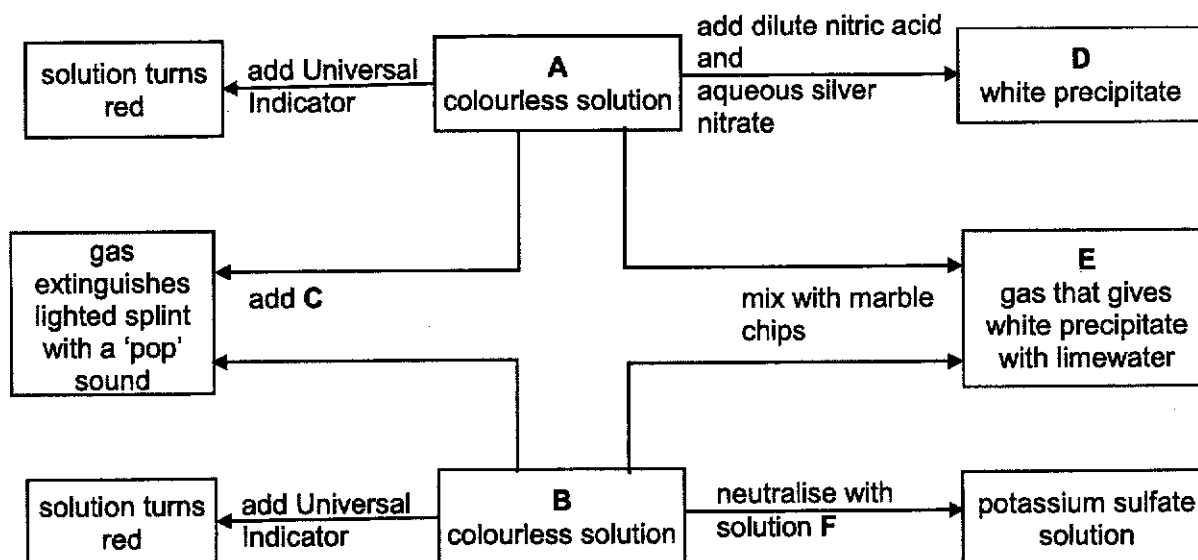
(b) One of the CFCs used is dichlorodifluoromethane .
Explain why dichlorodifluoromethane has a low boiling point. Refer to its bonding and structure in your answer.

.....
.....
..... [2]

[Total: 5]

A8 The flowchart below describes some properties and reactions of two solutions **A** and **B**.

For
examiner's
use



(a) Name the unknown substances.

A:

B:

C:

D:

E:

F:

[6]

(b) Write an ionic equation for the reaction between substance **A** and aqueous silver nitrate.

..... [1]

(c) Describe a test to confirm the anion in solution **B**.

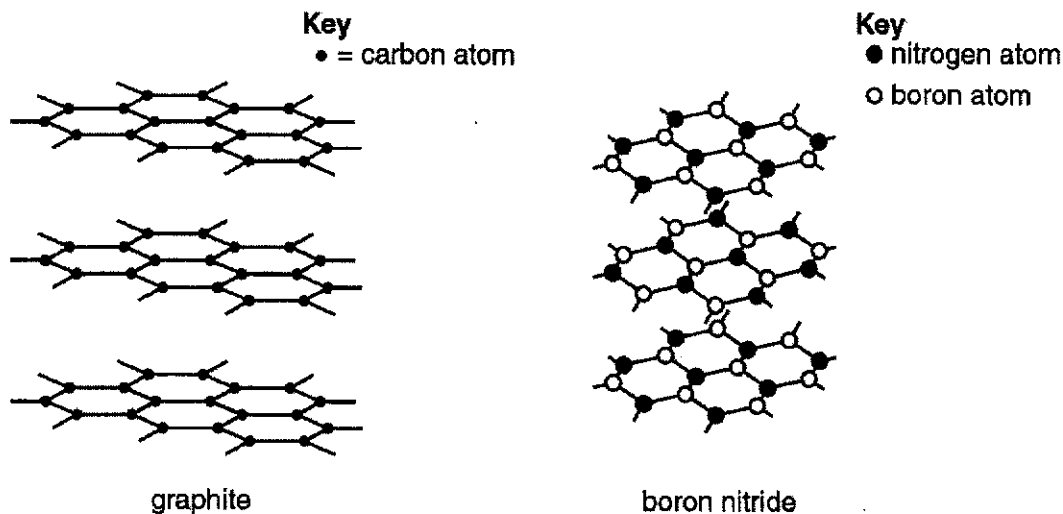
..... [2]

[Total: 9]

Section B (30 marks)

Answer all three questions from this section.

