Secondary 4 Express
Examination Papers
2016

Science Chemistry

1	**Anglo Chinese School**	**SA2**
2	**Bendermeer Secondary School**	**SA2**
3	**Commonwealth Secondary School**	**SA2**
4	**Edgefield Secondary School**	**SA2**
5	**Greendale Secondary School**	**SA2**
6	**Matflower Secondary School**	**SA2**
7	**Northview Secondary School**	**SA2**

Exam Index Number	

Anglo-Chinese School (Barker Road)

PRELIMINARY EXAMINATION 2016

SECONDARY FOUR (EXPRESS) / SECONDARY FIVE (NORMAL ACADEMIC)

SCIENCE (CHEMISTRY) 5076/3

1 HOUR 15 MINUTES

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your index number in the spaces provided at the top right hand corner of this page and on any separate answer paper used.Write in dark blue or black pen in the spaces provided on the Question Paper.You may use a pencil for any diagrams, graphs, or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions in **Section A** and any **two** questions in **Section B** In calculations, you should show all the steps in your working, giving your answer at each stage.

Enter the numbers of the **Section B** questions you have answered on the dotted grids.

A copy of the periodic table is printed on the last page of this booklet.

Total Marks	
Section A	/ 45
Section B	
Total	/ 65

This paper consists of 18printed pages inclusive of this page.

Section A

Answer **all** the questions in the spaces provided.
The total mark for this section is 45.

1 The table shows the atomic structure of six particles, represented by the letters **A** to **F**. These particles are either atoms or ions, and the letters are **not** the symbols of the elements.

particle	number of electrons	number of protons	number of neutrons
A	6	6	6
B	2	2	2
C	12	12	12
D	10	12	12
E	6	6	8
F	10	7	14

(a) Which two particles are an atom and an ion of the same element?

.....[1]

(b) Which particle(s) is/are chemically unreactive?

.....[1]

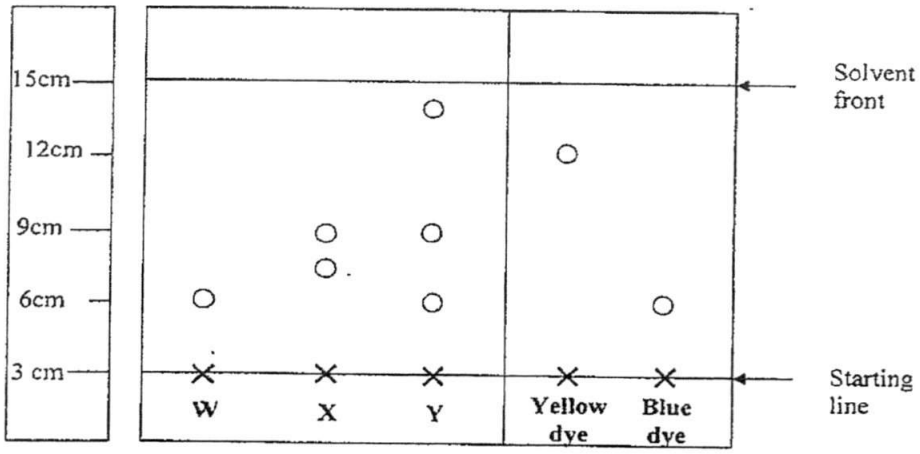
(c) Which two particles combine together to form a compound with a chemical formula which is in the form of X_2Y_3?

.....[1]

(d) Which particles are elements in Group IV of the Periodic Table?

.....[1]

2The chromatogram shows the dyes contained in three different sweets labelled **W, X** and **Y**. Yellow and blue dyes are harmful.



(a) Which sweet(s) is/are harmful?

.....[1]

(b) Explain why the starting line must not be submerged in the solvent during chromatography.

.....

.....[1]

(c) Explain why the result will be inaccurate if the solvent front stopsat the 9 cm mark.

.....

.....[1]

(d)The table below shows some information about the properties of three solids.

substance	effect of heat	hot water
solid **A**	no effect	very soluble
solid **B**	no effect	insoluble
solid **C**	sublimes	insoluble

Solid **Csublimes** when heated strongly. Explain the meaning of this statement.

.....

.....[1]

(e) Using this information, explain how you would obtain a pure, dry sample of solid **B** given a mixture of all three substances.

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.....[2]

3 (a) The box shows the names of some oxides.

aluminium oxidecarbon monoxide		nitrogen dioxide
sodium oxide	sulfur dioxide	zinc oxide

(i) Which oxide(s) will react with hydrochloric acid but not with aqueous sodium hydroxide?

..... [1]

(ii) Whichoxide(s) will react with both hydrochloric acid and aqueous sodium hydroxide?

..... [1]

(iii) Which oxide(s) will not react with hydrochloric acid or with aqueous sodium hydroxide?

..... [1]

(b) Two of the oxides are responsible for acid rain.

Identify thetwooxides from the table above and state the cause of their presence in the atmosphere.

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..... [3]

(c) Draw a 'dot and cross' diagram to show the bonding in sodium oxide. You only need to show the outer shell electrons.

[2]

4 Insoluble salts can be made by mixing solutions of two soluble salts.

A student mixed sodium carbonate solution with copper(II) sulfate solution.

(a)Construct a chemical equation for the reaction.

..... [2]

(b)Describe the method to separate the two products in (a)(i) completely.

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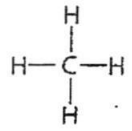
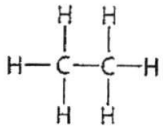
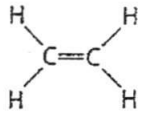
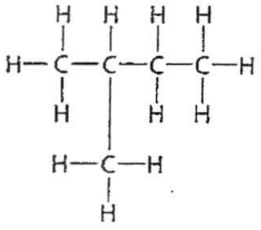
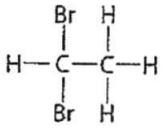
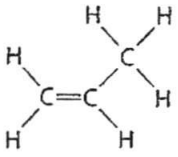
..... [2]

5The table six organic compounds, P, Q, R, S, T and U.

P 	Q 	R 
S 	T 	U 

(a)Which compounds will decolourise aqueous bromine?

.....[1]

(b)Which compound is formed by theaddition of hydrogen toR?

..... [1]

(c)Which compound,P or S,has a higher boiling point? Explain your answer.

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..... [2]

(d) Compound **U** can polymerise to form a large organic compound.

(i) Draw the structure of the product of polymerisation.

[1]

(ii) Name the compound you have drawn in (d)(i).

.....[1]

6 (a) Steel is an alloy containing iron.

The following are three differences between steel and aluminium.

- Steel can rust but aluminium resist corrosion.
- Steel has a higher density than aluminium.
- Steel is much stronger than aluminium.

(i) Use the information from the list to suggest why aluminum is the better material for making ladders.

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.....[1]

(ii) Use the information from the list to suggest why steel is the better material for making bridges.

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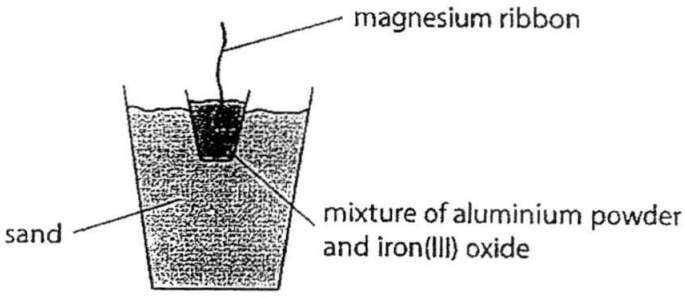
.....[1]

(b) The diagram shows how aluminium and iron(III) oxide react with each other.



The magnesium ribbon is lit to ignite the reaction mixture.The reaction is highly exothermic.

The equation for the reaction is

$$2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2\,Fe$$

(i) Define the term "exothermic".

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.....[1]

(ii) Explain how iron is produced in the above reaction.

.....

..... [2]

(iii) Which substance is oxidised in the reaction?

Explain your answer in terms of changes in the oxidation number.

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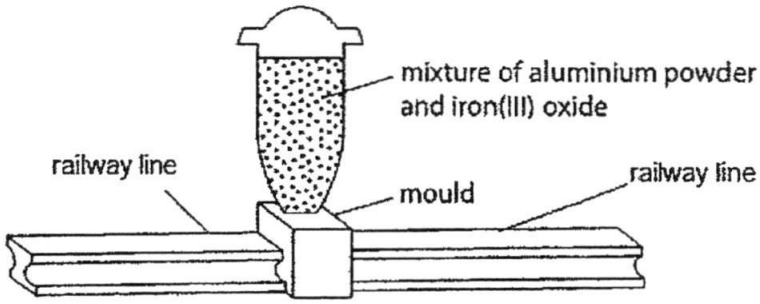
..... [2]

(c) The following diagram shows a chemical reaction between aluminium powder and iron (III) oxide, which is used to join together two railway lines.



The mixture is ignited and molten iron is collected in the mould. The molten ironsolidifies and creates a joint between the two rails. The mould is then removed.

Explain why the iron produced in the reaction is molten.

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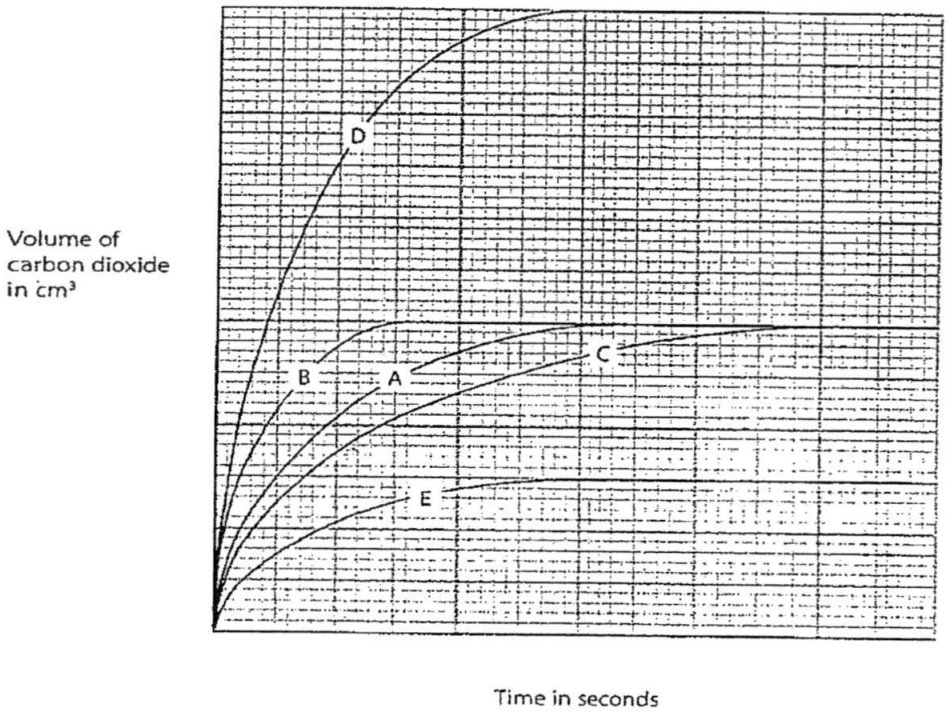
.....[1]

7 The graph shows the volumes of carbon dioxide given off when calcium carbonate lumps are reacted with hydrochloric acid,at room temperature and pressure, in five different experiments.



(a) Curve **A** shows the volume of carbon dioxide given off when somecalcium carbonate lumps are reacted with an excess of 1.0 mol/dm^3 hydrochloric acid.
The experiment that gave the results of Curve **A** was repeated a few times, each time with a different condition modified.

Complete the table below to identify the curve that corresponds each changed condition and explain your answer.

modification	curve	reason
half the mass of calcium carbonate lumps		
lower temperature		
powdered calcium carbonate		

[6]

(b) The equation for the reaction is

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

(i) Calculate the number of moles of carbon dioxide produced in the experiment represented by Curve **A**.

[The volume of any gas is 24 dm^3 at room temperature and pressure.]

[1]

(ii) Calculate the mass of calcium chloride produced in the experiment represented by Curve **A**.
[Relative atomic masses of Ca=40, Cl= 35.5, C=12, O= 16]

[2]

Section B

Answer any **two** questions.Write your answers on the lined pages provided.
The total marks for this section is 20.

8 The alcohols form a homologous series. The first member of this homologous series is methanol.

(a) Describe the four characteristics of members of a homologous series, using alcohol as an example.

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..... [4]

(b) Propane and propene are both hydrocarbons. Using equations to support your answer, describe the similarities and differences in their reactions.

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..... [6]

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9 (a) Magnesium sulfate can be made by reacting dilute sulfuric acid with either magnesium oxide or solid magnesium carbonate.

Describe the difference in observations between the two reactions, using equations to explain your answer.

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..... [5]

(b) A student dissolved some salt crystals in water. He added sodium hydroxide to the solution until it was in excess.

(i) Describe what the student would see if the salt contained lead(II) ions.

(ii) Explain why the result you have described in (b)(i) does not confirm that the salt contains lead(II) ions. Describe an additional test the student could do that would prove the salt contains lead(II) ions.

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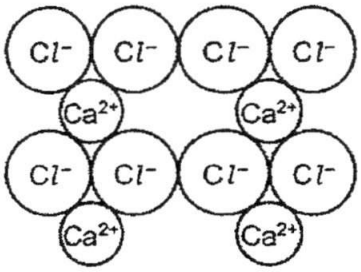
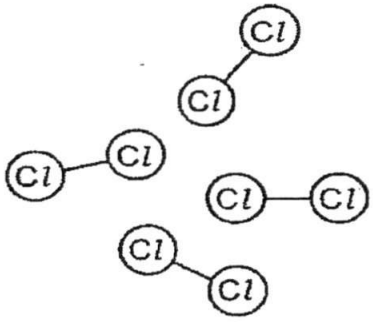
..... [5]

10 The figure shows the structures of calcium chloride and chlorine.



calcium chloride



chlorine

(a) Chlorine exists as two isotopes, ^{35}Cl and ^{37}Cl.

Compare and contrastthese two isotopes.

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..... [3]

(b) Calcium reacts with chlorine atoms to form calcium chloride. The following table shows the physical properties of calcium chloride and chlorine.

	conductivity	boiling point/ ^{o}C
calcium chloride	conducts in molten state but not in solid state	1935
chlorine	does not conduct electricity	-34

(i) Explain how a calcium atom combines with chlorine atoms.

(ii) Explainthe difference in properties of calcium chloride and chlorine shown in the table.

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..... [7]

End of Paper

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	Key: relative atomic mass / atomic symbol / name / atomic number										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	– Ra radium 88	– Ac actinium 89 †															

*58-71 Lanthanoid series	140 Ce cerium 58	141 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
†90-103 Actinoid series	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

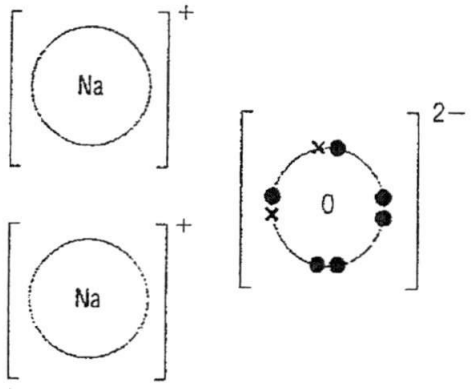
The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

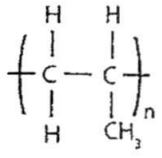
Science Chemistry P3

Sec 4E/5N PRELIMINARY EXAMINATION 5076 2016

Marking Scheme

					Remarks
1	(a)		C and D	1;	
	(b)		B	1;	
	(c)		D and F	1	
	(d)		A and E	1	
				(total: 4)	
2	(a)		W and Y	1;	
	(b)		This is to ensure that the dyes do not get washed off by the solvent, preventing a proper separation up the chromatogram.	1;	(b) accept answers that state/m into solvent". "preventing a prop chromatogram" left out by most
	(c)		Spots will not be distinct as dyes are not completely separated.	1;	(c) most state "yellow dye will n the 9 cm mark". Answers need t no full separation of colours"
	(d)		Its state changes from solid to gas directly without going through the liquid state.	1;	(d) "without going through liquid
	(e)		Dissolve the mixture in hot water and filter [1] Heat the residue until all the solid C has sublimed / there is no further change in mass [1]	1; 1 (total:6)	(e) no mark for first part if "hot"

3	(a)	(i)	sodium oxide	1;	Many still weak in this area. Nee oxides
		(ii)	aluminium oxide and zinc oxide	1;	[1]
		(iii)	carbon monoxide	1	[1]
	(b)		Sulfur dioxide and nitrogen dioxide;	1 (no ½ mark);	(b) Students misread "**cause** of "harmful effects **caused** by gas Reject if merely state "factories" burning of fuels.
			Sulfur dioxide is formed due to volcano eruptions / burning of fossil fuels/petroleum at the power stations / factories.	1;	
			Nitrogen dioxide is formed due to lightning / internal combustion in the car engines.	1;	
	(c)		 *mistake: change one dot to cross for oxide*	2	(c) Accept even if all shells drav Accept 2 [Na^+] instead of drawir
				(total: 8)	

			ion on opposite end correct charges & balancing [1]; no of electrons in ions [1]		
4	(a)	(i)	Na_2CO_3 (aq)+$CuSO_4$ (aq) →**$CuCO_3$** (s) +**Na_2SO_4** (aq)	1; 1 (state symbols)	(a) (i)Accept if no state symbols not ask for it) (BOD)
		(ii)	Filter the mixture; Rinse residue with **distilled water**, dry by pressing residue between 2 pieces of filter papers	1; 1; (total: 4)	(ii) "distilled/deionised water" ne mentioned.
5	(a)		**R** and **U**	1;	
	(b)		**Q**	1;	
	(c)		**S.** **S** is a bigger molecule than **P**, therefore hasstronger intermolecular forces of attraction and require more energy to overcome the forces;	1; 1	
	(d)	(i)		1;	(d) few draw polyethene insteac "n" has to be at right position.
		(ii)			

			polypropene	1; (total:6)	
6	(a)	(i)	Ladders made of aluminium are lighter and can resist corrosion/does not rust compared to steel	1;	(a) (i) "lighter" and "resist corros mentioned/equivalent in meanin rejected.
		(ii)	A steel bridge is stronger than aluminium, better able to withstand the weight of heavy objects	1	(ii) as long as "stronger" is ment meaning
	(b)	(i)	heat (energy) is given out to the surroundings	1;	"heat/heat energy" accepted. re
		(ii)	aluminium is more reactive than iron; it displaces iron from its oxide;	1;1	
		(iii)	Aluminium; The <u>oxidation state of aluminium increases from 0 in Al to +3 in Al_2O_3</u>;	1;1	(b) (iii) As long as student menti increases from 0 to +3
	(c)		<u>Heat is producedduring the reaction. Resulting temperature is higher than the melting point of iron.</u>	1; (total:8)	(c) "large amount of heat", "high required. Reject if merely sugge

7	(a)		<table><tr><th>modification</th><th>Curve</th><th>reason</th></tr><tr><td>Half the mass of calcium carbonate</td><td>E</td><td>Half the number of reacting particles of calcium carbonate, hence the volume of gas produced is half of 60 cm^3</td></tr><tr><td>Lower temperature</td><td>C</td><td>Lower temperature reduces the kinetic energy of the reacting particles, leading to lower frequency of effective collision and **decrease in speed** of reaction + **same yield**</td></tr><tr><td>Powdered calcium carbonate</td><td>B</td><td>Powdered marble chips have smaller particle size, **larger surface area** exposed to collisions, leading to higher frequency of effective collisions and greater speed of reaction.</td></tr></table>	Each blank =1 mark (total: 6)	(a) Curve E: "no of particles" ha halved to be suggested Curve C: lower temp resulting ir needs to be implied. No need to to explain (BOD since question Curve B: powdered marble chip surface area" for reaction needs need to use collision theory. (BC
	(b)	(i)	Volume of CO_2 collected is 60 cm^3 No of mole of CO_2 = 60/24000 = **0.0025**	1	(b) (i) Few did not convert 24 dr
		(ii)	Mole ratio of CO_2 : $CaCl_2$ is 1:1 No of mole of $CaCl_2$ = **0.0025** Mass of $CaCl_2$ = 40 +2(35.5) times 0.0025 = **0.278g (to 3 sf)**	1; 1 (total:9)	(ii) error carried forward (ECF) w/o 3 sf: minus 1 mark no units: minus 1 mark

Section B					
8	(a)		1. Members have the same general formula of $C_nH_{2n+1}OH$ 2. Members have the same functional group of –OH (or hydroxyl) and hence similar chemical properties 3. Each successive member increases by $-CH_2$ 4. Physical properties (e.g. boiling points, flammability) show agradual change as the number of C atoms increase.	1;1;1;1	Well attempted by most. (2) mentioning "–OH" crucial, merely state "similar chemica (3) mentioning "$-CH_2$" crucial (4) allow of "gradual" omitted
	(b)		**Similarity** Both react with oxygen completely to produce carbon dioxide and water $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ $2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$ **Differences** Propene undergoes addition reactions but propane undergoes substitution reaction. Substitution reaction: $C_3H_8 + Cl_2 \rightarrow C_3H_7Cl + HCl$ addition reactions **(any 1)** • hydrogenation $C_3H_6 + H_2 \rightarrow C_3H_8$, nickel catalyst, 200 ^oC • bromination $C_3H_6 + Br_2 \rightarrow C_3H_6Br_2$	1; 1; 1 1; 1; 1;	Conditions not required (BOI

			• hydration $C_3H_6 + H_2O \rightarrow C_3H_7OH$ phosphoric acid catalyst, 300 ^oC • Addition polymerisation $nC_3H_6 \rightarrow -(C_3H_6)-_n$		
9	(a)		Bubbling of gas is observed when magnesium carbonate is added to the acid but no bubbling of gas when magnesium oxide was added.	1	
			MgO does not produce CO_2/gas when added to sulfuric acid; $MgO(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2O(l)$	1;1	(a)State symbols not required (E
			$MgCO_3$ produces CO_2/gas when added to sulfuric acid; $MgCO_3(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2O(l) + CO_2$	1;1	
	(b)	(i)	He would see a white precipitate, soluble in excess NaOH to form a colourless solution.	1;	(b) (i) needs to mention "soluble
		(ii)	Zinc ions would also produce the same result; Additional test: add aqueous ammonia to the salt solution; observe a white ppt; insoluble in excess	1; 1 1;1	(ii) few get this correct. Some m additional test using aq ammoni **aluminium ions** have same res when it should be **zinc ions.** No penalty if lead ions instead c
10	(a)		Both have same number of protons of 17;	1	(a) Well answered by most
			They have different number of neutron/atomic mass;	1;	
			^{35}Cl has 18 neutrons/ mass number of 35,	1 (both values	accept "2 more neutrons"

			^{37}Cl. Has 20 neutrons/mass number of 37	calculated)	
	(b)	(i)	Calcium atom has an electronic configuration of 2.8.8.2. It has **2 valence electrons**. Chlorine has an electronic configuration of 2.8.7. It has **7 valence electrons**;	1;	(b) (i) failure to give complete ar after describing how ions are fo attraction between +ve and –ve However, accept if "ionic bondir
			Each **calcium atomtransferstwo valence electrons to 2 chlorine atoms**;	1;	
			Ca^{2+} and Cl^- ions are formed which are attracted by **electrostatic forces of attraction**;	1;	
		(ii)	When molten, **calcium ions are free to move** so they are **able to carry electrical charges around**;	1;	(ii) accept as long as "mobile ior state
			In solid form, **the ions are fixed in position** so they are unable to carry the electrical charges around.	1;	most fail to mention "ions fixed i long "no mobile ions" implied
			$CaCl_2$ has strong electrostatic forces of attraction between its positive and negative ions which requires a **large amount of energy to overcome**.	1;	both points have to mentioned, ' force" and "large amount of ene
			Chlorine exists as small covalent molecules. It has **weak intermolecular forces ofattraction**;	1	

Name		Register No.	Class

BENDEMEER SECONDARY SCHOOL
2016 PRELIMINARY EXAMINATION 2
SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)
SCIENCE (CHEMISTRY) PAPER 1
5076/01 and 5078/01

DATE : **29 August 2016**
DURATION : **1 hour**

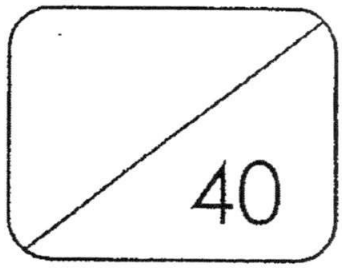
READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, class and register number on the work you hand in.
Do not use paper clips, glue or correction fluid.

There are **forty** 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 2B pencil on the OTAS sheet.

Read the instructions on the OTAS sheet very carefully.

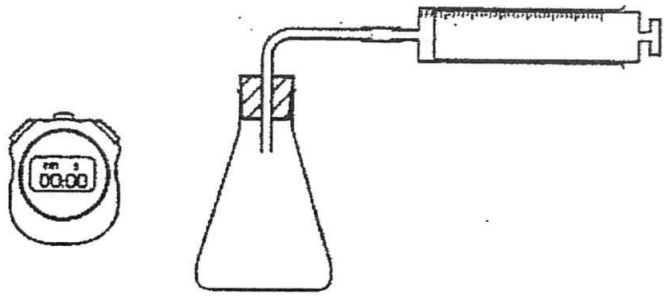
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on the question paper.
A copy of the Data Sheet is printed on page 18.
A copy of the Periodic Table is printed on page 19.
The use of an approved scientific calculator is expected, where appropriate.



This document consists of **19** printed pages.

[Turn over

21 The apparatus shown can be used to find the rate of some chemical reactions.



The rate of which reaction can be followed using this apparatus?

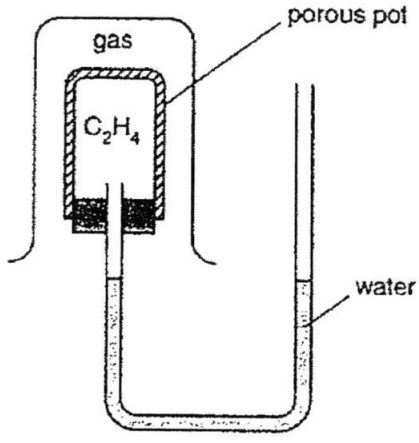
A $AgNO_3 + KI$

B $Mg + HCl$

C $NaOH + CuSO_4$

D $NaOH + HCl$

22 The apparatus can be used to show the diffusion of gases.



Which gas does not cause a change in the water levels?

A CH_4 B NH_3 C H_2 D N_2

[Turn over

23 Which of the following substances consists of atoms, molecules and ions?

	atoms	molecules	ions
A	copper	water	magnesium sulfate
B	iron	water	magnesium sulfate
C	nitrogen	carbon dioxide	zinc
D	oxygen	ethanol	sodium chloride

24 Which pair of substance are isotopes?

A $^{12}_{6}C$ and $^{14}_{6}C$

B carbon dioxide and carbon monoxide

C diamond and graphite

D C_2H_4 and C_3H_6

25 Which molecule has the largest number of electrons involved in covalent bonding?

A C_2H_4 B CO_2 C CH_3OH D N_2

26 Which substance does not react with hydrochloric acid?

A zinc carbonate

B zinc hydroxide

C zinc metal

D zinc nitrate

[Turn over

27 Samples of three oxides, X, Y and Z, are added separately to dilute hydrochloric acid and to dilute sodium hydroxide.

X and Y react with dilute hydrochloric acid but Z does not react.

Y and Z react with aqueous sodium hydroxide but X does not react.

Which type of oxide are each of X, Y and Z?

	type of oxide		
	acidic	amphoteric	basic
A	X	Y	Z
B	Y	X	Z
C	Z	X	Y
D	Z	Y	X

28 A student decomposes aqueous hydrogen peroxide using manganese(IV) oxide, MnO_2, as a catalyst. The equation for the reaction is

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

100 cm^3 of hydrogen peroxide is allowed to decompose completely and 120 cm^3 of oxygen is produced.

What is the concentration of the hydrogen peroxide used?

A 0.01 mol / dm^3

B 0.05 mol / dm^3

C 0.10 mol / dm^3

D 0.50 mol / dm^3

29 A volume of ethane, C_2H_6, at r.t.p. has a mass of 20 g.

What is the mass of an equal volume of propene, C_3H_6, at r.t.p.?

A 20 g B 21 g C 28 g D 42 g

[Turn over

30 Which pair of metals will slow down rusting when they are in contact with steel?

A magesium and silver

B magesium and zinc

C zinc and copper

D zinc and silver

31 M, N and P are three metals which form cations M^{2+}, N^{2+} and P^{+} respectively.

- $M^{2+} + P \rightarrow$ no reaction
- $2\,P^{+} + N \rightarrow N^{2+} + 2\,P$
- $N^{2+} + M \rightarrow N + M^{2+}$

Given the information above, what is the order of decreasing reactivity of the three metals?

A M, N, P

B N, M, P

C N, P, M

D P, N, M

32 An element is in Period 3 and Group VII of the Periodic Table.

Which statement about this element is correct?

A The element will form 1+ ions.

B The element will have 3 electrons in its outer shell.

C The element will have 7 electrons in its outer shell.

D The element will have 7 electron shells in its atom.

[Turn over

33 A solution Z forms a white precipitate both with dilute sulfuric acid and with aqueous silver nitrate. What could solution Z contain?

A barium chloride

B barium nitrate

C magnesium chloride

D magnesium sulfate

34 Which process or reaction is not a redox reaction?

A combustion of methane

B displacement of halogens

C extraction of iron from its ore

D neutralisation

35 In each of the four different experiments being carried out, the same mass of magnesium reacts with the same volume of an excess of sulfuric acid.

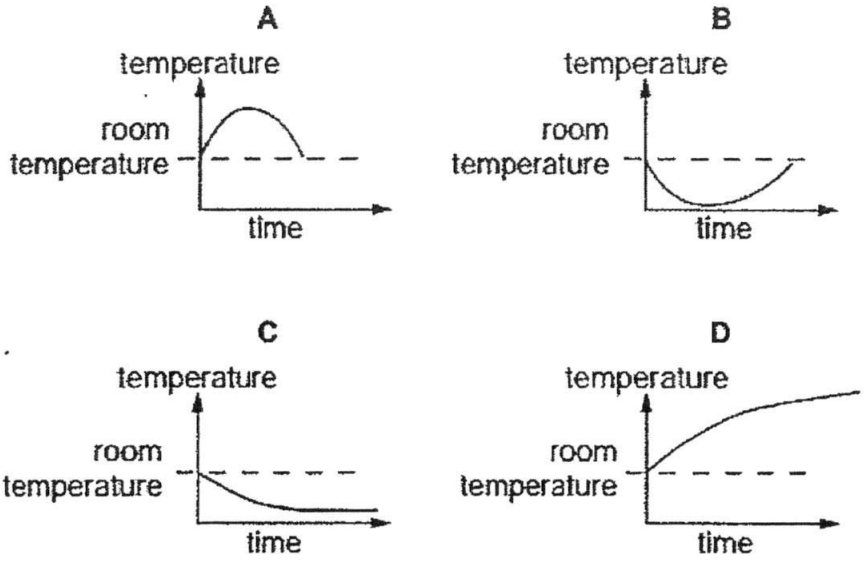
Which set of conditions will result in magnesium being used up the fastest?

	form of magnesium	concentration of acid / mol/dm^3	Temperature / °C
A	powder	1	30
B	powder	2	70
C	ribbon	1	70
D	ribbon	2	30

[Turn over

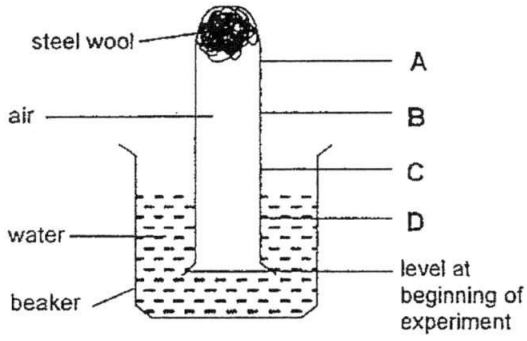
36 Dissolving ammonium nitrate in water is an endothermic reaction.

Which graph shows how the temperature alters as ammonium nitrate is added to water and the solution is left to stand?



