Class	Index Number	Name

ST HILDA'S SECONDARY SCHOOL

Secondary Four Express/ Five Normal Academic

PRELIMINARY EXAMINATION 2017

General Certificate of Education Ordinary Level

SCIENCE (~~PHYSICS~~, CHEMISTRY) **5076/01**

Paper 1 Multiple Choice August 2017

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, index number and class on the Answer Sheet in the spaces provided unless this has been done for you.

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.

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 **17**.

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

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

For Examiner's Use	
PHYSICS	/20
CHEMISTRY	/20
TOTAL	/40

Setters: Mr Vincent Tham, Mdm Sharizah
Vetters: Ms Suhaila, Ms Rachel Teo, Mr Raymond Ong
Mrs Lim SY, Ms Peh HS, Mrs Ho CK, Mr Abdul Bari,
Mr Eric Tan, Mr Charles Neo

This document consists of **18** printed pages.

[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 lanthenum 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 †															

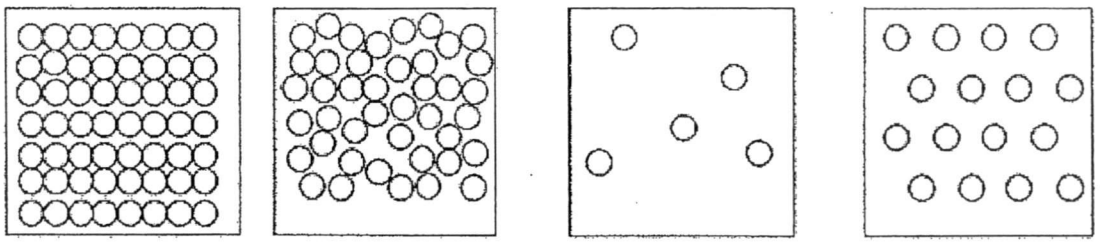
Key

relative atomic mass
atomic symbol
name
atomic number

*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

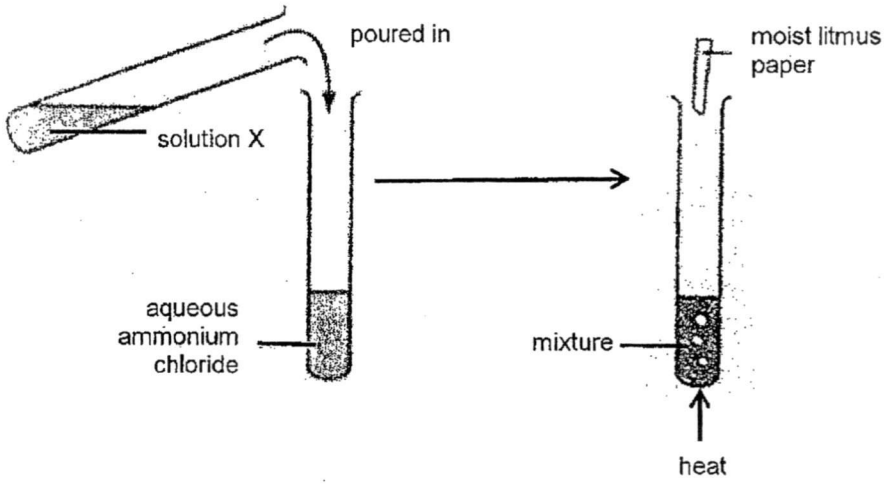
The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

21 Substance Y melts at -120 °C and boils at -10 °C.
Which diagram represents the arrangement of the particles in substance Y at -30 °C?



A B C D

22 An aqueous solution X was reacted with aqueous ammonium chloride and the mixture was heated. A gas, Y, is produced which changes colour of the moist litmus paper.



A gas Y, is produced which changes the colour of the moist litmus paper.

What are solution X and gas Y?

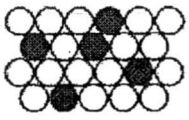
	solution X	gas Y
A	aqueous sodium hydroxide	ammonia
B	aqueous sodium hydroxide	chlorine
C	dilute sulfuric acid	ammonia
D	dilute sulfuric acid	chlorine

23 Which statement about an atom is correct?

A Each element has only one nucleon (mass) number.
B The nucleon (mass) number can be less than the proton (atomic) number.
C The nucleon (mass) number can equal the proton (atomic) number.
D The number of neutrons never equals the number of electrons.

24 Which of the following best describes the substances shown below?

i



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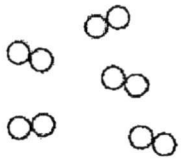
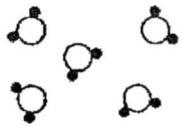


iii



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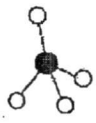


	elements	compounds	mixtures
A	ii	i, iii, iv	none
B	i, ii	iv	iii
C	ii	iii, iv	i
D	ii, iii	iv	i

25 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.

26 Element Z has three electrons in the outer shell.
What is the formula of the chloride and oxide of element Z?

	chloride of element Z	oxide of element Z
A	ZCl	ZO
B	ZCl_3	Z_2O_3
C	Z_3Cl	ZO_3
D	Z_3Cl_3	Z_3O_2

27 The formulae of four covalent compounds are shown

I H_2O

II CO_2

III CH_3OH

IV CH_3COOH

In which following pair of molecules does oxygen form at least one double bond in both molecules?

