BEATTY SECONDARY SCHOOL
MID YEAR EXAMINATION 2019

SUBJECT	**: CHEMISTRY**	**LEVEL**	**: Sec 3 Express**
PAPER	**: 6092/01**	**DURATION**	**: 45 minutes**
SETTER	**: Mr Yeo Chee Keong**	**DATE**	**: 21 May 2019**

CLASS :	NAME :	REG NO :

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, class and register number on the Optical Answer Sheet provided.
Do not use staples, paper clips, glue or correction fluid.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

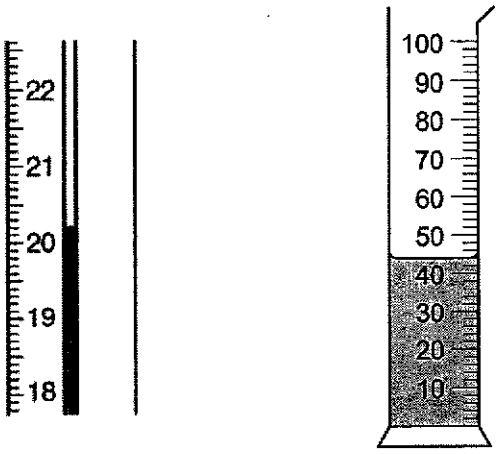
Read the instructions on the Answer Sheet very carefully.

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 13.
The use of an approved scientific calculator is expected, where appropriate.

This paper consists of **13** printed pages (including this cover page).

[Turn over

1 The diagram shows some readings in a thermometer and a measuring cylinder.

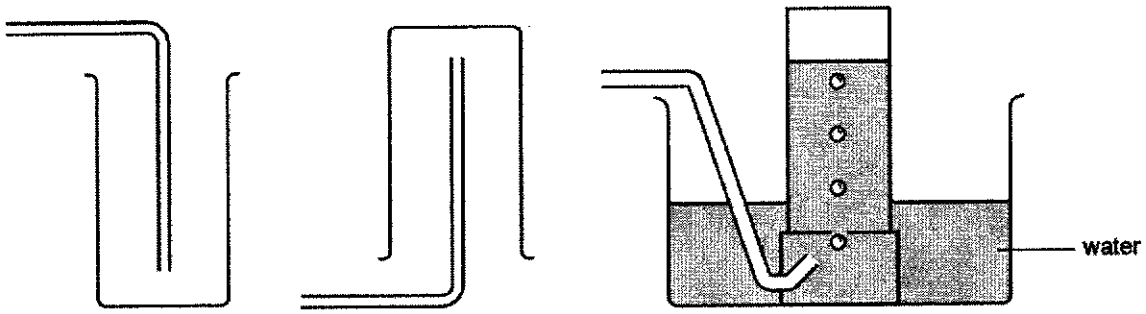


thermometer measuring cylinder

Which row shows the correct readings for the thermometer and the measuring cylinder?

	thermometer	measuring cylinder
A	20.2 °C	44.0 cm^3
B	20.4 °C	42.0 cm^3
C	22.0 °C	44.0 cm^3
D	24.0 °C	42.0 cm^3

2 Gas A is less dense than air and is insoluble in water.

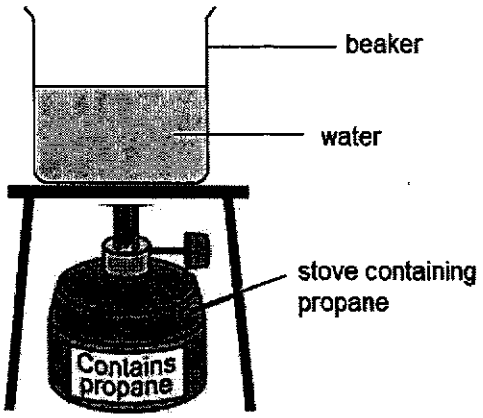


I II III

Which method(s) could be used to collect gas A?

A I only
B II only
C III only
D II and III only

3 A camping stove uses propane gas as a fuel. Justin wanted to find out how much energy was released when propane was burnt. He set up the experiment as shown.



The energy released from the burning of propane heats up the water in the beaker. The amount of energy released can be calculated using the equation:

$$Q = m \times 4.2 \times \Delta T$$

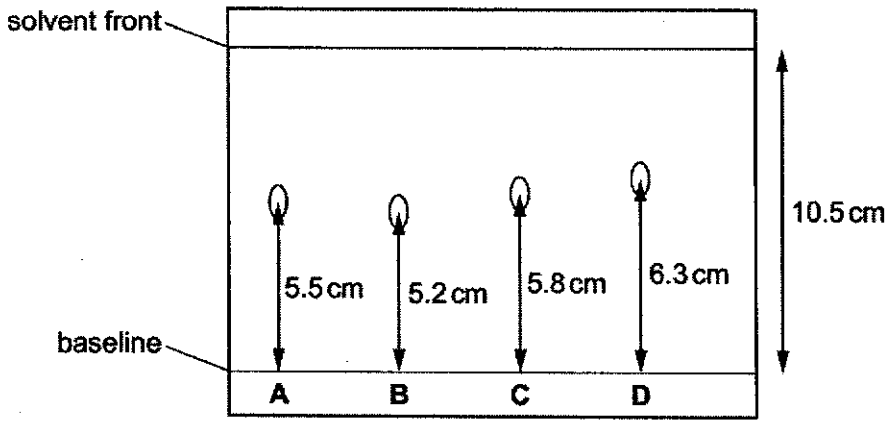
where Q = energy released
m = mass of water
ΔT = temperature change

Which set of apparatus is required for his investigation?

A burette and stopwatch
B electronic balance and gas syringe
C electronic balance and thermometer
D stopwatch and thermometer

4 A chromatogram obtained from the chromatography of four substances is shown.

Which substance has an R_f value of 0.600?

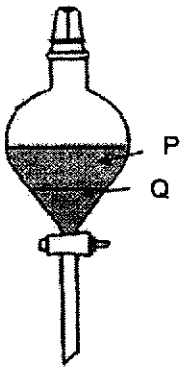


5 Benzene and cyclohexane are both flammable liquids. They are able to mix with each other without separating into two layers. They have very similar boiling points.

Why is it difficult to separate a mixture of benzene and cyclohexane by fractional distillation?

A They are both flammable.
B They are both liquids.
C They have very similar boiling points.
D They mix with each other completely.

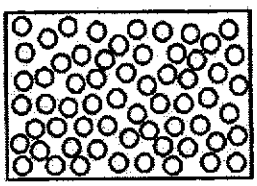
6 Two liquids, P and Q, are placed in a separating funnel. Two layers are formed as shown below.



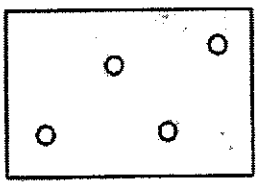
From the diagram, it can be deduced that liquid Q is _____

A denser than liquid P.
B more soluble than liquid P.
C more viscous (harder to flow) than liquid P.
D immiscible in all liquids.