The last question is in the form of either/or and only one of the alternatives should be attempted.

For
examiner's
use**B9** The structures of graphite and boron nitride are shown below.

- (a) Like graphite, boron nitride feels slippery to the touch.
Explain, in terms of bonding, why boron nitride feels slippery to the touch.

.....

 [2]

- (b) An isotope of boron is represented by the symbol ${}^{11}_5\text{B}$.
State the number of protons and neutrons in this isotope of boron.

number of protons

number of neutrons [1]

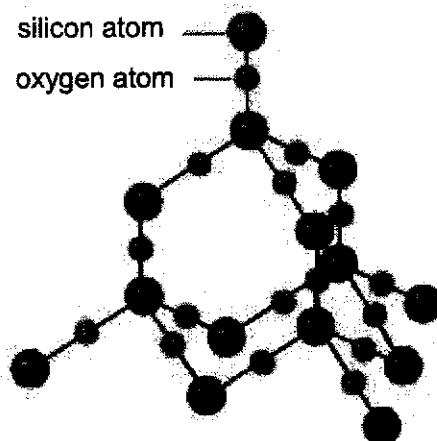
- (c) State and explain, in terms of bonding, the electrical conductivity of graphite at room temperature and pressure.

.....

 [2]

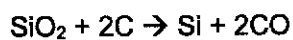
- (d) Similar to carbon, silicon is a non-metal found in Group IV of the Periodic Table. When it is combined with oxygen, forms a structure that is very similar to diamond.

For
examiner's
use



Silicon dioxide (SiO₂)

- (i) Silicon is manufactured by the reduction of silicon dioxide with carbon.



What is the maximum mass of silicon that can be made from 300 g of silicon dioxide?

mass of silicon g [2]

- (ii) State and explain, in terms of bonding and structure, the melting point of silicon dioxide.

.....

.....

.....

.....

.....

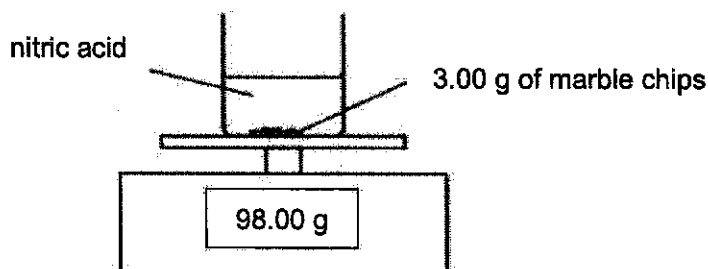
.....

[3]

[Total: 10]

- B10** Acid rain is prevalent in urban areas due to the large amount of oxides of nitrogen and carbon dioxide released from motor vehicles on the road. Many marble buildings and metal structures are damaged by acid rain.

Marble is made up of mainly calcium carbonate. The diagram below shows an experimental set-up in the laboratory to investigate how fast marble is damaged by acid rain. **Excess nitric acid is used to represent acid rain.**



A student recorded the reading on the balance at two-minute intervals.

The table below shows the results.

time / min	mass / g
0	98.00
2	97.92
4	97.84
6	96.98
8	96.95
10	96.94
12	96.93
14	96.92
16	96.92
18	96.92

Table 10.1

- (a) Using the two gases mentioned above, explain the formation of acid rain.

.....

[1]

- (b) (i) Write a balanced chemical equation, with state symbols, for the reaction between nitric acid and calcium carbonate.

.....

[2]

(ii) Based on your answer in b(i), explain why there is a decrease in the mass reading.

..... [1]

(c) Describe a test the student can carry out to confirm the identity of the gas.

.....
 [2]

(d) Complete the table below, using the information given in Table 10.1.

(i)	Initial reading / g	
	Final reading / g	
	Mass loss / g	

[2]

(ii) Calculate the volume of gas evolved in this reaction.

[2]

[Total: 10]

For
examiner's
use

Either

For
examiner's
use

- B11** Leroy is given a sample of an organic acid and asked to determine its relative molecular mass and then suggest its formula.

Leroy titrates **R**, an aqueous solution containing 7.00 g/dm^3 of the organic acid, with **S**, an aqueous solution containing 0.100 mol/dm^3 of sodium hydroxide.

- (a) **25.0 cm³ of S** is transferred into a **conical flask**.
A few drops of methyl orange indicator are added to the conical flask.
R is placed in the burette and then added to the solution in the conical flask until an end-point is reached.