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

28 A 6.0 g of pure carbon is burnt completely in oxygen.

$$C + O_2 \rightarrow CO_2$$

Which volume of carbon dioxide gas is produced, at rtp?

A 12 dm^3
B 24 dm^3
C 48 dm^3
D 96 dm^3

29 The scheme shows four stages, I to IV, in the conversion of solid candlewax, $C_{30}H_{62}$, into carbon dioxide and water.

I $C_{30}H_{62}$ (s) $\rightarrow$ $C_{30}H_{62}$ (*l*)

II $C_{30}H_{62}$ (*l*) $\rightarrow$ $C_{30}H_{62}$ (g)

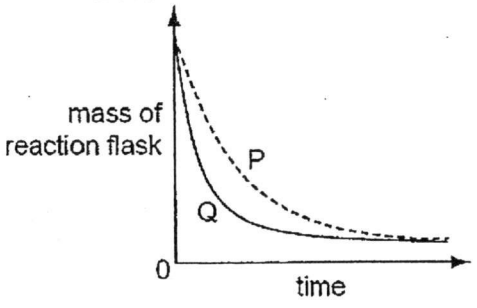
III $C_{30}H_{62}$ (g) + 45.5 O_2 (g) $\rightarrow$ 30 CO_2 (g) + 31 H_2O (g)

IV 30 CO_2 (g) + 31 H_2O (g) $\rightarrow$ 30 CO_2 (g) + 31 H_2O (*l*)

Which stages are exothermic?

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

30 A student investigates the rate of reaction between marble chips and dilute hydrochloric acid.
The loss in mass of the reaction flask is measured.
The graph shows the results of two experiments, P and Q.



Which of the following change explains the difference between P and Q?

A A catalyst is added in P
B A higher temperature is used in P
C Larger marble chips are used in Q
D Hydrochloric acid of a higher concentration is used in Q

31 Which of the following is an example of a redox reaction?

A $2SO_2 + O_2 \rightarrow 2SO_3$
B $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$
C $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$
D $H^+ + OH^- \rightarrow H_2O$

32 Which reactants could be used safely to prepare potassium chloride?

A aqueous potassium hydroxide and dilute hydrochloric acid
B aqueous potassium sulfate and aqueous sodium chloride
C potassium and aqueous sodium chloride
D potassium and dilute hydrochloric acid

33 The surface of aluminium saucepans will often oxidise and form a layer of aluminium oxide. This layer of aluminium oxide can be removed by reacting it with both acids and alkalis.

What can you say about the nature of aluminium oxide?

A Aluminium oxide is acidic.
B Aluminium oxide is amphoteric.
C Aluminium oxide is basic.
D Aluminium oxide is neutral.

34 Which of the following is not a property of Group I metals?

A They are soft and can be cut with a knife.
B They corrode rapidly when exposed to oxygen in the air.
C They produce an acidic solution when they react with water.
D They react rapidly with water producing hydrogen gas.

35 Three metals, X, Y and Z were heated separately with oxides of four metals, P, Q, R and S, to find out the order of reactivity.

The results are shown in the table.

metal	metal oxide			
	P	Q	R	S
X	×	×	×	×
Y	✓	✓	×	✓
Z	×	✓	×	×

key
✓ = reaction observed
× = no reaction observed

What is the order of reactivity of the metals from the least reactive to most reactive?

A X → Z → Y
B X → Y → Z
C Y → Z → X
D Z → Y → X

36 In how many of the following can kerosene be used as the energy source?

aircraft	air conditioning units	cars
domestic cooking	heavy lorries	power stations

A 1
B 2
C 3
D 4

37 A steel manufacturing plant is built near to a city.
The limestone buildings in the city begin to crumble.

Which gas is most likely to cause this damage?

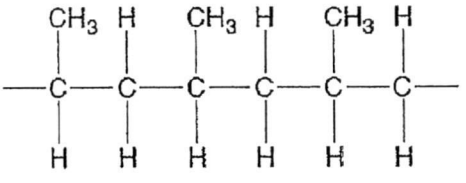
A carbon dioxide
B carbon monoxide
C oxygen
D sulfur dioxide

38 The general formula of the alkanes homologous series is C_nH_{2n+2}.

Which physical property decreases as *n* increases?

A boiling point
B flammability
C melting point
D viscosity

39 The diagram shows the structure of a polymer, X.



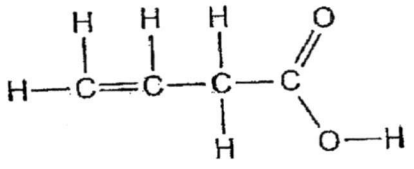
Which reactant does not react with the monomer of the polymer, X?

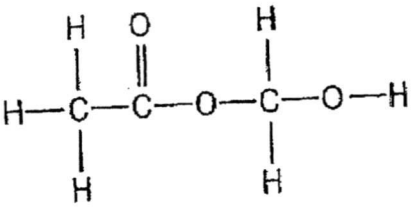
A aqueous bromine
B hydrogen
C sodium
D steam

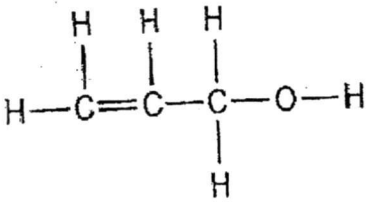
40 The table below shows the results of tests carried out on compound X.

