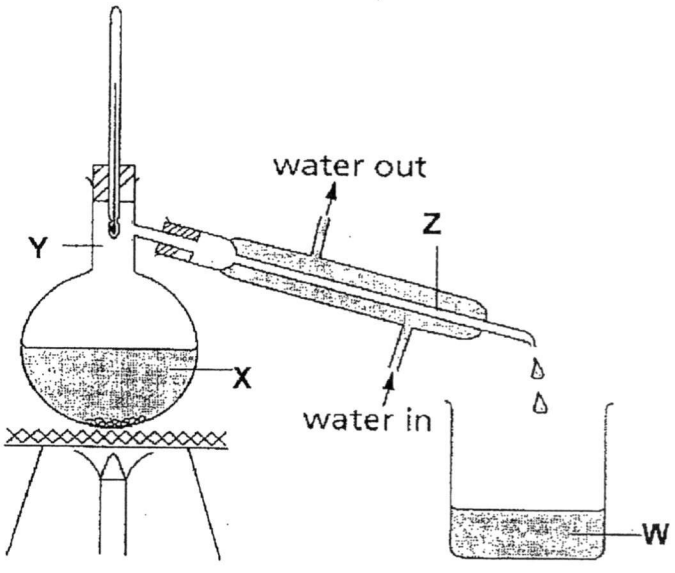
1 A student wants to find out the rate of reaction between 2.0 g of calcium carbonate and 25.0 cm^3 of dilute hydrochloric acid.

Which apparatus should the student use?

A electronic balance, digital stopwatch, measuring cylinder, gas syringe
B electronic balance, digital stopwatch, pipette, gas syringe
C electronic balance, digital stopwatch, measuring cylinder, thermometer
D electronic balance, digital stopwatch, pipette, thermometer

2 The diagram below shows the apparatus used to obtain water from aqueous copper(II) sulfate.



Which of the following statements about the separation process is correct?

A A blue solution is observed at **W**.
B Blue crystals are formed at **Z**.
C Colour of the solution at **X** becomes darker.
D Temperature at **Y** is the same as the boiling point of copper(II) sulfate.

3 A student was given a mixture containing ammonium sulfate and iron(II) sulfate.

He added excess aqueous sodium hydroxide, with shaking to a hot solution of the salts in a boiling tube until there was no further reaction. The boiling tube was then left to stand for some time.

Which one 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 The precipitate dissolved in excess aqueous sodium hydroxide.

D The precipitate turned brown on standing.

4 The boiling points of some gases are given in the table.

gas	boiling point / °C
helium	−269
nitrogen	−196
ammonia	−35.5
carbon dioxide	−78.5

When the mixture is cooled to −100 °C, some of these gases liquefy.

Which gases will liquefy?

A ammonia and carbon dioxide

B ammonia and helium

C carbon dioxide and nitrogen

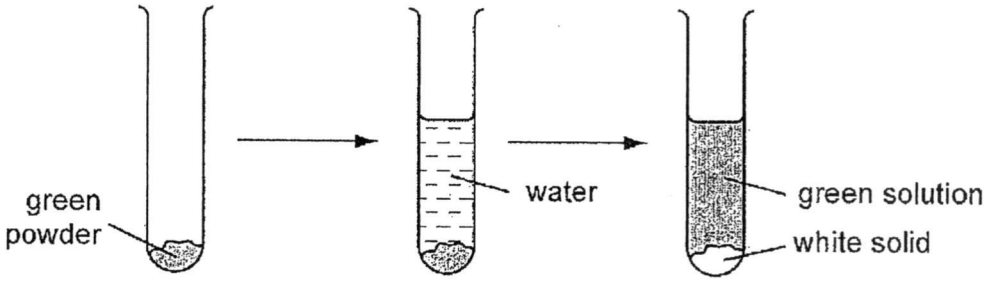
D helium and nitrogen

5 The nucleon number of an isotope of bromine is 81.

How many protons, neutrons and electrons are present in an atom of this isotope?

	protons	neutrons	electrons
A	35	46	35
B	35	46	46
C	37	44	35
D	37	44	37

6 Some water is added to some green powder. After shaking, a green solution and a white solid are seen.



What does the green powder contain?

A a compound
B a mixture of compounds
C a mixture of elements
D an element

7 Which of the following statements is **not** true?

A A single covalent bond is formed by the sharing of two electrons.
B Carbon dioxide molecule has two double bonds.
C Covalent compounds are usually solids at room conditions.
D In the formation of ammonia, each nitrogen atom will share three pairs of electrons with three hydrogen atoms.

8 Element **P** has n protons and forms an ion with a charge of 2−.
Element **Q** has (n+1) protons.

What is the type and formula of the compound formed between elements **P** and **Q**?