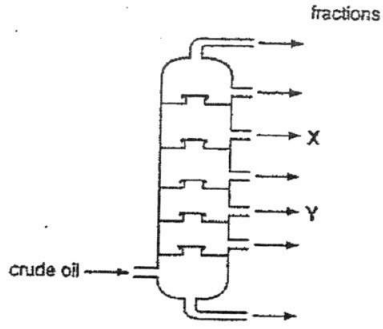
37 The diagram shows a lump of steel wool placed inside a test tube. The test tube is inverted in water and some air is trapped inside the test tube.

Where will the water level be after several days?



[Turn over

38 Crude oil is fractionally distilled in a fractionating column. The positions at which fractions X and Y are collected are shown.



Which statement is correct?

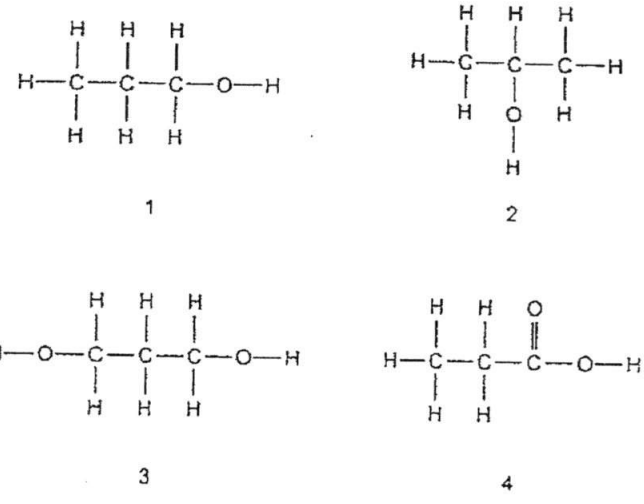
A The temperature at which the fractions are collected increases up the column.

B X condenses at a lower temperature than Y.

C X has a higher boiling point than Y.

D X has longer chain molecules than Y.

39 The structural formulae of some organic compounds are shown below.



1 2 3 4

Which compound(s) is/are alcohol(s)?

A 1 only

B 1 and 2

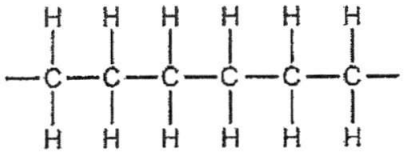
C 1, 2 and 3

D 4 only

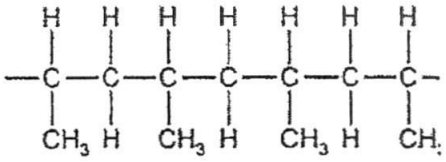
[Turn over

40 What is the partial structure of the polymer formed by the polymerisation of propene, $CH_3CH=CH_2$?

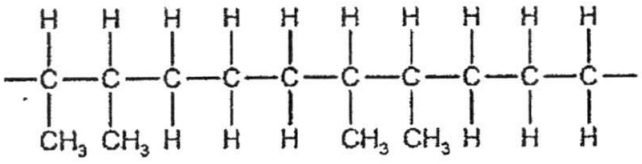
A



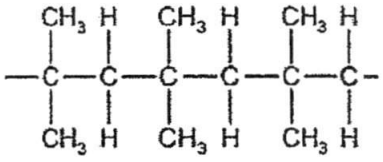
B



C



D



[Turn over

Data Sheet

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

[Turn over

The Periodic Table of Elements

Group I	Group II											Group III	Group IV
							1 H Hydrogen 1						
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14
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
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
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
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 +											

140 Ce Cerium 58	141 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
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

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

Name _____

Register No.	Class

BENDEMEER SECONDARY SCHOOL
2016 PRELIMINARY EXAMINATION 2
SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)
SCIENCE (Chemistry) PAPER 3
5076/03, 5078/03

DATE : **23 August 2016**
DURATION : **1 hour 15 minutes**

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on the work you hand in.
You may use a 2B pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
Do not use paper clips, glue or correction fluid.

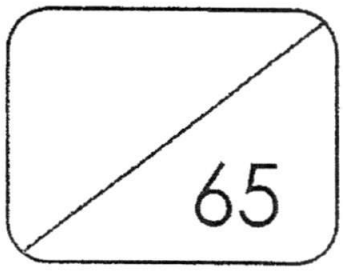
The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

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 Data Sheet is printed on page 17.
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 partquestion.



This documentconsists of 18printed pages.

[Turn over]

[Turn

Section A

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

1 Use the followinglist of equations to answer the questions below.

A $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$

B $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

C $C(s) + O_2(g) \rightarrow CO_2(g)$

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

E $CH_2=CH_2 + Br_2 \rightarrow C_2H_4Br_2$

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

G $NH_4^+(aq) + OH^-(aq) \rightarrow H_2O(l)) + NH_3(g)$

Each equation can be used once, more than once or not at all.
Give the letter of an equation which

(a) shows the formation of gas that turns moist red litmus blue,

..... [1]

(b) shows a reaction that forms a white precipitate,

..... [1]

(c) shows the neutralisation of dilute hydrochloric acid by aqueous sodium hydroxide,

..... [1]

(d) shows only reduction.

..... [1]

2 Fig. 2.1 shows the preparation of a coloured solution extracted from purple cabbage.

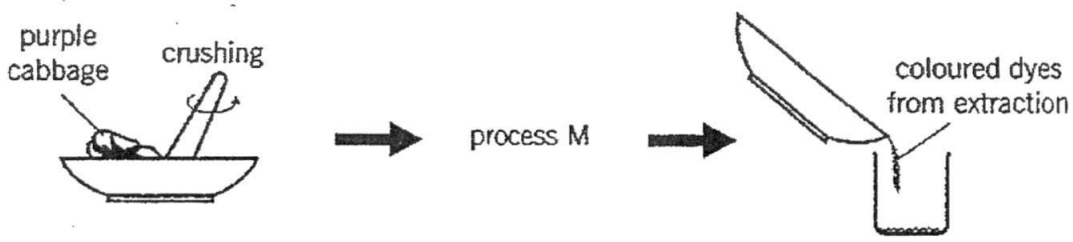


Fig. 2.1

(a) In order to obtain a clear coloured solution from the purple cabbage, process M is carried out to remove any uncrushed cabbage parts. Name process M.

..... [1]

(b) Thecoloured solution is then placed in two different solvents X and Y. The chromatograms obtained in both solvents are shown in Fig. 2.2.

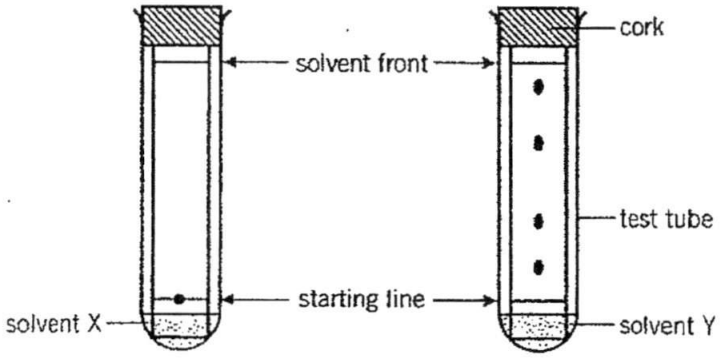


Fig. 2.2

(i)State a reason for the difference in the results of the chromatograms in both solvents.

.....

..... [1]

(ii)Is the coloured solution extracted from the purple cabbage a compound or a mixture? Explain your answer.

.....

.....

..... [2]

(iii)Give an advantage of using this method of separation.

..... [1]

[Turn over]

3 An oxide of copper dissolves in dilute sulfuric acid according to thereaction shown below:

$$Cu_2O\ (s) + H_2SO_4\ (aq) \rightarrow Cu\ (s) + CuSO_4\ (aq) + H_2O\ (l)$$

(a) Complete the table by writing down the oxidation states of copper in the substances shown:

substance	oxidation state
$CuSO_4$	
Cu	
Cu_2O	

[2]

(b) In terms of oxidation states, explain why this is a redox reaction.

.....

.....

.....

.....

..... [2]

(c) Describe the steps to obtain a pure sample ofcopper(II) sulfate from the above reaction.

.....

.....

.....

.....

.....

.....[3]

[Turn over]

4 A studentcarries out some experiments to find out more about metals around us.

(a) In the first experiment, he adds magnesium ribbon to dilute hydrochloric acid. The temperature of the dilute hydrochloric acid changes.

Fig. 4.1 shows parts of the thermometer stem giving the temperatures of the dilutehydrochloric acid before and after the addition of magnesium ribbon.

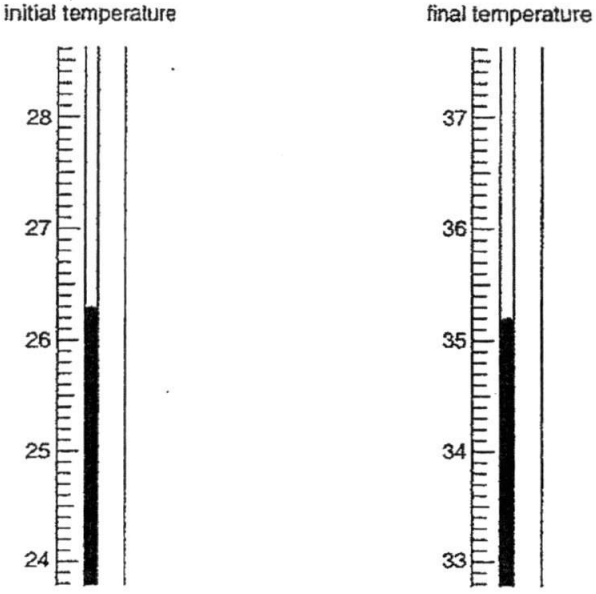


Fig. 4.1

(i) A gas is produced during the reaction. Name the gas and suggest a test and observation to identify the gas.

name of gas .....

test and observation ..... [2]

(ii) Complete the following table and calculate the change in temperature.

final temperature of the acid / °C	
initial temperature of the acid / °C	
change in temperature / °C	

[2]

(iii) What type of reaction does this temperature change indicate?

..... [1]

(iv) Construct the equationfor the reaction between magnesium and dilute hydrochloric acid.

..... [1]

[Turn over]

(b) The student sets up another experiment as shown in Fig. 4.2. It shows a test-tube and content that can be used to demonstrate the extraction of a metal from haematite ore.

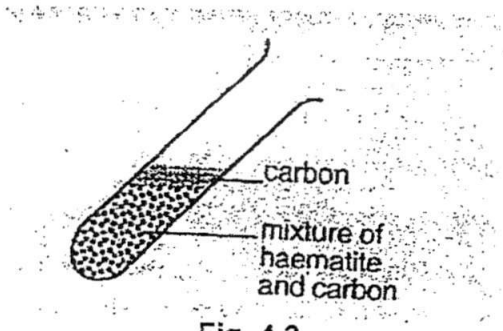


Fig. 4.2

(i) Suggest a way to start the reaction between haematite and carbon.

..... [1]

(ii) Suggest a physical technique to separate the metal extracted from other substances.

.....

..... [1]

(iii) Givea chemical test and result(s) to confirm the identity of the metal extracted.

.....

.....[1]

(iv) Write a balanced chemical equation to show the reaction between haematite and carbon. Include state symbols.

.....[2]

[Turn over]

5Fig. 5.1 represents a series of chemical reactions involving a white powder P.

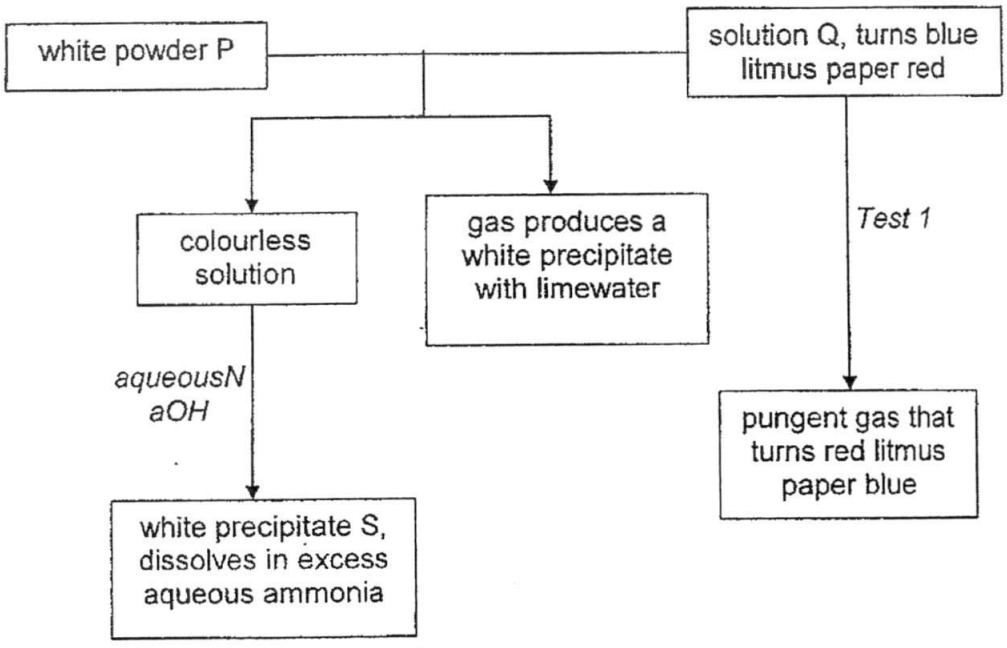


Fig.5.1

(a) Identify substances

(i) P .....

(ii) Q .....

(iii) S .....[3]

(b) Describe the procedure for *Test 1*to identify the anion in solution Q.

.....

..... [1]

[Turn over]

6 Aspirin can be regarded as an acid.Its tablets have important medical uses such as for treating fever.

(a) Aspirin is made when salicylic acid reacts with ethanoic anhydride.

The equation for this reaction is:

$$\underset{\text{salicylic acid}}{C_7H_6O_3} + C_4H_6O_3 \rightarrow \underset{\text{aspirin}}{C_9H_8O_4} + CH_3COOH$$

Calculate the maximum mass of aspirin that could be made from 100 g of salicylic acid.

[3]

(b) Suggest if a sick person should take aspirin before or after a light meal. Explain your choice of answer.

.....

..... [1]

[Turn over]

(c) Aimin is having a fever. Her mother suggests she takes the aspirin in its tablet form. As she finds it hard to swallow, she pounded the tablet into powder form.

The rate of reactions of aspirin in tablet and powder form are shown in Fig.6.1.

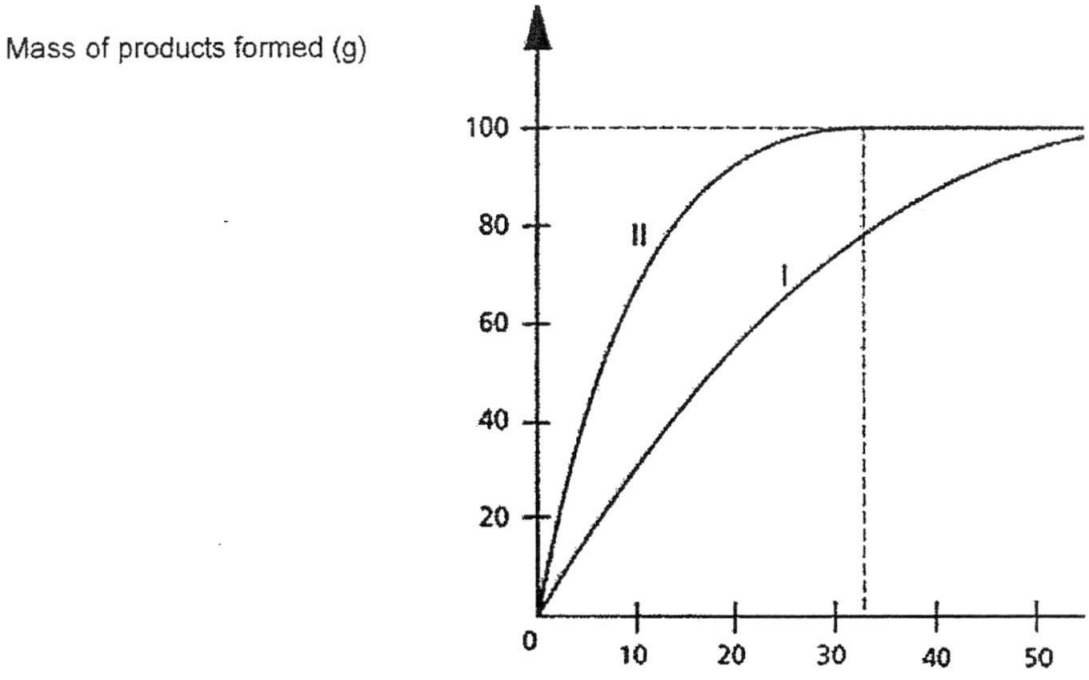


Fig. 6.1

Identify the graph that corresponds to the rate of reaction of aspirin in powder form. Using your knowledge on the kinetic particle theory, explain your choice of answer.

.....

.....

.....

.....

.....

.....

..... [3]

7 Natural gas supplied to homes and schools is mainly methane. Fig. 7.1 shows an apparatus to investigate the two substances produced when natural gas burns completely

in air.

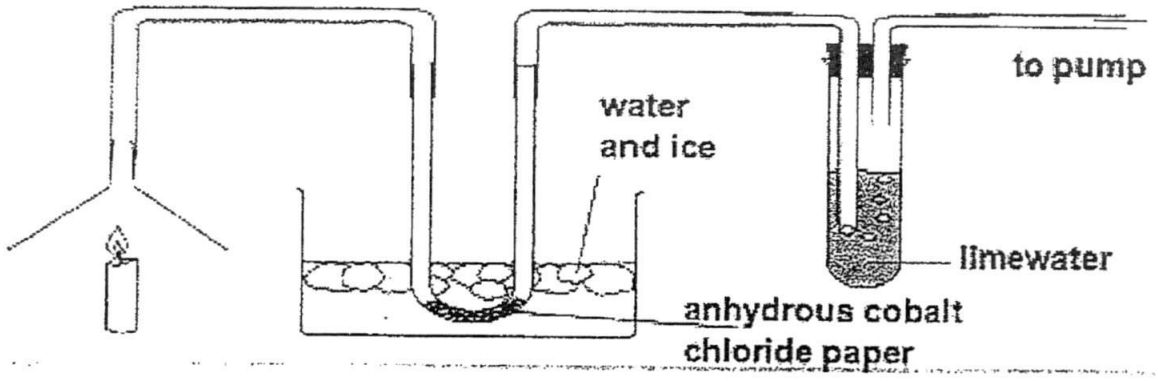


Fig.7.1

(a) Write a balanced chemical equation, including state symbols, when natural gas burns completely in air.

..... [2]

(b) Name the liquid that collects in the U-tube.

..... [1]

(c) What is the observation in the test tube of limewater?

..... [1]

(d) Some crude oil contains sulfur. Petrol and diesel fuels are produced from crude oil. The sulfur must be removed from these fuels before they are burned. Explain why.

.....

.....

.....

.....

..... [3]

[Turn over]

Section B

Answer **any two** questions in this section.
Write your answer in the spaces provided.

8 Chlorine, bromine and iodine are Group VII elements which are known as halogens.

(a) A teacher demonstrated the reactivity of the halogens to some students. Halogen vapour was passed over heated iron wool in a fume cupboard as shown in Fig. 8.1.

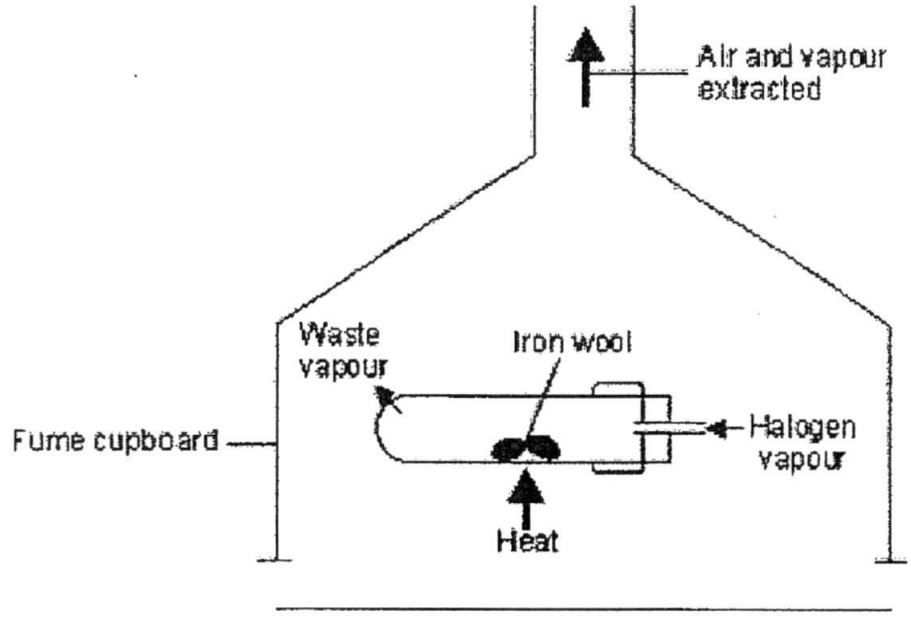


Fig. 8.1

The teacher's observations are shown in Table 8.1.

Table 8.1

	Observations	
	During the reaction	**After the reaction**
Bromine	The iron wool glowed	A red–brown solid had been produced
Chlorine	The iron wool glowed	A dark brown solid had been produced
Iodine	The iron wool did not glow	A black solid had been produced

From these observations, what conclusion can be made about the order of reactivity of the three halogens? Explain your conclusion.

.....

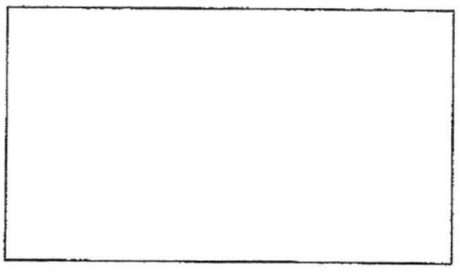
.....

.....

..... [2]

[Turn over]

(b) Explain why molecules of halogens have low boiling points.
Includea diagram in the box below to aid your explanation.Yourdiagram should show the electronic structure of the halogen molecule.



.....

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.....[3]

(c) You are to help the teacher design another experiment to investigate the reactivity of halogens. Choose an experiment to show the order of reactivity of bromine, chlorine and iodine.

Include the following in your answer to the question.

(i) Suggest the chemicals to be added to the different halogens and comment on the results or observations obtained. You may present your results in a table.

(ii) Write a balanced chemical equation for any one of the reactions in(i).

(iii) Use the results to state and explain the trend in reactivity of these Group VII elements.

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..... [5]

9 Brass is a common alloy used in making musical instruments. It is madeup of copper and zinc. The proportions of zinc and copper can be varied to create a range of brasses with varying properties.

(a) The symbols for two naturally occurring isotopes of copper are shown below.

$$^{63}_{29}Cu \qquad\qquad ^{65}_{29}Cu$$

Define what isotopes are. Compare the similarities and differences in the atomic structure of copper based on the information given.

.....

.....

.....

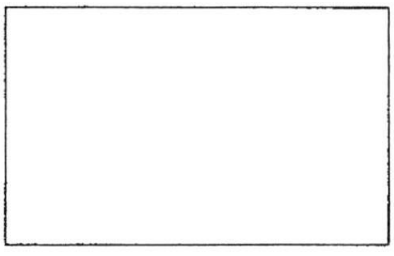
.....

.....

.....

..... [3]

(b) The use of alloys is preferred over the use of pure metals in the making of musical instruments.
Definewhat an alloy is.Why is the use of alloys preferred over pure metals? Includea diagram in the box below to aid your explanation.



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..... [4]

[Turn over]

(c) Aich's alloy is largely made up of 61% copper and 37% zinc. The melting point of copper is 1083°C and that of zinc is 419°C.
Predict the melting point of Aich's alloy and explain your answer.

.....

.....

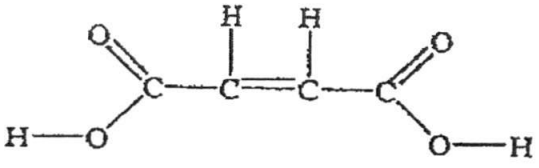
.....

.....

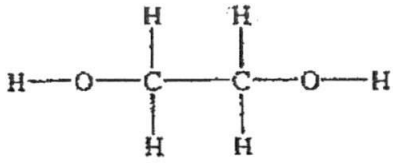
.....

..... [3]

10 (a) The full structural formulae of butenedioic acid and ethane-1.2-diol are shown in Fig. 10.1.



Butenedioic acid



Ethane-1,2-diol

Fig.10.1

Describe and explain the observations when butenedioic acid or ethane-1,2-diol reacts with

(i) aqueous bromine,
(ii) aqueous sodium carbonate and
(iii) acidified potassium manganate(VII).

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.....

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.....[6]

[Turn over]

(b) Propene is reactive. It undergoes a reaction to form poly(propene).

Name and briefly describe the reaction to form poly(propene) from propene. Use the structural formula of propene to explain how it can form poly(propene). Write an equation for the reaction. State symbols are not required.

.....

.....

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.....

.....

.....

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.....

.....

..... [4]

END OF PAPER

Data Sheet

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

Group

I	II											III	I[illegible]
							1 H Hydrogen 1						
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	[illegible]
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	[illegible]
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	[illegible]
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	[illegible]
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	[illegible]
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 +											

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

140 Ce Cerium 58	141 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	[illegible]
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	[illegible]

Key

a
X
b

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

Name _____

Register No.	Class

BENDEMEER SECONDARY SCHOOL

2016 PRELIMINARY EXAMINATION 2
SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)
SCIENCE (CHEMISTRY)
Paper 5 Practical Test
5076/05, 5078/05

DATE : **25 August 2016**
DURATION : **45 minutes**

Candidates answer on the Question Paper.
Additional Materials : As listed in the Confidential Instructions

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen.
You may use a2B pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.
The use of an approved calculator is expected, where appropriate.

Answer all questions.
Chemistry practical notes for this paper are printed on page 4.

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

15

This documentconsists of 4printed pages.

1 You are provided with a metal salt, **Q**. Carry out the following experiments and carefully record your observations. Note, the volumes given below are approximate and should be estimated rather than measured.

(a) (i) Add about 2 cm^3 of limewater to a test-tube. Using the tip of a spatula, place a small amount of solid **Q**in a **hard-glass** test-tube and heat strongly until no further change is seen. During the heating process, withdraw several samples of gas from inside the test tube using a teat pipette. Each time bubble the gas from the teat pipette through the limewater. Allow the contents of the hard-glass test–tube to cool. Record your observations.

Keep the cooled hard-glass test-tube for use in (a)(ii).

Observations

.....

.....

.....[3]

(ii) To the **cold** hard-glass test-tube containing the reside from **(a)(i)**, add 6-8 drops of aqueous cobalt(II) nitrate. Heat the test-tube gently at first to remove water. Then heat strongly until you see a colour change. Allow the contents of the test tube to cool.

Describe the appearance of the **cooled** residue.

appearance of the cold residue

.....[1]

(b) Place a spatula full of solid **Q** in a test-tube. Using a teat pipette, add sufficient dilute nitric acid to dissolve the solid. Test for any gases evolved. Record your observations and the name of any gas evolved.

observations

.....

.....[1]

test used to identify any gas evolved

.....[1]

name of any gas evolved

.....[1]

When all the solid has dissolved, add about 5 cm^3 of water to the test-tube, stopper and shake the test-tube.

Keep this solution for use in c(i), (ii) and (iii).

(c) **(i)** Add about 2 cm^3 of the solution from **(b)** to a test-tube. Add 1 cm^3 of aqueous silver nitrate. Record your observations and conclusion.

observations

.....[1]

conclusion

.....[1]

(ii) Add about 2 cm^3 of the solution from **(b)** to a large test-tube. Carefully add a few drops of dilute aqueous sodium hydroxide. Shake the test-tube. Continue to add aqueous sodium hydroxide, with shaking, until no further changes are seen. Record your observations.

observations

.....

.....[2]

(iii) Add about 2 cm^3 of the solution from **(b)** to a large test-tube. Carefully add a few drops of dilute aqueous ammonia. Shake the test-tube. Continue to add aqueous ammonia, with shaking, until no further changes are seen. Record your observations.

observations

.....

.....[2]

(d) Suggest the name of salt Q.