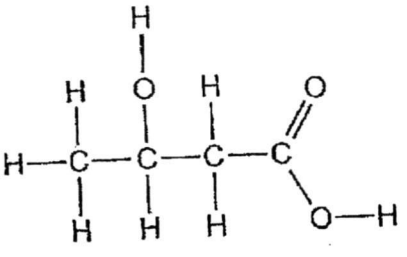
test	result
bromine water is added	bromine water is decolourised
sodium carbonate is added	colourless acidic gas evolved

Which formula represents compound X?

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 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
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– Fr francium 87	– Ra radium 88	– Ac actinium 89 †															

*58-71 Lanthanoid series

†90-103 Actinoid series

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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

Class	Index Number	Name

ST HILDA'S SECONDARY SCHOOL

SECONDARY FOUR EXPRESS / FIVE NORMAL ACADEMIC

PRELIMINARY EXAMINATION 2017

General Certificate of Education Ordinary Level

SCIENCE **5076/03 & 5078/03**

Paper 3 Chemistry **AUGUST 2017**

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

1 hour 15 minutes

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 a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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

Section B
Answer any **two** questions.
Write your answers in the spaces provided.

A copy of the Data Sheet is printed on page **14.**
A copy of the Periodic Table is printed on page **15.**

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

For Examiner's Use	
Section A	/ 45
Section B	/ 20
Total	/ 65

Setter : Mdm Sharizah
Vetters: Mrs Lim SY, Ms Peh HS, Mrs Ho CK
Mr Eric Tan, Mr Abdul Bari, Mr Charles Neo

This document consists of **15** printed pages including the Cover Page.

Section A

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

1 When completed, Table 1.1 describes the synthesis of two gases and their corresponding laboratory tests. Complete the table by filling in the blank boxes.

Reaction	gas produced	laboratory test	result of test
Decomposition of hydrogen peroxide	oxygen		
calcium + cold water		insert a lighted splint at the mouth of the test tube	

Table 1.1

[2]

2 In each of these redox equations, identify the oxidising agent and the reducing agent.

(a) $3C + Fe_2O_3 \rightarrow 3CO + 2Fe$

oxidising agent ..... reducing agent ..... [1]

(b) $Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$

oxidising agent ..... reducing agent ..... [1]

3 Name a suitable process to separate

(a) three miscible liquids with different boiling points;

..... [1]

(b) a mixture of sodium chloride and iodine;

..... [1]

(c) the products from reacting potassium sulfate and barium nitrate.

.....[1]

4 Fig. 4.1 shows the structural formula of a molecule of drug called LSD.
(Lysergic acid diethylamide)

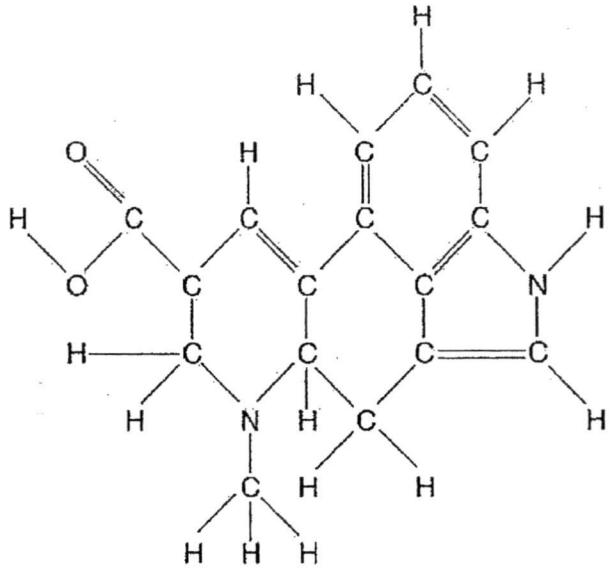


Fig. 4.1

(a) Write down the molecular formula of LSD.

.....[1]

(b) LSD is an unsaturated molecule. Describe a chemical test to prove that LSD is an unsaturated molecule.

Test .....

Observation .....

.....[1]

(c) LSD dissolve in water to produce a weakly acidic solution with pH 4.

(i) Explain why LSD produces a weakly acidic solution.

.....

.....[1]

(ii) On Fig. 4.1, circle the functional group present in the LSD molecule which is responsible for the acidic nature.

[1]

5 Students give their own special symbols to five **non-metallic** elements. All five non-metals are in the same group of the Periodic Table. The special symbols are shown in Fig. 5.1.

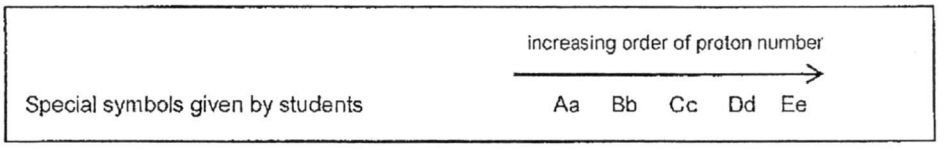


Fig. 5.1

The students know the following:

1. Sodium, Na, reacts with the non-metal of the given symbol, **Bb.**
   The compound formed has the chemical formula **NaBb.**
2. The elements exist as diatomic molecules.

(a) **(i)** In which group of the Periodic Table are these non-metallic elements placed?

.....[1]

(ii) Choose from Fig. 5.1 the special symbol of the element which is most likely to be a solid at room temperature and pressure.

.....[1]

(b) **(i)** Suggest the name of the element given the special symbol **Bb** by the students.