What is the colour of the solution in the **conical flask**

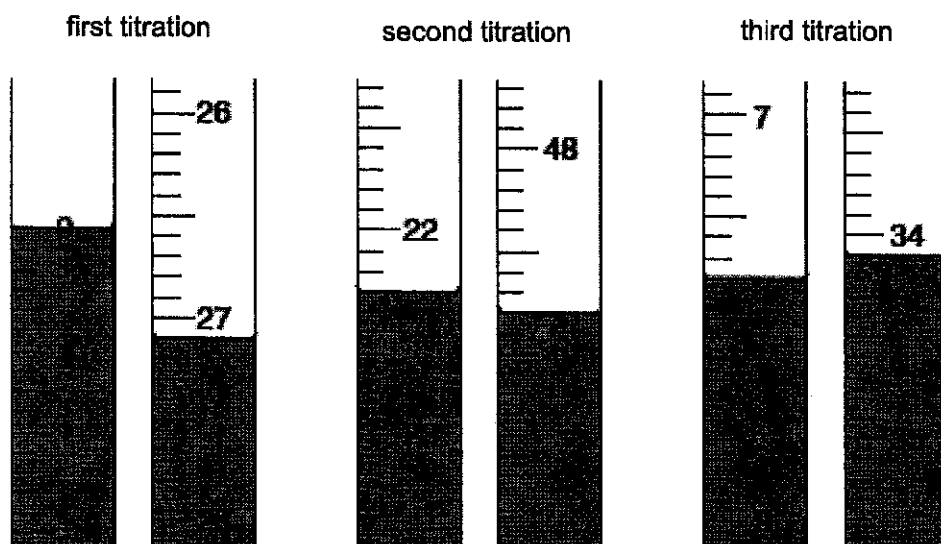
- (i) before **R** is added;

- (ii) at the end-point?

.....
.....

[2]

- (b) Leroy carried out three titrations. The figure below shows parts of the burette with the solution levels at the beginning and at the end of each titration.



Complete the titration table below

Titration	1	2	3
Final burette reading /cm ³			
Initial burette reading /cm ³			
Volume of R /cm ³			
Best titration result			

[2]

- (c) Based on your best titration results, calculate the average volume of **R** required for complete neutralization.

For
examiner's
use

[1]

- (d) Calculate the number of moles of sodium hydroxide in 25.0 cm³ of **S**.

[1]

- (e) Given that **1 mole of acid neutralises 1 mole of sodium hydroxide**, use your answer in (d) to deduce the number of moles of the organic acid in the average volume of **R**.

[1]

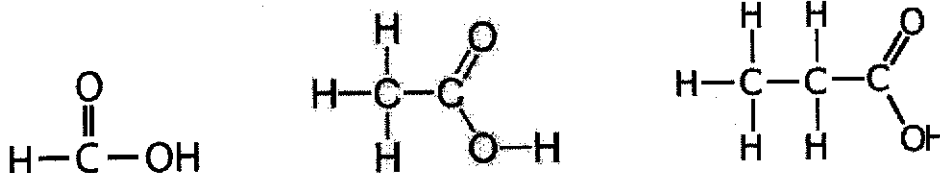
- (f) Calculate the number of moles of the acid in 1.00 dm³ of **R**.

[1]

- (g) Using your answer to (f) and the information that **R** contains 7.00 g/dm³ of the acid, calculate the relative molecular mass of the acid.

[1]

- (h) The organic acid could have one of the following structural formulae:



Using your answer to (g), deduce the formula for the organic acid.

[1]

[Total: 10]

OR

- B11 (a)** The acid dissociation constant K_a , is a quantitative measure of the strength of an acid in solution. The larger the K_a value, the more dissociation of the acid molecules in solution and thus the stronger the acid. The table shows the acid dissociation constants of some substances.

substance	formula of acid	acid dissociation constant
hydrofluoric acid	HF	6.8×10^{-4}
hydrochloric acid	HCl	1.0×10^{-5}
hydroiodic acid	HI	3.0×10^{-9}

Table. 11.1

Data extracted from : <http://chemistry.bd.psu.edu/jircitano/kakbtable>

- (i) With reference to Table 11.1, state and explain which substance is the **strongest** acid.

.....
 [2]

- (ii) Predict the acid dissociation of hydrobromic acid, HBr, and thus, compare the strength of hydrobromic acid, HBr to hydroiodic acid, HI.