A a covalent compound, P_2Q
B a covalent compound, PQ_2
C an ionic compound, PQ_2
D an ionic compound, P_2Q

9 Which one of the following has the same number of particles as one mole of magnesium atoms?

A the number of atoms in 71 g of chlorine gas
B the number of atoms in 64 g of copper metal
C the number of ions in 1 dm^3 of 0.25 mol/dm^3 of dilute hydrochloric acid
D the number of ions in 81 g of zinc oxide

10 Which of the following is an endothermic reaction?

A burning of petrol
B photosynthesis in plants
C reaction between aqueous sodium hydroxide and dilute nitric acid
D respiration in humans

11 What would be the best way to slow down the reaction between magnesium and dilute hydrochloric acid?

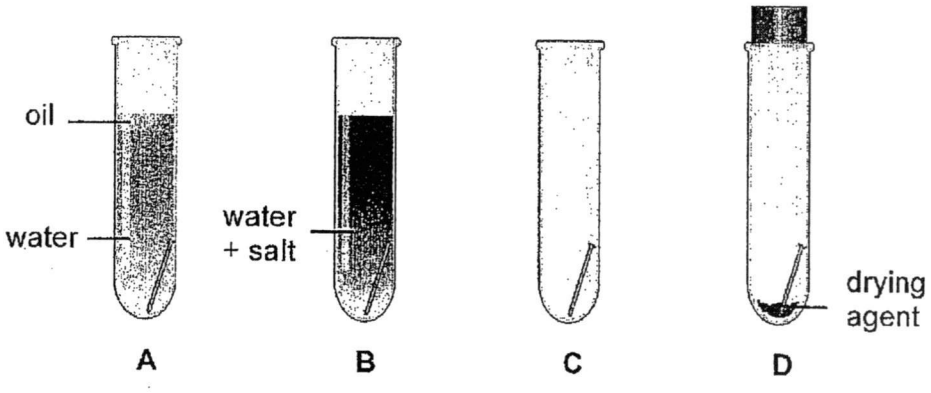
A add a catalyst
B add water to dilute the acid
C decrease the pressure
D stir the reaction mixture

15 A storage tank is made of a metal. It is ideal for storing cold water but dissolves away rapidly if used to store dilute acid.

What is the metal likely to be?

A calcium
B copper
C lead
D zinc

16 A student set up an experiment using iron nails, as shown.



In which tube does the iron nail undergo the most rusting after one week?

17 The following gases are present in car exhaust fumes.

- carbon dioxide
- carbon monoxide
- nitrogen
- nitrogen dioxide
- water vapour

Which of these gases is/ are also present in unpolluted air?

A nitrogen only
B nitrogen and water vapour only
C nitrogen, carbon dioxide and water vapour only
D nitrogen, carbon monoxide, carbon dioxide and water vapour only

12 Soil pH in a farm is around 6.0 to 6.5. The farmer wants to grow lilac which grows well in soil with a pH in the range of 7.1 to 8.0.

Which of the following is most suitable to be added to the soil?

A ammonium nitrate
B calcium carbonate
C calcium hydroxide
D sodium sulfate

13 Four oxides are added separately to aqueous sodium hydroxide.

1 aluminium oxide
2 carbon dioxide
3 copper(II) oxide
4 magnesium oxide

Which oxide(s) react(s) with aqueous sodium hydroxide?

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

14 Rubidium is below potassium in Group I of the Periodic Table.

Which statement is most likely to be correct?

A Rubidium can displace potassium from aqueous potassium chloride.
B Rubidium has a higher melting point than potassium.
C Rubidium is less dense than potassium.
D Rubidium reacts with water less vigorously than potassium.

18 What are all the possible combustion products of methane?

A carbon, carbon dioxide, carbon monoxide and water
B carbon, carbon monoxide and hydrogen
C carbon dioxide, carbon monoxide and hydrogen
D carbon dioxide, carbon monoxide, hydrogen and water

19 Which of the products, $C_{12}H_{24}$ and H_2, could be formed by cracking dodecane, $C_{12}H_{26}$?

	$C_{12}H_{24}$	H_2
A	x	x
B	x	√
C	√	x
D	√	√

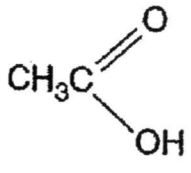
20 Wine can deteriorate after a period of time, because of atmospheric oxidation.

Which compound would be formed by the oxidation of the alcohol in the wine?