.....[1]

(ii) Write the special symbol of the element most likely to displace **Bb** from a solution containing ions of **Bb.**

.....[1]

(iii) Use the special symbols to write an ionic equation for the displacement reaction in **(b)(ii).** State symbols are not required.

.....[2]

6 Atoms of non-metallic elements can combine with other atoms to form many different compounds.

(a) One of these compounds is carbon tetrachloride, CCl_4, an organic solvent with low melting and boiling point and is a non-conductor of electricity.

(ii) Name the type of chemical bonding present in carbon tetrachloride.

.....[1]

(ii) Draw a 'dot-and-cross' diagram to show the arrangement of electrons in a molecule of carbon tetrachloride in the space below. Show only the outermost electrons. [Proton numbers: C, 6 ; Cl, 17]

[2]

(b) Another of these compounds is magnesium chloride. Unlike carbon tetrachloride, this compound has a high melting and boiling point and is a conductor of electricity when molten.

Write the chemical formula of magnesium chloride.

.....[1]

(c) Use your knowledge of the bonding in carbon tetrachloride and magnesium chloride to explain the difference in their

(i) melting and boiling points;

.....

.....

.....[2]

(ii) electrical conductivity.

.....

.....

.....[2]

7 The equation below shows the salts formed from the reaction between lead(II) nitrate and zinc sulfate.

$$Pb(NO_3)_2 + ZnSO_4 \rightarrow PbSO_4 + Zn(NO_3)_2$$

A student wanted to prepare one of the two products in the above reaction in the laboratory. He was told that only the following reagents are available for use.

dilute nitric acid	lead(II) hydroxide powder	aqueous lead(II) nitrate
dilute sulfuric acid	aqueous zinc chloride	zinc carbonate powder

(a) What volume (in cm^3) of 0.100 mol/dm^3 of lead(II) nitrate solution is required to react completely with a solution containing 0.0250 mol of zinc sulfate to produce the salts above?

volume of lead(II) nitrate ..... cm^3
[2]

(b) Suggest two reagents from the above list that can be used to prepare one of the products.

State the product which you wish to prepare: .....

Two reagents that can be used to prepare your chosen product:

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

(c) Describe the steps needed to prepare a pure and dry sample of the product you have chosen in **(b)**.

.....

.....

.....

.....

.....

.....[4]

8 The student investigated the temperature change when sodium hydrogencarbonate was added to excess dilute hydrochloric acid.

Fig. 8.1 shows the apparatus used during the investigation.

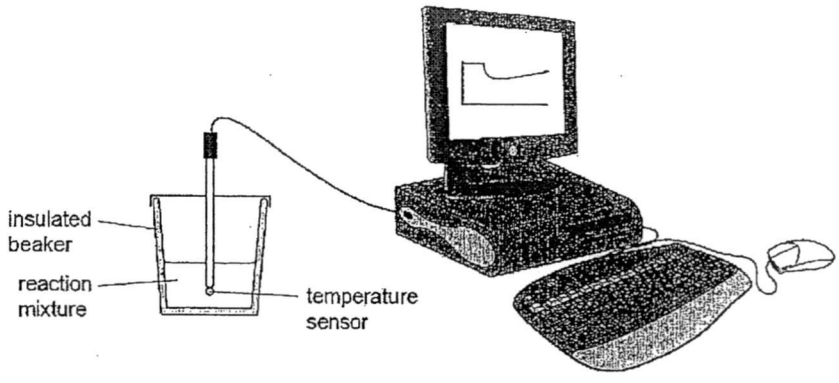


Fig. 8.1

Temperature measurements were displayed on the computer screen as a graph of temperature against time. This graph is shown in Fig. 8.2.

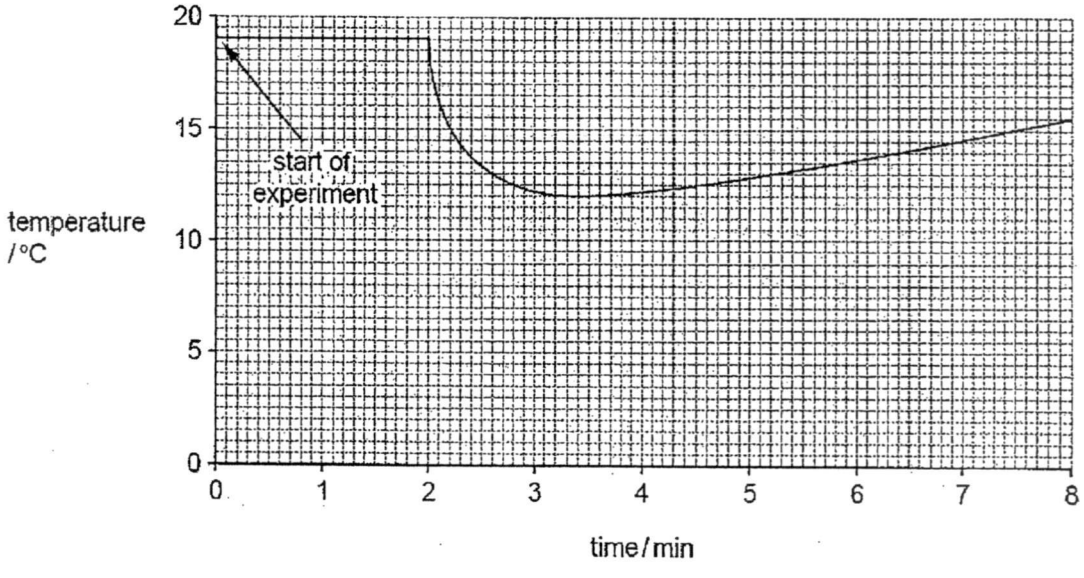


Fig. 8.2

(a) On the graph in Fig. 8.2, mark with an X the point where sodium hydrogencarbonate was added to the dilute hydrochloric acid.