7 The diagrams below show the particles in a substance at two different temperatures but at the same pressure.



−90 °C

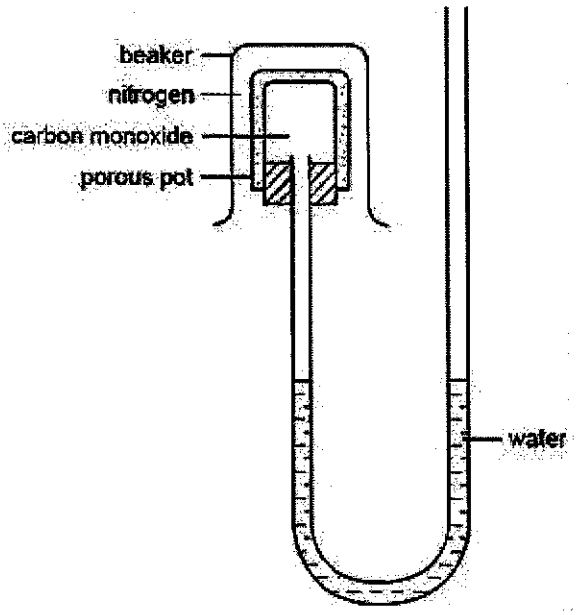


−5°C

Which of the following indicates a possible melting point and boiling point of the substance?

	melting point / °C	boiling point / °C
A	−183	−162
B	−102	−34
C	−82	−60
D	−76	−10

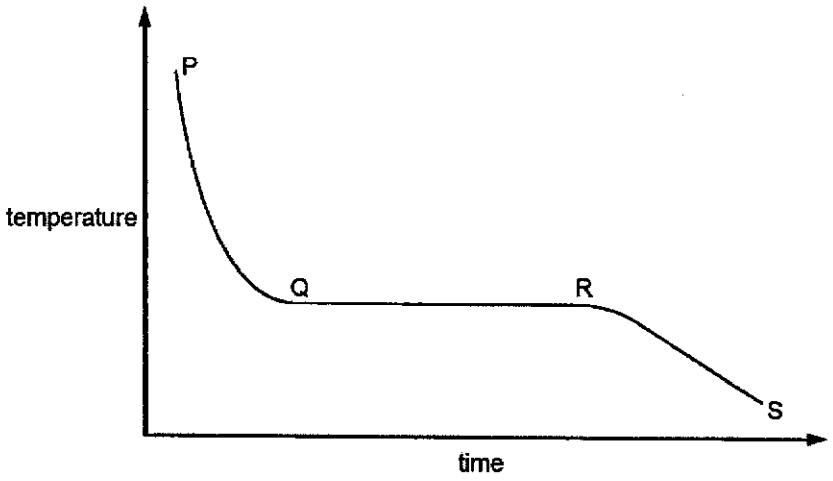
8 A beaker of nitrogen is inverted over a porous pot containing carbon monoxide as shown. The water level does not change.



Which reason best describes why the water level does **not** change?

A Both gas molecules are diatomic.
B Both gas molecules are in a state of constant, random motion.
C Both gas molecules have simple molecular structures.
D Both gas molecules have the same relative molecular masses.

9 A pure molten compound was allowed to cool until a change of state has occurred. The graph shows how the temperature of the compound changes with time.

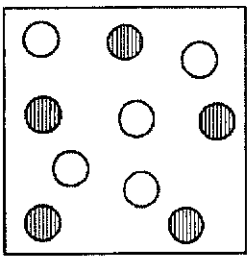


When are the liquid state(s) present in the graph?

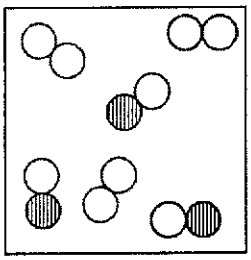
A P to Q
B P to Q and Q to R
C Q to R
D R to S

10 Which diagram shows a mixture of an element and a compound?

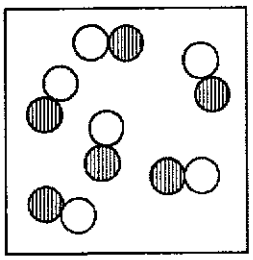
A



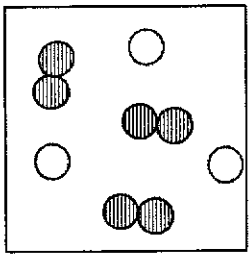
B



C



D



11 The melting points of three compounds, P, Q and R, are given in the table.

compound	P	Q	R
melting point / °C	104	130	133

Y is an unknown substance. In order to identify substance Y, it was mixed with each of the above compounds and the melting point of each mixture was determined. The following results were obtained.

mixture	Y and P	Y and Q	Y and R
melting point / °C	86 – 99	114 – 129	133

Four statements were made about substance Y.

I It behaves as an impurity when added to substances P and Q.
II It is substance R.
III It is the impure form of substance R.
IV It reacts with substances P and Q to form compounds with lower melting points.

Which statements are correct about substance Y?

A I and II
B II and III
C III and IV
D I and IV

12 Which statement is true for an element?

A An element can be decomposed by chemical means.
B An element can be separated by magnetic attraction.
C An element has a fixed melting and boiling point.
D An element is formed with a large energy change.

13 Heavy water is a type of water that contains an isotope of hydrogen known as deuterium. A deuterium atom has twice the mass of a hydrogen atom.

Given that water can be formed from either isotope of hydrogen, which of the following relative molecular masses is **not** possible for a water molecule?

A 18 **B** 19
C 20 **D** 21

14 Which statement is correct about the two atoms, $^{31}_{15}X$ and $^{32}_{16}Y$, represented by the nuclide notation?

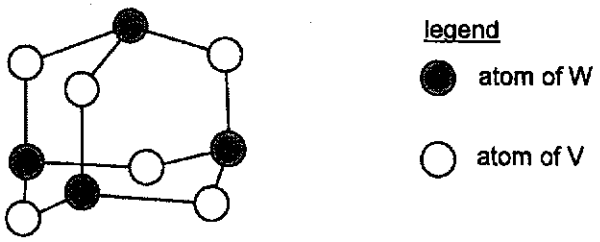
A Both X and Y are metallic in nature.
B Both X and Y are isotopes of the same atom.
C Both X and Y have different number of protons.
D Both X and Y have the same number of nucleons.

15 The ion Q^{2+} has three complete shells of electrons.

What is Q?

A calcium **B** magnesium
C oxygen **D** sulfur

16 A compound containing two types of atoms, W and V, has the following structure shown below.



Which statement is true about the compound?

A It exists as simple, discrete molecules.
B It has a giant molecular structure.
C The particles are able to slide over each other easily.
D The particles are held by strong electrostatic forces of attraction.

17 The following statements describe some properties of compound X.

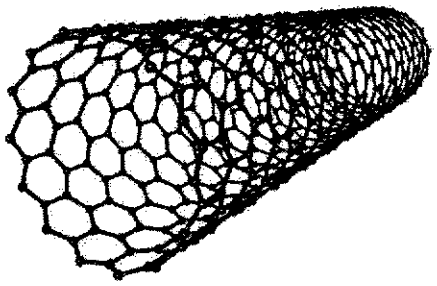
1 Compound X has a high melting point.
2 Compound X conducts electricity when molten or in aqueous solution.
3 Compound X does not conduct electricity in the solid state.
4 Compound X is made by reacting chlorine with element Z.

Which statement best describes a physical property of element Z?

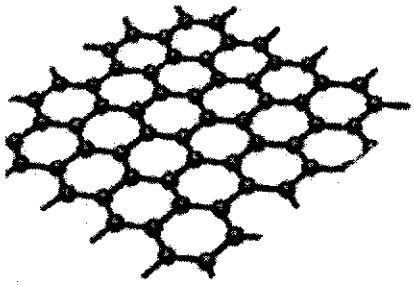
A Z does not conduct electricity.
B Z is a gas at room temperature.
C Z is malleable.
D Z is soluble in alcohol.

18 Carbon can form different structures as shown below.

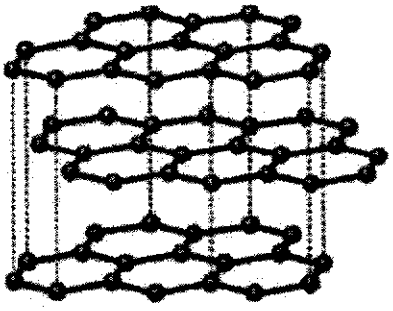
I



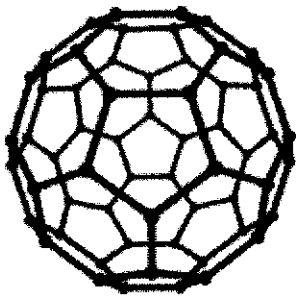
II



III



IV



Which structure(s) would allow an electric current to pass through?