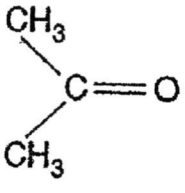
A

CH_3CH_2OH

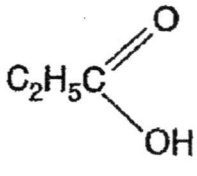
B



C



D



DATA SHEET

The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yitrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 =															

140 Ce Cerium 58	142 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series

=90-103 Actinoid series

Key: a X b — a = relative atomic mass; X = atomic symbol; b = proton(atomic)number

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

Candidate's name: _____ ( ) Class: _____

Evergreen Secondary School
Preliminary Examination 2017

Science (Chemistry) Paper 3
Secondary Four Express / Five Normal (Academic)

Date: 28 August 2017
Duration: 1 hour 15 minutes
Marks: 65

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the cover page.
You may use an HB pencil for any diagrams, graphs, table, or rough working.
Write in blue or black pen.
Do not use staples, paper clips, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A

Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B

Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

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

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.

For Examiner's Use	
Section A	
Section B	
Total	

This question paper consists of **18** printed pages, including the cover page.

[Turn Over]

Section A

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

1 Table 1.1 shows the melting points, boiling points and electrical conductivities of the five substances **A** to **E**.

Table 1.1

substance	melting point / °C	boiling point / °C	electrical conductivity	
			at room temperature	when dissolved in water
A	113	444	does not conduct	does not dissolve
B	0	100	very poor	very poor
C	803	1465	does not conduct	good
D	–5 to –10	102 to 105	good	good
E	–85	–60	does not conduct	does not dissolve

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

..... [1]

(b) Which **two** substances are liquids at room temperature?

..... [1]

(c) Which substance is an ionic compound?

..... [1]

(d) (i) Which substance is impure?

..... [1]

(ii) Explain your choice of answer for **(d)(i)**.

..... [1]

2 A student is investigating the dyes contained in three inks **1**, **2** and **3** using the chromatography method.

He has placed spots of the inks on the start line that he has marked on a piece of chromatography paper. He has rolled the paper into a tall cylinder and placed it inside a tall beaker as shown in Fig. 2.1.

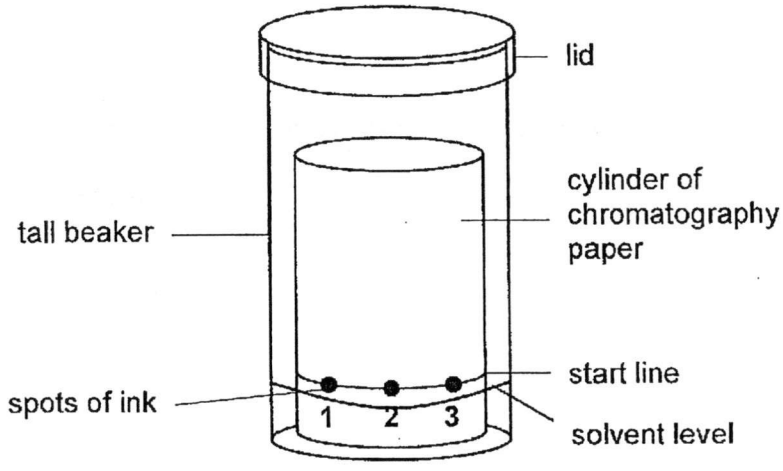


Fig. 2.1

At the end of the experiment, the chromatogram obtained is shown in Fig. 2.2.

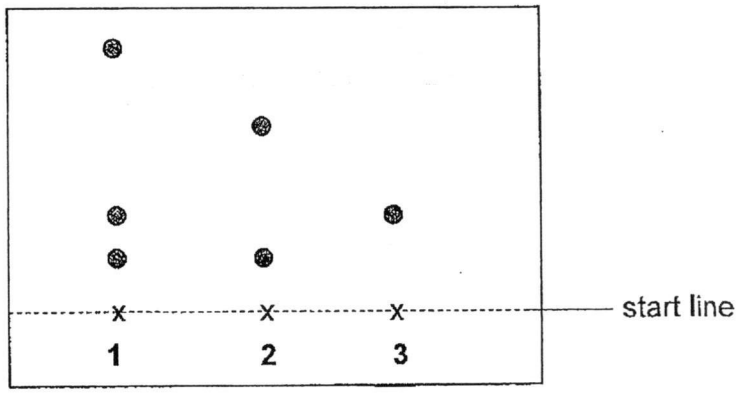


Fig. 2.2

(a) How many dyes are present in inks **1**, **2** and **3**?

..... [1]

(b) Suggest why the starting line should be drawn with a pencil rather than with ink.

.....

..... [1]

(c) What can the student conclude about the purities of inks **1**, **2** and **3**?

Explain your choice of answers.

.....

.....

.....

..... [3]

(d) The student repeated the experiment using a dye he extracted from a marker pen.

Ten minutes after the chromatography paper is placed in the solvent, the spot of dye remained at the starting line.

Explain the above observation.

.....