[1]

(b) Calculate the temperature change shown in Fig. 8.2 that occurred during the reaction.

temperature change ..... °C

[1]

(c) Use the results in Fig. 8.2 to explain the type of energy change that has taken place during the reaction between sodium hydrogencarbonate with excess dilute hydrochloric acid.

.....

.....

.....[2]

9 Fig. 9.1 describes some of the reactions of an organic compound **E**.

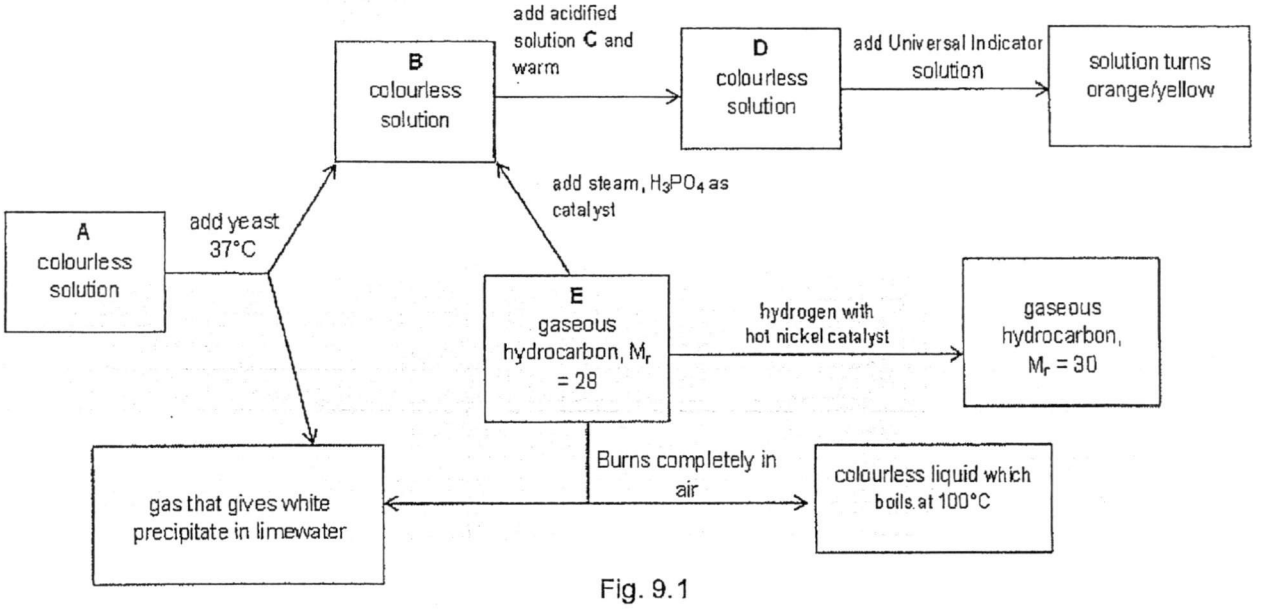


Fig. 9.1

(a) Identify

(i) **A**, ...

(ii) **B**, ...

(iii) **C**, ...

(iv) **D**, ...

(v) **E**, ...

[5]

(b) Write the balanced chemical equation to represent the reaction between hydrocarbon **E** with hydrogen.

.....[1]

(c) Hydrocarbon **E** undergoes further reaction under high heat and pressure; with a catalyst, to form a polymer.

(i) State the name of the polymer formed.

..... [1]

(ii) Draw the structure of one repeat unit of this polymer.

[1]

(iii) State one disadvantage of using the polymer.

.....

.....[1]

Section B

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

10 The Periodic Table printed on page **15** lists the elements in increasing proton number.
Use the Periodic Table to help you answer these questions.

(a) **(i)** An inspection of the electronic structure of an element's atom can give its group and period. Using any element from the first 20 elements in the Periodic Table, explain how the electronic structure can be used to determine which group and period the element is in.

.....

.....

.....

.....[3]

(ii) On moving across from Group I to Group VII, the character of the elements changes. Describe and explain the change.

.....

.....

.....

.....[3]

(b) Sodium and the element of proton number 12 can undergo similar chemical reactions.

Describe two of these similar reactions. Write a balanced chemical equation for **one** of the reactions you have described. Include state symbols.

Reaction 1 .....

.....

.....

Reaction 2 .....

.....

.....

Chemical equation

.....[4]

11 Calcium carbonate, in the form of marble chips, react with hydrochloric acid in the reaction shown below.

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

5.0 g of marble chips was added to 60.0 cm^3 of 2.0 mol/dm^3 hydrochloric acid at room temperature and pressure. The rate of reaction was tracked by measuring the volume of carbon dioxide produced during the reaction at regular time intervals.

Table 11.1 shows the results from the experiment.

time/min	0	2	4	6	8	10	12	14
total volume of CO_2/cm^3	0	240	360	440	460	474	480	480

Table 11.1

(a) Using the information from Table 11.1, describe how the rate of reaction changes with time.

.....

.....