A II only
B III only
C II and III only
D I, II, III and IV

19 Diamond is extremely hard and does not conduct electricity.

Which statement explains these properties?

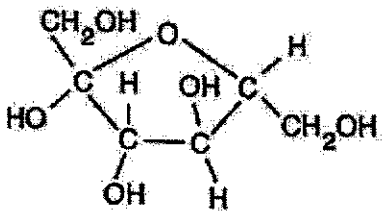
A It has a lattice of positive carbon ions in a 'sea of electrons'.
B It has delocalised electrons and each carbon atom forms three covalent bonds with other carbon atoms.
C It has no delocalised electrons and each carbon atom forms four covalent bonds with other carbon atoms.
D It has strong ionic bonds between each carbon atom.

20 An ionic compound is formed by two elements, metal P and non-metal Q. In the ionic lattice, every ion of P is surrounded by eight ions of Q. Conversely, every ion of Q is surrounded by four ions of P.

Deduce the formula of the ionic compound.

A PQ
B PQ_2
C P_2Q
D P_4Q_8

21 Fructose is a simple sugar used as a sweetener to sweeten food and beverages.



fructose

What are the number of elements and the total number of atoms present in fructose respectively?

	number of elements	total number of atoms
A	3	24
B	3	26
C	4	24
D	4	26

22 A compound has a formula of Al_2X_3.

What could be the identity of ion X?

A calcium
B carbonate
C chloride
D hydroxide

23 The reaction between ammonia and oxygen is given by the following equation:

$$w\text{NH}_3 + x\text{O}_2 \rightarrow y\text{N}_2 + z\text{H}_2\text{O}$$

What values of w, x, y and z will balance the equation?

	w	x	y	z
A	2	1	1	3
B	2	3	1	6
C	4	2	2	3
D	4	3	2	6

24 The chemical formulae of two substances, W and X are given.

W $NaAlSi_3O_8$
X $CaAl_2Si_2O_8$

Which statements are correct?

1 Both W and X contain the same number of silicon atoms.
2 Both W and X contain the four different types of atoms.
3 The anion, Si_3O_8 in W has a charge of 4− while the anion, Si_2O_8 in X has a charge of 8−.
4 There are a total of four ions present in one formula unit of W while there are a total of three ions present in one formula unit of X.

A 1 and 2 only
B 2 and 3 only
C 3 and 4 only
D 1 and 4 only

25 Different solids were added to separate portions of warm dilute sulfuric acid.

For which solid is the observation correct?

	solid	observation
A	ammonium sulfate	gas evolved turned moist red litmus paper blue
B	copper	gas evolved extinguished a lighted splint with a 'pop' sound
C	magnesium oxide	gas evolved relighted a glowing splint
D	zinc carbonate	gas evolved formed a white precipitate in limewater

26 An aqueous solution of the organic compound methylamine has a pH greater than 7.

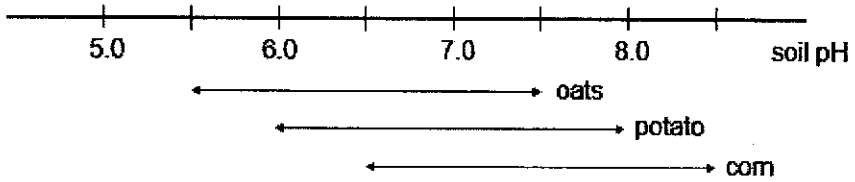
Which statement about methylamine is correct?

A It neutralises an aqueous solution of sodium hydroxide.
B It reacts with copper(II) carbonate to give carbon dioxide.
C It reacts with hydrochloric acid to form a salt.
D It turns blue litmus red.

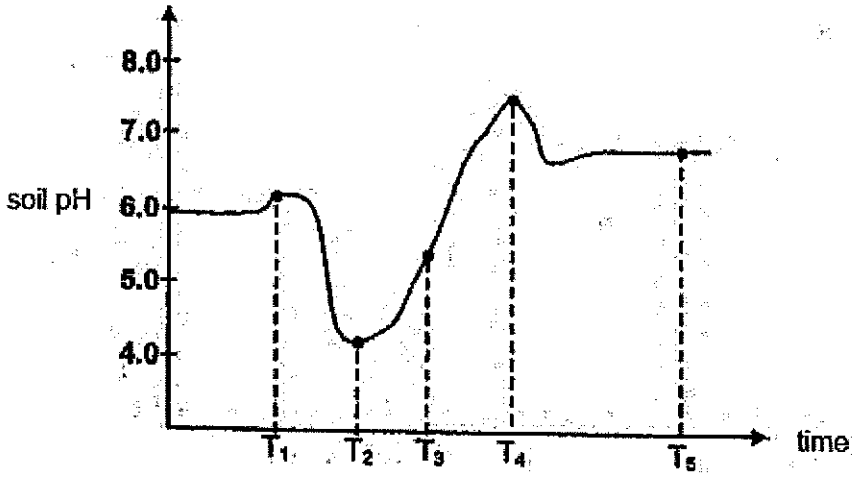
27 Which row correctly classifies the types of oxides in the table?

	carbon dioxide	nitrogen monoxide	potassium oxide
A	acidic	basic	amphoteric
B	acidic	neutral	basic
C	neutral	acidic	basic
D	neutral	amphoteric	amphoteric

28 The pH ranges required to grow oats, potato and corn crops are shown below.



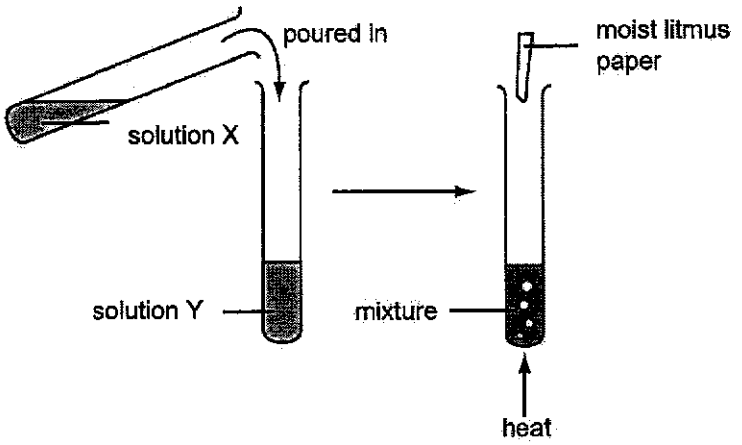
The following graph shows how the pH of the soil in a farm changes over a period of time.



During which period of time would all three crops grow well?

A between T_1 and T_2
B between T_2 and T_3
C between T_3 and T_4
D between T_4 and T_5

29 The diagram shows two solutions, X and Y, being heated together upon mixing.



The moist red litmus paper turned blue during the experiment. Which equation best explains the results observed?

A $NH_4NO_3 + NaOH \rightarrow NaNO_3 + NH_3 + H_2O$
B $NH_4NO_3 + HCl \rightarrow NH_4Cl + HNO_3$
C $2NH_4Cl + Na_2CO_3 \rightarrow 2NaCl + 2NH_3 + CO_2 + H_2O$
D $H_2SO_4 + K_2CO_3 \rightarrow K_2SO_4 + CO_2 + H_2O$

30 A series of four aqueous potassium hydroxide solutions with different concentrations was prepared, and tested with the indicator brilliant cresol blue. The results are shown below.

pH	colour with brilliant cresol blue
10	blue
11	green
12	yellow
13	yellow

Two unknown solutions were then tested with the indicator brilliant cresol blue.

unknown solution	colour with brilliant cresol blue
X	blue
Y	yellow

Based on the results of the above experiments, which of the following is the most likely conclusion about the pH of X and Y?