..... [1]

3 Fig. 3.1 describes reactions involving a white solid, **J**.

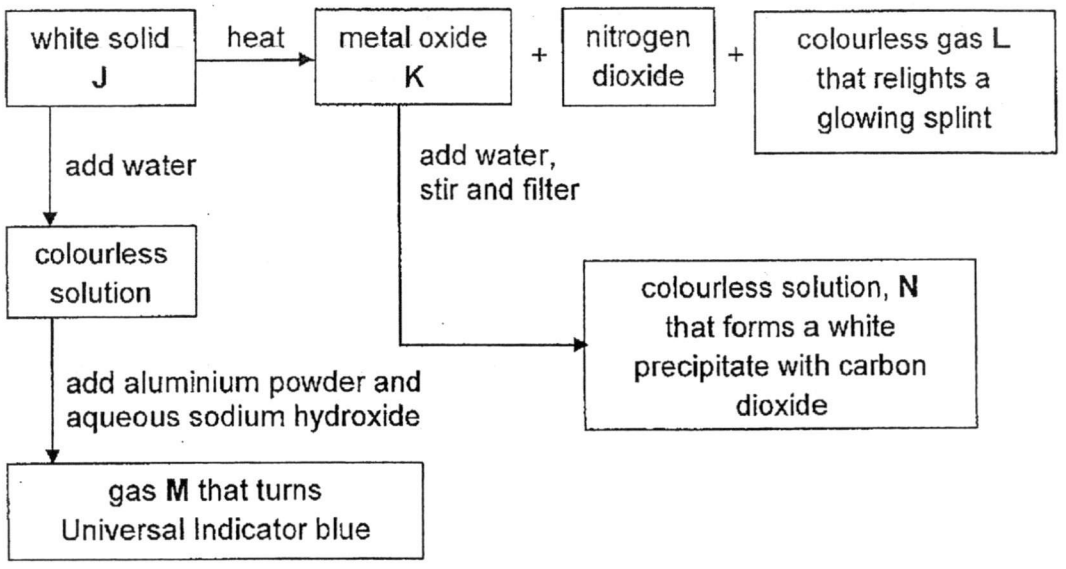


Fig. 3.1

(a) Identify substances J, K, **L**, **M** and **N**.

(i) **J** : ..... [1]

(ii) **K** : ..... [1]

(iii) **L** : ..... [1]

(iv) **M** : ..... [1]

(v) **N** : ..... [1]

(b) Write an equation for any one of the changes described in Fig. 3.1.

..... [2]

(c) What type of oxide is nitrogen dioxide?

..... [1]

4 Copper can be obtained by heating copper(II) oxide in a stream of hydrogen gas as shown in Fig. 4.1.

The burner is turned off when reaction is completed but the hydrogen is kept flowing until the tube is cold.

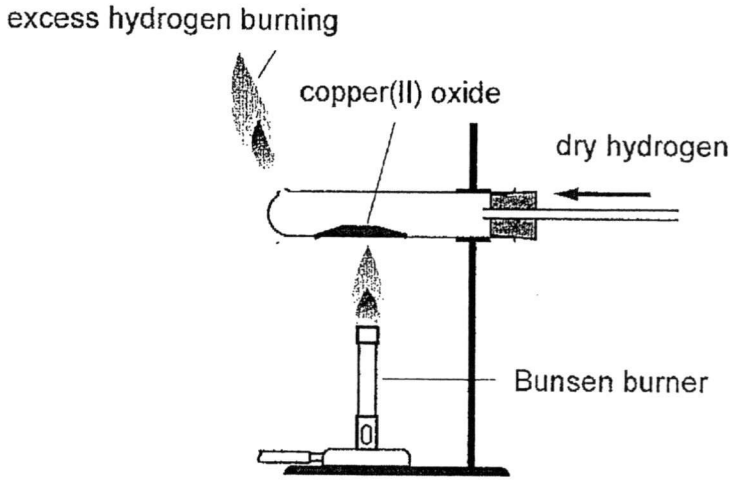


Fig. 4.1

The reaction is represented by the following equation.

$$CuO + H_2 \rightarrow Cu + H_2O$$

(a) Suggest why hydrogen is kept flowing until the tube is cold after the reaction is completed.

..... [1]

(b) Explain, in terms of oxidation state, whether copper(II) oxide has been oxidised or reduced.

.....

..... [1]

(c) Calculate the mass of copper formed when 8 g of copper(II) oxide is used.

[2]

(d) Calculate the volume of unreacted hydrogen gas if 10 dm^3 of hydrogen gas was used.

[3]

(e) Can copper be obtained by heating copper(II) oxide with carbon?

Explain your answer.

.....

..... [1]

5 Excess calcium carbonate is added to a fixed volume of dilute hydrochloric acid in a conical flask.

Fig. 5.1 shows how the loss in mass changes with time.