.....[2]

(b) Use your knowledge of reacting particles to explain the changes in the rate of reaction with time.

.....

.....

.....[2]

(c) Calculate the number of moles of marble chips and hydrochloric acid used in the reaction. Hence, determine the limiting reagent.

Number of moles of marble chips ..... mol

Number of moles of hydrochloric acid ..... mol

[2]

(d) Calculate the volume of carbon dioxide produced at room temperature and pressure during the reaction.

volume of carbon dioxide .....
[2]

(e) The graph in Fig. 11.2 shows the results obtained when 5.0 g of marble chips was added to 60.0 cm^3 of 2.0 mol/dm^3 hydrochloric acid.

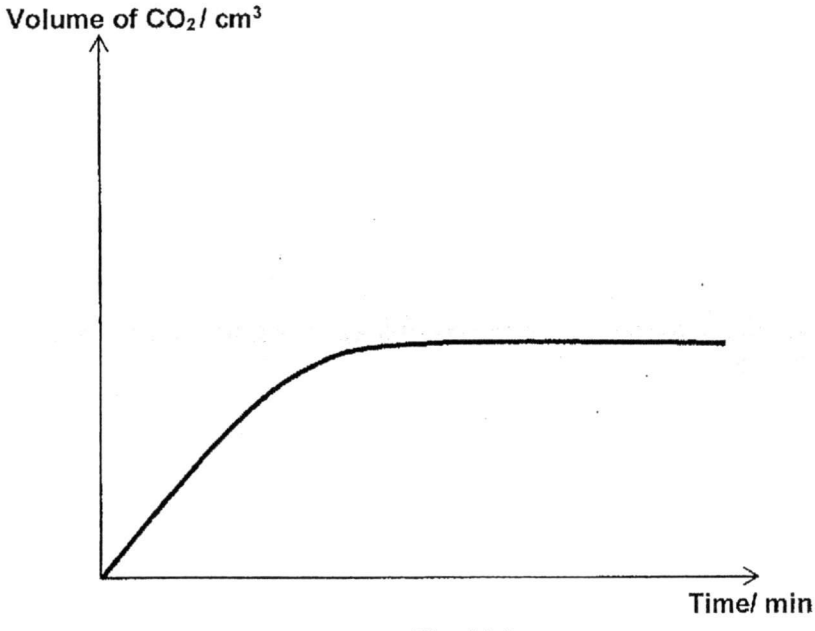


Fig. 11.2

The experiment above,

(i) is repeated using the 60.0 cm^3 of 1.0 mol/dm^3 hydrochloric acid.
Add to Fig. 11.2 the graph you would expect. Label this **graph A**.
[1]

(ii) is repeated using the same mass of powdered calcium carbonate.
Add to Fig. 11.2 the graph you would expect. Label this **graph B**
[1]

12 (a) (i) Calcium and zinc require different conditions to react with water.
By referring to these reaction conditions, justify the relative positions of calcium and zinc in the reactivity series.

.....

.....

.....

.....

.....[3]

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

.....[2]

(b) Metals can be extracted in many different ways.

Explain why carbon can be used to obtain iron from iron(III) oxide but not to obtain calcium from calcium oxide.

.....

.....

.....[2]

(c) The Statue of Liberty in New York is made from iron frame covered with copper plates. In 2004, work had to be carried out to stop the iron frame from rusting away.

The iron frame was rusting much faster than normal when it was in contact with copper.

Explain why copper in contact with iron causes the iron to rust at a faster rate.

.....

.....

.....[2]

(d) Suggest one reason why some countries concentrate more on recycling copper than on recycling iron.

.....

.....[1]

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

[Turn over

CANDIDATE NAME	CLASS

CENTRE NUMBER | | | | |

O-LEVEL INDEX NUMBER | | | | |

ST HILDA'S SECONDARY SCHOOL

Secondary Four Express/Secondary Five Normal (A)

PRELIMINARY EXAMINATION 2017

General Certificate of Education Ordinary Level

SCIENCE
Chemistry Booklet

5076/05, 5078/05

Paper 5 Practical Exam

August 2017

1 hour 30 minutes

Additional Materials: Nil

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 a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **both** questions.
You are advised to spend 45 minutes on each question.

INFORMATION FOR CANDIDATES

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.
Electronic calculators can be used in this paper.
A copy of the Chemistry Practical Notes is given on Page 5.

For Examiner's Use	
Total Marks	/15

Setter:
Vetted by:
2017Sec4E5NPrelimP5ScChem

This question paper consists of 5 printed pages including the cover page and the Chemistry practical notes.

You are provided with a sample of solid **Z** which is a mixture of two salts, **X** and **Y**.

Salt **X** is insoluble in water while salt **Y** is a water-soluble hydrated salt.

Carry out the following experiments and carefully record your observations in the table.

You should test for any gases evolved. The volumes given are approximate and should be estimated rather than measured, unless otherwise stated.

	tests	observations
(a)	Transfer three spatulas of **Z** into a large dry **hard glass** test-tube.	
	Heat **Z gently** for about 30 seconds for a gas to come out of the tube.	Water droplets/Condensation formed on the upper part of the boiling tube. [1/2] White fumes are given off [1/2] The white solid Z turns yellow. [1/2]
	Test the gas evolved using a piece of damp Indicator Paper strip. Using the colour chart, determine the pH of the gas evolved.	pH of gas evolved has a pH value of 11. (accept pH value 8-11). [*1] Gas evolved has a pungent smell. [1/2]
		Gas produced forms a white ppt in limewater [1/2]
	Continue heating **Z very strongly** until no further changes are seen.	Upon continued heating, white fumes are given off sublime to form white solids on the upper part of the boiling tube. [*1/2]
	Leave the tube to cool and study the appearance of the residue.	Solid is brown / reddish-brown / orange / grey / charred [*1] [4]
(b)	Transfer two spatulas of **Z** into a test tube. Add about 3 cm^3 of dilute nitric acid.	Effervescence / Bubbling / Fizzing occurs. [1] Gas produced forms a white ppt in limewater. [1] [2]

Add two spatulas of **Z** into a boiling tube.