.....[2]

Prelim 2 Exam 2016
4E/5NSc(Chem)
Marking Scheme

Section A [1 mark each; 20 marks total]

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

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

Section B [45 marks total]

1	(a)	G	[1]
	(b)	A	[1]
	(c)	D	[1]
	(d)	B	[1]
2	(a)	filtration	[1]
	(b)	(i) The coloured solution contains pigments which have different solubilities in different solvents. / The coloured solution is soluble in solvent Y and not solvent X.	[1]
		(ii) It is a mixture. [1] It is separated into its different components through a physical separation technique - chromatography. [1]	[2]
		(iii) Only a small amount of sample is needed. (accept any other appropriate answers)	[1]
3	(a)	+2 0 +1 [3 right – 2; 2 right – 1,1 right – no mark]	[2]
	(b)	Cu_2O is reduced because the oxidation state of Cu decreased from +1 in Cu_2O to 0 in Cu [1] Cu_2O is oxidised because the oxidation state of Cu increased from +1 in Cu_2O to +2 in $CuSO_4$ [1] Reduction and oxidation occurred simultaneously.	[2]

1

CHEMISTRY PRACTICAL NOTES

Test for anions

anion	*test*	*test result*
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Test for aqueous cations

cation	*effect of aqueous sodium hydroxide*	*effect of aqueous ammonia*
ammonium (NH_4^+)	ammonia produced on warming	-
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt.
copper (II) (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excessgiving a dark blue solution
iron (II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron (III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
lead (II) (Pb^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess giving a colourless solution

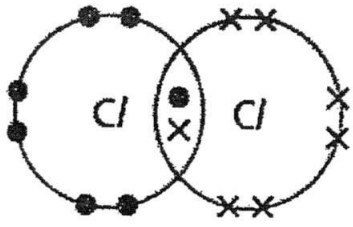
Test for gases

gas	*test and test result*
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	gives white ppt. with limewater (ppt. dissolves with excess CO_2)
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	"pops" with a lighted splint
oxygen (O_2)	relights a glowing splint
sulfur dioxide (SO_2)	turns aqueous acidified potassium manganate (VII) from purple to colourless

	(c)	- Add copper(I) oxide to sulfuric acid until no more dissolves. - Filter away the excess Cu_2O & Cu as residue & $CuSO_4$ as filtrate. - Heat the filtrate till it is saturated. - Cool the $CuSO_4$ filtrate for crystals to form. - Rinse with distilled water to remove impurities. - Dry copper(II) sulfate crystals between sheets of filter paper.[0.5] each	[3]
4	(a)	(i) name of gas: hydrogen [1] test & observation: Gas produced extinguished a lighted splint with 'pop' sound [1] no [0.5]	[2]
		(ii) Final temperature: 35.2 °C [0.5] Initial temperature: 26.3°C [0.5] Change : +8.9 °C [1] no ECF	[2]
		(iii) Exothermic	[1]
		(iv) $Mg + 2HCl \rightarrow MgCl_2 + H_2$	[1]
	(b)	(i) By heating it.	[1]
		(ii) Using a magnet [0.5], if iron is present, it will be attracted towards it [0.5].	[1]
		(iii) Add dilute sodium hydroxide to the extracted metal, a reddish-brown precipitate is formed.	[1]
		(iv) $2\ Fe_2O_3(s) + 3\ C(s) \longrightarrow 4\ Fe(l) + 3\ CO_2(g)$ Balanced equation [1] , state symbols [1]	[2]
5	(a)	(i) P – zinc carbonate / $ZnCO_3$	
		(ii) Q - Nitric acid / HNO_3	
		(iii) S - zinc hydroxide / $Zn(OH)_2$	[3]
	(b)	Add Al foil and excess aq sodium hydroxide to the solution and warm.	[1]
6	(a)	No. of mol of $C_7H_6O_3$ = mass/ molar mass = 100 / 138 = 0.725 [1] Mol ratio $C_7H_6O_3 : C_9H_8O_4$ 1 : 1 0.725 : 0.725 [1] Mass of aspirin : mol x molar mass = 0.725 x 180 = 130.5 g or 131 g (3s.f.) [1]	[3]

	(b)	A sick person should take aspirin after a light meal. Since it is acidic, It might irritate his stomach and cause side effects like indigestion, heartburn, or even stomach ulcers. By making sure he takes it after food or at least a glass of milk, he can protect hisstomach.	[1]
	(c)	Graph II [1] The aspirin tablet in powdered form has a larger surface area of contact than the tablet form for the reaction to take place. [1] This results in more frequent collisions of particles. The successful / effective collisions result in a faster rate of reaction.[1]	[3]
7	(a)	CH_4 (g) + $2O_2$ (g) → CO_2 (g) + $2H_2O$ (g) [1] for balanced chemical equation [1] for state symbols	[2]
	(b)	Water	[1]
	(c)	A white precipitate is formed in limewater.	[1]
	(d)	Sulfur dioxide is produced when sulfur burns [1] Therefore sulfur must be removed from these fuels because sulfur dioxide causes acid rain [1] Acid rain corrodes buildings and harms aquatic plants and animals. [1]	[3]

Section B (20 marks)

8	(a)	(i) The conclusion is that chlorine and bromine are more reactive than iodine [1] any suitable comparisons about the extent to which the iron wool glowed eg because iron glowed with chlorine and bromine but did not glow with iodine [1]	[2]
	(b)	 Electronic structure of any halogen molecule [1] A molecule of halogen is covalently bonded by sharing of electrons to obtain a obtain noble gas configuration. [1] They have weak intermolecular forces of attraction between molecules. Little energy is needed to overcome these forces and hence they have low boiling points. [1]	[3]
	(c)	Experiment: (i) Add aqueous chlorine to potassium bromide and potassium iodide solutions. In the former, solution turned-orange brown. In the latter, the solution turned brown/ violet. [1] Add aqueous bromine to potassium chloride and potassium iodide solutions. In the former, there's no visible reaction. In the latter, the solution turned brown/ violet. [1] Add aqueous iodine to potassium chloride and potassium bromide solutions. There are no visible reactions in both tests. [1] or	[5]

Solution	Potassium chloride	Potassium bromide	Potassium iodide
Chlorine		Solution turned orange-brown	Solution turned brown
Bromine	No reaction		Solution turned brown
Iodine	No reaction	No reaction	

[3]

$Cl_2 + 2KBr \rightarrow 2KCl + Br_2$ /

$Cl_2 + 2KI \rightarrow 2KCl + I_2$ /

$Br_2 + 2KI \rightarrow 2KBr + I_2$ [1]

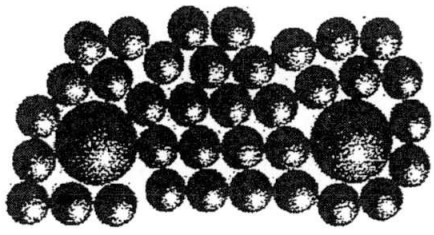
(any one equation)

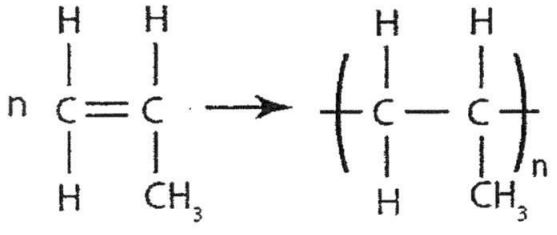
The reactivity of halogens, in ascending order, is iodine, bromine and chlorine. /

The reactivity of halogens, in descending order, is chlorine, bromine and iodine. [1]

(any one of the above)

5

9	(a)	Isotopes are atoms of the same element with the same number of protons but different number of neutrons. [1] They both have 29 protons and 29 electrons. [1] Cu-63 has 34 neutrons while Cu-65 has 36 neutrons. [1]	[3]
	(b)	 Diagram of an alloy [1] An alloy is a mixture of a metal with other element(s). [1] Alloys are preferred as they are stronger than pure metals.[1] The different size of the atoms of zinc will disrupt the orderly arrangement of the copper atoms. This will prevent the layers of atoms from sliding over one another easily. Hence, making it stronger. [1]	[4]
	(c)	The melting point of Aich's alloy: 871 – 904°C accept any range between 420 – 1082°C [1] The adding of zinc to copper is similar to adding impurities which cause the melting point of copper to decrease. [1] Since the alloy is now not pure/ a mixture, it will melt over a range of temperatures. [1]	[3]

10	(a)	**(i)** When aqueous bromine is added to butenedioic acid, the reddish-brown solution turns colorless. This is due to the presence of C=C bond in the acid. [1] When aqueous bromine is added to ethane-1,2-diol, there is no visible reaction. It remains reddish-brown. [1] **(ii)** When aqueous sodium carbonate is added to butenedioic acid, effervescence seen. Carbonate reacts with acid to produce carbon dioxide. [1] When aqueous sodium carbonate is added to ethane-1,2-diol, there is no visible reaction. [1] **(iii)** When acidified potassium manganate(VII) is added to butenedioic acid, there is no visible reaction. [1] When acidified potassium manganate(VII) is added toethane-1,2-diol, the solution changes from purple to colourless as alcohol is oxidized by the oxidizing agent to an acid. [1]	[6]
	(b)	Additional polymerization [1] At high temperature and pressure, thousands of propene molecules/monomersjoin together to form large molecules/polymer called poly(propene). [1] Each propene molecule has a C=C bond. One of the covalent bonds in the C=C bonds can break and allow each monomer to join together. [1]  Propene Polypropene [1]	[4]

Bendemeer Sec Sch
Science (Chemistry)
Secondary Four Express/ Five Normal Academic
Preliminary Examination 2Paper 5 2016
Marking Scheme

Qn 1	Answer	Max marks
ai	• Solid Q turns from **white** to **yellow** on heating. • **White ppt.**of $CaCO_3$formed in limewater. • On cooling, the residue turns from **yellow** to**white.**	1 1 1
ii	Green solid observed	1
b	• **Effervescence /bubbles of gas** • **White ppt.** of $CaCO_3$ formed in limewater.	0.5 0.5
	Bubble the gas into the limewater.	1
	Carbon dioxide	1
ci	• No visible changes/reaction • Cl^-/Chloride is absent/not present	1 1
ii	**White ppt.** formed **soluble in excess** sodium hydroxide to form a **colourless solution.**	1 1
iii	**White ppt.** formed **soluble in excess**aqueous ammonia to form a **colourless solution.**	1 1
d	Zinc carbonate	2

COMMONWEALTH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2016

SCIENCE (PHYSICS/CHEMISTRY)
(5076/1)

PAPER 1

Name: _____ ( ) Class: _____

SECONDARY FIVE NORMAL (ACADEMIC)

24 Aug 2016
1035 h – 1135 h

READ THESE INSTRUCTIONS FIRST

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

There are **FORTY** questions in 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 OTAS.

Read very carefully the instructions on the OTAS.

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 Data Sheet is printed on page 15.
A copy of the Periodic Table is printed on page 16.

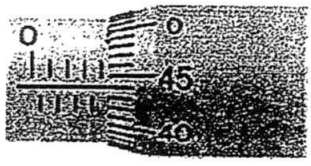
Take the gravitational field strength on Earth, g to be 10 Nkg^{-1}.

Name of setters: Mr Paul Cheong / Mr Simon Lew

This paper consists of **16** printed pages including the cover page.

[Turn over

1 A student was asked to measure the thickness of a sheet of paper. The diagram shows the reading on a micrometer when he measures the thickness of 50 sheets of similar paper.

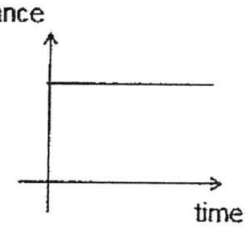


What is the thickness of one sheet of paper?

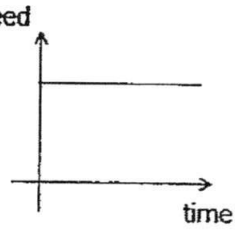
A 0.09 mm
B 0.17 mm
C 4.44 mm
D 8.44 mm

2 A truck is moving at constant speed along a straight road. Which of the following graphs best represents the truck's motion?

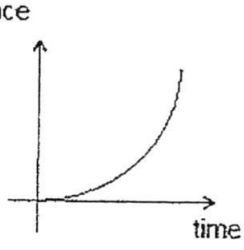
A



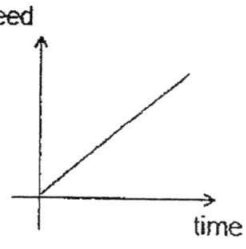
B



C



D



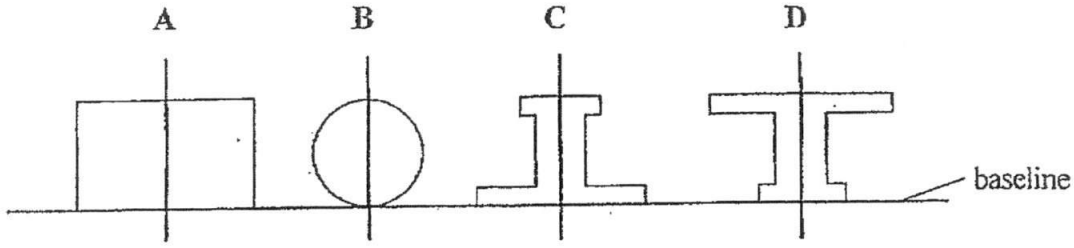
3 An object of mass 5 kg is moving along a rough surface with an acceleration of 2 ms^{-2} when a force of 30 N on the object. Determine the frictional force acting on the box.

A 10 N
B 20 N
C 30 N
D 40 N

4 Which of the following statement is true?

A An object takes longer to fall on the moon than on earth from the same height.
B An object takes longer to fall on earth than on the moon from the same height.
C An object takes the same time to fall on earth and the moon from the same height.
D It is impossible to determine without knowing the mass of the object.

5 The diagram shows four shapes cut from the same piece of card. Which shape has its centre of gravity nearest to the base line?



6 To prevent a cement mixer sinking into soft ground, the mixer is placed on a large flat board. Why does this prevent the mixer sinking?

A The large area increases the weight on the ground.
B The large area decreases the weight on the ground.
C The large area increases the pressure on the ground.
D The large area decreases the pressure on the ground.

7 Which of the following best defines power?

A Energy per unit work done
B Force per unit distance
C Force per unit time
D Work done per unit time

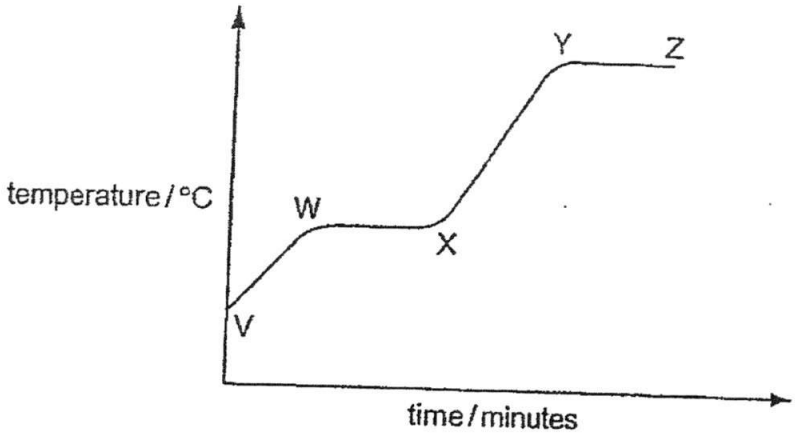
8 Substances in gaseous state have no fixed shape and size because

A they possess more kinetic energy.
B the intermolecular force between the molecules is very weak.
C they are less dense than when they are in solid or liquid state.
D the space between molecules is wider than when they are in solid state and liquid state.

9 Object A is 2 kg. It has a temperature of 40°C and has an internal energy of 500 000 J. Object B is 2 kg. It has a temperature of 50°C and has an internal energy of 400 000 J. Which of the following statement is correct?

A Heat flows from object A to object B.
B Heat flows from object B to object A.
C No heat flows between object A and object B.
D There is not enough information to determine the direction of heat flow.

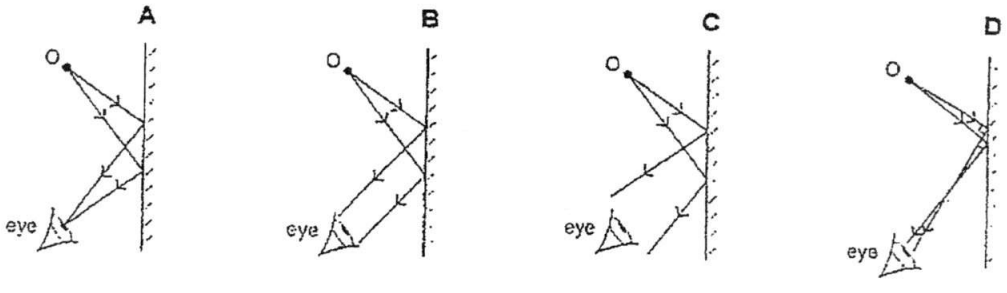
10 Some ice is placed in a beaker and is heated. The graph shows the temperature of the beaker and its contents during the experiment.



Between which two points on the graph does the beaker contain a mixture of solid and liquid?

A V and W
B W and X
C X and Y
D Y and Z

11 An eye sees an object O by reflection in a plane mirror. Which is the correct ray diagram?



12 The speed of a wave is 4×10^5 ms^{-1}. The wavelength of the same wave is measured to be 5×10^6 m. Determine the period of the wave.

A 5×10^{-13} s
B 0.08 s
C 12.5 s
D 2×10^{12} s

13 Microwaves are used in all of the following except

A global positioning systems (GPS)
B medical imaging
C mobile phones
D satellite television

14 The diagram shows a loudspeaker that is producing a continuous sound wave of frequency 200 Hz in air.

Which diagram best shows how the sound causes a molecule at P to move during 1/200 s?

A

B

C

D

15 A stationary negative charge in an electric field experiences an electric force in the direction shown.

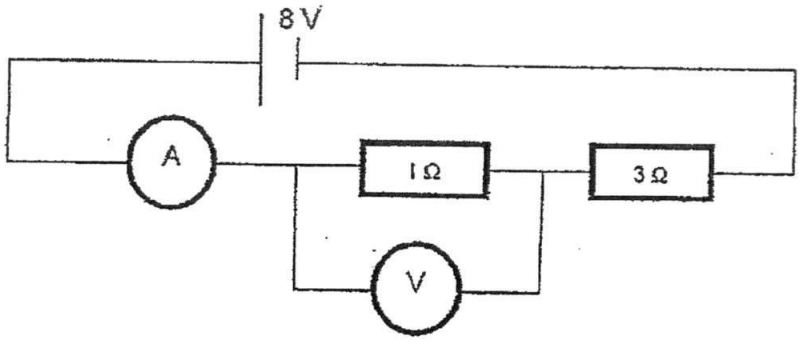
What is the direction of the electric field?

A horizontally to the left
B horizontally to the right
C vertically upwards
D vertically downwards

16 Which of the following correctly describes potential difference?

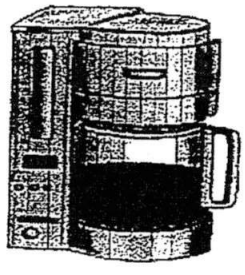
A It is the work done by a source in driving a unit charge around a complete circuit, and the SI unit is the Joule (J).
B It is the work done by a source in driving a unit charge around a complete circuit, and the SI unit is the Volt (V).
C It is the work done to drive a unit charge through any two points in a circuit, and the SI unit is the Joule (J).
D It is the work done to drive a unit charge through any two points in a circuit, and the SI unit is the Volt (V).

17 What are the readings of the ammeter and voltmeter of the following circuit?



	ammeter reading / A	voltmeter reading / V
A	2	2
B	2	6
C	4	2
D	4	6

18 An electric coffee pot is labelled with the following information:

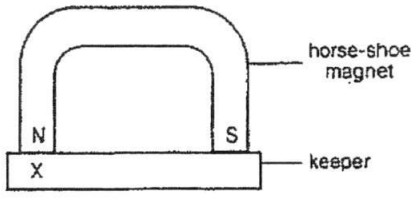


220 -230 V, 750 W

What is the best fuse rating for a fuse used in the plug of the coffee pot?

A 1 A
B 3 A
C 5 A
D 13 A

19 The diagram illustrates a permanent horseshoe magnet and a keeper. The keeper, which is easily magnetised, is placed across and in contact with the poles of the magnet when the magnet is not used.



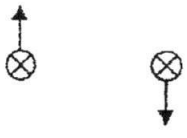
Which combination below correctly gives the material which should be used for the magnet and the keeper, and the polarity of X when it is placed as shown in the figure?

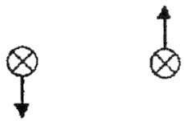
	magnet	keeper	polarity of X
A	soft iron	soft iron	north
B	soft iron	steel	south
C	steel	soft iron	north
D	steel	soft iron	south

20 Each diagram below is a cross-section through two parallel current-carrying conductors. Which diagram correctly shows the forces on the two conductors?

A 

B 

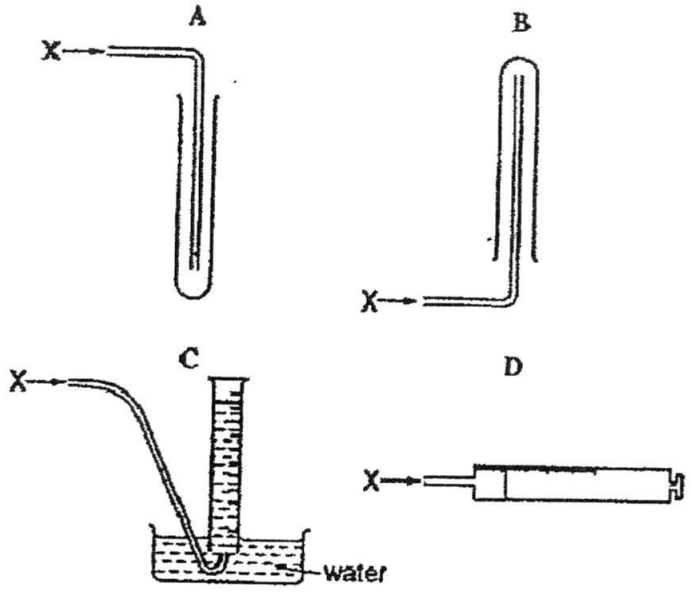
C 

D 

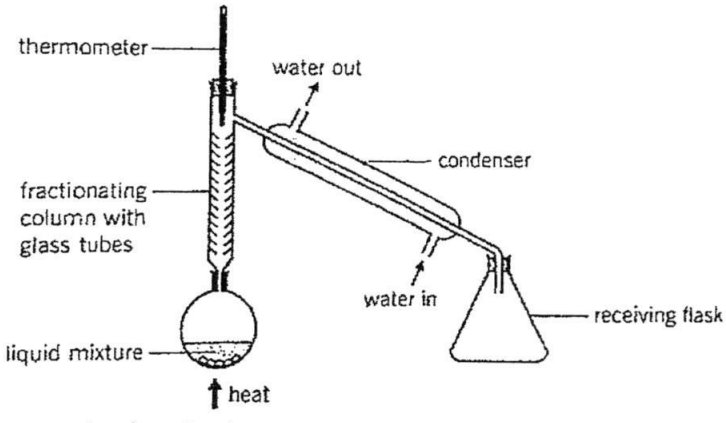
21. A gas has the following properties.

- Less dense than air
- Insoluble in water

Which method cannot be used to collect the gas?



22. The diagram shows a separation technique to separate ethanol from water.



Which part of the apparatus is not set up correctly?

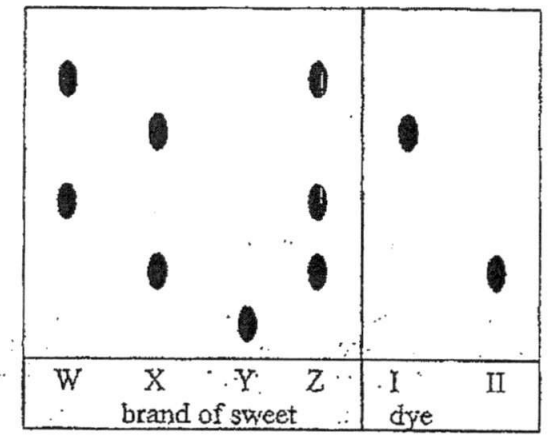
A The thermometer is placed at the wrong position.

B Water flows in the wrong direction in the condenser.

C The mouth of the receiving flask should be left open.

D The fractionating column should fill with glass beads.

23. The chromatogram shows the dyes contained in four different sweets labelled **W**, **X**, **Y** and **Z**. Dyes **I** and **II** are harmful.



Which of the sweets contain a harmful dye?

A **W** and **X**

B **W** and **Y**

C **X** and **Y**

D **X** and **Z**

24. When dry ice is heated, it sublimes. Which of the following statements is correct?

A The covalent bonds between carbon atoms and oxygen atoms are overcome.

B The attractive forces between carbon dioxide molecules are overcome.

C The ionic bonds between carbon dioxide molecules are overcome.

D The covalent bonds between carbon dioxide molecules are overcome.

25. Which of the following cannot be deduced from the number of valence electrons in an atom?

A The stability of the atom chemically.

B The number and type of charges when it forms an ion.

C The Period in which the atom lies in the Periodic Table.

D The Group in which the atom lies in the Periodic Table.

26. Which of the following best shows the properties of hexane, C_6H_{14}, which exists as a liquid at room temperature?

	Melting point / °C	Electrical Conductivity
A	- 95	Poor
B	270	Poor
C	- 55	Good
D	630	Good

27. Which of the following occupies the greatest volume?

A 4 g of H_2

B 28 g of N_2

C 11 g of CO_2

D 8 g of O_2

28. Which of the following processes is endothermic?

A dissolving ammonium chloride in water

B rusting of iron

C combustion of methanol

D neutralisation of sodium hydroxide with acid

29. Working in underground coal mines can be dangerous as there is a risk of explosions. What is likely to be the main reasons for explosion to occur?

A high temperature in the mines

B high concentration of oxygen in the air pumped into the mine

C high air pressure in the mines

D small size of coal dust particles present in the mines

30. Which substance contains nitrogen atom with the highest oxidation number?

A NH_3

B NO_3^-

C N_2

D Na_3N

31. In which of the following changes is the underlined substance reduced?

A $\underline{SO_2}$ to SO_3

B $\underline{FeO}$ to Fe_2O_3

C $\underline{Cl_2}$ to HCl

D $\underline{H_2}$ to H_2O

32. When hydrogen chloride is bubbled into methylbenzene solvent, the pH remains neutral. What could be the reason?

A Hydrogen chloride does not produce hydrogen ions in this solvent.

B Hydrogen chloride reacts with methylbenzene to form salt and water.

C Hydrogen chloride reacts with methylbenzene to form a neutral compound.

D Redox reaction takes place between hydrogen chloride and methylbenzene only.

33. A neutralisation reaction between magnesium hydroxide and sulfuric acid is shown below:

$$Mg(OH)_2 + H_2SO_4 \rightarrow MgSO_4 + 2H_2O$$

0.29 g of $Mg(OH)_2$ reacts completely with 100 cm^3 of sulfuric acid.
What is the concentration of sulfuric acid?

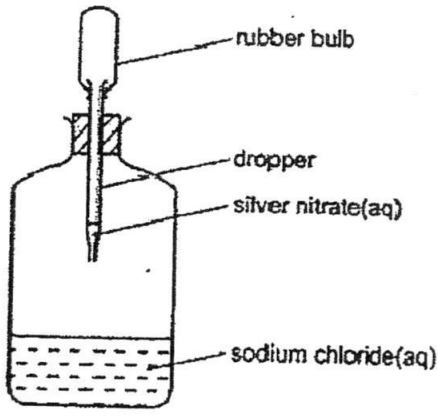
A 0.050 mol/dm^3

B 0.010 mol/dm^3

C 0.015 mol/dm^3

D 0.020 mol/dm^3

34. The setup below include a dropper filled with silver nitrate and a bottle containing aqueous sodium chloride. When the rubber bulb of the dropper in the diagram is squeezed, the aqueous silver nitrate drops into the aqueous sodium chloride and a white precipitate of silver chloride is formed.



What happenes to the total mass of the setup?

A It decreases because heat is evolved.

B It increases due the formation of the white precipitate.

C It increases as a chemical reaction has taken place.

D It remains the same because no additional substance was added.

35. Which statement is correct about changes in properties of the elements from left to right across a period in the Periodic Table?

A The number of valance electrons increases.

B The reactivity of the element increases.

C The number of electron shells increases.

D The elements changes from non-metallic to metallic.

36. Element P reacts with sodium to form Na_2P.
Which element is most likely to be found in the same group of the Periodic Table as P?

A nitrogen

B bromine

C sulfur

D argon

37. Which of the following elements is used in filing tubes for advertising lamps?

A argon

B helium

C oxygen

D neon

38. An organic compound **X** reacts with aqueous bromine to give a single compound with the chemical formula $C_3H_6Br_2$. What is compound **X**?

A propane

B propene

C propanol

D propanoic acid

39. A student investigated the reaction of vegetable oils with hydrogen.
100 cm^3 of hydrogen was bubbled through 1 g samples of four different vegetable oils containing a suitable catalyst.
The volume of hydrogen remaining after each experiment was recorded.

vegetable oil	volume of hydrogen remaining / cm^3
P	100
Q	87
R	63
S	0

Which vegetable oils are considered as unsaturated?

A **P**, **Q** and **R**

B **Q**, **R** and **S**

C **Q** and **R**

D **P** and **S**

40. Ethanol is manufacture by reaction between

A ethane and oxygen

B ethane and steam

C ethene and oxygen

D ethene and steam

COMMONWEALTH SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2016
SCIENCE(PHYSICS/CHEMISTRY)

Name: _____( ) Class: _____

SECONDARY FIVE NORMAL (ACADEMIC)

SCIENCE (CHEMISTRY)
5076/3

Friday
19 August 2016
1 h 15 min
0800 – 0915

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the booklet.
Write in dark blue or black pen.
You may use a pencil for any diagrams, graphs, tables or rough working

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 on the lined paper provided.

A copy of the Data Sheet is printed on page 12.
A copy of the Periodic Table is printed on page 13.

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	45
Section B	20
Total	65

Name of setter: Mr Simon Lew

This paper consists of <13> printed pages including the cover page.

For examiner's use

Section A

Answer all questions.

Write your answers in the spaces provided on the question paper.

1 The list shows the methods for purification of substances.

Filtration **Evaporation to dryness** **Fractional Distillation**

Chromatography **Simple distillation** **Crystallisation**

Select, from the list, one method by which each of the following may be separated from the stated mixture. You may use a method once, more than once, or not at all.

(a) Red dye from a mixture of red and yellow dyes in solution

..... [1]

(b) Nitrogen gas from liquid air

..... [1]

(c) Water from seawater

..... [1]

(d) Tea grains from tea solution

..... [1]

(e) Calcium chloride from calcium chloride solution

..... [1]

2 The table shows the atomic structures of seven particles, represented by the letters L to R.

particle	electrons	protons	neutrons
L	16	16	16
M	3	3	4
N	12	12	12
O	10	12	12
P	16	16	19
Q	10	10	10
R	11	11	12

(a) Which particle is a cation?

..... [1]

(b) Which two particles are atoms of different elements but belong to the same Group in the Periodic Table?

..... [1]

(c) Explain, using the information above, why particle **L** and particle **P** are isotopes.

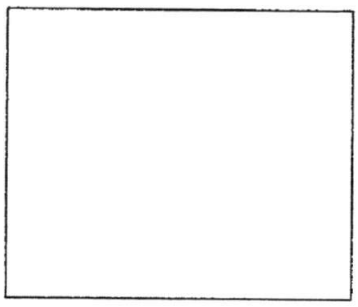
For examiner's use

.....

.....

..... [2]

(d) Given that particle **Q** is a gas at room temperature and pressure.
Draw the arrangement of the particles in the box below. [1]

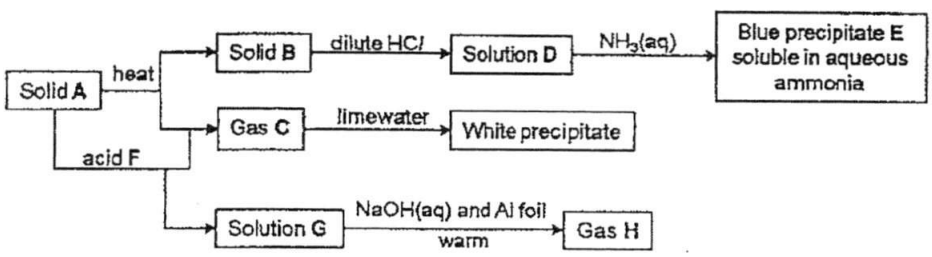


(e) Based on Kinetic Particle Theory, describe the arrangement and movement of particle **Q** at room temperature and pressure.

.....

..... [1]

3 Study the reaction scheme shown below.



(a) Identify the substances **A** to **H**.

A: ..... B: .....

C: ..... D: .....

E: ..... F: .....

G: ..... H: ..... [4]

(b) Describe a test to confirm the identity of gas **H**.

.....

..... [1]

For examiner's use

4 Phosphorus can react with chlorine to form a compound.
This compound has a melting point and boiling point of – 93 °C and 76 °C respectively.

(a) Deduce the physical state of the compound at room temperature.

..... [1]

(b) Is the compound an ionic or covalent compound? Explain your answer.

.....

..... [1]

(c) Draw a 'dot and cross' diagram to represent the bonding in this compound.
Show only the outer shell electrons. [2]

5 The rate of reaction involving zinc with hydrochloric acid was investigated. Excess hydrochloric acid was used in all experiments. The factors for each experiment are summarized in the table shown below.

Experiment	A	B	C	D	E	F
Concentration of acid used (mol/dm^3)	1	4	1	4	2	4
Particle size of zinc	Foil	Foil	Foil	Powder	Powder	Powder
Temperature of acid used (°C)	20	20	40	40	40	20

(a) Write a balanced chemical equation for the reaction between zinc and hydrochloric acid, with state symbols.

..... [2]

(b) Identify the experiment in which the reaction is the fastest.

..... [1]

For examiner's use

(c) (i) From the table above, which two experiments can be used to compare the effect of temperature on rate of reaction?

[1]

.....

(ii) Using the collision theory, explain how the temperature affects the rate of reaction.

[2]

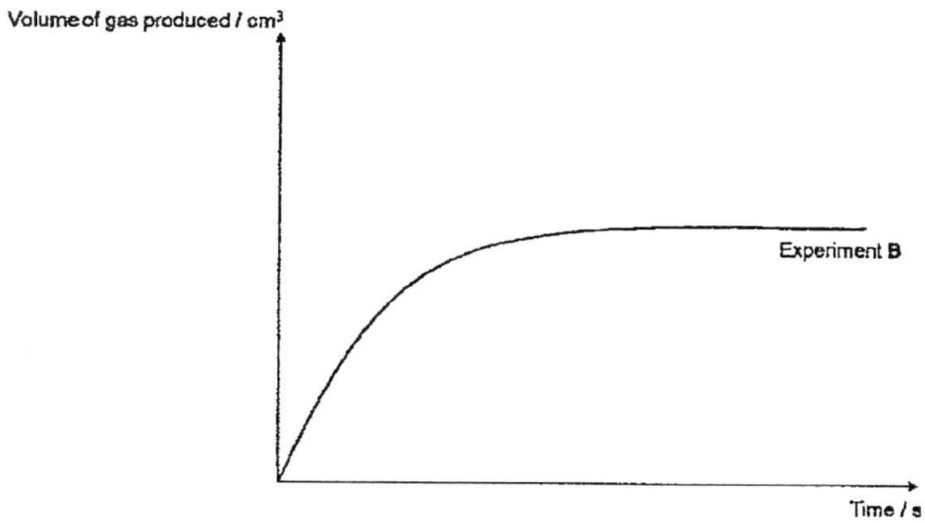
.....

.....

.....

(d) The graph below is a sketch showing the volume of gas produced over time for experiment B. Sketch another graph on the same axis to show the rate of reaction for experiment F.

[1]



(e) 130 g of zinc was used in experiment C.
What is the volume of gas obtained at room temperature?

[2]

6 The atomic number and mass number of Rubidium, Rb, are 37 and 85 respectively.

For examiner's use

(a) Fill in the table below to show the number of protons, electrons and neutrons in a rubidium atom. [1]

Number of protons	Number of electrons	Number of neutrons

(b) Would you expect the melting point of rubidium to be higher, lower or the same as compared to potassium in the same Group? Explain your answer.