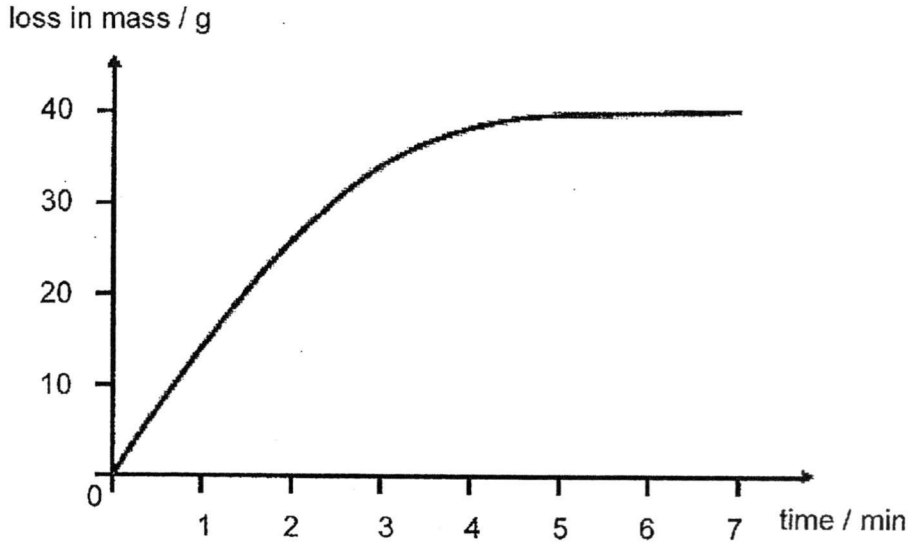


Fig. 5.1

The rate of reaction can be changed by changing the reaction conditions.

(a) Why does the loss in mass gradually increase as time increases?

..... [1]

(b) The experiment is repeated using warm dilute hydrochloric acid.

Using your knowledge of reacting particles, explain why the rate of reaction increases when the reaction mixture is heated to a higher temperature.

.....

.....

..... [2]

(c) On Fig. 5.1, sketch the graphs obtained when the experiment is repeated with

(i) more finely powdered calcium carbonate. Label this graph as **A**. [1]

(ii) dilute hydrochloric acid of half the original concentration.
Label this graph as **B**. [1]

6 (a) Use your knowledge of electronic structures to explain the following statements.

(i) Elements in Group II all have similar chemical properties.

.....

..... [1]

(ii) Elements from Group VI act as non-metals.

.....

..... [1]

(iii) Elements from Group 0 lack chemical reactivity.

.....

..... [1]

(b) Element **Z** with an atomic number of 85 is so unstable that it has never been seen by the naked human eye.

(i) Suggest two ways in which chlorine differs in properties from element **Z**.

1. .....

2. ..... [2]

(ii) Draw a 'dot-and-cross' diagram to show the structure of an **ion** of **Z**.
You only need to show the outer shell electrons.

[1]

(iii) Excess chlorine is bubbled through a solution containing ions of **Z**.

Write an ionic equation for the reaction involving chlorine and the solution containing ions of **Z**. State symbols are not required.

..... [2]

7 Table 7.1 shows the analysis of samples of river water from three different countries P, Q and R.

Table 7.1

ion present	concentration of ions in country **P** (mg/dm^3)	concentration of ions in country **Q** (mg/dm^3)	concentration of ions in country **R** (mg/dm^3)
magnesium, Mg^{2+}	32	67	2
sodium, Na^+	0	12	11
potassium, K^+	2	3	0
hydrogen, H^+	30	12	13
chloride, Cl^-	14	28	0
sulfate, SO_4^{2-}	31	82	52
phosphate, PO_4^{3-}	0	10	10

(a) Based on Table 7.1, suggest a reason which country has the most acidic water.

.....

..... [1]

(b) Give the name and formula of the salt that can be found in the river water from the three different countries **P**, **Q** and **R**.

..... [2]

(c) Phosphate ions are contaminants from factories. One way of treating river water to remove these phosphate ions is by adding calcium ions to form a precipitate.

Construct an ionic equation, with state symbols, to show the reaction between calcium ions and phosphate ions.

..... [2]

Section B

Answer any **two** questions in this section.

Write your answers in the spaces provided.

8 (a) When miners mine for gold, they often mistakenly find another metallic-yellow coloured material called pyrite. Pyrite is made up of iron(III) sulfide, sometimes also known as "fool's gold".

The iron can be extracted from pyrite by first passing oxygen gas across heated pyrite:

iron(III) sulfide + oxygen → iron(III) oxide + sulfur dioxide

(i) Sulfur dioxide is known to be an air pollutant.

Describe two harmful effects of sulfur dioxide on the environment.

.....

.....

..... [2]

(ii) State one **other** source of sulfur dioxide.