Measure out 10 cm^3 of deionized water using the measuring cylinder and pour it into the boiling tube.

Stopper the boiling tube and shake the contents gently for about two minutes.

Filter the contents of the boiling tube, keeping both the filtrate and residue on the filter paper in the filter funnel.

Carry out the tests shown on the next page.

	test on the residue in the filter paper	observations
(c)	Place the filter funnel together with the residue in a clean test-tube. Pour about 3 cm^3 of dilute nitric acid onto the residue contained in the filter funnel. To the solution collected in the test-tube, add dilute aqueous ammonia **drop by drop**, with shaking, until no further change is seen.	Effervescence / Bubbling / Fizzing occurs. [1/2] Green solid on the filter paper turns reddish-brown [1/2] A white ppt [1/2] was formed upon adding aq ammonia dropwise and is soluble in excess aqueous ammonia to give a colourless solution [1/2]. A green ppt was formed, insoluble in excess aqueous ammonia [1/2] [2]

	tests on the filtrate	observations
(d)	(i) To 2 cm^3 of the filtrate from **Z**, add in 1 cm^3 of dilute nitric acid, followed by 1 cm^3 of aqueous barium nitrate.	White ppt is formed. [1]
	(ii) To another 2 cm^3 of the filtrate from **Z**, add an equal volume of aqueous sodium hydroxide. Warm the mixture gently.	Green ppt is formed. [1] Upon warming, the gas produced turns <u>damp red litmus paper blue</u>. [1] [3]

(e) Consider the results of your experiments, give **one** conclusion about the observations made in **part (a) and/or (b)**. [1]

Any one of the following:

- The gas evolved from heating Z is an alkaline gas
- Carbon dioxide gas is produced when acid is added to Z in (b).
- Z contains carbonate ions as carbon dioxide gas is produced when acid is added to C in (b).
- *Upon heating Z, water droplets are formed, and hence Z contains a hydrated salt. (0m as its stated in qn already)*

(f) Consider the results of your experiments, give **one** conclusion about the ions present in salt **X**. Give evidence to support your conclusion. [1]

conclusion: Salt X contains zinc ions/Zn^{2+} [1/2]

evidence: A white ppt is formed that dissolves in excess aqueous ammonia in test (c) indicates that zinc ions are present in Salt X. [1/2]

conclusion: Salt A contains carbonate ions/CO_3^{2-} [1/2]

evidence: Carbon dioxide gas was produced in test (a) when Z was heated and Salt B contains sulfate ions, hence Salt X must contain carbonate ions. [1/2]

(g) Consider the results of your experiments, give **two** conclusions about the ions present in salt **Y**. Give evidence to support your conclusions. [2]

Any two of the following:

conclusion 1: Salt Y contains iron(II) ions/Fe^{2+} [1/2]

evidence 1: A green ppt is formed when aqueous ammonia is added to the filtrate in test (dii)/aqueous sodium hydroxide is added in test (diii) indicates that iron(II) ions are present in Salt B. [1/2]

conclusion 2: Salt Y contains ammonium ions/NH_4^+ [1/2]

evidence 2: Ammonia gas produced in test (diii) upon warming the mixture indicates that ammonium ions are present in Salt Y. [1/2]

conclusion 3: Salt Y contains sulfate ions/SO_4^{2-} [1/2]

evidence 2: White ppt was formed when acidified barium nitrate solution was added to the filtrate in test (di). [1/2]

NOTES FOR QUALITATIVE ANALYSIS

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 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

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

Sec 4E5N Prelim Practical Exam 2017
Prep List

Each candidate will require

1. about **3.0 g** of a mixture of approximately equal masses of **ammonium iron(II) sulfate-6-water, $(NH_4)_2SO_4.FeSO_4.6H_2O$** and **zinc carbonate, $ZnCO_3$, labelled solid Z.**
   This should be mixed on the morning of the exam and then weighed out; [T]
2. standard rack of test-tubes with 2 boiling tubes
3. bunsen burner (1 each);
4. lighter (1 each);
5. Indicator Paper strip (2 each) and colour chart
6. blue and red litmus papers (2 each)
7. filtration apparatus (plastic filter funnel and filter papers (2 each));
8. distilled water;
9. teat pipettes (2 each);
10. spatula (one each);
11. measuring cylinder to measure 10 cm^3; (1 each)
12. delivery tube (1 each);
13. stopper for boiling tube (1 each);
14. wooden splint (1 each)
15. one beaker each placed at sink for rinsing
16. **Communal Reagents** (Labels do not need to include concentrations)

    (a) aqueous ammonia of concentration 1.0 mol / dm^3; [H]
    (b) aqueous sodium hydroxide of concentration 1.0 mol / dm^3; [C]
    (c) dilute hydrochloric acid of concentration 1.0 mol / dm^3; [C]
    (d) dilute nitric acid of concentration 1 mol / dm^3; [C]
    (e) barium nitrate solution of sufficient concentration to give a positive sulfate test; [T]
    (f) silver nitrate solution [T]
    (g) limewater

Note: Additional Preparation

For the Universal Indicator Colour Chart:

Please label the following:

The Universal Indicator Colour Chart can be used to determine the pH of a gas or solution. To determine the pH, observe the colours produced on the Indicator Paper strip and match them with the different colour shades of the standard Universal Indicator Colour Chart.