.....
 [2]

- (iii) Describe a chemical test to confirm the strength of acids in a(ii).

.....

 [2]

- (b) Hydrated nickel(II) nitrate, $Ni(NO_3)_2 \cdot 6H_2O$, can be produced by reacting excess nickel(II) carbonate with dilute nitric acid. The resulting mixture is then filtered and heated to saturation. Green nickel(II) nitrate crystals can be obtained by allowing the saturated solution to cool at room temperature.

- (i) Explain why nickel(II) nitrate crystals were obtained by allowing the saturated solution to cool at room temperature instead of heating to dryness.

.....
 [1]

For
examiner's
use

- (ii) 25.0 cm³ of 1.00 mol/dm³ dilute nitric acid was reacted with **excess** nickel(II) carbonate in an experiment to produce hydrated nickel(II) nitrate.

Given that 2 moles of nitric acid is required to react to produce 1 mole of hydrated nickel(II) nitrate, calculate the mass of hydrated nickel(II) nitrate crystals obtained at the end of the reaction.

For
examiner's
use

[3]

[Total: 10]

**** END OF PAPER ****

The Periodic Table of Elements

		Group															
I	II	III	IV	V	VI	VII	0					0					
3 Li lithium 7	4 Be beryllium 9	5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20					18 Ar argon 40					
11 Na sodium 23	12 Mg magnesium 24	13 Al aluminum 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40					36 Kr krypton 84					
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium 98	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs cesium 133	56 Ba barium 137	57-71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium —	85 At astatine —	86 Rn radon —
87 Fr francium —	88 Ra radium —	89-103 actinoids	104 Rf rutherfordium —	105 Db dubnium —	106 Sg seaborgium —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —	113 Nh nihonium —	114 Fl flerovium —	115 Lv livermorium —	116 Uu ununoctium —	117 Ts tennessine —	118 Og oganeson —

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

1
H
hydrogen
1

57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium —	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
89 Ac actinium —	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkelium —	98 Cf californium —	99 Es einsteinium —	100 Fm fermium —	101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —

lanthanoids

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).



COMMONWEALTH SECONDARY SCHOOL

END OF YEAR EXAMINATION 2019

CHEMISTRY PAPER 1 & 2

ANSWERS

1.	B	2.	C	3.	A	4.	A	5.	D
6.	A	7.	C	8.	B	9.	C	10.	C
11.	C	12.	C	13.	B	14.	C	15.	C
16.	C	17.	B	18.	D	19.	C	20.	A
21.	B	22.	B	23.	B	24.	B	25.	C
26.	D	27.	D	28.	D	29.	C	30.	D
31.	C	32.	D	33.	B	34.	D	35.	B
36.	B	37.	D	38.	A	39.	C	40.	A

Section A (50 marks)

Answer all the questions in the spaces provided.

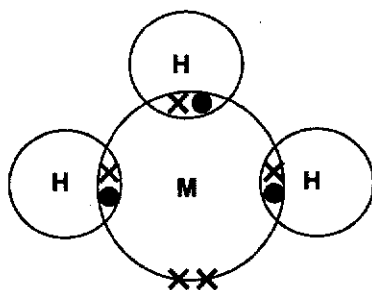
For
examiner's
use

- A1 (a) Chlorine / Cl_2 [1]
 (b) It has the **largest relative molecular mass** (Mr) of 71/ molar mass (71 g, 71 g/mol) [1]
 (c) 264 s /seconds [1]
 (d) hydrogen gas/ helium gas [1]
 (e) They are soluble/ dissolve in water. [1]
 [Total: 5]

- A2 (a) Statement 1:
 Correct
 The **number of proton is equal to number of electron (15)**, hence electrically neutral.
 Statement 2:
 Incorrect
 The **number of electron (18) is more than from the number of proton (15) / 3 more electrons than protons**, so it is a **negative ion**.
 Statement 3:
 Incorrect
 The **number of electron (18) is more than from the number of proton (15) / 3 more electrons than protons**, so it is a **negative ion**. Since **M_2 is not an atom/is a negative ion**, M_2 is not an isotope of M_3 .
 [1m each, total 3m]

[3]

(b)



[2]

[Total: 5]

A3 (a)

element	Group
W	VII
X	IV / VI
Y	III
Z	II

1m for every 2 correct answer

For
examiner's
use

[2]

(b) Z is a metal / in Group II [1], hence will form an ionic compound with oxygen / with a crystal lattice structure.
ZO is a solid at room temperature [1]Large amount of energy is needed to overcome strong electrostatic forces of attraction between the ions [1]