..... [1]

(b) Iron can also be manufactured in a blast furnace using iron ore, coke and limestone.

(i) Name a suitable iron ore.

..... [1]

(ii) Describe, with the aid of full chemical equations, how impurities are removed from iron.

.....

.....

.....

.....

.....

..... [3]

(c) (i) What is meant by *recycling*?

.....

..... [2]

(ii) Give one reason why iron is recycled.

..... [1]

9 (a) A student was asked to prepare a pure sample of copper(II) carbonate.

Use the following information below, describe how the student can prepare a pure sample of copper(II) carbonate from copper metal.

- Copper does not react with dilute acids.
- Copper reacts with concentrated nitric acid to form copper(II) nitrate.
- All nitrates are soluble in water.
- Copper(II) carbonate is insoluble in water.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(b) (i) The reaction between copper and concentrated nitric acid is highly exothermic.

A student placed a thermometer into a beaker containing copper and concentrated nitric acid.

Describe what he will observe.

..... [1]

(ii) The student repeated the experiment by reacting silver metal with concentrated nitric acid.

State and explain if he will make the same observations as described in **(b)(i)**.

.....

..... [1]

(c) The student placed a magnesium rod and a zinc rod into separate beakers containing aqueous copper(II) nitrate.

Describe and explain what he will observe during the experiments.

.....

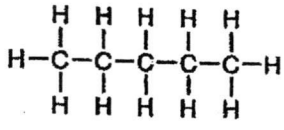
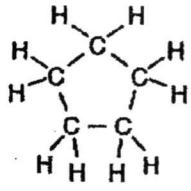
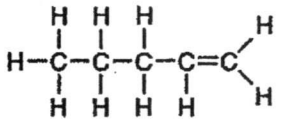
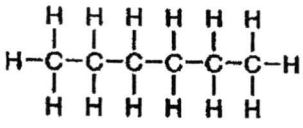
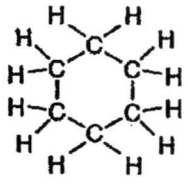
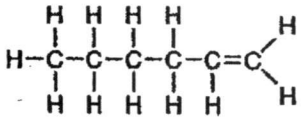
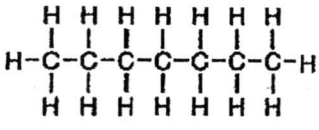
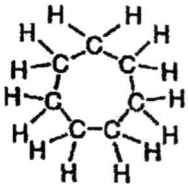
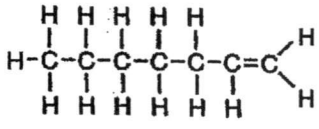
.....

.....

..... [3]

10 Table 10.1 shows the names and structures of some hydrocarbons.

Table 10.1

number of carbon atoms	alkane	cycloalkane	alkene
5	pentane 	cyclopentane 	pentene 
6	hexane 	cyclohexane 	hexene 
7	heptane 	cycloheptane 	heptene 

(a) Cycloalkanes are an example of a homologous series.

(i) Explain how the formulae of the cycloalkanes in Table 10.1 show this.

.....

..... [1]

(ii) State two **other** general properties of a homologous series.

1 .....

2 ..... [2]

(b) The percentage of carbon and hydrogen in some molecules are shown in the Table 10.2.

Table 10.2

name of molecules	percentage of carbon by mass	percentage of hydrogen by mass
hexane	84	16
hexene	86	14
cycloheptane	86	14

Explain why the percentages of carbon and hydrogen are the same for hexene and cycloheptane but different for hexane.

.....

.....

.....

..... [2]

(c) Bromine water can be used in a test to distinguish between alkanes and alkenes.

Describe the results that would be obtained if this test is carried out on separate samples of hexane and hexene.

.....

.....

..... [2]

(d) Pentene undergoes addition polymerisation to form addition polymers.

Use the structural formula of pentene to explain how it can form addition polymers.

.....

.....

.....

..... [3]

---------- End of Paper ----------*Prelims/2017*

DATA SHEET

The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 =															

140 Ce Cerium 58	142 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series
=90-103 Actinoid series

Key: a X b — a = relative atomic mass; X = atomic symbol; b = proton(atomic)number