A The pH of X is 10, and the pH of Y is 12.
B The pH of X is 10, and the pH of Y is 12 or more.
C The pH of X is 10, and the pH of Y is between 12 and 13, inclusive.
D The pH of X is 10 or less, and the pH of Y is 12 or more.

The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							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
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
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 -	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 caesium 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 –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	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
actinoids	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 –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

BEATTY SECONDARY SCHOOL
MID YEAR EXAMINATION 2019

SUBJECT	**: CHEMISTRY**	**LEVEL**	**: Sec 3 Express**
PAPER	**: 6092/02**	**DURATION**	**: 1 hour 45 minutes**
SETTER	**: Mr Yeo Chee Keong**	**DATE**	**: 10 May 2019**

CLASS :	NAME :	REG NO :

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

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

Section B
Answer all **three** questions.
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 20.

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

Section	Marks
A	/ 50
B7	/ 12
B8	/ 8
B9	/ 10
Total	/ 80

This paper consists of **20** printed pages (including this cover page).

[Turn over

Section A

Answer **all** questions in this section in the spaces provided.
The total mark for this section is 50.

A1 **(a)** Use the list of separation techniques to answer the questions.

crystallisation	**evaporation to dryness**
filtration	**using the separating funnel**
simple distillation	**fractional distillation**
magnetic attraction	**sublimation**

(i) Which method(s) can be used to obtain iron from a mixture of iron and sand?

.....[1]

(ii) Which method(s) can be used to obtain dry solids from their solution mixtures?

.....[1]

(iii) Which method(s) can be used to obtain zinc from a mixture of zinc and sodium chloride solution?

.....[1]

(iv) Which method(s) can be used to remove oil from a mixture of oil and water?

.....[1]

(v) Which method(s) can be used to obtain alcohol from a mixture of alcohol and water?

.....[1]

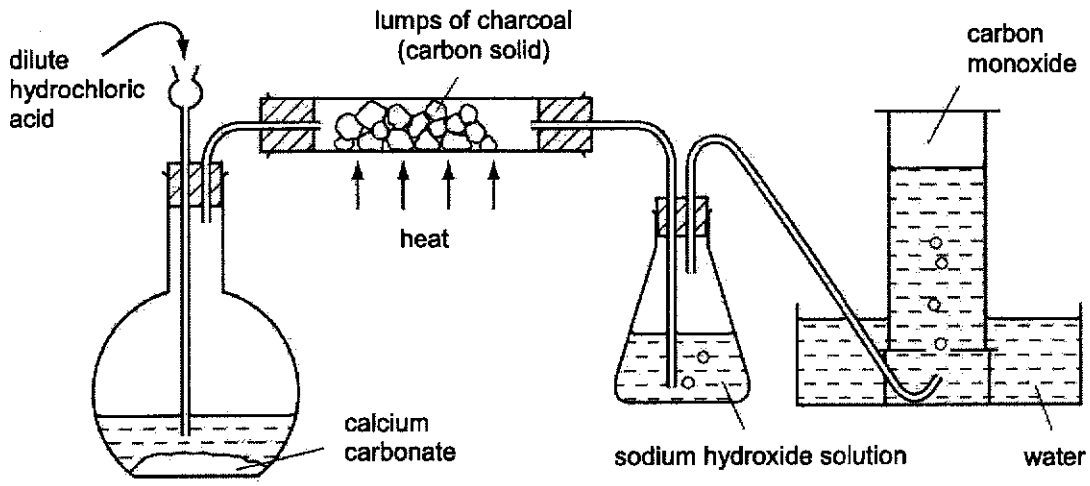
(b) Describe and explain a limitation when using evaporation to dryness as a method of separation.

.....

.....[1]

[Total: 6]

A2 The diagram below shows an experiment for the collection of carbon monoxide gas.



(a) Identify the gas produced when dilute hydrochloric acid reacts with calcium carbonate.

.....[1]

(b) The gas produced when dilute hydrochloric acid reacted with calcium carbonate is then passed through lumps of charcoal to form carbon monoxide gas only.

(i) Write an equation, with state symbols, for the formation of carbon monoxide.

.....[2]

(ii) Based on the diagram, deduce one property of the carbon monoxide gas collected.

.....[1]

(c) Explain why sodium hydroxide solution was used in the experiment.

.....

.....[1]

[Total: 5]

A3 Jenson conducted some experiments on five substances, **A**, **B**, **C**, **D** and **E**. He recorded his observations in the following statements.

Statement 1:
Substance **A** is a black solid that forms a reddish-brown solid and a colourless gas when heated.

Statement 2:
When excess dilute sulfuric acid is added to solid **B**, effervescence was produced and a colourless solution was formed. The gas produced extinguishes a lighted splint with a 'pop' sound.

Statement 3:
Substance **C** is a grey thin wire that glows red when electricity is passed through it. When there is no current passing through substance **C**, the thin wire remains grey.

Statement 4:
When excess water is added to a green solid, a green solution **D** is formed.

Statement 5:
Substance **E** turns into a liquid on heating, but turns back to the same solid upon cooling.

(a) Which **two** statements represent a chemical change? Explain your answer.

.....

.....[2]

(b) Use the statements above to decide whether each substance **A** to **E** is an element, mixture or compound. Show your decision by ticking (✓) the correct box for each substance in the table.

substance	element	compound	mixture	element or compound
A				
B				
C				
D				
E				

[3]

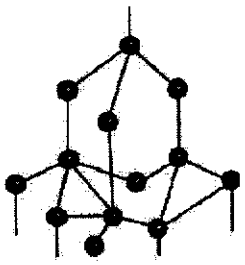
(c) When 0.500 g of substance **A** was heated, Jenson predicted that the mass of the reddish-brown solid obtained would also be 0.500 g due to the law of conservation of mass. Do you agree with Jenson? Explain your answer.

.....

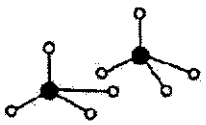
.....[2]

[Total: 7]

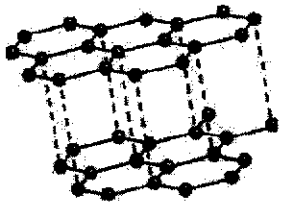
A4 The diagram below shows the structures of substances, **X**, **Y** and **Z**.



substance **X**



substance **Y**



substance **Z**

(a) **(i)** Substance **X** and **Z** are considered to be allotropes. Define the term *allotropes*.

.....[1]

(ii) Hence, identify which of the above substances could be graphite and diamond respectively.

graphite .....

diamond .....[1]

(b) Substance **X** and substance **Y** have large differences in their melting points. With reference to the structures and bonding, explain the large difference in their melting points.

.....

.....

.....

.....

.....

.....

.....

.....[4]

(c) Explain why substance **Z** is often used as lubricants.

.....

.....

.....[2]

[Total: 8]

A5 The table below shows some information about substances **J**, **K**, **L**, **M** and **N**. Use the information in the table to answer the following questions.

substance	melting point / °C	boiling point / °C	electrical conductivity at room temperature	solubility in water
J	sublimes at 184		no	no
K	1710	2230	no	no
L	962	1560	no	yes
M	–114	78	no	yes
N	1085	2562	yes	no

(a) Which substance is a liquid at room temperature?

.....[1]

(b) **(i)** Describe how the arrangement and movement of particles in substance **L** change when it is heated from 1500 °C to 2000 °C.

.....

.....

.....

.....[2]

(ii) Substance **L** was determined to be barium chloride. Draw a 'dot-and-cross' diagram to show the bonding in substance **L**.

Show outer electrons only.

[2]

(c) **(i)** Given that substance **N** is ductile, predict the type of structure present in substance **N**.

.....[1]

(ii) With reference to the bonding in substance **N**, explain why it is able to conduct electricity at room temperature.

.....

.....

.....