[3]

(c) sulfate of Z: ZSO_4
nitrate of Z: $Z(NO_3)_2$

[Total: 7]

A4 (a) It means that they exist as single atom. [1]

[1]

(b) Their outermost/valence shell is completely filled with electrons. [1]

[1]

(c)

Elements	xenon	oxygen	fluorine
Mass /g	0.55	0.13	0.32
Ar/Mr	131	16	19
Mole/ mol	$0.55/131 =$ 0.004198	$0.13/16 =$ 0.008125	$0.32/19 =$ 0.01684
Ratio	$0.004198/0.$ $004198= 1$	$0.008125/0.00$ $4198 = 2$	$0.01684 /$ $0.004198 = 4$

empirical formula: XeO_2F_4

[3]

- (d) **Condense/Cool** the mixture to **liquid state [1]**
Heat or boil the liquid mixture to **vaporise it** (and collect fractions) [1]
 The gas with the lowest boiling point will **condense first / collected at the higher portion of the column.**
 The gas with the **highest boiling point condense last / collected at the lower portion of the column.** [1 – for the order of the gas] [3]
 [Total: 8]

- A5 (a) Paper **chromatography** [1]
 Different pigments have **different solubility** in the **solvent.**[1] [2]
- (b) **Ink is a mixture of dyes/substance/components** and will **dissolve in the solvent, hence separating out with the other dyes in substance M/interfering with the separation results.** [1] [1]
- (c) **R & T** [1] [1]
- (d) Spray a **locating agent/ UV light** to react with the sugars so that it is **visible/form coloured spots.** [1] [1]
 [Total: 5]

- A6 (a) (i) **Hydrogen** ions [1]
- (ii) Similarity:
Effervescence / A gas is evolved during the reaction/
 Both **can react with dilute sulfuric acid/**
 Both form **a salt** in the reaction.
 Both solid **dissolve.**
 Any 1 answer above
- Difference:
 With iron - **hydrogen gas** evolved / **green solution formed / no water** produced
 With copper (II) carbonate - **carbon dioxide** given off / **blue solution formed / water** produced as a product [2]
- (b) (i) When the knob is struck, it punctures the glass container with **sodium carbonate.** [1]
Sodium carbonate exposed reacts with dilute sulfuric acid to produce carbon dioxide which will be released through the nozzle to **extinguish fire.**[1] [2]
- (ii) $\text{Na}_2\text{CO}_3(\text{aq/s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{Na}_2\text{SO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$ [1]
 [Total: 6]

- A7 (a) (i) Chlorine / Cl atom [1] [1]

(ii) These holes allow more UV rays to enter into the atmosphere. [1]
 These lead to an increase risk of cataracts/eye diseases/skin cancer/cell mutation. [1]

For
examiner's
use

[2]

(b) Dichlorodifluoromethane is a covalent compound with a simple molecular structure. [1]

Little energy is needed to overcome the weak intermolecular forces of attraction between the molecules. [1] Hence, the boiling point is low.

[2]

[Total: 5]

- A8 (a) A: Hydrochloric acid
 B: Sulfuric acid
 C: Magnesium, iron, zinc any reactive metal
 except Group I and Cu, Pt, Ag, Au
 D: Silver chloride
 E: Carbon dioxide
 F: Potassium hydroxide / Potassium carbonate

[6]

(b) $Cl^- + Ag^+ \rightarrow AgCl$ [1]

[1]

(c) Add dilute nitric acid and aqueous barium nitrate / acidified aqueous barium nitrate to solution B. [1]

A white precipitate would form. [1]

[2]

[Total: 9]

Section B (30 marks)

B9 (a) Small amount of energy is required to overcome the weak intermolecular forces of attraction between the layers of atoms. [1]

These layers are able to slide over each other easily thus it is slippery. [1]

[2]

(b) number of protons: 5
 number of neutrons: 6

[1]

(c) Graphite can conduct electricity at room temperature and pressure. [1]
 Each carbon atom only uses 3 out of 4 valence electrons for bonding / There is 1 unbonded valence electron available as mobile charged carrier to conduct electricity. [1]

[2]

- (d) (i) No. of moles of SiO₂ added = $300 / (28 + 16 + 16) = \underline{5 \text{ mol}}$ [1]

SiO₂ : Si
1 : 1

No. of moles of Si = 5 mol

Mass of Si = $5 \times 28 = 140\text{g}$ [1]

mass of silicon **140 g**

[2]