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

4E5N Prelim 2017
ANSWER

Paper 1

1	2	3	4	5	6	7	8	9	10
B	C	C	A	A	B	C	B	A	B

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

---------- End of Paper ----------*Prelims/2017*

4E5N Prelim 2017
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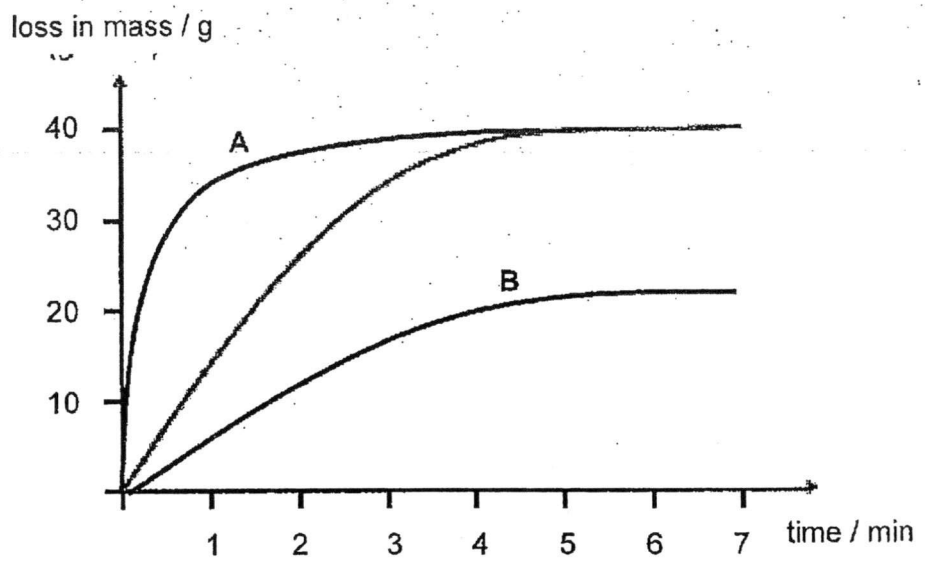
Paper 3 Section A

1	(a)		E	[1]
	(b)		B & D	[1]
	(c)		C	[1]
	(d)		(i) D [1] (ii) It melts and boils over a range of temperature. [1] OR It does not have a fixed and sharp melting and boiling point. [1] **Reject : variable melting and boiling point or a range of melting and boiling point	[2]
2	(a)		4 dyes	[1]
	(b)		Ink is a mixture of dyes, thus it will also separate up and interfere with the results on the chromatogram.	[1]
	(c)		Inks 1 and 2 are impure. Ink 1 forms three spots upon separation [1] while Ink 2 forms two spots upon separation. [1] Ink 3 is pure as it forms only 1 spot upon separation. [1] Award 1m if student comments about the purity of ink 1, 2 and 3 without giving explanation.	[3]
	(d)		The spot of dye is insoluble in the solvent used.	[1]
3	(a)	(i)	Calcium nitrate / $Ca(NO_3)_2$	[1]
		(ii)	Calcium oxide /CaO	[1]
		(iii)	Oxygen / O_2	[1]
		(iv)	Ammonia / NH_3	[1]
		(v)	Calcium hydroxide or limewater / $Ca(OH)_2$	[1]
	(b)		$2\ Ca(NO_3)_2 \rightarrow 2\ CaO + 4\ NO_2 + O_2$ OR $CaO + H_2O \rightarrow Ca(OH)_2$ [1] for correct chemical formula [1] for balanced chemical equation **If state symbol is included, deduct [1] for incorrect state symbols.	[2]
	(c)		Acidic oxide	

4	(a)	To ensure copper formed is not oxidised to form copper(II) oxide again.	[1]
	(b)	Copper(II) oxide has been reduced as the oxidation state of copper has decreased from +2 (in CuO) to 0 (in Cu). [1]	[1]
	(c)	No. of moles of CuO used = 8 ÷ (64 + 16) = 0.1 mol From the equation, 1 mol of CuO → 1 mol of Cu 0.1 mol of CuO → 0.1 mol of Cu [1] Mass of Cu formed = 0.1 x 64 = 6.4 g [1]	[2]
	(d)	From the equation, 1 mol of CuO → 1 mol of H_2 0.1 mol of CuO → 0.1 mol of H_2 [1] Volume of H_2 used = 0.1 x 24 = 2.4 dm^3 [1] Volume of H_2 unreacted = 10 – 2.4 = 7.6 dm^3 [1]	[3]
	(e)	Yes, as carbon is more reactive than copper and displace copper from copper(II) oxide.	[1]
5	(a)	It is due to the increase in the mass of carbon dioxide formed which escapes from the flask. [1]	[2]
	(b)	At higher temperature, the molecules gain kinetic energy and move faster. [1] This will lead to more effective collisions between reacting particles, forming more products per unit time [1] and thus increasing the rate of reaction.	[2]

(c)