.....[2]

(d) Jane is given a 7 g sample of a mixture containing substances **J**, **K** and **L**. Describe an experiment that she can conduct to determine the **percentage** of substance **K** in the mixture. You may assume that substances **L** and **K** do not decompose on heating.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

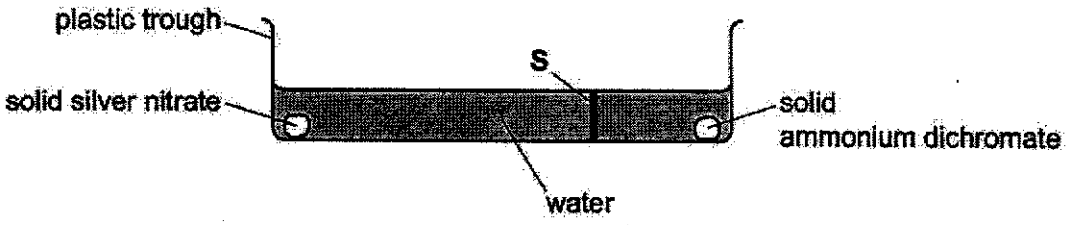
.....

.....[5]

[Total: 13]

A6 Silver dichromate, $Ag_2Cr_2O_7$, is a red insoluble solid.

Silver dichromate can be made by reacting silver nitrate solution with ammonium dichromate solution. The apparatus was set up as shown.



After five minutes, a red solid appeared along the line marked '**S**' on the diagram. This reaction can also be represented by a chemical equation as shown.

$$2AgNO_3(aq) + (NH_4)_2Cr_2O_7(aq) \rightarrow 2NH_4NO_3(aq) + Ag_2Cr_2O_7(s)$$

(a) (i) Deduce the charge on the dichromate ion in $Ag_2Cr_2O_7$.

.....[1]

(ii) Explain what is meant by (aq) and (s) in the chemical equation.

.....

.....[1]

(b) (i) Describe and explain how the red solid appeared along the line marked '**S**'.

.....

.....

.....

.....

.....

.....[3]

(ii) The experiment was repeated at a higher temperature.

What effect, if any, would this have on the time taken for the red solid to appear? Explain your answer.

.....

.....[2]

(c) Ammonium dichromate, $(NH_4)_2Cr_2O_7$, undergoes thermal decomposition.

The products are solid chromium(III) oxide, nitrogen and water.

(i) Explain what is meant by the term *thermal decomposition*.

.....

.....[2]

(ii) Write an equation, with state symbols, for the reaction in **(c)**.

.....[2]

[Total: 11]

Section B

Answer **all** three questions in this section.

B7 Development of the Atomic Structure

The development of the theory about atoms began from John Dalton in 1800s, followed by J.J. Thomson in 1897 and Ernest Rutherford and Niels Bohr in 1911. A summary of the main points of their theories are as shown.

John Dalton

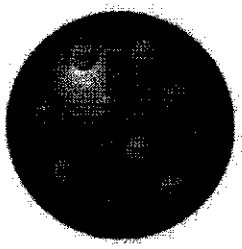
Dalton proposed that atoms were like billiard balls, where they were solid, hard spheres. His theory included elements consisting of tiny, indivisible particles called atoms. Dalton also proposed that all the atoms of a given element are identical and that the atoms of different elements differ in size and mass, as shown in Fig. 7.1.

atoms are like billiard balls, with different atoms having different sizes

Fig. 7.1

J.J. Thomson

In 1897, J.J. Thomson proposed the plum pudding model, where the atom consists of electrons simply surrounding the positive matter in the atom. In Thomson's plum pudding model of the atom, the electrons were embedded in a uniform sphere of positive charge like blueberries stuck into a muffin, as shown in Fig. 7.2.



electrons embedded in a uniform sphere of positive charge

Fig. 7.2

11

He also discovered electrons from experiments conducted using the cathode ray tube. Fig. 7.3 shows how a cathode ray tube works.

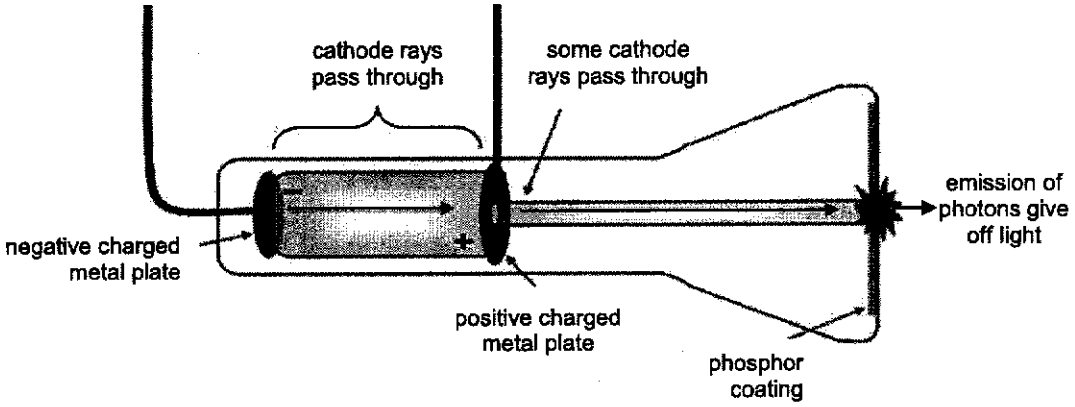


Fig. 7.3

Cathode rays are produced by the negatively charged metal plate. They accelerate past the positively charged metal plate and hit the phosphor coating. This causes the phosphor to emit photons. Thus, the path taken by the cathode rays can be tracked.

In one of Thomson's experiment, he placed positively and negatively charged metal plates, **A** and **B** respectively, in the path of the cathode rays. He found that the rays were deflected as shown in Fig. 7.4. The cathode rays were eventually known to be made up of electrons.

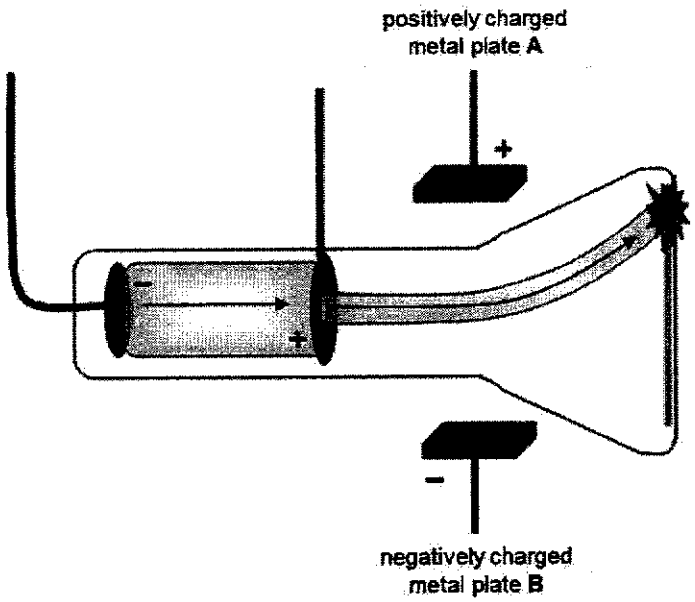


Fig. 7.4

12

Ernest Rutherford and Niels Bohr

Ernest Rutherford proposed that an atom must contain a central nucleus. This was further evidence that an atom contained smaller pieces. Rutherford conducted the famous gold foil experiment which eventually replaced Thomson's model of the atom. Fig. 7.5 below shows the experiment conducted by Rutherford.