.....

..... [2]

(c) Predict the chemical formula of the compound formed when rubidium reacts with the following elements.

(i) Reaction with oxygen

..... [1]

(ii) Reaction with bromine

..... [1]

(d) A piece of rubidium is placed in cold water.

(i) Predict the observation.

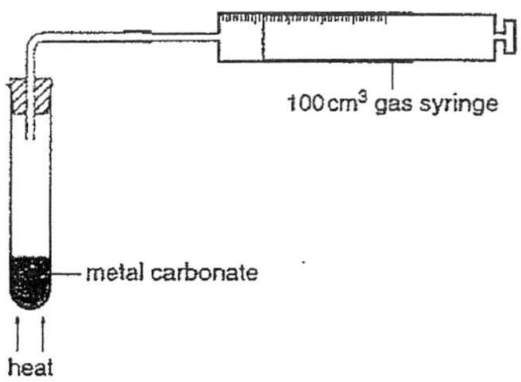
..... [1]

(ii) What would happen when Universal Indicator is added to the solution after the reaction?

..... [1]

For examiner's use

7 Margaret investigated the decomposition of five different metal carbonates. The diagram shows the apparatus she used. A less stable metal carbonate decomposes more readily than a more stable metal carbonate.



Margaret heated samples of each carbonate using the Bunsen burner. She measured the time taken for 100 cm^3 of gas to be collected in the gas syringe. The table below shows her results.

Carbonate	Time taken to collect 100 cm^3 of gas /s
Metal U carbonate	25
Metal V carbonate	100
Metal X carbonate	300
Metal Y carbonate	No gas produced after 1000 seconds
Metal Z carbonate	50

Margaret used calcium carbonate, copper(II) carbonate, magnesium carbonate, sodium carbonate and zinc carbonate.

(a) Identify the metals U, V, X, Y and Z. [2]

U: .....

V: .....

X: .....

Y: .....

Z: .....

(b) Explain how you used Margaret's results to identify each metal.

.....

..... [2]

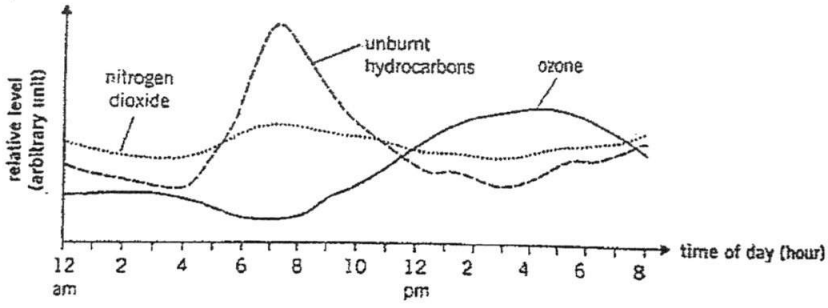
(c) Give two factors that must be kept constant to ensure a fair experiment.

.....

..... [2]

8 The graph below shows the relative levels of three air pollutants on the major traffic roads of a city measured over a period of 20 hours on a particular day.

For examiner's use



(a) What could be the source of nitrogen dioxide that is shown in this graph?

.....

[1]

(b) Why does the concentration of unburnt hydrocarbons reach the maximum level from 6 am to 10 am?

.....

[1]

(c) Suggest another possible air pollutant that can found in the city.

.....

[1]

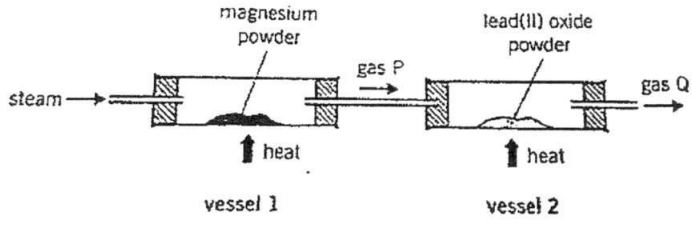
Section B

Answer **any two** questions.

Write your answers on the lined papers provided. Begin each question on a fresh page.

For examiner's use

9 The diagrams below show an experiment to investigate the reactions of steam and magnesium powder.



When steam flows through 0.400 g of magnesium powder in vessel 1, a gas P is produced. Gas P is then allowed to flow through vessel 2 containing lead(II) oxide and a gas Q is produced.

(a) Suggest the identity of gases P and Q.

.....

[1]

(b) Write a balanced chemical equation for the reaction in vessel 1.

.....

[1]

(c) Name the solid products that are formed in vessels 1 and 2 after gases have flown through them.

.....

[2]

(d) After lead(II) oxide has reacted, heat is removed to allow the vessel to cool. However, gas P is allowed to flow through continuously. Explain why it is so.

.....

.....

[2]

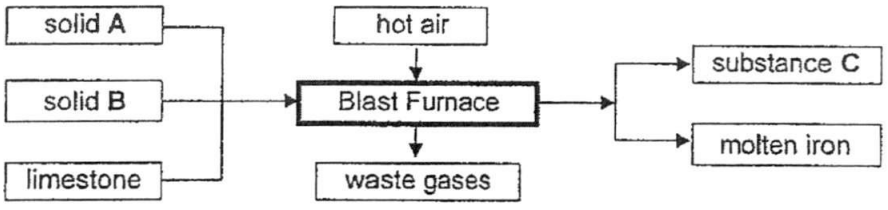
(e) A mass of 0.187 g of steam reacts completely with the magnesium powder.

(i) What is the mass of solid formed in vessel 1? [2]

(ii) What is the percentage of magnesium reacted? [2]

10 The diagram below shows a simplified flowchart of the processes that took place in the blast furnace during the manufacturing of iron.

For examiner's use



(a) Identify solid **A**, solid **B** and substance **C** in the above flowchart. [2]

Solid **A**: .....

Solid **B**: .....

Substance **C**: .....

(b) Give two reasons why limestone is essential in the manufacturing of iron in the blast furnace.

.....

.....

..... [2]

(c) In the blast furnace, iron is produced during redox reaction.
Write a balanced chemical equation, with state symbols, for this redox reaction and identify the substance that has been reduced. Explain your choice.

.....

.....

.....

..... [4]

(d) Some of the raw materials added to the blast furnace contain impurities like sulfur. Suggest how the sulfur present could eventually lead to the damage of buildings.

.....

..... [2]

For examiner's use

11 (a) Give two characteristics of members in the same homologous series.

.....

..... [2]

(b) Dodecane, an alkane containing 12 carbon atoms, can undergo the following reaction to form nonane, an alkane containing 9 carbon atoms, and substance **U**.

$$C_{12}H_{26} \rightarrow C_9H_{20} + U$$

(i) State the conditions needed for the above reaction to occur.

.....

..... [2]

(ii) Give the name of substance **U**.

..... [1]

(c) PVC is the polymer produced from chloroethene. Chloroethene can be made by an addition reaction between one mole of ethene and one mole of hydrogen chloride.

(i) Using full structural formulae, write the equation for the formation of chloroethene. [2]

.....

(ii) Hence, draw a full structural formula to show PVC. [1]

(iii) PVC is non-biodegradable. Explain the meaning of this term and describe one problem that this property causes.

.....

..... [2]

-End of paper-

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

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 †															

*58-71 Lanthanoid series

†90-103 Actinoid series

140 Ce Cerium 58	141 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

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

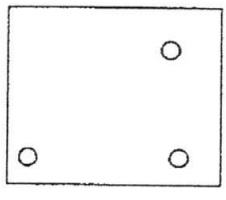
The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

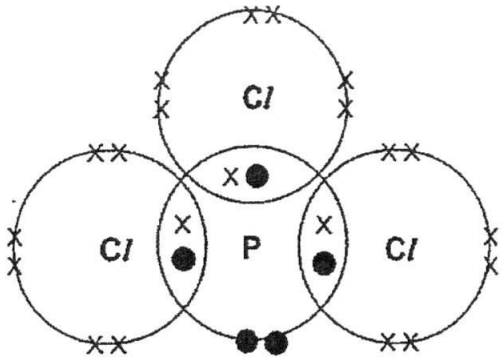
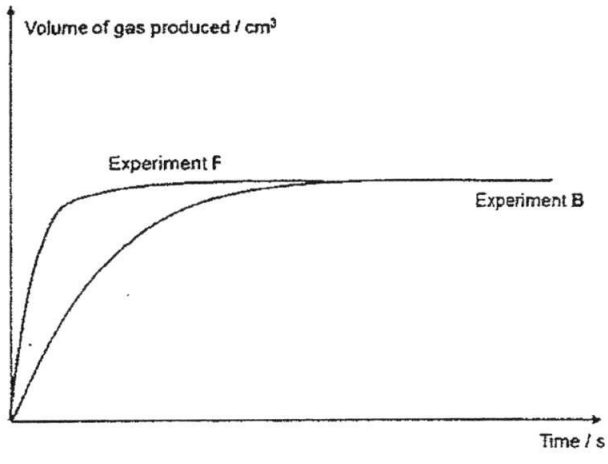
COMMONWEALTH SECONDARY SCHOOL
SCIENCE DEPARTMENT
CHEMISTRY UNIT
2016 SEC 5NA PRELIM EXAM

Paper 1

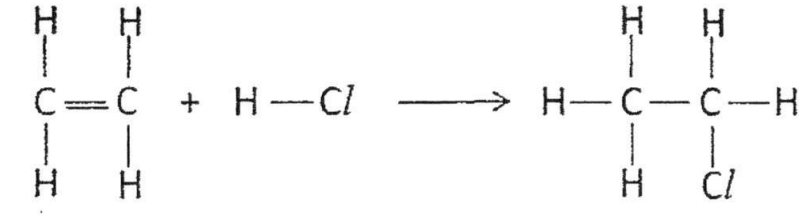
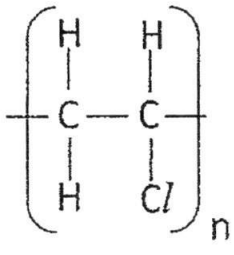
21	A	31	C
22	C	32	A
23	D	33	A
24	B	34	D
25	C	35	A
26	A	36	C
27	A	37	D
28	A	38	B
29	D	39	B
30	B	40	D

Paper 3

1	(a)		Chromatography **[1m]**
	(b)		Fractional distillation **[1m]**
	(c)		Simple distillation **[1m]**
	(d)		Filtration **[1m]**
	(e)		Crystallisation **[1m]**
2	(a)		Particle **O** **[1m]**
	(b)		Particle **M** and particle **R** **[1m]**
	(c)		Particles **L** and **P** are atoms of the same element as they have the same number of protons, 16. **[1m]** However, they have different number of neutrons. Particle **L** has 16 neutrons while particle **P** has 19 neutrons. **[1m]** **OR** Particle **P** has 3 more neutrons than particle **L**
	(d)		 **(3 circles of particle randomly space out in the box)**
	(e)		Particle **Q** is spaced far apart in a disorderly manner and move randomly and rapidly in all direction. **[1m]**
3	(a)		A: Copper carbonate B: Copper(II) oxide C: Carbon dioxide D: Copper(II) chloride E: Copper(II) hydroxide F: Nitric acid G: Copper(II) nitrate H: Ammonia **(Every 2 correct answers – 1m)**
	(b)		Place a moist red litmus paper in the gas, the gas will turns moist red litmus paper to blue indicating the presence of ammonia **[1m]**

4	(a)		Liquid **[1m]**
	(b)		Covalent compound. This is because both phosphorus and chlorine are non-metals / This is because the compound has a low melting and boiling point. **[1m]**
	(c)		 **(correct no of P and Cl atoms – 1m)** **(correct drawing of valence electrons – 1m)**
5	(a)		$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$
	(b)		Experiment **D** **[1m]**
	(ci)		Experiment **D** and Experiment **F** **[1m]** OR Experiment **A** and Experiment **C**
	(cii)		The higher the temperature, the particles gain more energy and move faster [1m], hence the frequency of effective collision increases, reaction rate increases. **[1m]**
	(e)		 (steeper gradient and reaction end earlier)
	(f)		No. of mole of Zn = 130/65 = 2 mol **[1m]** No. of mole of H_2 produced = 2 mol Volume of H_2 produced = 2 x 24 = 48dm³ **[1m]**
6	(a)		Protons: 37 Electrons: 37 Neutrons: 48 **(All correct – 1m)**

	(b)		Lower. This is because the trend of melting point decreases down the group. **[1m]** The position of rubidium is lower than that of potassium in group I **[1m]** hence the melting point should be lower.
	(c)	(i)	Rb_2O **[1m]**
		(ii)	RbBr **[1m]**
	(d)	(i)	Rubidium will react explosively in the cold water **[1m]**
		(ii)	The Universal Indicator will turns from green to violet **[1m]**
7	(a)		U – copper V – magnesium X – calcium Y – sodium Z – zinc **(Every 2 correct – 1m)**
	(b)		The more reactive the metal, the more stable its carbonate **[1m]** and the longer the time it takes to decompose **[1m]** / the slower the rate of decomposition
	(c)		Mass of carbonate Intensity of the flame Volume of gas collected Use of dry apparatus **(Any 2 of the above for 2m)**
8	(a)		Oxygen and nitrogen from the air reacts under high temperature in the car combustion engines. **[1m]**
	(b)		Between 6 am to 10 am, there is a lot of people commute to work using vehicles therefore high level of unburnt hydrocarbons are produced from these vehicles. **[1m]**
	(c)		Carbon monoxide **[1m]**
9	(a)		P is hydrogen Q is water vapour **(Both correct 1m)**
	(b)		$Mg + H_2O \rightarrow MgO + H_2$
	(c)		Magnesium oxide in vessel 1**[1m]** Lead in vessel 2**[1m]**
	(d)		This is to prevent the hot lead **[1m]** from reacting with the oxygen in the air to form lead(II) oxide. **[1m]**
	(e)	(i)	Mole of steam reacted = 0.187 / 18 = 0.01039 mol **[1m]** Mass of solid formed = 0.01039 * (24 +16) = 0.416 g **[1m]**
		(ii)	Mass of Mg reacted = 0.01039 * 24 = 0.249 g **[1m]** Percentage = 0.249 / 0.4 *100 = 62.3% **[1m]**
10	(a)		solids A & B: haematite and coke **[1m]** substance C: molten slag **[1m]**

	(b)		Limestone decomposes to form calcium oxide which reacts with acidic impurities to form molten slag. **[1m]** The carbon dioxide produced will react with carbon to form carbon monoxide. **[1m]**
	(c)		Fe_2O_3 (s) + 3CO (g) → 2Fe (l) + $3CO_2$ (g) All correct formulae and balanced equation **[1m]** All correct state symbols **[1m]** Fe_2O_3 / iron(III) oxide is reduced **[1m]** Fe_2O_3 loses oxygen atoms to form Fe or Oxidation number of Fe decreases from +3 (in Fe_2O_3) to 0 (in Fe) or Fe^{3+} (in Fe_2O_3) gained electrons to form Fe. **[1m]**
	(d)		Sulfur combusted to form sulfur dioxide **[1m]** Sulfur dioxide react with oxygen and dissolves in rain to produce acid rain **[1m]** which corrodes limestone/ concrete in buildings and kills plants/ marine life.
11	(a)		• Members in the same homologous series have the same general formula. • Successive members differ by a CH_2 group. • The physical property of the members changes gradually as the number of carbon atoms increases. • Members have the same functional group. • Members undergo the similar chemical reactions. **(Any 2 for 2m)**
	(b)	(i)	Heating at high temperature **[1m]**in the presence of aluminium oxide / silicon(IV) oxide / broken pot catalyst **[1m]**
		(ii)	Propene**[1m]**
	(c)	(i)	 **[1m for reactant, 1m for product]**
		(ii)	 **[1m]**
		(iii)	Non-biodegradable means that it cannot be decomposed by bacteria **[1m]** An accumulation of waste PVC can cause land pollution **[1m]**

Paper 5

	observations with solution X	observations with solution Y	observations with solution Z
(ai)	No visible reaction	Effervescence observed. Colourless and odourless gas forms white precipitate in limewater **[1m]**	Effervescence observed. Colourless and odourless gas forms white precipitate in limewater **[1m]**
(aii)	White precipitate formed **[1m]**	White precipitate formed **[1m]**	No visible reaction

[4]

(aiii)

X contains sulfate ions

Y contains sulfate and carbonate ions

Z contains carbonate ions
**No marks for the above mention of ions.*

anion 1 is sulfate as in experiment (aii), white precipitate of barium sulfate was formed when barium nitrate solution is added. **[1m]**

anion 2 is carbonate as in experiment (ai), effervescence of carbon dioxide which forms white precipitate of calcium carbonate in limewater is given off when nitric acid is added. **[1m]**

**For anion 1 and 2, must mention the identity of the anion*

	observations
(bi)	Colourless and odourless gas formed white precipitate in limewater **[1m]** Green solid turns black after heating **[1m]**
(bii)	Black solid dissolve in acid to form a blue solution **[1m]**
(biii)	Blue precipitate formed **[1m]** Blue precipitate dissolve in excess aqueous ammonia to form a deep blue solution **[1m]**

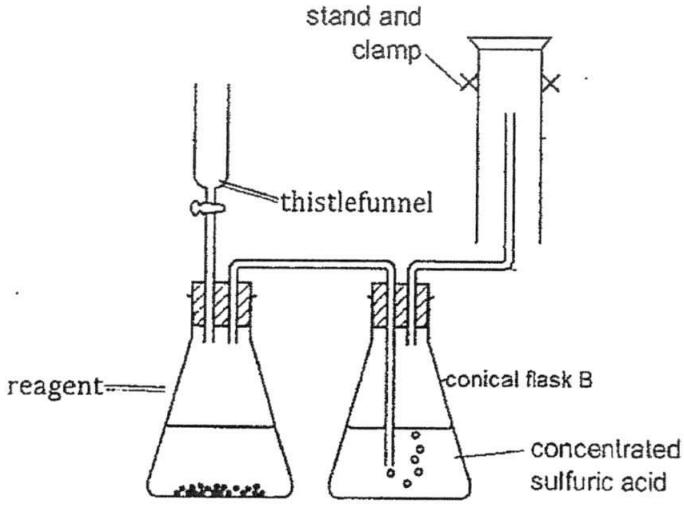
(c)

Conclusion 1: Solid P contains **copper(II) ions [1m]**
Evidence: From expt (biii). **blue precipitate formed, soluble in excess aqueous ammonia forming a deep blue solution** [1m]

Conclusion 2: Gas produced is **carbon dioxide [1m]**
Evidence: **Colourless and odourless gas formed white precipitate in limewater [1m]**

X is aqueous sodium sulfate
Y is a mixture of aqueous sodium sulfate and sodium carbonate
Z is aqueous sodium carbonate
P is copper(II) carbonate
Q is sulfuric acid

21 A student attempted to collect ammonia gas by using the experiment set-up.



What correction/corrections should be made in the apparatus set-up?

A bottom tubing of thistle funnel should be immersed in the reagent.
B bottom tubing of thistle funnel should be immersed in the reagent and calcium oxide should be used instead of concentrated sulfuric acid.
C gas collection by downward delivery should be done instead.
D two delivery tubes in conical flask B should be immersed in concentrated sulfuric acid.

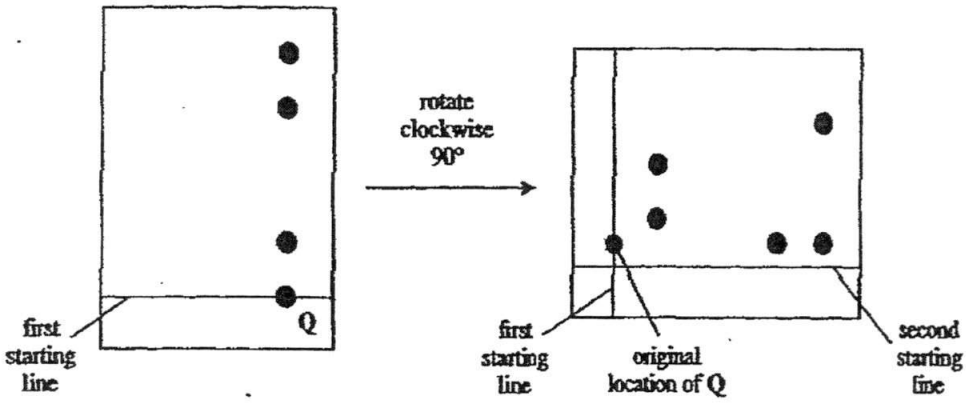
22 You are given a mixture of methylbenzene and aqueous solution of copper(II) sulfate. Methylbenzene boils at 111°C and is immiscible with water. Which two methods could be used to obtain samples of methylbenzene and copper(II) sulfate crystals?

	first method	second method
A	filtration	crystallisation
B	filtration	evaporation
C	using a separating funnel	crystallisation
D	using a separating funnel	evaporation

23 A chromatography experiment is performed to determine the number of colourings present in a sample of food dye **Q**.

Chromatogram **A** shows the separation of colourings using methanol as the solvent. The chromatogram is then removed, rotated clockwise by 90° and placed in a second solvent, ethanol.

The results are shown in chromatogram **B**.



Chromatogram **A** Chromatogram **B**

How many different types of colourings are present in food dye **Q**?

A 3

B 5

C 6

D 8

24 The table shows the structure of different atoms and ions.

particle	proton number	nucleon number	number of protons	number of neutrons	number of electrons
Mg	12	24	12	W	12
Mg^{2+}	X	24	12	12	10
F	9	19	9	Y	9
F^-	9	19	9	10	Z

What are the values of W, X, Y and Z?

	W	X	Y	Z
A	10	10	9	9
B	10	12	10	9
C	12	10	9	10
D	12	12	10	10

25 Propane burns completely in oxygen as shown in the equation.

C_3H_8 (g) + $5O_2$ (g) → $3CO_2$ + $4H_2O$ (l)

If 4.4g of propane is burnt completely, what volume of carbon dioxide is obtained, measured at room temperature and pressure?

A 0.1 dm^3
B 0.3 dm^3
C 2.4 dm^3
D 7.2 dm^3

26 20 cm^3 of ethyne, C_2H_2, are reacted with 500 cm^3 of oxygen.
The equation for the reaction is

$2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(l)$

What is the total volume of gas remaining at the end of the reaction?
(all volumes are measured at room temperature and pressure)

A 400 cm^3
B 450 cm^3
C 490 cm^3
D 520 cm^3

27 Element X forms an acidic, covalent oxide.

Which row shows how many electrons there could be in the outer shell of an atom of X?

(√) indicates presence and (x) indicates absence of number of valence electrons.

	number of valence electrons			
	1	2	6	7
A	√	√	×	×
B	√	×	√	×
C	×	√	×	√
D	×	×	√	√

28 The diagram shows the pH ranges of two indicators, methyl orange and methyl red.

methyl orange	red			yellow	
pH	2	3	4	5	6

methyl red	red				yellow
pH	2	3	4	5	6

The table shows the pH of four solutions:

solution	Y	Z	E	F
pH	2.0	3.0	4.0	6.0

In which of the solutions are **both** indicators yellow?

A F only

B Y only

C Y and Z

D Z and E

29 Which of the following pairs of salts can be prepared using the same method?

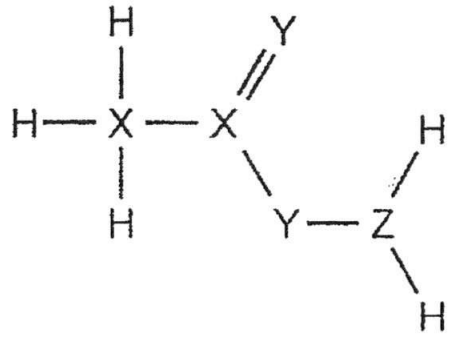
A aluminium sulfate and ammonium sulfate

B barium sulfate and barium chloride

C calcium nitrate and copper(II) chloride

D lead(II) chloride and zinc sulfate

30 The diagram shows the structure of a covalent compound containing the element hydrogen, H, and the unknown elements X, Y and Z.

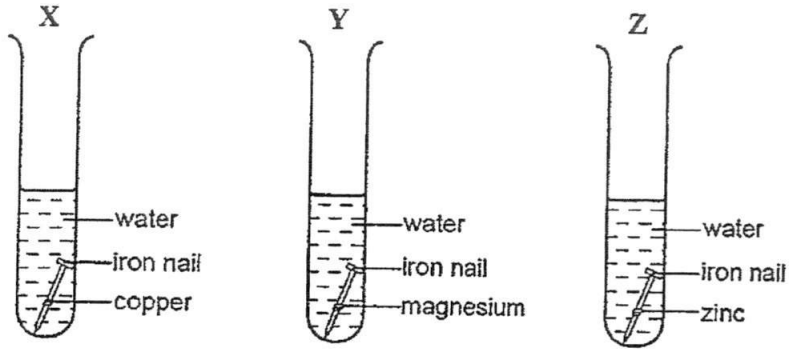


To which groups of the Periodic Table do these three elements, X, Y and Z, belong?

	X	Y	Z
A	IV	II	III
B	IV	VI	V
C	V	II	VI
D	V	VI	IV

31 The following test tubes are set up to investigate the sacrificial protection of iron.

Copper, magnesium or zinc piece is tied to the iron nail in each test tube.



In which test tubes will the iron nail rust?

A **X** only
B **Y** only
C **X** and **Z**
D **Y** and **Z**

32 Which one of the following ionic equations represents the reaction between barium chloride solution and zinc sulfate solution?

A $2Ba^{+}(aq) + SO_4^{2-}(aq) \rightarrow Ba_2SO_4(s)$
B $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$
C $Ba^{2+}(aq) + ZnSO_4(aq) \rightarrow BaSO_4(s) + Zn^{2+}(aq)$
D $BaCl_2(aq) + Zn^{2+}(aq) \rightarrow ZnCl_2(aq) + Ba^{2+}(aq)$

33 Which equation shows an exothermic process?

A $2AgCl(s) \rightarrow 2Ag(s) + Cl_2(g)$
B $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
C $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$
D $H_2O(l) \rightarrow H_2O(g)$

34 Which process involves a redox reaction?

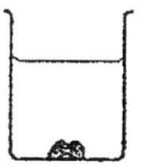
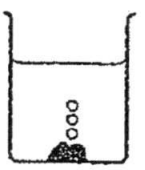
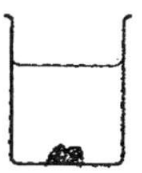
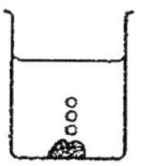
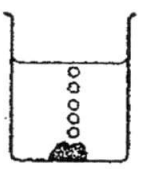
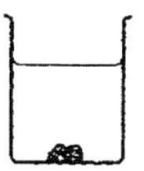
A $AgNO_3 + HCl \rightarrow AgCl + HNO_3$

B $CaO + 2HCl \rightarrow CaCl_2 + H_2O$

C $CuSO_4 + Zn \rightarrow ZnSO_4 + Cu$

D $NaOH + HNO_3 \rightarrow NaNO_3 + H_2O$

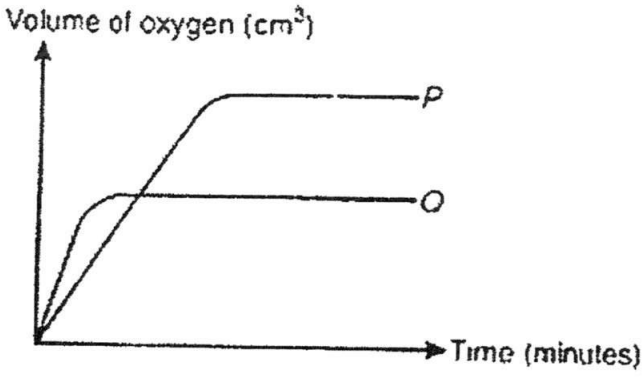
35 The diagrams show what happens when metals X, Y and Z are placed in water and in dilute hydrochloric acid.

liquid	*metal* X	*metal* Y	*metal* Z
water			
dilute hydrochloric acid			

What is the order of reactivity of the metals?

	most reactive ⟶ least reactive		
A	X	Y	Z
B	X	Z	Y
C	Y	X	Z
D	Y	Z	X

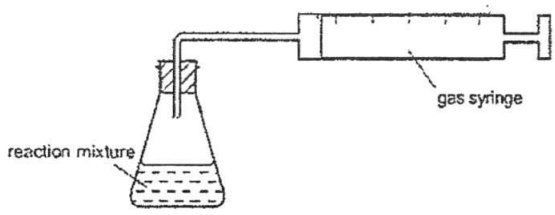
36 Hydrogen peroxide, H_2O_2 will decompose to produce oxygen and water. 40 cm^3 of 0.4 mol/dm^3 hydrogen peroxide are used in this experiment, at a temperature of 30 °C. The results obtained are shown in curve Q.



Which one of the following will produce curve P given that the same volume of hydrogen peroxide is used?

	concentration of H_2O_2 (mol/dm^3)	temperature (°C)
A	0.2	20
B	0.2	40
C	0.8	20
D	0.8	40

37 The apparatus shown can be used to measure the volume of gas given off.



For which two reactions would this apparatus be suitable?

reaction 1 : $AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$

reaction 2 : $2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$

reaction 3 : $MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l)$

reaction 4 : $ZnCO_3(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + CO_2(g) + H_2O(l)$

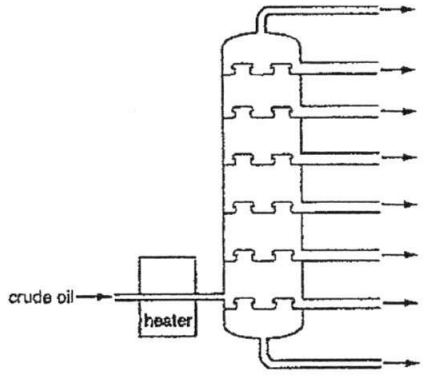
A 1 and 2

B 1 and 3

C 2 and 4

D 3 and 4

38 The diagram shows the apparatus used for the fractional distillation of petroleum.



Which statement about the fractional distillation of petroleum is **incorrect**?

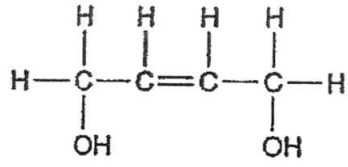
A At each level in the column, only one compound is collected.

B The higher up the column, the lower the temperature.

C The molecules collected at the bottom of the column are the least flammable.

D The molecules reaching the top of the column have the smallest relative molecular mass.

39 The diagram shows the structure of compound X.

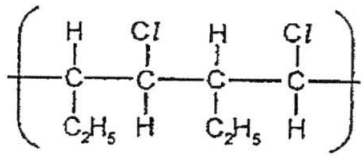


Which statements about compound X are correct?

1. Compound **X**decolourises aqueous bromine.
2. Compound **X** turns acidified potassium manganate(VII) from purple to colourless.
3. Compound **X** reacts with sodium carbonate to produce a gas that gives a white precipitate with limewater.

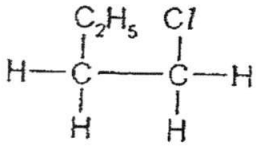
A 1 and 2
B 1 and 3
C 2 and 3
D All of the above

40 The structural formula of a polymer is shown below.

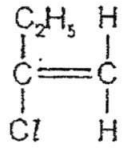


Which monomer will form this polymer?

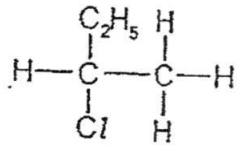
A



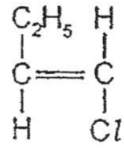
B



C



D



Data Sheet

Colours of some common metal hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc(II) hydroxide	white

SECTION A [45 marks]

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

1 The Dead Sea is a salt lake bordering Jordan, Palestine and Israel. It is well known for its mineral-rich salt, with an overall salt concentration of 340 g/dm^3. The table below shows the concentration of some of the ions present in the water of the Dead Sea which has a pH between 5.8 and 6.0.

ions	concentration in g/dm^3
chloride	121.4
bromide	84.3
magnesium	45.9
sodium	36.6
calcium	17.6
potassium	7.8

(a) Name the salt present in the largest quantity in the Dead Sea.

..... [1]

(b) State the formula of an ion, other than those in the table, which must be present in the Dead Sea.

..... [1]

(c) Name the process by which the water from the Dead Sea can be made into drinking water.