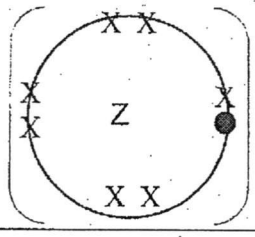


[1] for each correct graph drawn

6	(a)	(i)	All the elements in Group II have the same number of valence electrons, which are responsible for chemical reactions, hence they have similar chemical properties.	[1]
		(ii)	Elements in Group VI have 6 valence electrons, hence they have a tendency to gain 2 electrons to form negative ion of charge 2-, acting as non-metals.	[1]
		(iii)	Elements in Group O have full electron shells, hence does not need to lose or gain or share electrons. Accepted: 'fully filled electron shells' – Pease inform students to use 'full electron shells' in future. Reject: if 'share electrons' is missing. Reject: 'transfer' in place of 'lose or gain'	[1]
	(b)	(i)		[1]

Chlorine	Element **Z**
1. yellowish green gas at rtp	1. black solid at rtp
2. more reactive	2. less reactive
3. lower mp & bp	3. higher mp & bp
4. lower colour intensity	4. higher colour intensity

Must show comparison between chlorine and element Z.
[1] for each comparison, max [2]

		(ii)	Dot-and-cross of ion Z  	[1]
		(iii)	$Cl_2 + 2\ Z^- \rightarrow 2\ Cl^- + Z_2$ Chemical formula – 1m ; balanced equation – 1m	[1]

7	(a)	P as it has the highest concentration of hydrogen ions.	[1]
	(b)	Magnesium sulfate [1] $MgSO_4$ [1]	[2]
	(c)	$3\ Ca^{2+}\ (aq) + 2\ PO_4^{3-}\ (aq) \rightarrow Ca_3(PO_4)_2\ (s)$ Balanced ionic equation [1] State symbols [1] only if equation is balanced	[2]

Paper 3 Section B

8 (a) (i) Dissolves/Reacts with rainwater to form acid rain
[Must be present in the answer]
Reject: mix ~~/ dissolve~~ in rainwater to form acid rain

1) kills the aquatic plants and fishes
2) corrodes limestone buildings and statues
3) increase the pH of soil and make it unsuitable for plant/ crop growth
Any 2 [2] [2]

(ii) Volcanic eruption
Reject if only mention volcano [1]

(b) (i) Haematite [1]

(ii) 1) Limestone is decomposed by heat to produce calcium oxide and carbon dioxide.

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$ [1]

2) The silicon dioxide will react with calcium oxide to produce molten slag which is mainly calcium silicate.

$$CaO(s) + SiO_2(s) \rightarrow CaSiO_3(l)$$ [1]

[1] for description of process [3]

(c) (i) Recycling metals means that metals that are no longer needed are collected and melted [1]
to produce blocks of new metals so as to make new objects. [1] [2]

(ii) 1. It helps to conserve finite natural resources.
2. It helps to reduce environmental problems related to extracting metals from their ores.
3. It saves the cost of extracting metals from their ores.
Any 1 [1] [1]

9 (a) 1. Add excess copper power to fixed volume of concentrated nitric acid in a beaker [1] and filter to collect aqueous copper(II) nitrate as the filtrate. [1] [5]

2. Add an equal volume of an aqueous sodium carbonate to aqueous copper(II) nitrate. [1]
Reject if did not mention aqueous / solution

3. Filter the resulting mixture to obtain copper(II) carbonate as the residue. [1]

4. Wash the copper(II) carbonate with distilled water and dry by pressing between pieces of dry filter paper. [1]

(b) (i) Temperature increase rapidly.
Reject 'higher temperature than room temperature' / 'high temperature'
[1]

(ii) Yes.
Reaction of acid with metals are exothermic. [2]

(c) In both reactions, [3]
Blue solution turn colourless [1]
Reddish brown solid formed [1]
Both magnesium and zinc are more reactive than copper, thus they will displace copper from aqueous copper(II) nitrate. [1]

10 (a) (i) C_5H_{10}, C_6H_{12}, and C_7H_{14} have a general formula of C_nH_{2n}

(ii) 1) Same functional group
2) Gradual change in physical properties
Reject: if listed out individual physical properties
3) Successive members differ by a $-CH_2-$ group
4) undergoes similar chemical reactions
Any 2 – 2m

(b) Hexene (C_6H_{12}) and cycloheptane (C_7H_{14}) have the same ratio of carbon:hydrogen of 1:2 and hence, their percentages by mass of carbon and hydrogen are the same. [1] [2]

Hexane (C_6H_{14}) has a different ratio of carbon:hydrogen from hexane and cycloheptane, thus the percentages by mass of carbon and hydrogen will be different. [1]

(c) Bromine water remains reddish-brown when hexane, is added. [1] [2]
Reddish-brown bromine water decolourises / turns colourless in the presence of hexene. [1]

(d) Pentene is unsaturated. It has a carbon-carbon double bond [1] which enables pentene to undergo addition reaction with another pentene molecule [1]. [3]
When many thousands pentene molecules (monomers) are added together, poly(pentene) is formed [1].

---------- End of Paper ----------*Prelims/2017*

The Periodic Table of the 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.).