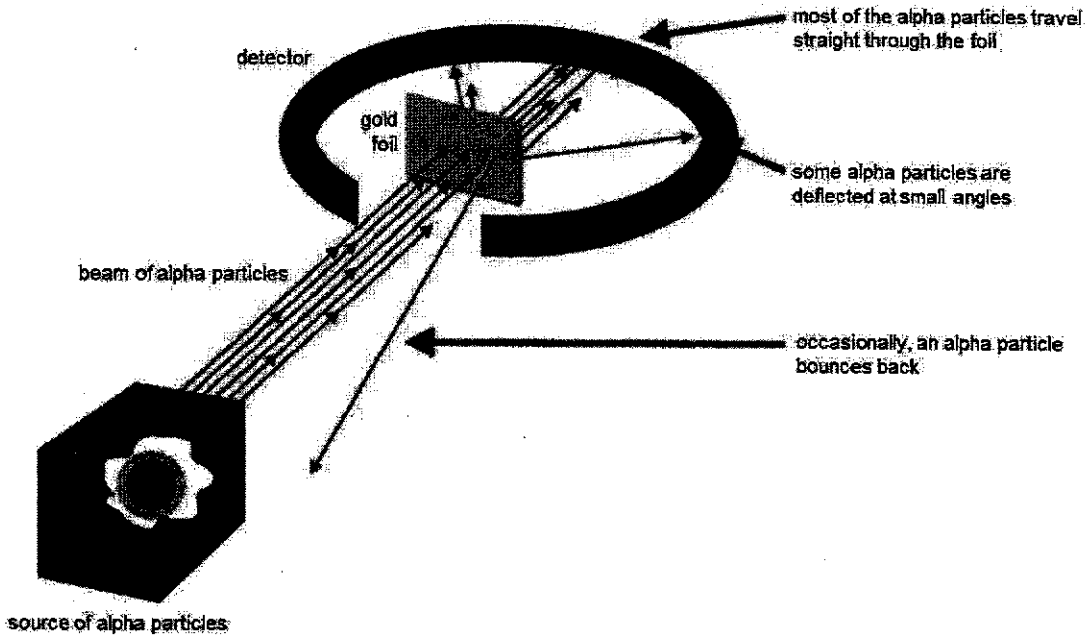


Fig. 7.5

In Rutherford's gold foil experiment, he bombarded the gold foil (consisting of gold atoms) with positively charged alpha particles. In his discovery, most of the alpha particles travel straight through the foil, with only some alpha particles deflected at small angles, and occasionally an alpha particle bouncing back. The Rutherford model thus served to concentrate a great deal of the atom's charge and mass to a very small core in the nucleus.

Niels Bohr then further developed and modified Rutherford's nuclear atom model with electrons. He discovered that electrons occupy particular shells and move around the nucleus of an atom. This development of Science constitutes to the current model and structure of an atom.

Sources:
http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_gateway/periodic_table/atomstrucrev5.shtml
http://en.wikibooks.org/wiki/High_School_Chemistry/Further_Understanding_of_the_Atom
http://m.teachastronomy.com/astropedia/article/The-Structure-of-the-Atom

(a) John Dalton believed that **all** the atoms of a given element are identical. Do you agree with him? Use your knowledge on atomic structure to explain your answer.

.....

.....

.....[2]

(b) **(i)** With reference to Fig. 7.3, suggest why the path taken by the cathode rays can be easily tracked.

.....

.....[1]

(ii) What is the relative charge of an electron?

.....[1]

(iii) Based on Fig. 7.4, what evidence was there in Thomson's experiment that proved that the electron had the relative charge as suggested in **(b)(ii)**?

.....

.....[1]

(c) In Rutherford's experiment shown in Fig. 7.5, the thin gold foil was bombarded with a beam of alpha particles. An alpha particle can be represented by the following symbol:

$$^{4}_{2}He^{2+}$$

(i) Determine the number of protons, electrons and neutrons present in an alpha particle.

number of protons .....

number of electrons .....

number of neutrons .....

[2]

(ii) Based on the Rutherfold's gold foil experiment in Fig. 7.5, what evidence is there to believe that an atom is made up **mainly** of **empty space** with a very **small nucleus** that is **positively charged**?

.....

.....

.....

.....

.....

.....

.....[3]

(d) The exact masses of the subatomic particles were also determined in the development of Science.

subatomic particle	mass / kg
proton	1.6726×10^{-27}
neutron	1.6749×10^{-27}
electron	9.1093×10^{-31}

(i) Using the mass of proton as a reference, calculate the relative mass of an electron.

[1]

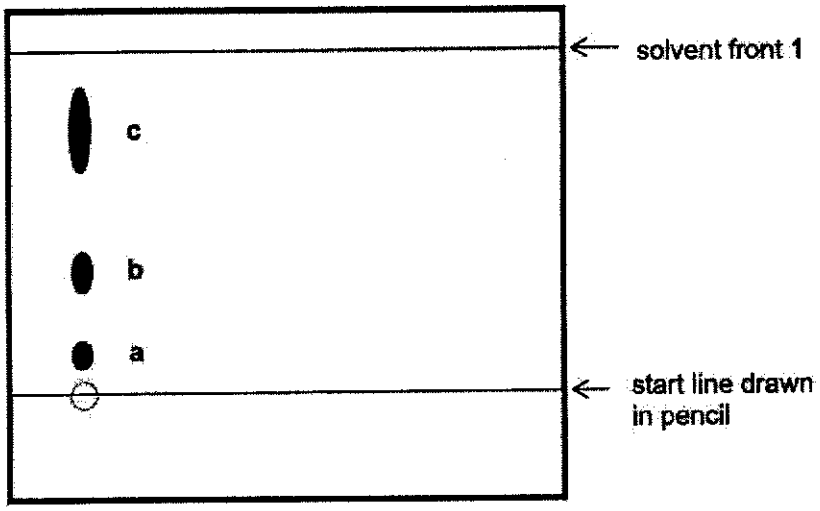
(ii) Would the mass of a helium atom differ much from an alpha particle? Explain your answer.

.....

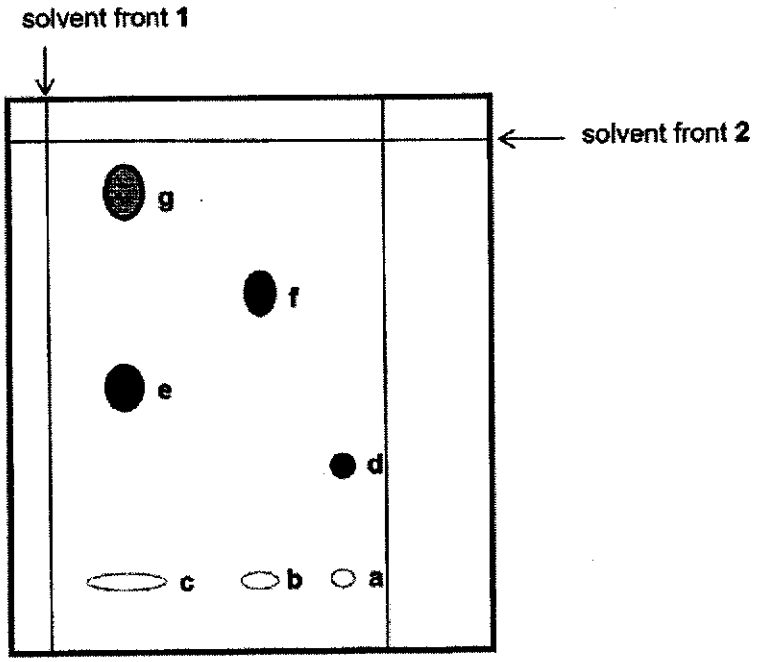
.....[1]

[Total: 12]

B8 The components in a drug sample were separated using water as the solvent. The developed chromatography paper is shown in the diagram below.



The chromatography paper was left to dry. It was **rotated** 90° anti-clockwise and placed in another solvent – solvent **2**. The rotated chromatogram with the spots labelled from **a** to **g** is shown in the diagram below.



(a) **(i)** The rotated chromatography paper was developed in solvent **2** in a container with an enclosed lid. Explain why the experimental set-up was carried out in an enclosed lid.

.....[1]

(ii) Suggest the identity of solvent **2**.

.....[1]

(b) A locating agent was sprayed onto the chromatography paper after developing it in water. Explain why.

.....