..... [1]

The Periodic Table of the Elements

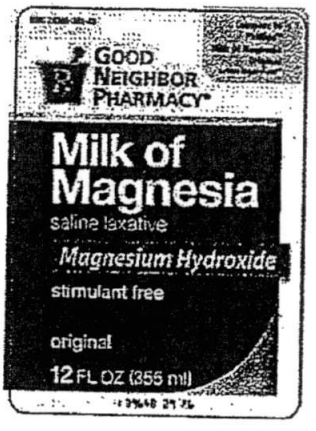
Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 H hydrogen 1										4 He helium 2
7 Li lithium 3	9 Be beryllium 4											11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12											27 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	– Ra radium 88	– Ac actinium 89 †															

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

140 Ce cerium 58	141 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

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

2 Milk of magnesia works as an antacid to treat stomach problems. Milk of magnesia is a mixture of magnesium hydroxide and water. The solubility of magnesium hydroxide in water is low.



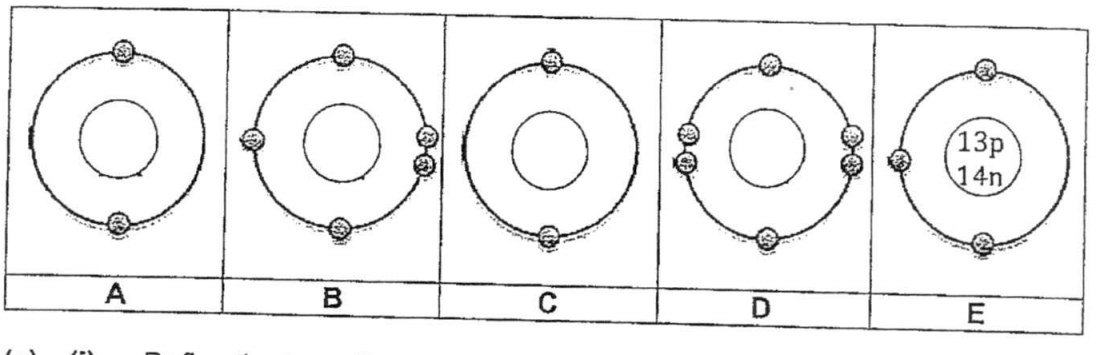
Suggest how milk of magnesia works as an antacid.
Write a balanced chemical equation to support your explanation.

.....

.....

..... [2]

3 The diagrams show the electron arrangement in the outer shells of some atoms of the elements from Period 3.



(a) (i) Define the term "isotopes".

.....

..... [1]

(ii) Which of the above atoms are isotopes?

..... [1]

(b) What is the charge of the ion formed by element **E**? Explain.

.....

.....

..... [2]

(c) (i) Write the formula of the compound formed between elements **A** and **D**.

..... [1]

(ii) Draw the 'dot and cross' diagram to show the bonding between elements **A**and **D**. Only the outer shells of electrons need to be shown.

[2]

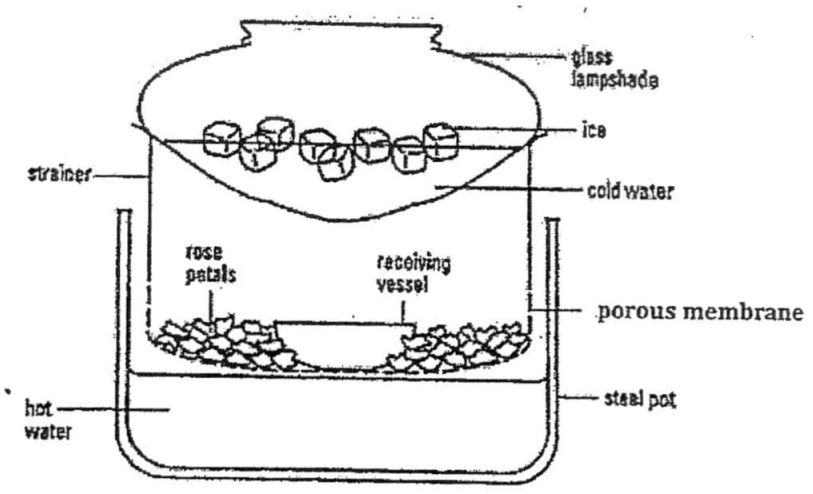
(iii) Is the boiling point of the compound formed between A and D high or low? Explain.

.....

.....

..... [2]

4 To obtain fragrant oils used in perfumes, a method called steam distillation is often used. The diagram below shows the apparatus used by a student to obtain fragrant oils from rose petals.



(a) Explain why the upper container contains ice and cold water.

.....

.....

..... [1]

(b) Suggest what happens when steam passes through the rose petals.

.....

..... [1]

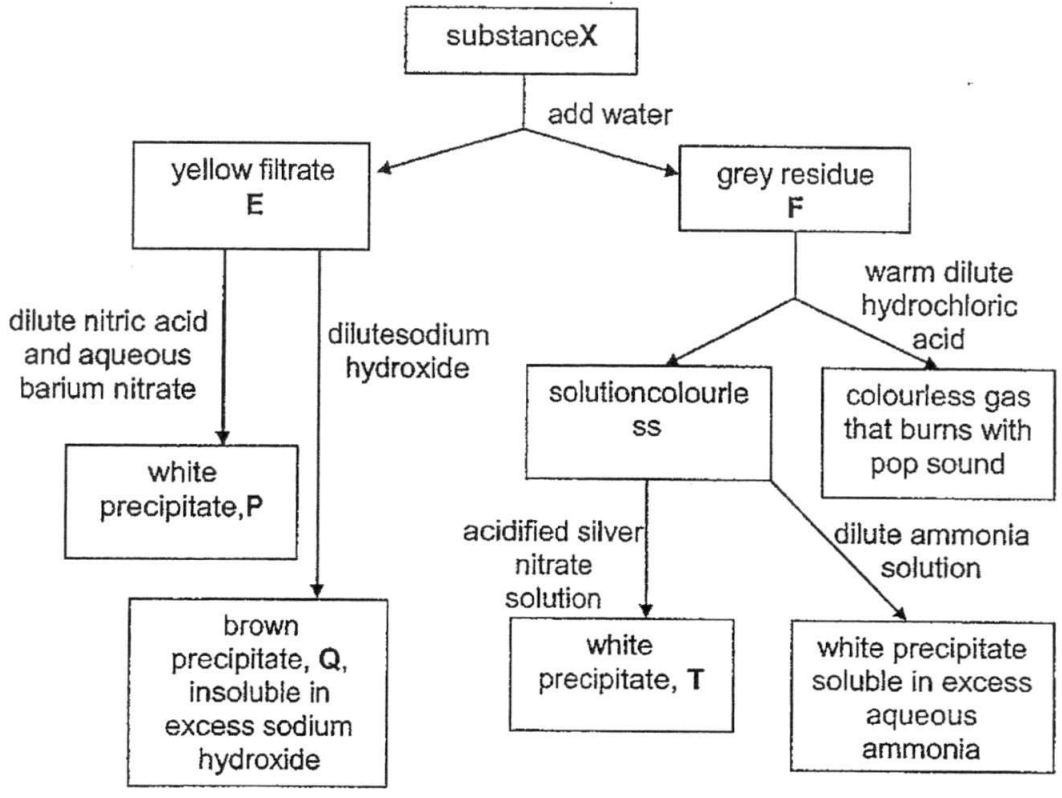
(c) Two liquids would be collected in the receiving vessel.
Suggest and explain a method to separate these two liquids.

.....

.....

..... [2]

5 Substance **X** is amixture of compound **E** and element **F**. Compound **E** is soluble in water but element **F** is not soluble. The reaction scheme shows the results of some experiments **on** substance **X.**



(a) Identify substances **E, F, P, Q** and **T.**

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

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

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

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

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

(b) Write an ionic equation, with state symbols, for the formation of white precipitate **T.**

..... [1]

6 The Periodic Table is an arrangement of elements in order of increasing atomic number.
Elements **W, X, Y** and **Z** are all in the same period of the Periodic Table.
The following information about the elements is given.

- W_2O exists as a strong basic oxide.
- XCl_3 is a covalent compound.
- **Y** forms an ionic oxide Y_2O_3.
- **Z** produces an ion Z^-.

(a) Put **W, X, Y** and **Z** in their respective groups of the Periodic Table on the basis of the above information.

W: Group .....

X: Group .....

Y: Group .....

Z: Group ..... [2]

(b) Rubidium is in Group I. Suggest two physical properties of rubidium that are different from copper.

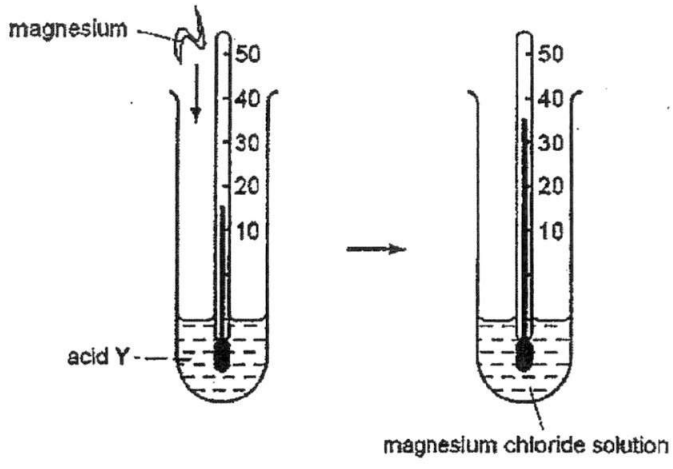
.....

.....

.....

..... [2]

7 A student investigates the reaction between magnesium metal and dilute acid Y. The diagram shows the metal being added to the acid in a test tube, and also the same test tube some time later.



(a) What can you conclude from the diagram about the reaction between the metal and the acid? Give an observation to support your conclusion.

.....

..... [2]

(b) The student further investigates the temperature changes when three metals, L, M and N are added to magnesium chloride solution.

0.2 g of each metal was added to a test tube containing magnesium chloride solution and the maximum temperature of the mixture measured and recorded.

The table shows the results she obtained.

metal	initial temperature / °C	maximum temperature / °C
L	29.5	29.5
M	28.5	33.5
N	30.0	34.0

The student concludes that the order of reactivity of the metals is as follows.

most reactive ⟶ least reactive

N M L magnesium

Do the student's results agree with her conclusion? Explain your reasoning.

.....

.....

.....

.....

..... [3]

8 The average concentration of carbon monoxide in the air in Orchard Road for two years is given in the table below.

	time interval (hours)					
	6 am - 8 am		8 am -10 am		10 am - 12pm	
year	2001	2002	2001	2002	2001	2002
concentration of carbon monoxide (volume of carbon monoxideper 1000 000 cm^3 of air)	2	3	4	5	1	2

(a) What is the main source of carbon monoxide at Orchard Road?

.....

..... [1]

(b) Describe the variation in concentration of carbon monoxide over the 6-hour period.Suggest an explanation for this phenomenon.

.....

.....

.....

..... [2]

(c) Suggest a reason for the difference in concentration of carbon monoxide

recorded over the two years.

.....

.....

..... [1]

9 A solution of sodium hydroxide, NaOH, has a concentration of 20g/dm^3

(a) Calculate the concentration of the solution in mol/dm^3.

[1]

(b) Sodium hydroxide reacts with ammonium sulfate as follows:

$$2NaOH + (NH_4)_2SO_4 \rightarrow Na_2SO_4 + 2H_2O + 2NH_3$$

What mass of ammonium sulfate reacts with 300 cm^{3}of 2.0mol/dm^{3}sodium hydroxide?

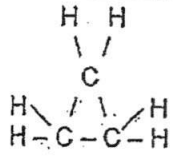
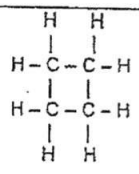
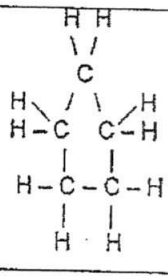
[2]

(c) Another aqueous sodium hydroxide solution is made by diluting 1.0 mole of

sodium hydroxide to make up to 5 dm^3 of solution.
What is the concentration of this solution in mol/dm^3?

[1]

10 The table shows some information about a homologous series of organic compounds calledcycloalkanes.

name	number of carbon atoms	full structural formula	boiling point /°C
cyclopropane	3		-33.0
cyclobutane	4		12.5
cyclopentane	5		40.2

(a) Explain how the formulae in the table show that the organic compounds belong to the same homologous series.

.....

.....

..... [1]

(b) Put tick (√) in the boxes to show the statements about the cycloalkane

homologous series that are true and (X) for the statements that are false.

	true	false
They have the same percentage by mass of carbon.		
They have the same empirical formula.		
They are unsaturated hydrocarbons.		
They decolourise aqueous bromine in the presence of sunlight.		

[2]

(c) Draw the full structural formula of cyclohexane.

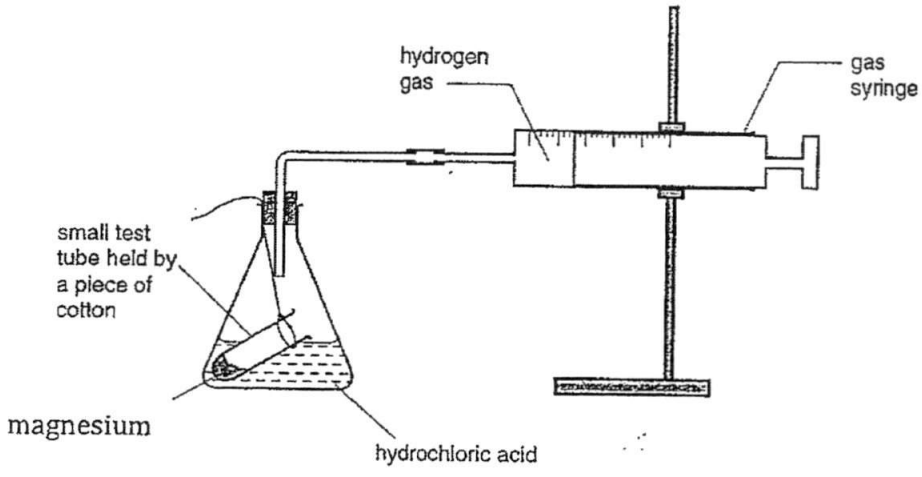
[1]

SECTION B [20 marks]

Answer any **two**questions on the writing paper.

11 A student investigates the reaction between 0.06 g of magnesium and excess hydrochloric acid with the apparatus shown below.

$Mg\ (s) + 2HCl\ (aq) \rightarrow MgCl_2\ (aq) + H_2\ (g)$



The student reads the volume of hydrogen in the syringe every minute. The results are shown in the table.

time in minutes	0	1	2	3	4	5	6	7
volume of gas in cm^3	0	23	35	45	52	58	60	60

(a) Plot the volume of gas against time on a piece of graph paper. Label this graph as **GraphA**. [2]

(b) Explain why the volume of gas stays the same after six minutes. [1]

(c) Suggest the chemical formulae of the 3 ions found in the solution after six minutes. [1]

(d) Suggest a change that can be made to increase the rate of reaction. Explain your answer in terms of Collision Theory. [3]

(e) The student repeated the experiment using 0.03 g of magnesium.

(i) Calculate the volume of gas produced, leaving your answer in cm^3. [2]

(ii) Draw, on the same axes as **part (a)**, the shape of the graph you would expect for the experiment with 0.03 g of magnesium. Label this graph as **GraphB**. [1]

12 (a) Below is a recipe that gives the steps for making blackcurrant wine:

Recipe for blackcurrant wine

1. Boil 4 dm^3 of water and add 2 kg of sugar. Stir until all the sugar dissolves.
2. Add 1.5 kg of crushed blackcurrants and let the mixture cool to 25 °C.
3. Add some yeast.
4. Cover the container and leave it in warm place for five days.
5. Filter the mixture into a glass jar and fit an airlock.

(i) State one step in the recipe which**CANNOT** be used to increase the speed of reaction. [1]

(ii) Why was the mixture cooled before the yeast was added to it? [1]

(iii) Give the name of this process of making wine and give the structural formula of the main compound made in this process. [2]

(iv) Write the equation for the formation of the main compound stated in **a(iii)**. [1]

(v) What is the function of yeast in this reaction? [1]

(b) The blackcurrant wine may have a sour taste after long storage.

(i) Give the name and chemical formula of the compound which causes the sour taste in blackcurrant wine. [2]

(ii) Suggest how the compound in **(d)(i)** might be formed. [1]

(iii) Write the equation to show how the sour compound is formed. [1]

13 (a) Explain the following observations:

(i) Greasing an iron nail prevents it from rusting. [1]

(ii) Acidic food can be safely packed in aluminium containers even though aluminium is a reactive metal. [1]

(iii) Ammonium nitrate and water are used in making a cold pack. [1]

(iv) Filament bulbs are filled with argon and not air. [2]

(b) Sodium hydride reacts with water as shown by the equation below.

$NaH + H_2O \rightarrow NaOH + H_2$

(i) Explain in terms of oxidation states, why this is a redox reaction. [2]

(ii) State the reducing agent in the reaction. [1]

(iii) State a reagent that can be used to identify the reducing agent.
What would you see when this reagent is added to the reducing agent? [2]

DATA SHEET

Colours of some common metal hydroxides	
calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc(II) hydroxide	white

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	– Ra radium 88	– Ac actinium 89 †															

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

140 Ce cerium 58	141 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

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

PRELIM EXAM-2016
Sc(Chem)-P1
Marking scheme

Q No.	21	22	23	24	25	26	27	28	29	30
Ans	B	C	B	D	D	C	D	A	C	B
Q No.	31	32	33	34	35	36	37	38	39	40
Ans	A	B	C	C	C	C	C	A	A	D

EDGEFIELD SECONDARY SCHOOL
2016 PRELIMINARY EXAMINATION
Sc(Chemistry)- 5076/5078/3
Secondary 4 Express/5 Normal (A)
Marking Scheme

Q No.		Answers	Marks
		SECTION A	
1	a	magnesium chloride	1
	b	H^+	1
	c	distillation	1
2		Magnesium hydroxide is a base and neutralizes the acid in the stomach. $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + H_2O$	1 1
3	a(i)	Atoms of the same element having the same number of protons but different number of neutrons.	1
	a(ii)	**A** and **C**	1
	b	+3, loses 3 electrons to have stable octet configuration.	1 1
	c(i)	AD	1
	c(ii)	Correct "dot and cross" diagram for A and D	1 1
	c(iii)	High Because a lot of energy is needed to overcome the strong electrostatic forces of attraction between oppositely charged ions.	1 1
4	a	To condense the fragrant oil vapour.	1
	b	As steam passes through the rose petals, the oil from the rose petals vapourises.	1
	c	Separating funnel as the fragrant oil and water are immiscible.	1 1
5	a(i)	**E** : iron(III) sulfate	1
	a(ii)	**F** : zinc	1
	a(iii)	**P** : barium sulfate	1
	a(iv)	**Q** : iron(III) hydroxide	1
	a(v)	**T** : silver chloride	1
	b	$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$	1
6	a	**W:** Group I **X** : Group V **Y** : Group III **Z** : Group VII	Every 2 correct ans 1 mark
	b	Rubidium has low m.p.(below 100°C, i.e 39°C) while copper has high m.p. Rubidium is soft and can be cut with a scissor while copper cannot be cut with a scissor.	1 1
7	a	Reaction between magnesium and the acid is an exothermic reaction as there is an increase in temperature.	1 1

	b	Displacement reaction is exothermic, the more heat given off, the more reactive the metal. Hence, N is more reactive than M and both are more reactive than magnesium. When L is added to magnesium chloride there is no heat evolved, hence no displacement→ magnesium is more reactive than L. Therefore the order of reactivity should be N > M > magnesium> L. Student's results do not agree with her conclusion.	1 1 1
8		Incomplete combustion of carbon fuels.	1
	b	Concentration of carbon monoxide increases and then drops and is highest between 8 and 10 am due to the large number of vehicles on the road during peak hour (8 to 10 am).	1 1
	c	There is a higher concentration of carbon monoxide in 2002 compared to 2001 due to greater number of vehicles on the road or vehicle ownership in 2002.	1
9	a	Concentration = 0.5mol/dm^3	1
	b	39.6 g	Cal-1 Ans-1
	c	0.2 mol/dm^3	1
10	a	Hydrocarbon having the general formula C_nH_{2n}	1
	b	true true false true	Every 2 correct - 1 mark
	c	Correct structural formula of cyclohexane	1
11	a	Correct axis Correct plot	1 1
	b	Reaction has stopped	1
	c	Mg^{2+}, H^+, Cl^- (all must be correct)	1
	d	Increase in temperature or increase in concentration of hydrochloric acid or use powdered magnesium. Explanation- e.g increase in temperature→increase in kinetic energy of particles→increase in number of collisions→ increase in number of effective collisions→ increase in rate of reaction	1 1 1
	e(i)	30 cm^3	Cal -1 Ans -1
	e(ii)	Graph B • Steepness same as Graph A • Volume of gas is half of Graph A	1
12	a(i)	Step 5	1
	a(ii)	Yeast will die if the mixture is hot.	1
	a(iii)	Fermentation Structural formula of ethanol	1 1

	a(iv)	$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$	1
	a(v)	Yeast contains an enzyme that speeds up the reaction.	1
	b(i)	Ethanoic acid CH_3COOH	1 1
	b(ii)	Air oxidation of ethanol	1
	b(iii)	$C_2H_5OH + 2[O] \rightarrow CH_3COOH + H_2O$	1
13	a(i)	Greasing forms a coating around iron and prevents it from coming into contact with air/oxygen and water which are needed for rusting.	1
	a(ii)	Aluminium reacts with oxygen and forms a coating of aluminium oxide around aluminum. This coating prevents acidic food from coming into contact with aluminium.	1
	a(iii)	When ammonium nitrate dissolves in water, heat is absorbed from the surrounding(endothermic reaction) and therefore used in making a cold pack.	1
	a(iv)	When electricity passes through the tungsten filament in the bulb, it converts to heat. At high temperature tungsten can react with oxygen in air to form tungsten oxide which cannot conduct electricity. At high temperature, tungsten cannot react with argon which is a noble gas having stable octet configuration.	1 1
	b(i)	+1 -1 +1 -2 +1 -2 +1 0 $NaH + H_2O \rightarrow NaOH + H_2$ Water is reduced as oxidation stateof hydrogen decreases from +1 to 0. Sodium hydride is oxidized as oxidation state of hydrogen increases from -1 to +1.	 1 1
	b(ii)	Reducing agent is sodium hydride	1
	b(iii)	Acidified potassium permanganate Changes colour from purple to colourless	1 1

Name: ( )	Class:

SERVE-LEAD-EXCEL

GREENDALE SECONDARY SCHOOL
Preliminary Examination 2016

SCIENCE (PHYSCIS/CHEMISTRY) **5076/01**

Paper 1 Multiple Choice 05 August 2016

Secondary 4 Express / 5 Normal Academic **1 hour**

Additional Material: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST
Do not open this booklet until you are told to do so.

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

There are **forty** 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 question paper.

A copy of the Data Sheet is printed on page 9.
A copy of the Periodic Table is printed on page 10.

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

This document consists of 10 printed pages.

[Turn over

1 Potassium nitrate crystals can be separated from sand by using the processes shown.

What is the correct order for the processes?

A dissolve → evaporate → crystallise → filter
B dissolve → evaporate → filter → crystallise
C dissolve → filter → evaporate → crystallise
D filter → dissolve → evaporate → crystallise

2 Which changes occur when a liquid at 50 °C becomes a gas at 120 °C?

	attractive forces between particles	separation of particles	energy of particles
A	decreases	decreases	increases
B	decreases	increases	increases
C	increases	decreases	decreases
D	increases	increases	decreases

3 An atom of element X is represented by $^{7}_{3}X$.

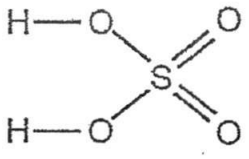
Which statement about this atom of X is correct?

A It is in Group III of the Periodic Table.
B It is in Group VII of the Periodic Table.
C The total number of protons and electrons is 6.
D The total number of protons and neutrons is 10.

4 Which substances could be sodium chloride?

	melting point / °C	conduction of electricity	
		when liquid	in aqueous solution state
A	−114	none	none
B	−114	none	good
C	180	none	insoluble
D	808	good	good

5 A molecule of sulfuric acid has the structural formula shown.



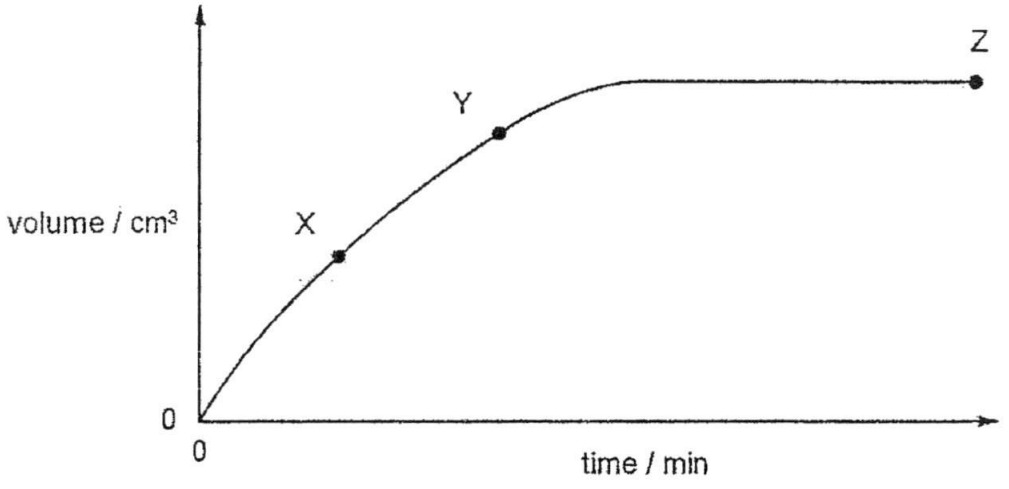
How many electrons are involved in forming all the covalent bonds in one molecule?

A 6 **B** 8 **C** 12 **D** 16

6 What is the mass of sodium hydroxide present in 0.100 dm^3 of 1.0 mol/dm^3 sodium hydroxide solution? [Relative atomic masses: Na, 23; O, 16; H, 1]

A 0.1 g **B** 1.0 g **C** 4.0 g **D** 40.0 g

7 The graph shows the total volume of carbon dioxide evolved, plotted against time, when excess calcium carbonate reacts with 20 cm^3 of hydrochloric acid containing 2 mol/dm^3.



Which statement is correct?

A The time taken to reach completion decreases if 20 cm^3 of hydrochloric acid containing 4 mol/dm^3 is used.
B The total volume of carbon dioxide evolved is greater if a greater mass of calcium carbonate is used.
C The reaction first reaches completion at point Z.
D The reaction is faster at point Y than at point X.

8 Some reactions are endothermic.

How does the temperature and energy change in an endothermic reaction?

	temperature change	energy change
A	decreases	energy taken in
B	decreases	energy given out
C	increases	energy taken in
D	increases	energy given out

9 What does an oxidising agent do?

A It turns acidified potassium manganate(VII) colourless.
B It turns aqueous potassium iodide brown.
C It turns Universal Indicator blue.
D It turns Universal Indicator red.

10 When carbon, zinc and calcium burn in oxygen, oxides are formed.

Which row identifies the type of oxide that is formed by each one of them?

	calcium oxide	carbon dioxide	zinc oxide
A	acidic	basic	amphoteric
B	amphoteric	acidic	basic
C	amphoteric	basic	acidic
D	basic	acidic	amphoteric

11 Which statements about alkalis are correct?

1 When reacted with an acid, the pH of the alkali decreases.
2 When tested with litmus, the litmus turns blue.
3 When warmed with an ammonium salt, ammonia gas is given off.

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

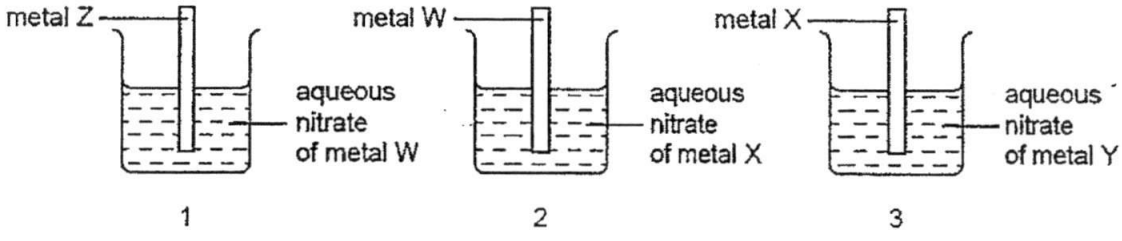
12 What is used to decide the order of the elements in the Periodic Table?

A density
B number of protons
C number of valence electrons
D relative atomic mass

13 What are the properties of bromine?

	state at room temperature	result of adding bromine to aqueous potassium iodide
A	gas	reaction
B	gas	no reaction
C	liquid	reaction
D	liquid	no reaction

14 Three different reactions were set up as shown.



In beaker 1 metal W is displaced from solution.

In beaker 2 metal X is displaced from solution.

In beaker 3 metal Y is displaced from solution.

What is the order of reactivity of these four metals?

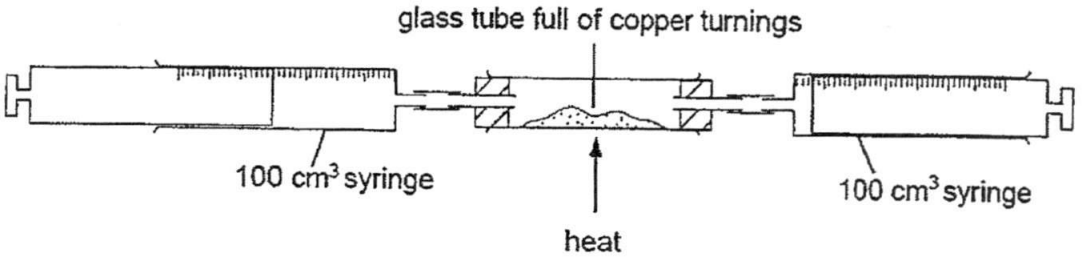
	most reactive ⟶			least reactive
A	W	X	Z	Y
B	X	Y	W	Z
C	Y	X	W	Z
D	Z	W	X	Y

15 Carbon monoxide is a pollutant emitted from car exhausts.

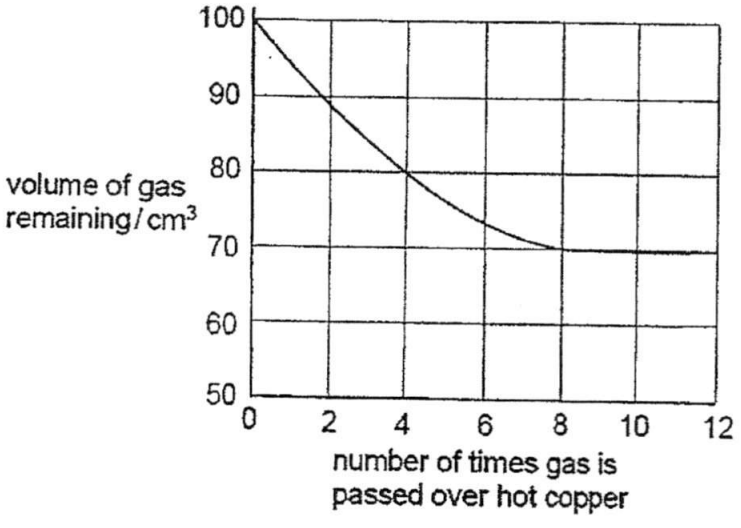
Which of its properties makes it harmful to humans?

A It combines with oxygen in the lungs.
B It forms a stable compound with blood.
C It has a corrosive action on lung tissue.
D It has no colour, taste or smell.

16 A 100 cm^3 sample of bottled gas used for diving was placed in a gas syringe in the apparatus shown.



The gas was passed backward and forward over heated copper turnings. The results obtained were used to plot the graph.



What is the percentage of oxygen in the bottled gas?

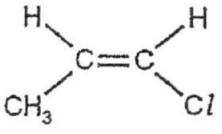
A 30% B 50% C 70% D 80%

17 Which statement about an homologous series is **not** correct?

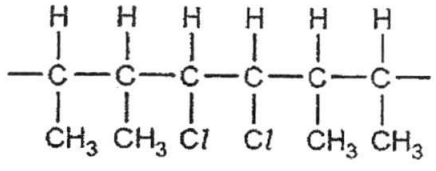
All the members in the series have the same

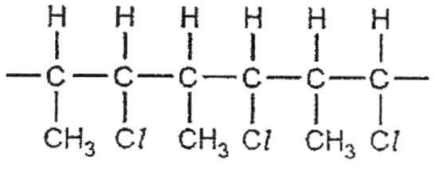
A chemical reactions.
B functional group.
C general formula.
D physical properties.