- (ii) Silicon dioxide **has a high melting point.**[1]

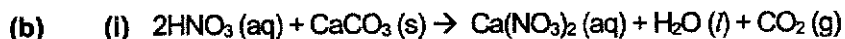
- Silicon dioxide has a **giant molecular structure** and all the atoms are bonded by **covalent bonds.**[1]
- **A lot of energy is required to break the strong covalent bonds between the atoms.** [1]

[3]

[Total: 10]

- B10** (a) Acidic gases like **nitrogen dioxide/oxides of nitrogen and carbon dioxide dissolves in rainwater and reacts with oxygen/oxidise by air/oxygen in air** to produce acid rain. [1]

[1]



[2]

- (ii) It is due to the **loss of carbon dioxide** gas to the surroundings.

[1]

- (c) **Bubble/Pass** the gas into **limewater.** [1]

If a **white precipitate** is formed in limewater/limewater turns **chalky**, the gas is carbon dioxide [1]

[2]

(d) (i)

Initial reading /g	98.00
Final reading /g	96.92
Mass loss /g	1.08

[2]

- (ii) Mr of CO₂ = $12 + 2(16) = 44$

No. of mole CO₂ produced = $1.08 / 44 = 0.02454 \text{ mol}$ [1]

Volume of CO₂ produced = $0.02454 \times 24 = 0.589 \text{ dm}^3$ [1]

[2]

For
examiner's
use

[Total: 10]

Either

B11

- (a) (i) Yellow [1]
(ii) Orange [1]

[2]

(b)

Titration	1	2	3
Final burette reading /cm ³	27.10	48.80	34.10
Initial burette reading /cm ³	0.00	22.30	7.80
Volume of R /cm ³	27.10	26.50	26.30
Best titration result		✓	✓

[2]

- (c) Using these results, the average volume of R = $\frac{26.50+26.30}{2} = 26.40 \text{ cm}^3$ [1]

[1]

- (d) No of moles of NaOH
= Conc x Vol
= 0.1 mol/dm³ x 0.025 dm³
= 0.0025 mol [1]

[1]

- (e) No of moles of acid used = 0.0025 mol (in 26.40cm³ of R)

[1]

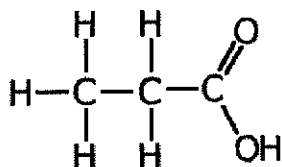
- (f) No of moles of acid in 1 dm³ of R
= 0.0025 mol ÷ 0.0264 dm³ (from part b)
= 0.0947 mol

[1]

- (g) Mr of acid
= mass ÷ moles
= 7g ÷ 0.09470 mol
= 73.92 (NO units)
= 73.9 (3 sf)

[1]

- (h) Calculate the Mr of all the structure above and determine the formula of organic acid is C₃H₆O₂ / C₂H₅COOH

For
examiner's
use

[1]

[Total: 10]

OR

B11 (a) (i)

Hydroiodic acid is the strongest acid.[1]It has the **highest dissociation constant** i.e. **0.00001** and thus shows more dissociation of the acid molecules in solution [1]

[2]

(ii) $1.0 \times 10^{-5} < \text{Value} < 3.0 \times 10^{-9}$ [1]Hydrobromic acid would be **less acidic/weaker acid** [1] compared to hydroiodic acid.

[2]

(iii) Add a piece of **magnesium/any reactive metal/metal carbonate** into a test tube containing dilute hydrobromic acid and another test tube containing dilute hydroiodic acid.[1]**Effervescence** will be observed in both test tubes but **more vigorous** in the test tube containing **dilute hydroiodic acid**. [1]

This confirm that dilute hydroiodic acid is stronger than hydroiodic acid.

[2]

(b) (i) If the solution is heated to dryness, **anhydrous** nickel(II) nitrate will be obtained / nickel(II) nitrate will **decompose/ lost water of crystallisation**. [1]

[1]

(ii) No. of moles of HNO_3 added = $25/1000 \times 1.00 = \underline{0.0250 \text{ mol}}$ [1]

2 : 1

No. of moles of nickel(II) nitrate produced = $0.0250 \times 2 = \underline{0.0125 \text{ mol}}$ [1]Mass of hydrated nickel(II) nitrate, $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$

$$= 0.0125 \times [59 + 2(14) + 6(16) + 6(18)]$$

$$= 3.6375 \text{ g}$$

$$= \underline{3.64 \text{ g (3sf)}} \text{ [1]}$$

[3]

[Total: 10]