.....[1]

(c) With reference to **both** the developed chromatograms, determine the number of components present in the drug sample.

.....[1]

(d) List out any **two** conclusions about the components of the mixture. Support your conclusion with evidence.

conclusion 1 .....

evidence 1 .....

conclusion 2 .....

evidence 2 .....[2]

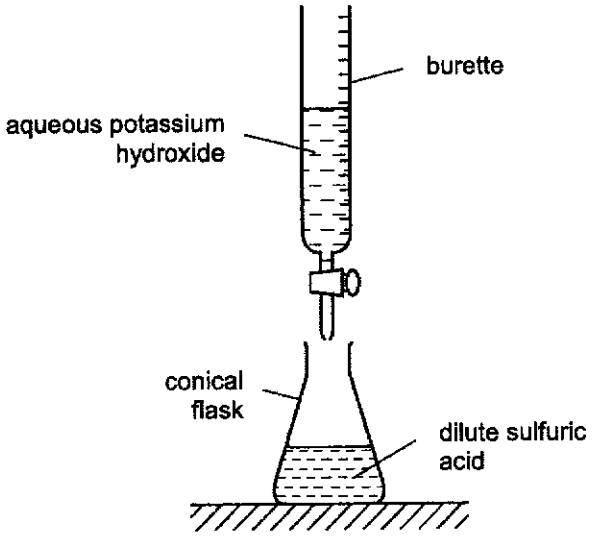
(e) Describe clearly how you would determine if the extracted liquid from spot **d** is pure.

.....

.....[2]

[Total: 8]

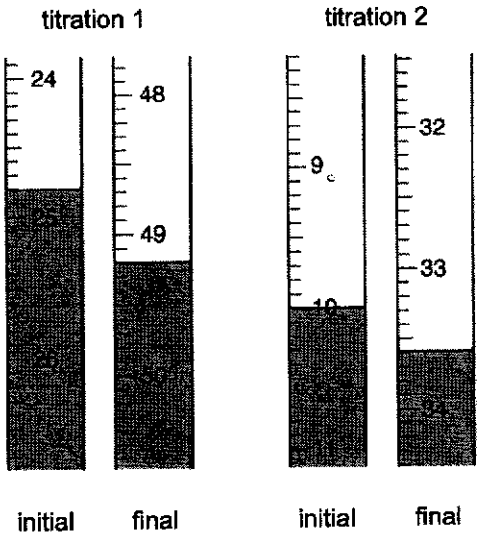
B9 In an attempt to determine the concentration of an unknown sample of aqueous potassium hydroxide, a titration experiment was carried out to titrate aqueous potassium hydroxide against dilute sulfuric acid as shown.



As the products of the reaction are colourless, a few drops of methyl orange was added to the conical flask as an indicator to determine the end-point of the reaction. This can be observed when the first drop of aqueous potassium hydroxide added to the mixture turns the indicator from red to orange.

For an accurate titration result, the experiment should be carried out over a few times to ensure that the volume of potassium hydroxide required should be consistent within a **range of 0.20 cm^3**.

(a) Johnny proceeded with the titration experiment twice and the results are as shown.



(i) Use Johnny's results to complete the results table.

titration number	1	2
final burette reading / cm^3		
initial burette reading / cm^3	24.80	10.00
volume of potassium hydroxide used / cm^3		

[2]

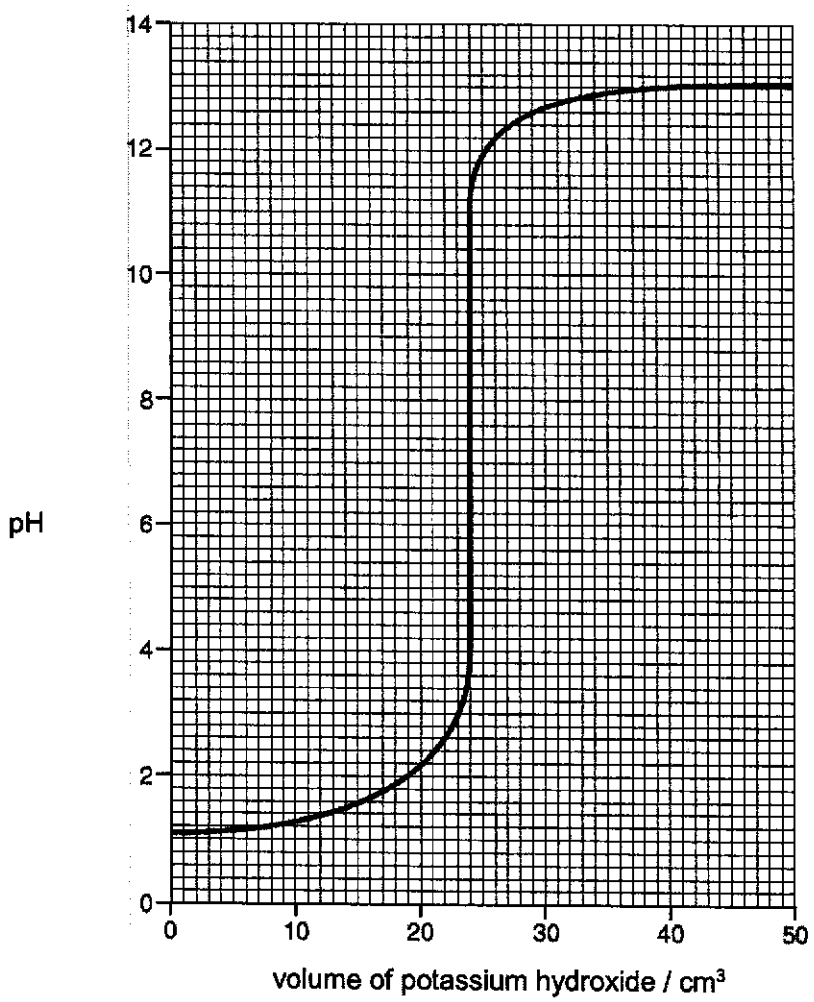
(ii) Suggest a reason why it is necessary for Johnny to repeat the experiment for at least one more time and what he can do to obtain an accurate volume of potassium hydroxide.

.....

.....

.....[2]

(b) A data-logger attached to a pH sensor was used to observe the pH changes in the reaction flask.



(i) Given that the salt formed in the product is soluble in water, write an equation, with state symbols, for the reaction of dilute sulfuric acid and aqueous potassium hydroxide.

.....[2]

(ii) Based on the graph, determine the exact volume of potassium hydroxide required for complete neutralisation with dilute sulfuric acid.

.....[1]

(c) Another student, Janice carried out the same experiment. She uses the same technique but instead of using three drops of methyl orange, she added 3 cm^3 of methyl orange to the conical flask.

(i) Methyl orange is a weak acid. Explain the term *weak acid*.

.....

.....[1]

(ii) Explain how the addition of 3 cm^3 instead of three drops of methyl orange would **affect** the titration volume of aqueous potassium hydroxide used.

.....

.....