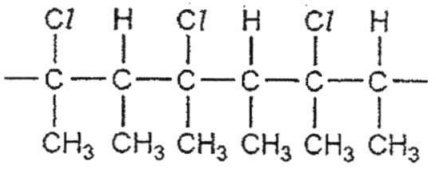
18 The following formula represents a monomer.

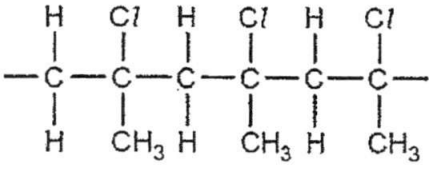


Which formula shows a part of the addition polymer formed from this monomer?

A


B


C


D


19 Which equation represents **complete** combustion of ethanol?

A $C_2H_5OH + O_2 \longrightarrow 2C + 3H_2O$
B $C_2H_5OH + 2O_2 \longrightarrow C + CO_2 + 3H_2O$
C $C_2H_5OH + 2O_2 \longrightarrow 2CO + 3H_2O$
D $C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$

20 What type of reaction occurs when C_2H_5OH is converted to CH_3COOH?

A dehydration
B hydration
C oxidation
D reduction

DATA SHEET

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

Name: ( ) Class:

SERVE·LEAD·EXCEL

GREENDALE SECONDARY SCHOOL
Preliminary Examination 2016

SCIENCE (PHYSICS / CHEMISTRY) **5076/03**
SCIENCE (CHEMISTRY / BIOLOGY) **5078/03**

Paper 3 Chemistry
Secondary 4 Express / 5 Normal Academic

29 July 2016
1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST
Do not open this booklet until you are told to do so.

Write your name, class and register number on all the work you hand in.
You may use an HB pencil for any diagrams, graphs or rough working.
Write in dark 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 Data Sheet is printed on page 13.
A copy of the Periodic Table is printed on page 14.

At the end of the examination, fasten all work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Paper 1	/ 20
Paper 3 Section A	/ 45
Paper 3 Section B	/ 20
Paper 5	/ 15
Total	/ 100

This document consists of 14 printed pages.

[Turn over

DATA SHEET
The Periodic Table of the Elements

Group I	II											III	IV	V	VI	VII	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	141 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.)

Section A

Answer all the questions in the spaces provided.

1 Some properties of five substances are shown in Table 1.1. The letter given for each substance is **not** the chemical symbol of that substance.

Table 1.1

substance	conducts electricity when solid	conducts electricity when melted	melting point / °C	solubility in water
P	no	no	–78	yes
Q	yes	yes	63	reacts with water
R	no	no	119	no
S	no	yes	857	yes
T	yes	yes	1083	no

Use the letters in Table 1.1 to answer the following questions.

Each letter may be used once, more than once or not at all.

(a) The substance that is **not** a solid at room temperature is .....[1]

(b) (i) The substance that is a Group I metal is .....[1]

(ii) Justify your choice in part **(i)**.

.....

.....[1]

(c) (i) The substance that is an ionic compound is .....[1]

(ii) Give **two** reasons for your choice in part **(i)**.

1. .....

.....

2. .....

.....

[2]

2 Table 2.1 gives the composition of three particle **X**, **Y** and **Z**.

Table 2.1

particle	number of protons	number of electrons	number of neutrons
X	15	15	16
Y	15	18	16
Z	15	15	17

(a) (i) What is the electronic structure (configuration) of particle **X**?

.....[1]

(ii) Is element X a metal or a non-metal? Give a reason for your choice.

.....

.....[1]

(b) What is the evidence in the table for the following?

(i) **X**, **Y**, and **Z** are all particles of the same elements.

.....

.....[1]

(ii) Particles **X** and **Z** are isotopes of the same element.

.....

.....[1]

(iii) Particle **X** is a neutral particle.

.....

.....[1]

3 Fig. 3.1 shows some reactions of ethene.

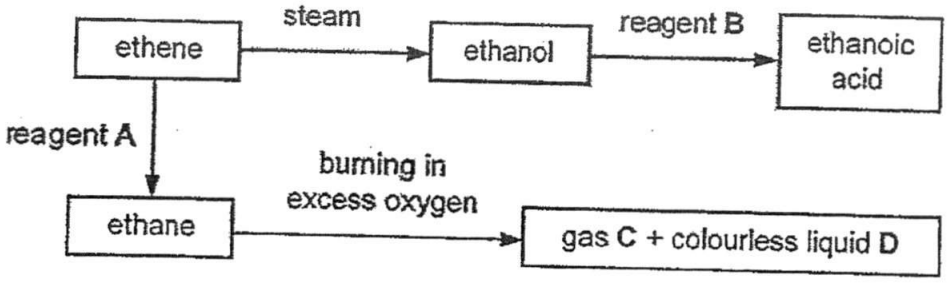


Fig. 3.1

(a) Identify the following.

(i) reagent **A** .....

(ii) reagent **B** .....

(iii) gas **C** .....

(iv) colourless liquid **D** .....

[4]

(b) Name the type of reaction for ethane in excess oxygen producing gas **C** and colourless liquid **D**.

..... [1]

(c) What chemical test is used to distinguish between ethane and ethene?

test .....

results.....

.....

[2]

(d) The molecular formula of ethanol is C_2H_5OH. Draw the structural formula of ethanol.

[1]

4 Fig. 4.1 gives the properties and reactions of several substances.

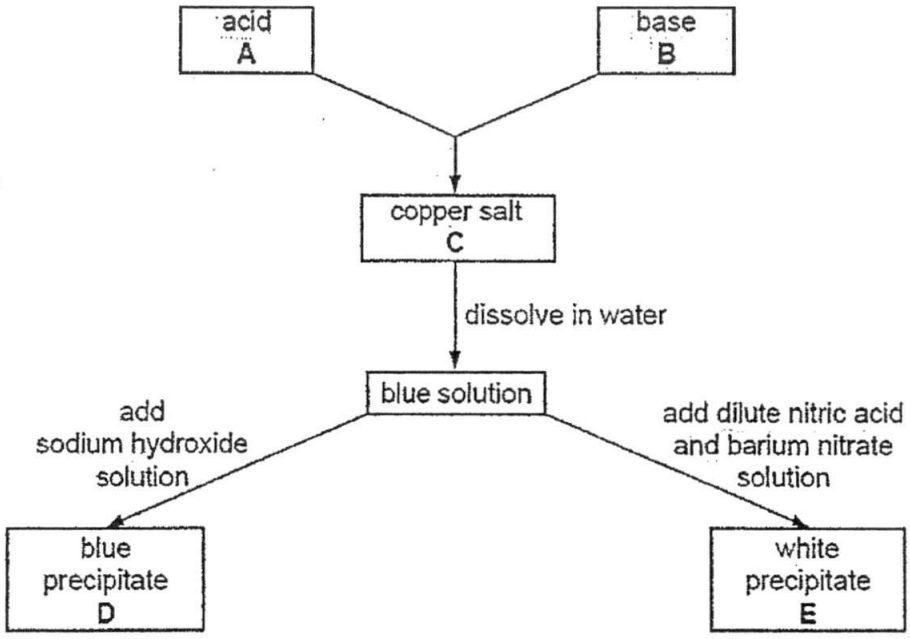


Fig. 4.1

(a) Identify the following.

(i) blue precipitate **D** .....

(ii) white precipitate **E** .....

(iii) copper salt **C** .....

(iv) acid **A** .....

(v) base **B** .....

[5]

(b) Write an ionic equation, including state symbols, for the formation of blue precipitate **D**.

..... [2]

5 Hydrogen peroxide, H_2O_2, decomposes at room temperature to form water and oxygen gas. This reaction is catalysed by manganese(IV) oxide.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

A student conducted a study on the speed of decomposition of aqueous hydrogen peroxide at room temperature. He did this by adding exactly 1.0 g of small lump of manganese(IV) oxide to the solution and weighing the mixture at timed intervals. He recorded the losses of mass in Table 5.1 shown below. He missed out the reading at 180 second.

Table 5.1

time/ s	0	30	60	120	180	240	300
loss in mass/ g	0	0.2	0.3	0.4		0.5	0.5

(a) Why did the mixture lose mass?

.....[1]

(b) On Fig. 5.1, draw a graph of loss of mass against time.

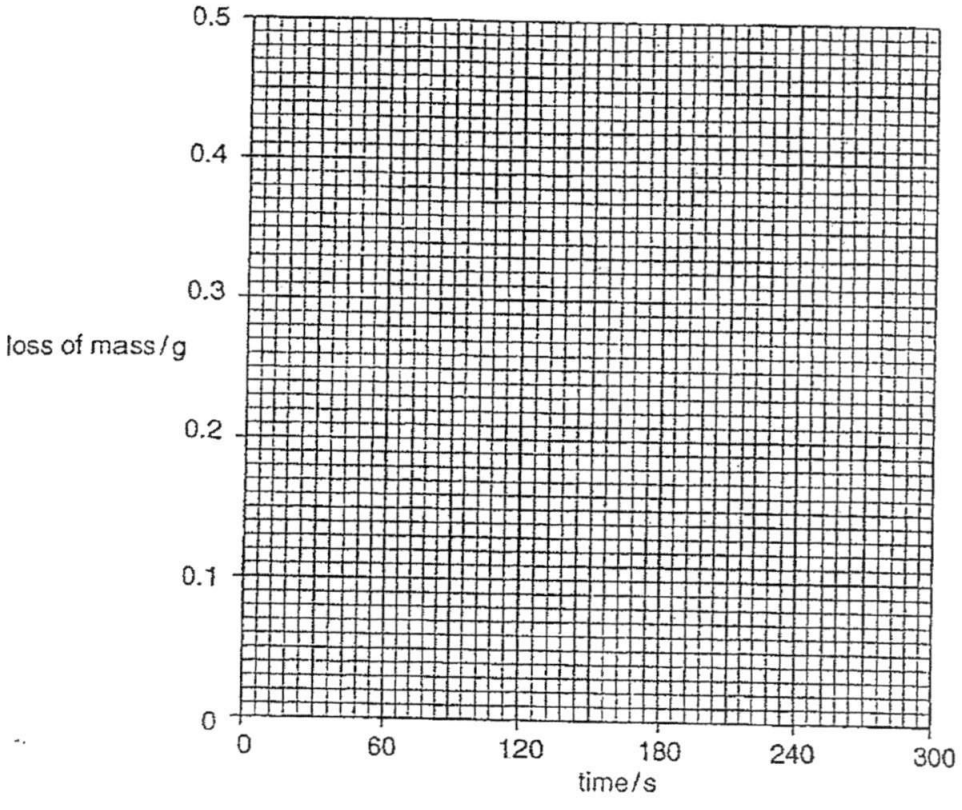


Fig. 5.1

[2]

(c) Use your graph to estimate the missing reading. ..... [1]

(d) Calculate the average speed of decomposition in g/s for the first 120 seconds?

average speed.....g/s [1]

(e) What was the reaction rate at 300 seconds?

rate .....g/s [1]

(f) The study was repeated at 50 °C. All the other variables were kept the same. On Fig. 5.1, sketch the graph that would be expected. [1]

(g) Give a chemical test for oxygen.

.....

..... [1]

6 Fig 6.1 shows how a soluble salt, hydrated lithium sulfate, is made from the soluble base lithium hydroxide.

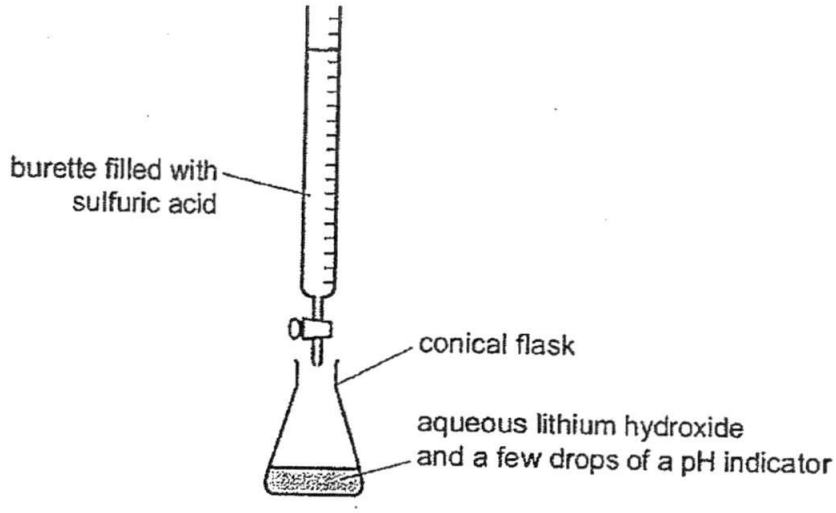


Fig. 6.1

The sulfuric acid is added slowly from the burette until the indicator just changes colour. The volume of sulfuric acid needed to just neutralise the lithium hydroxide is noted.

(a) Name the method shown in Fig. 6.1.

..... [1]

(b) The formula for sulfuric acid is H_2SO_4.

State the formulae of the two different ions produced by sulfuric acid.

..... and ..... [1]

(c) When Universal Indicator is added to aqueous lithium hydroxide, the solution turns violet.

Suggest the pH of the solution. ..... [1]

(d) Describe how you would continue the experiment to obtain pure crystals of hydrated lithium sulfate.

.....

.....

.....

.....

..... [3]

7 Use the Periodic Table to help in answering this question.

(a) An element has eleven electrons in each atom. Why should this element be placed in Group I of the Periodic Table?

.....

..... [1]

(b) Write the equation of the reaction between the element in **(a)** and water. State symbols are not required.

..... [1]

(c) Francium, Fr, is also a member of Group I. Predict a property of francium.

..... [1]

(d) Write the formula of the compound that is formed between francium and

(i) an element from Group VI, ...

(ii) an element from Group VII, ...
[2]

Section B

Answer any **two** questions in this section.
Write your answers in the space provided.

8 When combining with other elements, chlorine can form both ionic bonds and covalent bonds.

(a) Draw the electronic structures of **two** named substances which contain chlorine, **one** named substance with ionic bonds and **one** named substance with covalent bonds. Show outermost electrons only.

[6]

(b) Give **two** ways in which the physical properties of these two substances differ.

.....

.....

.....

..... [2]

(c) Use your knowledge of the particles in ionic and covalently bonded substances to suggest reasons for these differences.

.....

.....

.....

..... [2]

9 (a) Petroleum is separated into several useful fractions of hydrocarbons in the fractionating column. Describe the separation process.

.....

.....

.....

.....

..... [3]

(b) Naphtha obtained from fractional distillation contains a mixture of long-chain alkanes. Briefly describe the manufacture of ethene from naphtha.

.....

.....

.....

.....

..... [4]

(c) What volume of oxygen gas, measured at room temperature and pressure, is needed to burn completely 10 dm^3 of ethene?

[3]

10 (a) Iron is extracted from its ore, haematite, in the blast furnace. Describe the reactions involved in this extraction.

Include **one** equation for a redox reaction and **one** for an acid/base reaction.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(b) The increasing order of chemical reactivity of three metals is copper, magnesium and calcium.

Suggest a simple chemical experiment that could be used to justify the relative order of reactivity for these metals.

Write a chemical equation for the reaction of **one** of the elements in your experiment. State symbols are **not** required.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

DATA SHEET

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

Updated 31 Jul 2016

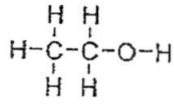
4E/5N Science Chemistry

Preliminary Examination 2016 Marking Scheme

Paper 1

1	2	3	4	5	6	7	8	9	10
C	B	C	D	D	C	A	A	B	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A	B	C	D	B	A	D	B	D	C

Paper 3 Section A

Question	Answer
1(a)	P
1(b)(i)	Q
1(b)(ii)	Conducts electricity when solid **and** low melting point
1(c)(i)	S
1(c)(ii)	1. Conducts electricity when melted not when solid. 2. Soluble in water
2(a)(i)	2.8.5
2(a)(ii)	Non-metal; gains (three) electrons to form negative charge ion.
2(b)(i)	Same number of proton / all have 15 protons / or WTTE.
2(b)(ii)	They are atoms with the **same number of proton** but **different number of neutrons** / or state the number of neutrons.
2(b)(iii)	Same number of protons and electrons
3(a)(i)	Hydrogen
3(a)(ii)	Acidified potassium manganate(VII)
3(a)(iii)	Carbon dioxide
3(a)(iv)	Water
3(b)	(complete) combustion Reject: oxidation
3(c)	Test: add (aqueous/liquid) bromine Results: Ethane: bromine remained from reddish-bromine / orange-brown / brown. Ethene: bromine turned from reddish-bromine / orange-brown / brown to colourless.
3(d)	
4(a)(i)	Copper(II) hydroxide
4(a)(ii)	Barium sulfate
4(a)(iii)	Copper(II) sulfate
4(a)(iv)	Sulfuric acid
4(a)(v)	Copper(II) oxide / copper(II) hydroxide
4(b)	$Cu^{2+}(aq) + 2OH^{-}(aq) \rightarrow Cu(OH)_2(s)$

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	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	141 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.)

Question	Answer
	Correct formulae of reactants and products and balanced equation. [1] Correct state symbols [1] – only if formulae of reactants and products are correct.
5(a)	Escape of (oxygen) gas to the atmosphere
5(b)	All data points are correctly plotted. [1] Small best fit [1]
5(c)	0.46 g ± 0.02
5(d)	0.4/120 = 0.00333 g/s (3 s.f.) ignore working
5(e)	0 g/s
5(f)	Graph with steeper gradient and level off before 240 s at 0.5 g.
5(g)	Relights glowing splint
6(a)	titration
6(b)	H^+; SO_4^{2-} (both correct)
6(c)	14 (accept 13)
6(d)	(1) Repeat the titration using the same volume of sulfuric acid and lithium hydroxide without the pH indicator. (2) Heat the mixture to get a saturated solution. (3) Allow the mixture to cool to obtain the crystals. (4) Filter the mixture, rinse the crystals with cold water. Dry the crystals with filter paper.
7(a)	One valence electron / one electron in outermost shell / one electron in valence shell
7(b)	$Na + 2H_2O \rightarrow 2NaOH + H_2$
7(c)	Any property of Group I metals
7(d)(i)	Fr_2O or any correct formula with any Group VI element
7(d)(ii)	FrF or any correct formula with any Group VII element
10(b)	one equation from: $Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2(g)$ $Mg(s) + 2H_2O(l) \rightarrow Mg(OH)_2(aq) + H_2(g)$ $Mg(s) + H_2O(g) \rightarrow MgO(s) + H_2(g)$ Simple chemical experiment: Reaction with cold water / reaction with dilute acid. Three descriptions of reactivity with water / dilute acid: • calcium reacts readily with water; • magnesium reacts slowly with water/ magnesium reacts vigorously with steam; • copper does not react with water or steam;

Paper 3 Section B

Question	Answer	
8(a)	Correct dot-and-cross diagram of any ionic compound formed between chlorine and any Group I or Group II metal. [total 3] Name of ionic compound. [1] Correct arrangement of electrons in cations and anions / number of cations and anions [1] Correct charge of cations and anions [1] OR Name of ionic compound. [1] Correct arrangement of electrons in cations / charge / number of cations [1] Correct arrangement of electrons in anions / charge / number of anions [1] Correct dot-and-cross diagram of any covalent substance formed between two chlorine atoms or between chlorine atom and oxygen atom or sulfur atom. [total 3] Name of covalent substance or compound / correct number of atoms [1] Correct number of bonding electrons [1] Correct number of non-bonding electrons [1] – only if number of bonding electrons is correct.	6
8(b)	Comparing melting & boiling points / solubility in water / electrical conductivity. (any two) - ignore mistake in part (a)	2
8(c)	Melting & boiling points: Strong electrostatic forces of attraction between ions vs weak intermolecular forces of attraction. [1] Electricity conductivity: No free moving ions vs free-moving ions [1] Note: students are not expected to explain solubility property in term of lattice energy. - ignore mistake in part (b)	2
9(a)	• Heated and vapourises/evaporated [1] • Condensed according to different boiling points [1] • Hydrocarbons with lower boiling points condensed nearer to the top of column; higher boiling points nearer to the bottom.	3
9(b)	• a specific temperature e.g. 600°C ± 50°C [1] • catalyst [1] • named catalyst: aluminium oxide / silicon(IV) oxide [1] • finely divided [1]	4
9(c)	• $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ [1] • 10 mol C_2H_4 : 30 mol O_2 [1] ecf with mole ratio in equation • 10 dm^3 C_2H_4 : 30 dm^3 O_2 [1]	3

Question	Answer	
10(a)	one redox equation from: [1] $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ $C + O_2 \rightarrow CO_2$ $CO_2 + C \rightarrow 2CO$ one acid/base equation: [1] $CaO + SiO_2 \rightarrow CaSiO_3$ $CaCO_3 + SiO_2 \rightarrow CaSiO_3 + CO_2$ Any three additional equations or comments from: [3] • carbon burns or reacts to form carbon dioxide; • this reaction is exothermic or produces heat; • carbon dioxide is reduced to carbon monoxide; • carbon monoxide reduces hematite to iron; • carbon reduces hematite to iron; • limestone removes silica to form slag; • limestone decomposes;	5

Name _____ Reg. No _____ Class _____

MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL

4EX/5NA

Science (Chemistry) **5076/1**
(with Biology/Physics Component) **5078/1**
Paper 1

PRELIMINARY EXAMINATION TWO
Aug 2016
1 hour

Additional Materials:
Electronic calculator
OTAS Answer Sheet

INSTRUCTIONS TO CANDIDATES:

Do not open this booklet until you are told to do so.
Write your name, index number and class in the spaces at the top of this page and on any separate answer paper used.
Write in soft pencil.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **twenty** 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 OTAS answer sheet.

Read carefully the instructions on the answer sheet.

At the end of the examination, hand in your OTAS sheet and question paper separately.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 11.

This question paper consists of 11 printed pages.

Setter: Mdm Jarina Banu Vetter: Mr Wesley Cheong

Paper 1 (Multiple Choice Questions)

Answer **all** the questions on the **OTAS**.

21 The boiling points of some elements are given in the table below.

element	melting point / °C	boiling point / °C
nitrogen	-210	-196
xenon	-112	-108
oxygen	-219	-183

Which of the substances will be in a liquid state at -194 °C?

A nitrogen and oxygen only
B nitrogen and xenon only
C oxygen only
D xenon only

22 Labels from 4 bottles containing colourless solutions have fallen off. A series of different tests are carried out on each of the solutions and the results are recorded below.

Which bottle contains ammonium chloride solution?

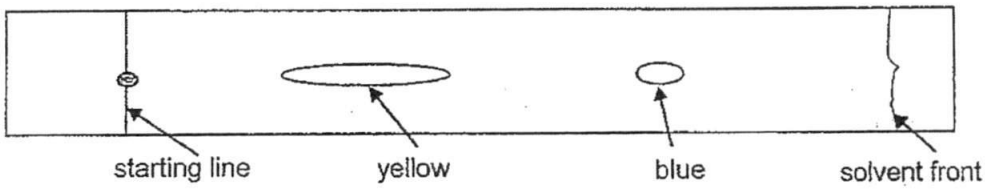
	Test 1 addition of dilute HCl	**Test 2** addition of warm aqueous NaOH	**Test 3** addition of acidified $AgNO_3$
A	Effervescence	gas produced turns moist red litmus blue	No reaction
B	No reaction	gas produced turns moist red litmus blue	White precipitate seen
C	No reaction	gas produced turns moist red litmus blue	No reaction
D	No reaction	No reaction	White precipitate seen

23 An anion X^{2-} has 16 neutrons and 18 electrons. How many protons does it have?

A 14 **B** 16 **C** 18 **D** 34

[Turn over

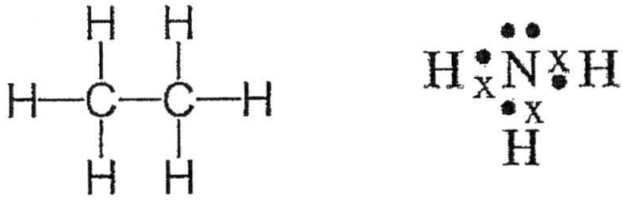
24 The chromatogram of the dyes used for the colouring of a drink is shown in the diagram below.



Which of the following statements can be deduced from the chromatogram?

A The colour of the drink is red.
B The yellow dye has a higher molecular mass than the blue dye.
C The yellow dye is less soluble than the blue dye in the solvent used.
D The molecules of the yellow dyes are smaller than those of the blue dyes.

25 Ethane, C_2H_6 and ammonia, NH_3, are covalent compounds. The electronic structure of these compounds and statements about them are given below.



1 A molecule of ethane contains double the number of hydrogen atoms as a molecule of ammonia.

2 An uncombined nitrogen atom has 5 valence electrons.

3 In an ethane molecule, the bond between the carbon atoms is formed by sharing 2 electrons, one from each carbon atom.

Which statements are correct?

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

[Turn over

26 20 cm^3 of ethene are reacted with 70 cm^3 of oxygen as shown in the chemical equation below.

$$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$$

What is **total** volume of gas remaining at the end of the reaction?

A 40 cm^3 **B** 50 cm^3 **C** 80 cm^3 **D** 90 cm^3

27 When solid **X** is heated, carbon dioxide is produced. The residue reacts with both dilute hydrochloric acid and aqueous sodium hydroxide.

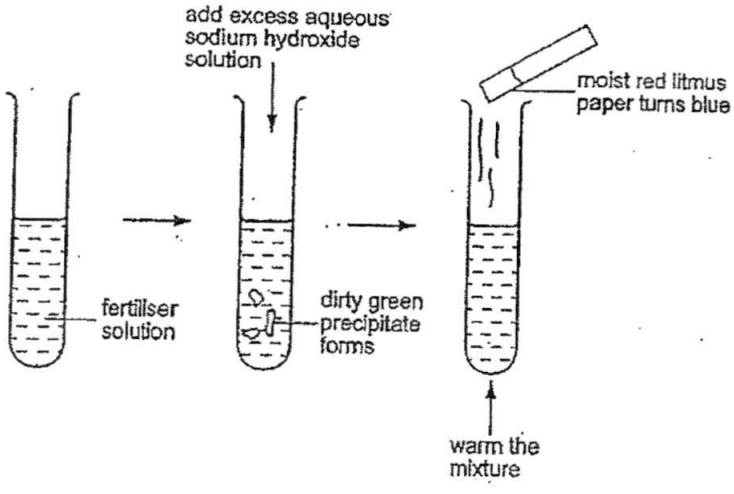
Which of the following could solid **X** be?

A calcium carbonate
B copper carbonate
C lead(II) oxide
D zinc carbonate

28 Which substance is added to dilute sulfuric acid to prepare the insoluble lead(II) sulfate?

A aqueous lead(II) nitrate
B lead metal
C powdered lead(II) carbonate
D powdered lead(II) oxide

29 A solution of fertiliser was tested as shown.



Which ions must be present in the fertiliser?

A Fe^{3+} and NO_3^- **B** Fe^{2+} and SO_4^{2} **C** NH_4^+ and Fe^{2+} **D** NH_4^+ and NO_3^-

[Turn over

30 Parts of some chemical reactions are shown below.

Which reaction represents oxidation?

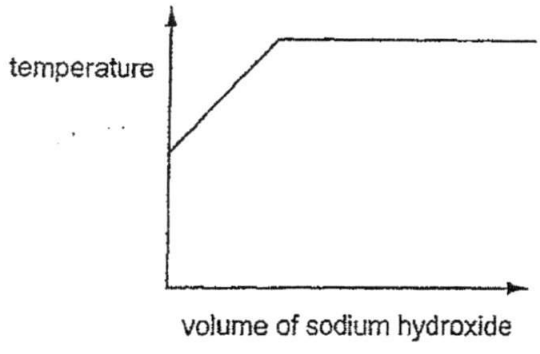
A $Cl_2(g) \rightarrow 2Cl^-(aq)$
B $CuO(s) \rightarrow Cu(s)$
C $Fe^{3+}(aq) \rightarrow Fe^{2+}(aq)$
D $Zn(s) \rightarrow Zn^{2+}(aq)$

31 The reaction between aqueous sodium hydroxide and dilute hydrochloric acid is exothermic.

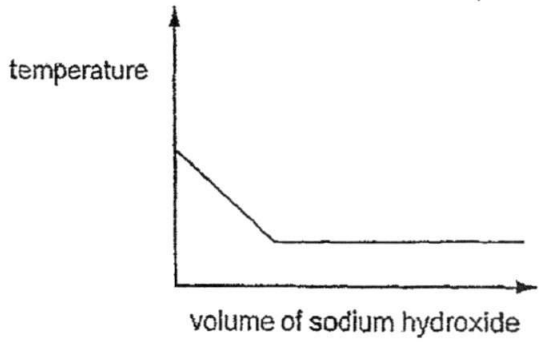
Both the hydrochloric acid and sodium hydroxide are initially at room temperature.

Which graph shows how the temperature changes when aqueous sodium hydroxide is added to dilute hydrochloric acid until the alkali is present in excess?

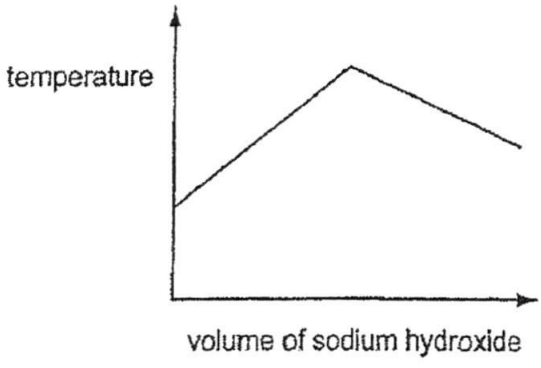
A



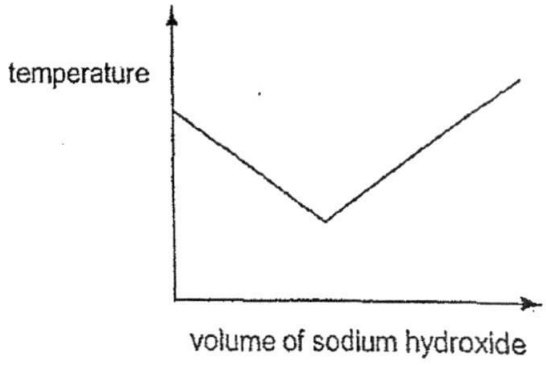
B



C



D

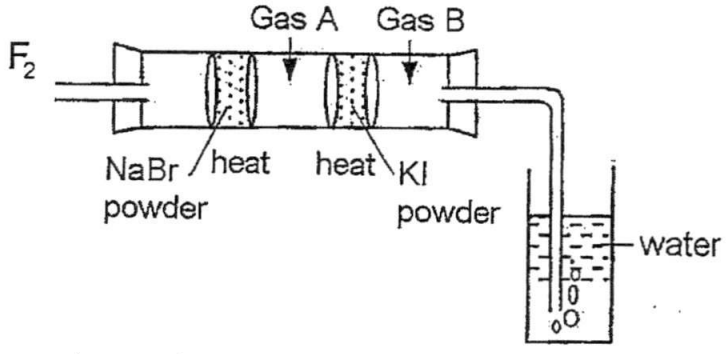


[Turn over

32 Which statement about the extraction of iron in the blast furnace is correct?

A Slag is the basic impurity present in iron ore.
B Slag sinks below molten iron at the base of the furnace.
C The oxide of iron is oxidised by carbon monoxide.
D The reaction between the oxide of iron and carbon monoxide liberates carbon dioxide.

33 The diagram shows the displacement of halogens.



What are the colours observed for Gas **A**, **B** and in the water during the experiment?

	Gas **A**	Gas **B**	water
A	pale yellow	reddish brown	violet
B	pale yellow	violet	violet
C	reddish brown	violet	brown
D	reddish brown	brown	reddish brown

34 Working in underground coal mines can be dangerous as there is a risk of explosions.

What is likely to be the main reason for explosions to occur?

A high air pressure in the mines
B high temperature in the mines
C small size of coal dust particles present in the air in the mines
D high concentration of oxygen in the air pumped into the mines

[Turn over

35 Calcium carbonate was reacted with an excess of dilute hydrochloric acid at room temperature.

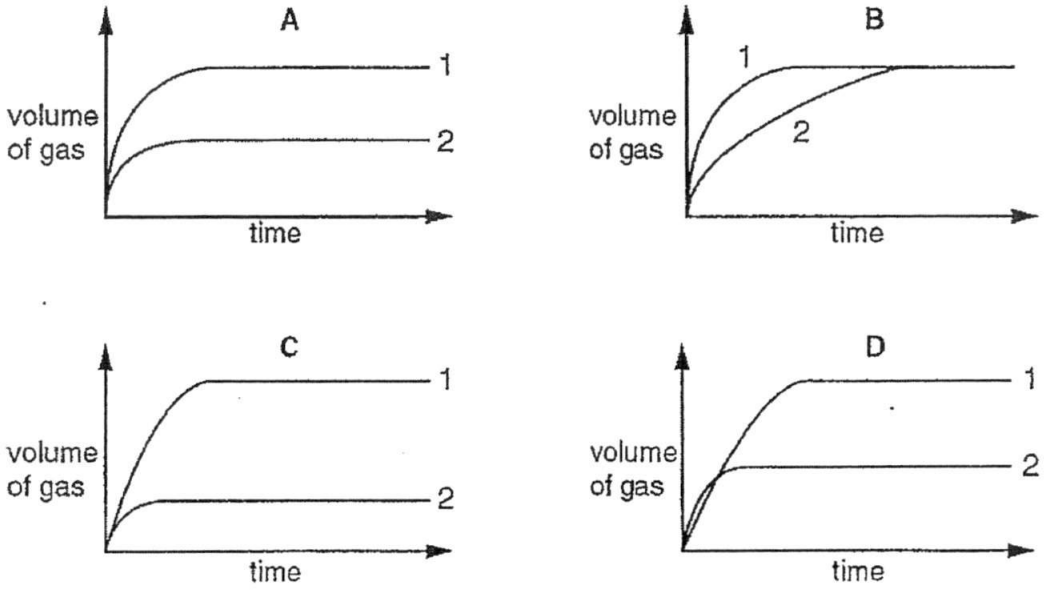
$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

Two experiments were carried out.

Experiment **1:** 100 g of calcium carbonate in large lumps.

Experiment **2:** 50 g of calcium carbonate as a fine powder.

Which graph is correct?



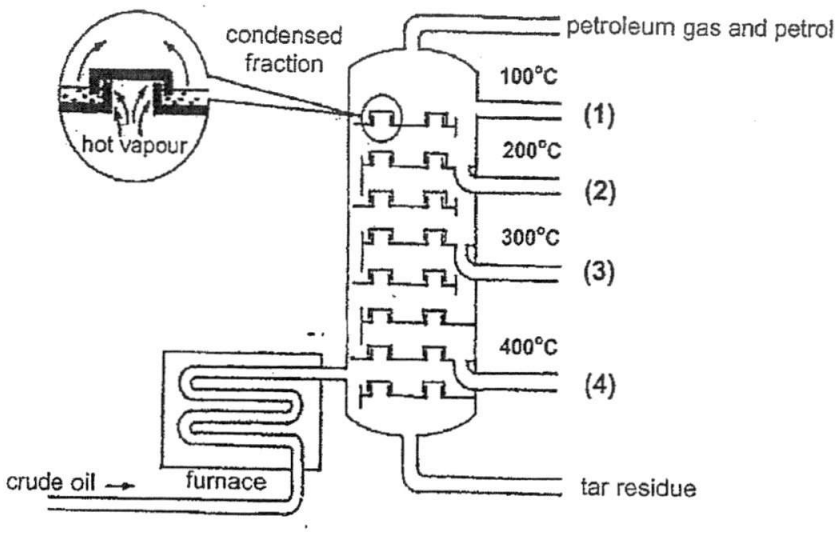
36 Most aluminium cans are made from recycled aluminium.

Why are some aluminium cans still made from aluminium extracted from its ore?

A Demand is not met by recycling aluminium alone.
B Extraction of ore produces better quality aluminium.
C Extraction from the ore uses electricity and is expensive.
D There is a maximum number of times that aluminium can be recycled.

[Turn over

37 A schematic diagram of the fractionating tower for petroleum refinery is shown below.



Which fraction is collected from outlet (2) of the fractionating tower?

A diesel
B kerosene
C lubricating oil
D naphtha

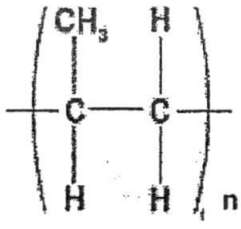
38 Which of the following statements correctly describes the homologous series of alkanes, alkenes, alcohols and carboxylic acids?

A They are all hydrocarbons.
B They are all soluble in water.
C They are able to undergo addition polymerization.
D They burn in excess oxygen to form carbon dioxide and water.

39 Which of the following compounds is formed when ethanol is oxidised by acidified potassium manganate(VII)?

A ethane
B ethene
C ethanoic acid
D potassium ethanoate

40 The repeated unit of poly(propene) is shown below.



Which row is correct?

	name of monomer	formula of monomer
A	propane	C_3H_6
B	propane	C_3H_8
C	propene	C_3H_6
D	propene	C_3H_8

--- End of paper ---

[Turn over

Colours of Some Common Metal Hydroxides

Calcium hydroxide	white
Copper(II) hydroxide	light blue
Iron(II) hydroxide	green
Iron(III) hydroxide	red-brown
Lead(II) hydroxide	white
Zinc hydroxide	white

[Turn over

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	– Ra radium 88	– Ac actinium 89 †															

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

140 Ce cerium 58	141 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

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.).

Name

Reg. No | Class

4EX/5NA

Science (Physics, Chemistry) **5076/05**
Science (Biology, Chemistry) **5078/05**
Chemistry Component

Paper 5

PRELIMINARY EXAMINATION TWO
Aug 2016
1 hour 30 minutes

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your answers in the spaces provided.

Write your name, register number and class on all the work you hand in.

Write in dark blue or black pen.

Answer all questions. 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.

You are advised to spend 45 minutes on the Physics / Biology Section and 45 minutes on the Chemistry Section.

FOR EXAMINER'S USE	
Total Mark	15

This document consists of 5 printed pages.

Setter: Mdm Jarina Banu

Vetter: Mr Wesley Cheong

[Turn over

1 You are provided with a sample of solid salt, **Z**.

Carry out the following experiments and carefully record your observations.

The volumes given below, unless referring to drops of solution, are approximate and should be estimated rather than measured.

	test	observations
(a)	Transfer 2 spatula full of solid **Z** into a **dry test tube**. Heat the solid carefully but strongly for 8 minutes until **no further changes are seen.** Test any gas evolved using a lighted splinter. Record all your observations. Leave the test tube on the test tube rack and allow the contents to cool completely. Set aside the contents for test **(g)**. While you are waiting, continue with the rest of the tests.	[3]
(b)	Soak the end of a wooden splint with water. Dip the wet end of the splint into the sample of solid **Z**. Make sure that the end of the splint is well covered with solid **Z**. Ensure that your bunsen flame is non-luminous. Place the moist end of your wooden splint into the flame. Record your observation.	[1]
(c)	Using a spatula, add about 2 level spoonfuls of solid **Z** to a **clean boiling tube**. Add 20 cm^3 of distilled water to the boiling tube and stir the mixture with a glass rod until no further change is observed. Record your observations. **Separate this solution into 3 different parts into 3 clean test tubes for tests (d), (e) and (f).**	[2]

[Turn over

	test	observations
(d)	Boil the first test tube of solution from test (c) gently, until no further changes are observed. Record your observations.	[1]
(e)	To the second test tube containing the solution from test (c), add about 1 cm^3 of dilute sulfuric acid. Then add 3 to 4 drops of potassium manganate (VII) to the mixture. Swirl the contents until no further change is seen. Record your observation.	[2]
(f)	Using the third test tube of solution from test (c), add a few drops of acidified barium chloride. Record your observation.	[1]
(g)	From the cooled substance left over from test (a), record your observation on any new changes.	[1]

(h) From your observations in test (f),

(i) Predict the anion present in soild Z.

..... [1]

(ii) Based on your observation, what is this reaction commonly known as?

..... [1]

(i) From your observations in test (e), provide one major conclusion and evidence for it.

.....

.....

..... [2]

END OF PAPER

[Turn over

SCIENCE CHEMISTRY PRACTICAL NOTES

Tests for anions

anion	*test*	*test result*
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	Acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide then aluminium foil; warm carefully	ammonia produced
sulphate (SO_4^{2-}) [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Test for aqueous cations

cation	*effect of aqueous sodium hydroxide*	*effect of aqueous ammonia*
ammonium (NH_4^+)	ammonia produced on heating	-
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt. or very slight white ppt.
copper (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess giving a dark blue solution
iron (II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron (III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
Lead(II) (Pb^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess giving a colourless solution

Tests for gases

gas	*test and test result*
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	gives white ppt. with limewater (ppt. dissolves with excess CO_2).
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	"pops" with a lighted splint
oxygen (O_2)	relights a glowing splint
sulfur dioxide (SO_2)	turns aqueous acidified potassium manganate(VII) from purple to colourless

[Turn over

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	– Ra radium 88	– Ac actinium 89 †															

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

140 Ce cerium 58	141 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

Key: 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.).

Name | Reg. No | Class

MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL MAYFLOWER SECONDARY SCHOOL

4EX/5NA

Science (Chemistry) **5076/3**
[65 marks] **5078/3**

PRELIMINARY EXAMINATION TWO
Aug 2016
1 hour 15 minutes

Additional Materials: Electronic calculator

INSTRUCTIONS TO CANDIDATES:

Do not open this booklet until you are told to do so.

Write your name, index number and class in the spaces at the top of this page and on any separate answer paper used.

Write in dark blue or black pen on both sides of the paper. You may use a soft pencil for any diagrams, graphs or tables or rough working. Do not use staples, paper clips, highlighters, glue or correction fluid.

FOR EXAMINER'S USE	
Section	**Marks**
Paper 1 MCQ	**/ 20**
Paper 3 Section A	**/ 45**
Section B	**/ 20**
Paper 5	/15
Total	**/ 100**

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

Section B
Answer **all** questions on the spaces provided.
Answers any **two** questions out of the three questions given.

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 17.
The use of an approved scientific calculator is expected, where appropriate.

This question paper consists of **17** printed pages.

Setter: Mdm Jarina Banu Vetter: Mr Wesley Cheong

[Turn over

Section A (45 marks)

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

1 Fig.1.1 shows an experiment that is used to separate seawater by using heat. The substance obtained from the heating of seawater has a boiling point of 100^0C.

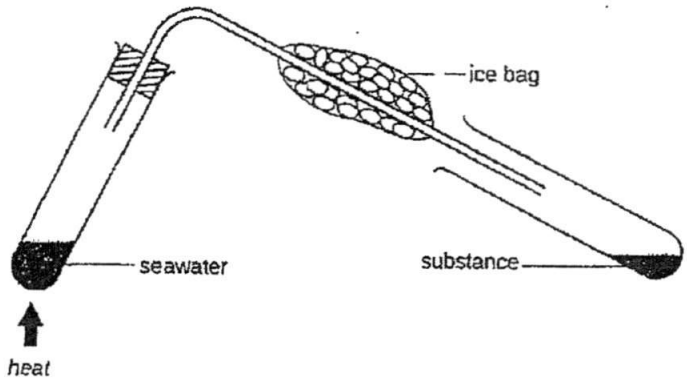


Fig. 1.1

(a) Which physical separation method can be represented by the experiment in Fig.1.1?

..... [1]

(b) Identify the substance obtained at the end of this experiment.

..... [1]

(c) Name the apparatus that has the same function as the ice bag and explain the function of this apparatus.

.....

.....

..... [2]

2 Fig. 2.1 represents the structures of three unknown substances, A, B and C.

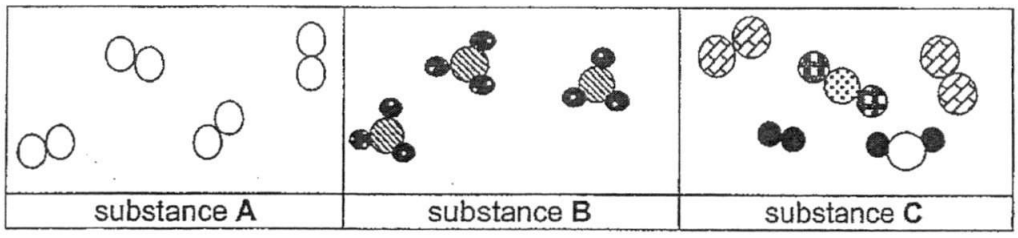


Fig. 2.1

(a) Complete Table 2.2 by

(i) stating if the substance is an element, compound or mixture and

(ii) determining a possible identity of the substance by selecting a substance from the list given below.

ammonia	lithium oxide	air	nitrogen	silver

Table 2.2

substance	element, compound or mixture	possible identity of substance
A		
B		
C		

[3]

(b) Describe the arrangement and movement of particles in substance B.

.....

.....

..... [2]

(c) Name the separation technique by which nitrogen can be obtained from air.

..... [1]

[Turn over

3 An element has atomic number of 9 and relative atomic mass of 20.

(a) Determine the number of protons and neutrons in the nucleus of this element.

..... [1]

(b) State and explain which group this element is placed in the Periodic Table.

.....

..... [1]

(c) Suggest how the nucleus of an atom of an isotope of this element may differ from your answer in (a).

..... [1]

(d) Lithium reacts with this element to form a compound that has a very high melting point of 845 °C.

Explain, in terms of bonding, why this compound has a high melting point.

.....

.....

.....

..... [2]

4 Fig. 4.1 describes some of the reactions of a green solid, **J**.

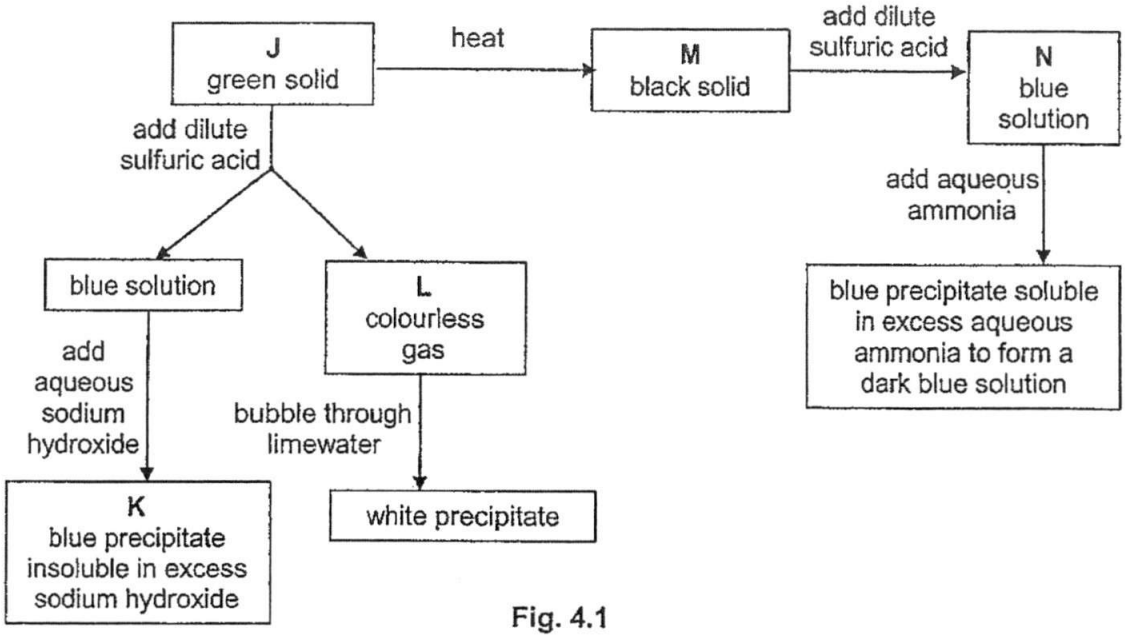


Fig. 4.1

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

J .....

K .....

L .....

M .....

N ..... [5]

(b) Write a balanced chemical equation, with state symbols, for any one of the changes described in Fig. 4.1.

..... [2]

[Turn over

5 (a) Copper(II) nitrate decomposes on heating as shown in the equation below.

$$2Cu(NO_3)_2(s) \rightarrow 2CuO(s) + 4NO_2(g) + O_2(g)$$

In an experiment, 4 moles of nitrogen dioxide, NO_2, were produced from decomposing a sample of copper(II) nitrate.

(i) Calculate the volume of oxygen produced, measured at r.t.p.

volume = ...dm^3 [2]

(ii) Calculate the mass of copper(II) nitrate heated.

mass = ...g [2]

(b) A solution of sodium carbonate has a concentration of 2.0 mol/dm^3. In a reaction, dilute sulfuric acid was added to 0.4 dm^3 of the sodium carbonate solution until the reaction was complete. The equation is shown below.

$$Na_2CO_3\,(aq) + H_2SO_4\,(aq) \rightarrow Na_2SO_4\,(aq) + CO_2\,(g) + H_2O\,(l)$$

(i) How many moles of sodium carbonate were used?

moles = ...mol [1]

(ii) Hence, calculate the mass of water produced.

mass = ...g [2]

[Turn over

6 Carbon monoxide detectors can be used in the home as shown in Fig. 6.1.

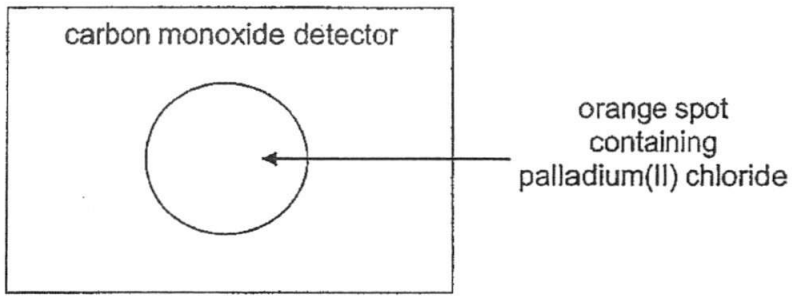


Fig. 6.1

The orange spot turns black if there is a high concentration of carbon monoxide in the air.

(a) Explain why carbon monoxide is hazardous.

.....

.....

..... [2]

(b) The spot turns black when palladium(II) chloride reacts with carbon monoxide to form palladium metal as shown in the equation below.

$$PdCl_2\,(s) + H_2O\,(g) + CO\,(g) \rightarrow Pd\,(s) + 2HCl\,(g) + CO_2\,(g)$$

Complete Table 6.2 to show the oxidation states of palladium and carbon before and after the reaction takes place.

Table 6.2

element	oxidation state before reaction	oxidation state after the reaction
palladium		
carbon		

[2]

(c) Use the information from Table 6.2 to explain why this is a redox reaction.

.....

.....

..... [2]

[Turn over

7 (a) State why ethene can be made into a polymer but ethane cannot.

.....

..... [1]

(b) Describe what happens when ethene molecules undergo polymerization.

.....

..... [1]

(c) Fig. 7.1 shows the structural formula of part of an addition polymer.

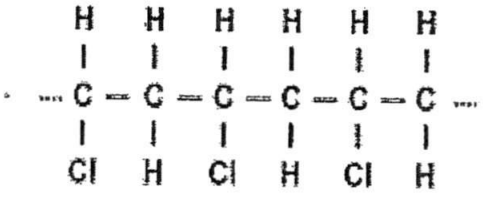


Fig. 7.1

Draw the structural formula of the monomer from which this polymer is made. [1]

(d) This polymer is **non-biodegradable**. Explain the meaning of the term in bold and hence, describe the problems which the objects made of this polymer can cause.

.....

.....

..... [2]

8 A single strand of hair consists of an inner cortex, surrounded by hair cuticles. Depending on the pH of the surroundings, the hair cuticles open or close. Fig. 8.1 shows the appearance of hair cuticles at different pH.

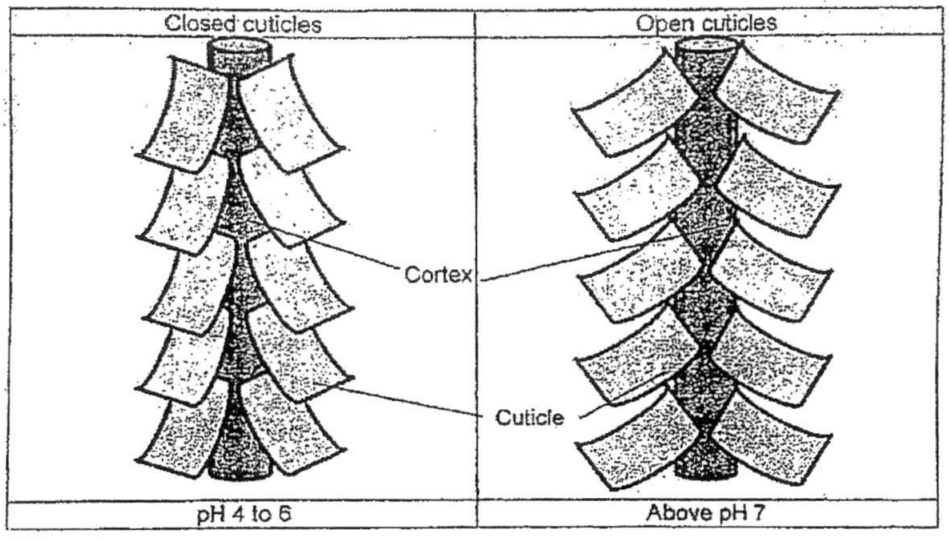


Fig. 8.1

Open cuticles will result in tangles. Conditioners are often used after shampooing to make hair more manageable and tangle free.

(a) Name the type of chemical reaction that has occurred when an acid reacts with a base or alkali.

..... [1]

(b) Are hair conditioners acidic or alkaline? Explain using the information from Fig. 8.1.

.....

..... [2]

(c) Hair colours are applied directly to the hair cortex. Hair dressers usually use a relaxer on the hair to open the cuticles before applying the dye.

Predict the colour of the universal indicator when added to the relaxer. Explain using the information from Fig. 8.1.

.....

..... [2]

- - - - - End of Section A - - - -

Section B

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

Write your answer in the spaces provided.

9 Table 9.1 shows the concentration of the important greenhouse gases in parts per billion (ppb).

Table 9.1
The Important Greenhouse Gases
U.S. Department of Energy (October, 2000)

greenhouse gases (all concentrations expressed in parts per billion, ppb)	pre-industrial baseline / ppb	natural additions / ppb	man-made additions / ppb	total concentrations / ppb	percent of total
carbon dioxide, CO_2	288,000	68,520	11,880	368,400	99.438%
methane, CH_4	848	577	320	1750	0.471%
oxides of nitrogen	285	12	15	312	0.084%
other gases (CFC, etc.)	25	0	2	27	0.007%
total	289,158	69,109	12,217	370,484	100

Source: http://www.geocraft.com/WVFossils/greenhouse_data.html

(a) Name a possible source for oxides of nitrogen and state how it affects the environment.

.....

..... [2]

(b) The greenhouse effect is causing global warming.

What adverse effect does global warming have on the environment?

.....

..... [1]

[Turn over

(c) Using Table 9.1, compare the differences in the greenhouse gas emissions through natural and man-made means.

.....

..... [2]

(d) There are two ways to obtain methane.
One of the ways is through the separation of crude oil.

(i) State and describe the separation process of crude oil.

.....

.....

.....

.....

.....

..... [4]

(ii) Methane is obtained from petroleum gas component. State the use of methane.

..... [1]

[Turn over

10 (a) Three experiments were carried out to find the order of reactivity of three metals as shown in Fig. 10.1. The metals used were zinc, tin and an unknown metal **X**.

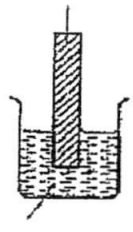
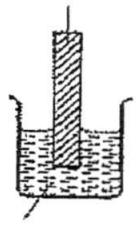
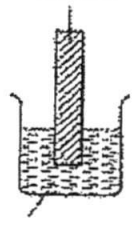
		experiment 1	experiment 2	experiment 3
		zinc  tin(II) chloride	tin  metal **X** sulfate	metal **X**  zinc sulfate
colour of metal	start	silver-grey	silver-grey	orange-brown
	end	silver-grey with crystals formed on surface		
colour of solution	start	colourless	blue	colourless
	end	colourless	pale blue	

Fig. 10.1

(i) Suggest the name of metal **X**.

..... [1]

(ii) Fill the spaces in Fig. 10.1 to show the colour of the metal and the solution at the end of experiment 3.

..... [1]

(iii) Place the metals in Fig. 10.1 in order of reactivity, starting with the most reactive.

..... [1]

[Turn over

(iv) Write a balanced chemical equation, including state symbols for the reaction in experiment 1.

..... [2]

(b) Sodium and iron require different conditions to react with water. By referring to these reaction conditions, justify the relative positions of sodium and iron in the reactivity series.

Include any observations when these metals react with water under different conditions.

.....

.....

.....

.....

.....

.....

.....

..... [5]

[Turn over

11 The hydrocarbon, $C_{10}H_{22}$, is present in crude oil. Fig.11.1 shows some of the products that can be obtained from this hydrocarbon.

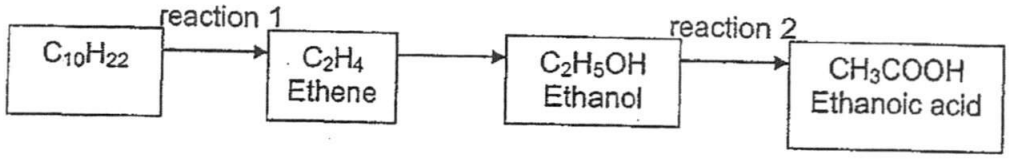


Fig. 11.1

(a) Name the reagent necessary for reaction 2 to occur.

.....

[1]

(b) Reaction 1 is an example of cracking. Besides C_2H_4, another hydrocarbon, **T** and a gas, **U**, which extinguishes a lighted splint with a pop sound, are also produced.

Identify the hydrocarbon **T** and gas **U** and write your answers in Fig. 11.2.

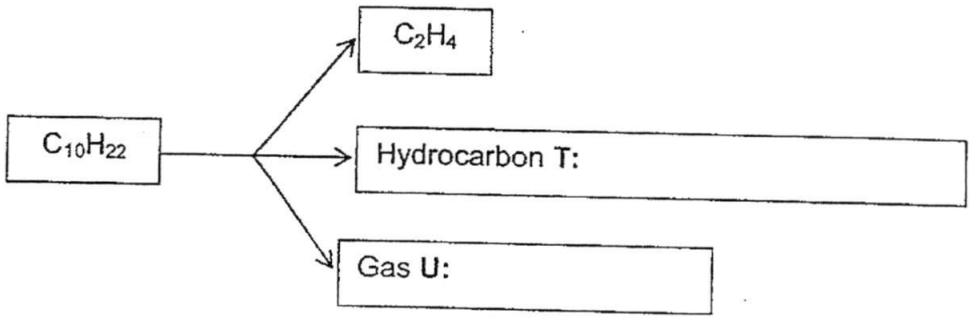


Fig. 11.2

[2]

(c) Describe a chemical test to distinguish between C_2H_4 and C_2H_6.

.....

.....

.....

[2]

(d) A solution of ethanol can be made by fermentation of glucose. Describe how this process is carried out in the laboratory, stating all the essential reagents and conditions.

.....

.....

.....

.....

.....

.....

.....

..... [5]

- - - - - End of Section B - - - -

End of Paper

DATA SHEET

Colours of some common metal hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

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	– Ra radium 88	– Ac actinium 89 †															

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

140 Ce cerium 58	141 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

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.).

Name

Reg. No Class

MAYFLOWER SECONDARY SCHOOL

4EX/5NA

Science (Chemistry)

[65 marks]

SOLUTIONS

5076/3
5078/3

PRELIMINARY EXAMINATION TWO
Aug 2016
1 hour 15 minutes

Additional Materials: Electronic calculator

INSTRUCTIONS TO CANDIDATES:

Do not open this booklet until you are told to do so.
Write your name, index number and class in the spaces at the top of this page and on any separate answer paper used.
Write in dark blue or black pen on both sides of the paper. You may use a soft pencil for any diagrams, graphs or tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

FOR EXAMINER'S USE	
Section	Marks
Paper 1 MCQ	/ 20
Paper 3 Section A	/ 45
Section B	/ 20
Paper 5	/15
Total	/ 100

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

Section B
Answer all questions on the spaces provided.
Answers any **two** questions out of the three questions given.

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 17.
The use of an approved scientific calculator is expected, where appropriate.

This question paper consists of **17** printed pages.

Setter: Mdm Jarina

Vetter: Mr Wesley Cheong

Answer Key (Sec 4E5NA Prelim 2 – Science Chem 2016)

Paper 1: 20 MCQs [20 marks]

21.	C	31.	C
22.	B	32.	D
23.	B	33.	C
24.	C	34.	C
25.	D	35.	D
26.	B	36.	A
27.	D	37.	B
28.	A	38.	D
29.	C	39.	C
30.	D	40.	C

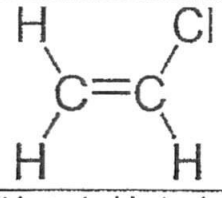
Paper 3 Section A: Answer all questions [45 marks]

<table>
<tr><th>Qn</th><th></th><th>Solutions</th><th>Marks</th></tr>
<tr><td>1</td><td>a</td><td>Simple distillation</td><td>1</td></tr>
<tr><td></td><td>b</td><td>Pure water</td><td>1</td></tr>
<tr><td></td><td>c</td><td>Condenser.
When the hot vapour rises and touches the cooler surface of the condenser, it condenses and changes to liquid droplets.</td><td>1
1</td></tr>
<tr><td>2</td><td>a</td><td><table><tr><th>substance</th><th>element, compound or mixture</th><th>possible identity of substance</th></tr><tr><td>A</td><td>element</td><td>nitrogen</td></tr><tr><td>B</td><td>compound</td><td>ammonia</td></tr><tr><td>C</td><td>mixture</td><td>air</td></tr></table></td><td>Each row 1 m</td></tr>
<tr><td></td><td>b</td><td>Molecules are random and far apart. [Arrangement]
The molecules move rapidly and freely in all directions. [Movement]</td><td>1
1</td></tr>
<tr><td></td><td>c</td><td>Fractional distillation</td><td>1</td></tr>
<tr><td>3</td><td>a</td><td>9 protons and 11 neutrons</td><td></td></tr>
<tr><td></td><td>b</td><td>Gp VII. Group number corresponds to the 7 valence electron of the element.</td><td>1</td></tr>
<tr><td></td><td>c</td><td>The number of neutrons are different but the number of protons remain as 9.</td><td></td></tr>
</table>

[Turn over

Qn		Solutions	Marks
	d	Lithium reacts with the element to form an ionic compound. Large amount of energy is required to overcome the strong electrostatic forces of attraction between lithium ions and the fluoride ions/ negative ions.	1 1
4	a	**J**: copper(II) carbonate / $CuCO_3$ **K**: copper(II) hydroxide / $Cu(OH)_2$ **L**: carbon dioxide /CO_2 **M**: copper(II) oxide / CuO **N**: copper(II) sulfate / $CUSO_4$	1 1 1 1 1
	b	$CuCO_3$ (s) + H_2SO_4 (aq)→ $CuSO_4$ (aq) + CO_2 (g) + H_2O (l) CuO (s) + H_2SO_4 (aq) → $CuSO_4$ (aq) + H_2O (l) $CuSO_4$ (aq) + 2NaOH (aq)→ $Cu(OH)_2$ (s) + Na_2SO_4 (aq) CO_2 (g) + $Ca(OH)_2$ (aq) → $CaCO_3$ (s) + H_2O (l) Or any other reactions	Any one of the reactions with state symbols 2m
5	ai	NO_2 : O_2 4 : 1 4mol : 1 mol Volume of O_2 = 1 × 24 = 24 dm^3	 1 1
	ii	NO_2 : $Cu(NO_3)_2$ 4 : 2 4 mol : 2 mol Mass of $Cu(NO_3)_2$ = 2 × 184 = 368 g	 1 1
	bi	Moles = conc × vol = 2.0 × 0.4 = 0.8 mol	 1
	bii	Na_2CO_3 : H_2O 1 : 1 0.8 mol : 0.8 mol Mass of water = 0.8 × 18 = 14.4 g	 1 1
6	a	Carbon monoxide is colourless and odouless which binds with the haemoglobin in the blood. This prevents the transportation of oxygen to the rest of the body causing breathing difficulties.	1 1
	b	element / oxidation state before reaction / oxidation state after the reaction palladium / +2 / 0 carbon / +2 / +4	
	c	Palladium in palladium chloride decreases in oxidation state from +2 to 0 and gets reduced. Carbon in carbon monoxide increases in oxidation state from +2 to +4 and gets oxidized. Since oxidation and reduction occurs simultaneously this is a redox reaction.	1 1
7	a	Ethene has c=c double bond (unsaturated) but ethane has c-c single bonds (saturated).	1
	b	Thousands of ethene molecules join together by breaking the c=c to form a long chain macromolecule polyethene.	1

[Turn over

Qn		Solutions	Marks
	c		1
	d	It is not able to decompose by microorganisms in the soil naturally. Discarded plastic objects will lead to land pollution as they are non-biodegrable and if they are burnt they will produce harmful gases that can harm the environment.	1 1
8	a	Neutralization	1
	b	Acidic. Conditioners cause the cuticles to close and hence pH of 4 to 6.	1 1
	c	Blue or purple. Relaxers cause the cuticles to open exposing the hair cortex and hence pH above 7.	1 1

Paper 3 Section B: Answer any 2 questions [20 marks]

Qn		Solutions	Marks
9	a	Source: Internal combustion in car engines or lightning Effect on environment: combines with water in the air and fall as acid rain	1 1
	b	Melting of polar ice caps causing the rise in sea levels. Or any other acceptable answers	1
	c	High amounts of CO_2 and CH_4 gases are released thru naturally than man made means. But higher amounts of oxides of nitrogen and other gases like CFC are mainly man made.	1 1
	di	Fractional distillation is used to separate crude oil. Crude oil is heated in the fractional distillation column where it vaporizes. The hot vapour rises up the fractionating column and begins to cool and condense. The components with the lower boiling point will distill off first and collected at the top of the fractionating column. The heavier fractions having a higher boiling point will distill off last and is collected at the bottom.	1 1 1 1
	dii	Fuel for cooking	1
10	ai	Copper	1
	aii	Brown metal and colourless solution	1
	aiii	Zinc, tin and copper	1
	aiv	$Zn(s) + SnCl_2(aq) \rightarrow Sn(s) + ZnCl_2(aq)$	1m for correct equation and 1m for state symbols

[Turn over

Qn		Solutions	Marks
	b	Sodium react vigorously with cold water burning with an orange flame. Iron does not react with cold water or when heated. Red hot iron reacts with steam. Both reactions with cold water and steam produces a lot of effervescence due to the production of hydrogen gas. Hence iron is placed below sodium in the reactivity series.	1 1 1 1 1
11	a	Acidified potassium manganate (VII) or oxygen in the air	1
	b	T: C_8H_{16} and H_2	2
	c	Bromine solution decolourises in the presence of C_2H_4. Bromine solution remains reddish brown in the presence of C_2H_6.	1 1
	d	Mix glucose solution and yeast in a conical flask. Maintain the reaction at the temperature of 37 °C as yeast works best at this temperature. Yeast catalyses the breakdown of glucose to ethanol. Carbon dioxide is formed in this reaction. The ethanol is then extracted from the liquid mixture by fractional distillation. If chemical equation is given – 1m	1 1 1 1 1

[Turn over

Name

Reg. No | Class

4EX/5NA

Science (Physics, Chemistry) **5076/05**

Science (Biology, Chemistry) **5078/05**

Chemistry Component

Paper 5 SOLUTIONS

PRELIMINARY EXAMINATION TWO

Aug 2016

1hour 30 minutes

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your answers in the spaces provided.