.....[2]

[Total: 10]

The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							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
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
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 -	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 caesium 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 –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	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
actinoids	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 –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Beatty Secondary School
Mid Year Exam 2019
Chemistry 6092
Secondary 3 Express

Marking Scheme

Paper 1

1	2	3	4	5	6	7	8	9	10
A	D	C	D	C	A	B	D	B	B
11	12	13	14	15	16	17	18	19	20
A	C	D	C	A	A	C	D	C	B
21	22	23	24	25	26	27	28	29	30
A	B	D	B	D	C	B	D	A	C

Paper 2

Section A

A1		**Total = 6**
ai	magnetic attraction	1
aii	evaporation to dryness, crystallisation	1
aiii	filtration	1
aiv	using the separating funnel	1
av	fractional distillation	1
b	The solid obtained by this process may not always pure as soluble impurities would also be left behind with the desired solid / or This method can only be used for solids that do not decompose when they are heated strongly / Solids that are not stable to heat may decompose upon heating. *Any 1 of the answer*	1
A2		**Total = 5**
a	carbon dioxide	1
bi	$CO_2(g) + C(s) \rightarrow 2CO(g)$ correct balanced equation – [1] correct state symbols – [1] **Note: second mark for state symbols is only awarded if the equation is balanced*	2
bii	The gas is insoluble in water.	1
b	Purpose of sodium hydroxide solution: It is to remove any unwanted / excess carbon dioxide gas that would contaminate the carbon monoxide produced [1].	1

A3 **Total = 7**

a Statements 1 and 2 [1]. In both reactions, (two) new products are formed [1]. 2

b 3

substance	element	compound	mixture	element or compound
A		✓		
B	✓			
C	✓			
D			✓	
E				✓

5 correct – [3]
3 – 4 correct – [2]
1 – 2 correct – [1]

c No *[no marks awarded]*. The mass of the reddish-brown solid will be less than 0.500 g [1]. The mass lost is due to the release / escape of the colourless gas [1]. 2

A4 **Total = 8**

ai Allotropes are different forms of the same element, with different arrangement of the atoms. 1

aii graphite: substance Z
diamond: substance X 1

b Substance X has a macromolecular/giant molecular/giant covalent structure but Substance Y has a simple molecular/covalent structure [1]. 4

The atoms in substance Y are held together by numerous strong covalent bonds. As such, a large amount of energy is required to break the strong covalent bonds [1].

On the other hand, a small amount of energy is required to overcome the weak intermolecular forces of attraction [1] between molecules in substance Y.

This results in substance Y having a low melting point whereas substance X has a high melting point [1].

c A small / little amount of energy is required to overcome the weak intermolecular forces of attraction between each layer of substance Z [1]. 2

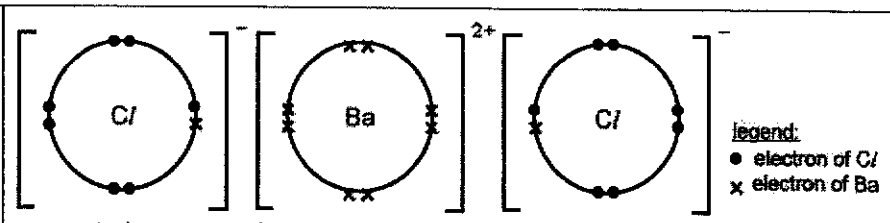
Hence, when a force is applied, the hexagonal layers of substance Z can slide over each other easily. This makes Z soft and slippery to be used as a lubricant [1].

A5 **Total = 13**

a Substance M 1

bi When heated from 1500 °C to less than 2000 °C, the particles in substance L which are initially close together in a disorderly/random manner become far apart [1]. 2

The particles which could initially move freely throughout the liquid volume / slide past each other are now able to move freely at high speeds in all directions, occupying every available space [1].

bii	 correct charges on ions – [1] correct number of valence electrons showing the electron transferred – [1]	2
ci	(giant) metallic	1
cii	Substance N consists of a lattice of positive metal ions in a 'sea of delocalised electrons' [1]. The 'sea of delocalised electrons' in sodium are mobile and function as charge carriers to allow the metal to conduct electricity [1].	2
d	1. Place the mixture of J, K and L in an evaporating dish. Warm the mixture gently until all the solid J sublimes and escapes as a vapour. 2. Add water to the remaining mixture of substances K and L to ensure all the substance L is completely dissolved. 3. Filter the mixture using a filter funnel. The residue contains substance K, while the filtrate contains substance L. 4. Dry substance K between sheets of filter paper before measuring the mass of substance K obtained using an electronic mass balance. 5. Use the following formula to obtain the percentage of substance K in the mixture: Percentage of K = [mass of substance P obtained ÷ mass of mixture (7 g)] x 100 % *Award a maximum of 4 marks if students performed the addition of water before sublimation. Soluble impurities of L might be trapped in J and K.*	5
A6	**Total = 11**	
ai	2–	1
aii	(aq) – aqueous state (s) – solid state	1
bi	Both silver nitrate and ammonium dichromate crystals dissolve in water [*1 mk pt*] to form silver, nitrate, ammonium and dichromate ions. Silver ions has a lower relative molecular mass than dichromate ions [*1 mk pt*] and travels / diffuses a further distance to point S [*1 mk pt*]. Silver ions then react with dichromate ions to form the red insoluble solid [*1 mk pt*]. 4 mk pts – [3] 2 – 3 mk pts – [2] 1 mk pt – [1]	3
bii	The time taken will be shorter / lesser than 5 minutes [1]. This is because as the temperature increases, particle gain more kinetic energy and moves faster, increase the speed of reaction [1].	2
ci	Thermal decomposition is the breaking down of a compound into two or more simpler substances [1] by heat [1].	2
cii	$(NH_4)_2Cr_2O_7(s) \rightarrow Cr_2O_3(s) + N_2(g) + 4H_2O(l)$ correct balanced equation – [1] correct state symbols – [1] **Note: second mark for state symbols is only awarded if the equation is balanced*	2

Section B

B7		Total = 12
a	I disagree. This is due to the occurrence of isotopes [1], hence atoms of the same element can have the same number of protons but different number of neutrons. [1]	2
bi	This is due to the emission of photons that give off light, making the pathway easy to track.	1
bii	1–	1
biii	The electron was attracted to the positively charged metal plate **A** but repelled the negatively charged metal plate **B** / electron deflected to metal plate **A**.	1
ci	number of protons: 2 number of electrons: 0 number of neutrons: 2 3 correct – [2] 1 – 2 correct – [1]	2
cii	In the experiment, most of the alpha particles are able to travel straight through the gold foil. This shows that an atom is made up mainly of empty space. [1] Some of the alpha particles are deflected at small angles and occasionally, an alpha particle bounces back. [1] As like charges repel, this shows that an atom consists of a nucleus that is positively charged. [1]	3
di	relative mass = $(9.1093 \times 10^{-31} + 1.6726 \times 10^{-27})$ = 0.000545	1
dii	It will not differ much. Mass of electrons are negligible.	1
B8		**Total = 8**
ai	The lid is to prevent the complete evaporation of the volatile solvent.	1
aii	alcohol / ethanol	1
b	The spots are colourless / not visible to the eye, hence the locating agent will react with the components to form coloured compounds to ensure visibility of the components.	1
c	4	1
d	conclusion 1: Components d, e, f and g are insoluble in water. evidence 1: These spots were absent in the first chromatogram. conclusion 2: Component c consists of components g and e. evidence 2: Two spots of g and e were observed when c is separated using solvent 2. conclusion 3: Component b is component f. evidence 3: Only 1 spot of component f was observed during separation. or conclusion 3: Component a is component d. evidence 3: Only 1 spot of component d was observed during separation. *Any plausible conclusion*	2
e	Determine the boiling point of liquid d [1]. If the liquid boils at a fixed temperature, the liquid d is pure [1]. method of determination – [1] results – [1]	2

B9 **Total = 10**

ai

titration number	1	2
final burette reading / cm^3	49.20	33.60
initial burette reading / cm^3	24.80	10.00
volume of potassium hydroxide used / cm^3	24.40	23.60

4 correct – [2]
2 – 3 correct – [1] — 2

aii The first two titrations are not consistent to within 0.20 cm^3 of each other / readings are too far apart [1]
He can use all the titration values and calculate the average of the readings to improve the accuracy [1]. — 2

bi $H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$

correct balanced equation – [1]
correct state symbols – [1]
**Note: second mark for state symbols is only awarded if the equation is balanced* — 2

bii 24.00 cm^3 — 1

ci A weak acid ionises partially to give a low concentration of hydrogen ions when dissolved in water. — 1

cii Methyl orange will neutralise potassium hydroxide [1]. Hence, a larger volume of potassium hydroxide would be required for the titration [1]. — 2