Write your name, register number and class on all the work you hand in.

Write in dark blue or black pen.

Answer all questions. 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.

You are advised to spend 45 minutes on the Physics / Biology Section and 45 minutes on the Chemistry Section.

FOR EXAMINER'S USE	
Total Mark	/ 15

This document consists of 4 printed pages.

Setter: Mdm Jarina Banu

Vetter: Mr Wesley Cheong

1 You are provided with a sample of solid salt, **Z**.

Carry out the following experiments and carefully record your observations.

The volumes given below, unless referring to drops of solution, are approximate and should be estimated rather than measured.

	test	observations
(a)	Transfer 2 spatula full of solid **Z** into a **dry test tube**. Heat the solid carefully but strongly until **no further changes are seen.** Test any gas evolved using a lighted splinter. Record all your observations. Leave the test tube on the test tube rack and allow the contents to cool completely. Set aside the contents for test **(g)**. While you are waiting, continue with the rest of the tests.	Water droplets observed on side of test tube. [1] Beige / brown or black residue upon strong heating. [1] Lighted splint extinguished. [1] Also accepted: Crystals changed to a hardened solid after strong heating. [1]
(b)	Soak the end of a wooden splint with water. Dip the wet end of the splint into the sample of solid **Z**. Make sure that the end if the splint is well covered with solid **Z**. Ensure that your bunsen flame is non-luminous. Place the moist end of your wooden splint into the flame. Record your observation.	No significant changes in flame colour observed. [1]
(c)	Using a spatula, add about 3 level spoonful of solid **Z** to a **clean boiling tube**. Add 20 cm^3 of distilled water to the boiling tube and stir the mixture with a glass rod until no further change is observed. Record your observations. **Separate this solution into 3 different parts into 3 clean test tubes for test (d), (e) and (f).**	Solid **Z** dissolved in water to form a pale green / pale yellow solution. [2]

[Turn over

	test	observations
(d)	Boil the first test tube of solution for test **(c)** gently, until no further changes are observed. Record your observations.	Solution turns dark yellow / light brown [1]
(e)	To the second test tube containing the solution from test **(c)**, add about 1 cm^3 of dilute sulfuric acid. Then add 3 drops of potassium manganate (VII) to the mixture. Swirl the contents until no further change is seen. Record your observation.	On addition of acid, pale green solution turned colourless. [1] On addition of potassium manganate (VII), solution remains colourless. [1] OR Purple potassium manganate (VII) turns colourless. [1]
(f)	Using the third test tube of solution from test **(c)**, add a few drops of acidified barium chloride. Record your observation.	White ppt observed. [1]
(g)	From the cooled substance left over from test **(a)**, record your observation on any new changes.	No change in the substance or substance remained as test (a). [1] OR Black residue turns brown upon cooling [1]

(h) From your observations in test **(f)**,

(i) Predict the anion present in soild **Z**.

Sulfate anion [1]

(ii) Based on your observation, what is this reaction commonly known as?

Precipitation [1]

(i) From your observations in test **(e)**, provide one major conclusion and evidence for it.

Conclusion: An oxidation reaction occurred or reducing agent detected. [1]

Evidence: purple potassium manganate (VII) turns colourless. [1]

END OF PAPER

21 The melting and boiling points of four substances are given in the table. Which substance will evaporate quickly if left exposed at room temperature?

	melting point °C	boiling point °C
A	-21	194
B	-27	8
C	-35	57
D	42	87

22 A beaker contains a mixture of ethanol and water. Which method could be used to separate the mixture of ethanol and water and the corresponding purity check for the separated ethanol?

	method of separation	purity check
A	filtration	check the smell and colour
B	fractional distillation	check the smell and colour
C	fractional distillation	find the boiling point
D	simple distillation	find the boiling point

23 Which information correctly describes the movement of particles in molten calcium chloride and oxygen gas?

	molten calcium chloride	oxygen gas
A	moves rapidly	slide pass each other
B	slide pass each other	moves rapidly
C	slide pass each other	vibrate in fixed position
D	vibrate in fixed position	moves rapidly

24 Which of the following does **not** have the same electronic configuration as argon?

A Cl^-

B K^+

C Na^+

D S^{2-}

25 Element X of proton number 12 reacts with element Y of proton number 17. What is the formula and type of compound formed?

	formula	type of compound
A	XY_2	covalent
B	XY_2	ionic
C	XY_4	covalent
D	X_2Y	ionic

26 Metal **M** forms a carbonate with the formula $M_2CO_3.5H_2O$, of relative molecular mass of 198. What is metal **M**?

A calcium

B magnesium

C potassium

D sodium

27 Which equation represents the ionic equation for the neutralisation reaction between dilute nitric acid and aqueous potassium hydroxide?

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

B $K^+(aq) + NO_3^-(aq) \rightarrow KNO_3(aq)$

C $KOH(aq) + HNO_3(aq) \rightarrow KNO_3(aq) + H_2O(l)$

D $OH^-(aq) + HNO_3(aq) \rightarrow NO_3^-(aq) + H_2O(l)$

28 Ammonia gas decomposed according to the equation below.

$$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$$

What is the volume of nitrogen gas produced when 400 cm^3 of ammonia gas decomposed? (measurements at r.t.p.)

A 200 cm^3

B 400 cm^3

C 600 cm^3

D 2400 cm^3

29 A student made some statements about alkalis.

1 Alkalis has a pH value of 1.

2 A base is a substance which can neutralise an alkali.

3 Alkalis turns damp red litmus paper blue.

4 Ammonia gas is produced when an alkali is reacted with ammonium chloride.

5 In a neutralisation reaction, the pH of the alkaline will fall towards 1.

Which two statements are correct?

A 1 and 2
B 2 and 3
C 3 and 4
D 4 and 5

30 Which of the following combinations of reactants is most suitable for the preparation of the given salt?

	reactants	salt to be prepared
A	calcium carbonate and sulfuric acid	calcium sulfate
B	copper(II) oxide and hydrochloric acid	copper(II) chloride
C	magnesium nitrate and sulfuric acid	magnesium sulfate
D	sodium and nitric acid	sodium nitrate

31 The alloy brass is harder than either of its constituent elements, copper and zinc, because the zinc atoms _____.

A bond to the copper atoms making the alloy harder.
B form a stable metallic lattice.
C prevent layers of copper atoms from sliding easily.
D raise the melting point of the copper.

32 Ammonia reacts with hot copper(II) oxide according to the equation:

$$3CuO + 2NH_3 \longrightarrow 3Cu + N_2 + 3H_2O$$

Which statement about this reaction is **not** true?

A CuO is reduced.

B Cu^{2+} ions gain electrons.

C NH_3 is oxidised.

D NH_3 is an oxidising agent.

33 Which list correctly shows the components of the atmosphere correctly placed in decreasing abundance?

A carbon dioxide, oxygen, nitrogen

B nitrogen, oxygen, carbon dioxide

C nitrogen, carbon dioxide, oxygen

D oxygen, nitrogen, carbon dioxide

34 Fluorine and chlorine are in the same group in the Periodic Table. Which statements about these elements are correct?

1 Fluorine is a gas and chlorine is a liquid at room temperature.

2 Chlorine is darker in colour than fluorine.

3 Fluorine and chlorine are diatomic molecules.

4 Fluorine and chlorine both can react with a solution of sodium iodide.

A 1 and 2

B 1, 2 and 3

C 2 and 3

D 2, 3 and 4

35 A nail left near a sea shore rusts far more quickly than an iron nail left inland. What could the reason be?

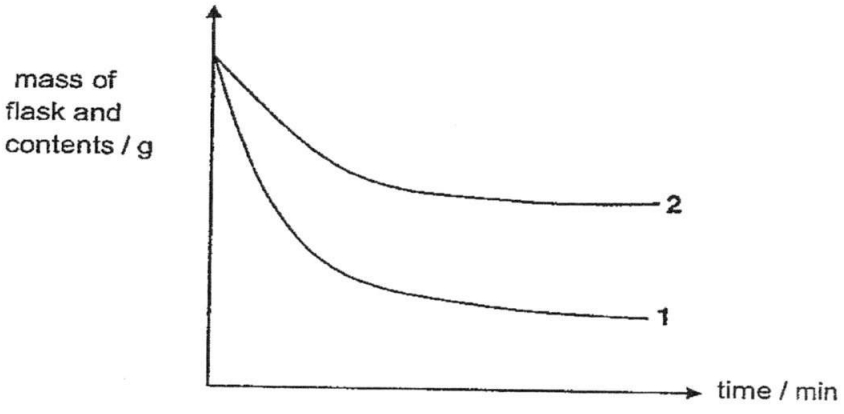
A The increase of exposure to wind increase the rate of rusting.

B The presence of higher temperature increase the rate of rusting.

C The presence of sand increase the rate of rusting.

D The presence of sodium chloride increase the rate of rusting.

36 Excess calcium was reacted with dilute hydrochloric acid of concentration 1.00 mol/dm^3 in a conical flask at room temperature and pressure. The flask was placed on an electronic balance. A graph of the mass of the flask and contents was plotted against time and curve **1** was obtained.



What change in the conditions of the experiment could give curve **2**?

1 The same mass of calcium but in larger pieces.

2 The same volume of dilute hydrochloric acid of concentration 0.50 mol/dm^3.

3 Raising the temperature by 25°C.

A 1 only

B 2 only

C 3 only

D 2 and 3 only

37 Which of the following is an endothermic process?

A combustion of methane

B neutralization of sulfuric acid with potassium hydroxide

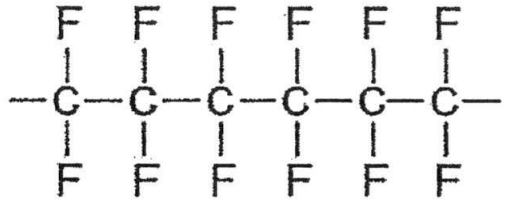
C respiration of human body

D thermal decomposition of copper (II) carbonate

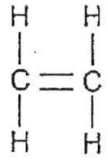
38 When crude oil undergoes fractional distillation, several products are obtained. What is the correct order of their boiling points?

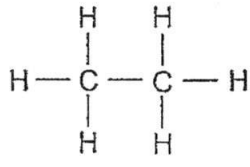
	lowest boiling point →			highest boiling point
A	bitumen	diesel	naphtha	petrol
B	petrol	lubricating oil	naphtha	kerosene
C	petrol	naphtha	kerosene	diesel
D	lubricating oil	kerosene	naphtha	petrol

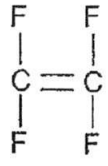
39 The structure of a polymer, Teflon, is shown.

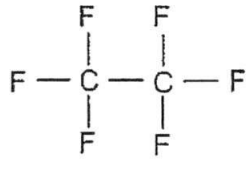


Which of the following is the monomer of Teflon?

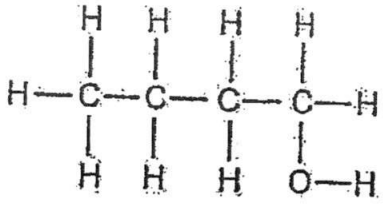
A 

C 

B 

D 

40 Compound **Q** has the structure shown.



Which of the following substances is formed when compound **Q** oxidizes in air?

A C_4H_{10}

B C_4H_8

C C_3H_7COOH

D C_4H_9COOH

End of Paper

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	– Ra radium 88	– Ac actinium 89 †															

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

140 Ce cerium 58	141 Pr praseodymium 59 m	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 mendeleviu m 101	– No nobelium 102	– Lr lawrencium 103

Key: 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

Section A (45 marks)

Answer all the questions in the spaces provided.

1 The melting and boiling points of four substances **W**, **X**, **Y** and **Z** are given in the table below.

substance	melting point/°C	boiling point/°C
W	-220	-120
X	-101	-33
Y	-7	58
Z	1140	1830

(a) Give the physical state of each of these substances at room temperature (25°C) and pressure.

W : ..... X : .....

Y : ..... Z : ..... [2]

(b) Which substance is most likely to be a metal?

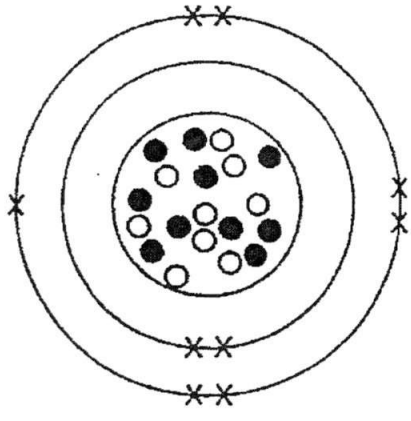
..... [1]

(c) Explain what happens to the arrangement and movement of particles in substance **Y** when the substance is heated from -20 °C to 0 °C.

.....

..... [2]

2 The diagram below shows the structure of an atom of element **Q**.



(a) Complete the table below about the three sub-atomic particles found in an atom of element **Q**.

particle	name of particle	relative charge	relative mass
X	electron	negative charge	
●			
○			1

[3]

(b) Element **Q** reacts with calcium to form the compound $\mathbf{CaQ_2}$.

(i) Draw a dot-and-cross diagram to show the bonding in the compound. All electrons should be shown.

[2]

(ii) Would you expect this compound to have a high or low melting point? Explain your answer.

.....

..... [2]

(c) Element **Q** has another isotope, **P**. State one physical property of isotope **P** that differs from **Q**.

..... [1]

3 A new element Visium, Vs, with relative atomic mass of 300 was found to belong to Group VII.

(a) What is the colour and physical state of visium at room temperature (25 °C)?

..... [2]

(b) Visium reacts with magnesium to form a compound.

(i) Predict the type of bonding in the compound. Explain your answer.

.....

..... [1]

(ii) Write the formula of the compound formed by visium and magnesium.

..... [1]

(c) (i) What would be observed if aqueous chlorine is bubbled into a solution of potassium bromide?

..... [1]

(ii) Write an ionic equation for the above reaction.

..... [1]

4 The table below shows the colours of 3 acid-base indicators at various pH values.

name of indicator	pH value: 1 2 3 4 5 6 7 8 9 10 11 12
methyl orange	red → ← yellow
litmus	red → ← blue
thymol blue	red → ← yellow → ← blue

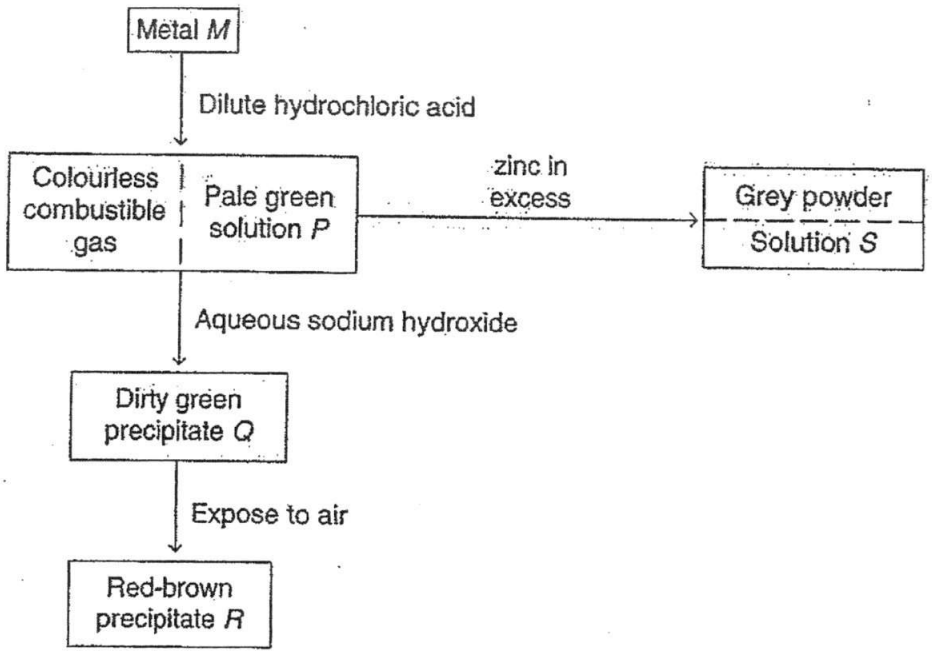
(a) Which indicators will show the same colour when added to sodium hydroxide?

..... [1]

(b) Both methyl orange and thymol blue changed to yellow when added to a solution of K. What can you conclude about the pH of solution K?

..... [1]

5 The figure below shows some of the reactions of several substances.



(a) Identify M, P, Q and R.

M : ..... P : .....

Q : ..... R : ..... [4]

(b) Write the balanced equation, including state symbols, for the reaction between metal M and dilute hydrochloric acid.

..... [2]

(c) (i) Explain the observation when zinc is added to solution P.

.....

..... [1]

(ii) State the colour change you would expect to observe for the reaction in **(c)(i)**.

..... [1]

6 Carbon monoxide reacts with copper (II) oxide according to the following equation.

$$CO + CuO \rightarrow CO_2 + Cu$$

(a) Which substance has been oxidised? Explain your answer in terms of oxidation states.

.....

..... [2]

(b) Given that 4.0 g of copper (II) oxide has reacted with 2.4 dm^3 of carbon monoxide, determine which is the limiting reagent.

[2]

7 The table below shows some properties of the metals magnesium and titanium.

metal	melting point/°C	boiling point/°C	density g/dm^3	relative atomic mass
magnesium	650	1091	1.7	24
titanium	1668	3287	4.5	48

Using information in the table above, briefly explain how <u>one</u> property of magnesium makes it

(a) <u>less</u> suitable than titanium for spacecraft construction;

.....

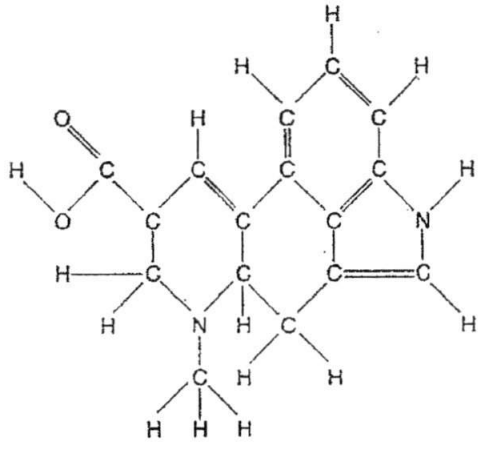
..... [1]

(b) <u>more</u> suitable than titanium for spacecraft construction;

.....

..... [1]

8 The diagram below shows the structural formula of a drug called LSD. (Lysergic acid diethyamide)



(a) What is the molecular formula of LSD?

..... [1]

(b) What would be observed if aqueous bromine is added to LSD?

..... [1]

(c) LSD is acidic. Circle the part of the drug that indicates that it is acidic. [1]

9 (a) The decomposition of hydrogen peroxide takes place in the presence of a catalyst, manganese (IV) oxide, according to the equation below.

$$2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$$

(i) Using ideas of the collision theory, explain how and why the rate of decomposition changes with increasing temperature.

.....

.....

.....

..... [3]

(ii) The rate of this reaction can be studied by measuring the volume of gas produced at regular time intervals.

Describe with the aid of a labelled diagram how you can measure the rate of this reaction.

.....

.....

.....

.....

.....

..... [4]

Section B

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

Write your answers in the spaces provided.

10 The table below shows a study of the reaction between aqueous sodium sulfate and aqueous barium nitrate. Different volumes of aqueous sodium sulfate are added separately to 5.0 cm^3 of aqueous barium nitrate in a reaction tube. The height of the precipitate is measured and recorded.

volume of sodium sulfate added/ cm^3	1.0	1.5	2.0	2.5	3.0	3.5
height of precipitate / cm	2.5	3.0	3.5	4.0	4.0	

(a) Write a balanced chemical equation, including state symbols, for the reaction between aqueous sodium sulfate and aqueous barium nitrate.

..... [2]

(b) Describe how a dry, pure sample of precipitate can be prepared in the science laboratory from the given reactants.

.....

.....

.....

.....

.....

..... [4]

(c) Predict, in cm, the height of the precipitate in reaction tube 6. Explain your answer.

.....

.....

..... [2]

(d) Describe a test to identify nitrate ions in barium nitrate.

.....

..... [2]

11 Metals are extracted based on their position in the reactivity series.

(a) Suggest the method to obtain the following metals:

- aluminium from bauxite.
- iron from haematite.

Explain why each method is used.

.....

.....

.....

..... [3]

(b) The iron obtained is mixed with scrap steel during recycling, which is then converted to alloys such as mild steel and high carbon steel.

The table below shows how hardness of the alloy changes with percentage by mass of carbon

type of steel	% of carbon	hardness level
mild steel	0.2	low
high carbon steel	1.0	high

(i) Why is recycling of metals important?

.....

..... [1]

(ii) Based on the table shown, explain, in terms of structure, the relationship between the hardness of an alloy and the mass of carbon added.

.....

.....

.....

..... [3]

(iii) State 3 differences in physical properties between iron and Group I metals.

.....

.....

..... [3]

12 Ethanol can be manufactured from sugar cane.

(a) Describe how glucose from sugar cane can be converted into ethanol by the process of fermentation.

.....

.....

.....

..... [3]

(b) (i) Explain why the yield of ethanol produced is around 15%.

.....

..... [1]

(ii) Suggest a method to obtain pure ethanol to be used as a fuel.

..... [1]

(c) Ethanol can also be oxidised in the laboratory to produced ethanoic acid. Describe how this can be done in the laboratory.

.....

.....

..... [2]

(d) Write a balanced chemical equation, including state symbols for this reaction.

.....[2]

(e) Draw the full structural formula of ethanoic acid. [1]

End of Paper

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper (II) hydroxide	light blue
iron (II) hydroxide	green
iron (III) hydroxide	red-brown
lead (II) hydroxide	white
zinc hydroxide	white

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	– Ra radium 88	– Ac actinium 89 †															

*58-71 Lanthanoid series

†90-103 Actinoid series

140 Ce cerium 58	141 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 thullium 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

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

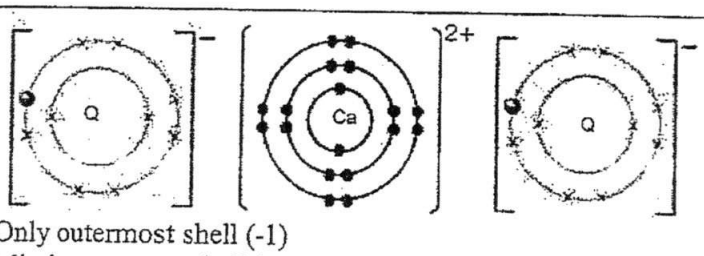
The volume of one mole of any gas is 24 dm^3 at room temperature and pressure

Sec 4E/5NA Sc(chem) Prelim 2016 P3 MS

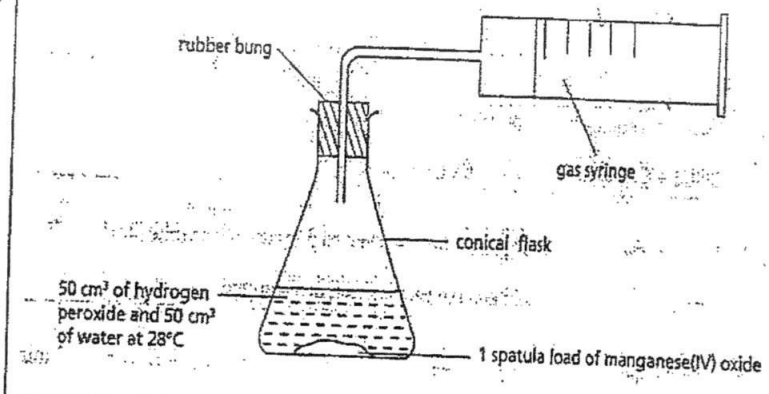
Section A

1(a)	W: gas X: gas Y: liquid Z: solid	1 mark for every 2 correct
1(b)	Z	1
1(c)	From -20°C to -7°C, the particles are closely packed in orderly arrangement and will start to vibrate more [1]. From -7°C to 0°C, the particles will begin to slide over each other and the particles are still closely packed but not in orderly arrangement [1].	2
2(a)		1 mark for every 2 correct

particle	name of particle	relative charge	relative mass
X	electron	negative charge	$\frac{1}{1840}$ or $\frac{1}{1836}$
●	neutron	0	1
○	Proton	Positive charge	1

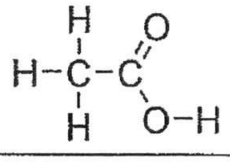
2(bi)	 Only outermost shell (-1) Missing or extra shell (no marks)	2
2(bii)	High melting point. The compound exists as a giant crystal lattice structure with strong electrostatic forces of attraction(1) between the ions which requires high energy to overcome (1).	2
2(c)	MP/ BP / Density (higher / lower not accepted)	1
3(a)	Black solid.	2
3(bi)	Ionic (½), metal and non-metal (½).	1
3(bii)	$MgYs_2$	1
3(ci)	The **colourless** solution will turn **reddish brown**.	1

3(cii)	$Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$	1
4(a)	Litmus and thymol blue	1
4(b)	pH value of between 5 and 9.	1
5(a)	M: iron, Fe P: iron (II) chloride, $FeCl_2$ Q: iron (II) hydroxide, $Fe(OH)_2$ R: iron (III) hydroxide, $Fe(OH)_3$	4
5(b)	$Fe(s) + 2HCl(aq) \rightarrow FeCl_2(aq) + H_2(g)$	1 mark balanced 1 mark correct state symbols
5(ci)	Zinc being **more reactive than iron** will **displace iron.**	1
5(cii)	Pale green solution turns colourless	1
6(a)	CO is oxidised (1) to CO_2 because the oxidation state of C in CO increases from +2 to +4 in CO_2 (1).	2
6(b)	Mol of CuO = 4/80 = 0.05 mol Mol of CO = 2.4/24 = 0.1 mol CuO is limiting reagent.	1
7(a)	**Low melting point** may cause the spacecraft to melt due to the **high temperature when reentering earth.**	1
7(b)	**Low density** which means that the spacecraft would be **lighter.**	1
8(a)	$C_{16}H_{15}O_2N_2$	1
8(b)	**Reddish brown** aqueous bromine will turn **colourless.**	1
8(c)	-COOH circled.	1
9(ai)	Increasing temperature will cause the particles to have more energy and vibrate faster. This leads to more frequent collision per unit time resulting in an increase in the number of effective collision per unit time leading to a faster rate of reaction/decomposition. Higher energy makes it easier to achieve activation energy.	1 1 1

9(aii)		Labeled diagram (1; 1)
	Using the apparatus above, record the volume of gas given off over regular time interval. Plot a graph of volume of gas vs time taken. The gradient of the graph will give the rate of reaction.	1 1

Section B

10(a)	$Ba(NO_3)_2$ (aq) + Na_2SO4 (aq) → $BaSO_4$ (s) + $2NaNO_3$ (aq) 1m eqn, 1m ss	2
10(b)	Mix barium nitrate to sodium sulfate. (1) Filter the mixture to collect the precipitate (barium sulfate) (1). Wash the precipitate with a little distilled water to remove impurities. (1). Dry the precipitate with filter paper. (1)	4
10(c)	4.0 cm (1) Barium nitrate is the limiting reagent and is used up and hence no more precipitation occurs. (1)	2
10(d)	Add sodium hydroxide and aluminium foil and warm gently. (1) Ammonia gas which turns damp red litmus paper blue will be produced. (1)	2
11(a)	Aluminium is extracted by electrolysis and Iron is extracted by reduction with carbon. (both correct to get 1 mark) Aluminium is a reactive metal and is found as a stable compound hence electricity is used to decompose the compound. Iron is a fairly less reactive metal hence carbon is strong enough to reduce it.	1 1 1
11(bi)	To conserve the finite resources / to prevent land / air pollution.	1
11(bii)	When the number of percentage carbon by mass increase, the hardness also increase.(1) This is due to more carbon atoms disrupting the orderly arrangement of the iron (1), making it harder for the layers of atoms harder to slide pass each other. (1)	3
11(c)	Iron is harder than group I metal (group I metals are softer) (1) Iron has a higher density than group I metal. (group I metals are less dense) (1) Iron has a higher melting point than group I metals. (group 1 metals have a	3

	lower melting point. (1)	
12(a)	Add yeast (1) to the sugar solution at 37°C (1), in the absence of oxygen. (1)	3
12(bi)	Yeast will denatured when the concentration is too high.	1
12(bii)	Fractional distillation	
12(c)	Heat a mixture of ethanol with acidified potassium manganate (VII).(1) The purple solution will turn colourless to show that oxidation has taken placed. (1)	2
12(d)	C_2H_5OH (aq) + 2[O] → CH_3COOH (aq) + H_2O (l) 1m eqn, 1m ss	2
12(e)		1

Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
C	C	B	C	B	B	A	A	C	B
Q31	**Q32**	**Q33**	**Q34**	**Q35**	**Q36**	**Q37**	**Q38**	**Q39**	**Q40**
C	D	B	D	D	B	D	C	B	C

END