Sec 4E/5N Sc(Chem) Prelims Exam 2017
Marking Scheme

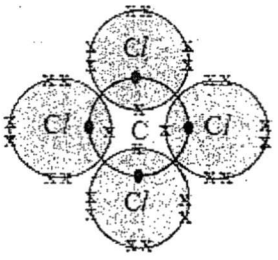
5076 & 5078: Paper 1

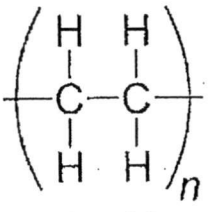
1/21	B	**11/31**	A
2/22	A	**12/32**	A
3/23	C	**13/33**	B
4/24	C	**14/34**	C
5/25	C	**15/35**	A
6/26	B	**16/36**	B
7/27	C	**17/37**	D
8/28	A	**18/38**	B
9/29	C	**19/39**	C
10/30	D	**20/40**	A

Sec 4E/5N Sc(Chem) Prelims Exam 2017
Marking Scheme
Sc(Chemistry): 5076/04 & 5078/4

<table>
<tr><th>Qn</th><th>Suggested Answers</th><th>Marks allocation</th></tr>
<tr><td>1</td><td>
<table>
<tr><th>Reaction</th><th>gas produced</th><th>laboratory test</th><th>result of test</th></tr>
<tr><td>Decomposition of hydrogen peroxide</td><td>oxygen</td><td><u>Insert a glowing splint near the gas</u></td><td><u>Glowing splint is rekindled/ relighted/ burst into flames</u></td></tr>
<tr><td>calcium
+
cold water</td><td><u>hydrogen</u></td><td>insert a lighted splint at the mouth of the test tube</td><td><u>Lighted splint is extinguished with a pop sound</u></td></tr>
</table>
</td><td>4 entries – 2m

2 entries – 1m</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>2</td><td>(a) oxidizing agent: <u>Fe_2O_3</u> reducing agent: <u>C</u></td><td>1m – all correct</td></tr>
<tr><td></td><td>(b) oxidizing agent: <u>Cu^{2+}</u> reducing agent: <u>Mg</u></td><td>1m – all correct</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>3</td><td>(a) <u>fractional</u> distillation (reject: distillation)</td><td>1m</td></tr>
<tr><td></td><td>(b) sublimation</td><td>1m</td></tr>
<tr><td></td><td>(c) filtration</td><td>1m</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>4</td><td>(a) $C_{16}H_{15}O_2N_2$</td><td>1m</td></tr>
<tr><td></td><td>(b)
Test: <u>Add LSD to aqueous bromine / a solution of bromine</u>
Observation: <u>Reddish brown</u> bromine is quickly <u>decolourised/turns colourless</u></td><td>Both correct
= 1m</td></tr>
<tr><td></td><td>(c)(i) When dissolved in water, LSD molecule <u>dissociate partially</u>, producing a <u>low concentration of H^+ ion</u>, resulting in a weakly acidic solution.</td><td>1m</td></tr>
<tr><td></td><td>(c)(ii) Circle –COOH functional group</td><td>1m</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>5</td><td>(a)(i) Group VII (reject: Halogens, Group 7)</td><td>1m</td></tr>
<tr><td></td><td>(a)(ii) Dd or Ee (either one)</td><td>Either one – 1m</td></tr>
<tr><td></td><td>(b)(i) Chlorine (reject if written chemical symbol, Cl)</td><td>1m</td></tr>
<tr><td></td><td>(b)(ii) Aa</td><td>1m</td></tr>
<tr><td></td><td>(b)(iii) $Aa_2 + 2Bb^- \rightarrow 2Aa^- + Bb_2$</td><td>1m – correct formula of substances
1m – balance</td></tr>
</table>

Qn	Suggested Answers	Marks allocation
6	(a)(i) covalent (bonding) ; precise spelling	1m
	(a)(ii)  	1m: correct sharing of electrons between C and Cl 1m: correct number of valence electrons in all atoms
	(b) $MgCl_2$	1m
	(c)(i) melting and boiling points Carbon tetrachloride has low melting and boiling point, as <u>little energy</u> is required to <u>overcome weak intermolecular forces of attraction.</u> On the other hand, <u>more energy</u> is required to overcome <u>strong electrostatic forces of attraction between Mg^{2+} and Cl^- / oppositely-charged ions</u> resulting in a high melting and boiling point. (c)(ii) Electrical conductivity Carbon tetrachloride is a non-conductor of electricity as it has <u>no free moving/mobile ions or electrons</u> which can act as charge carriers. On the other hand, molten magnesium chloride is a conductor of electricity as the <u>Mg^{2+} and Cl^- ions are mobile</u> and <u>can act as charge carriers</u>.	2m; 1m – difference in amt of energy required 1m – provide accurate info on the types of attraction 2m; 1m – mention that CCl_4 has no mobile ions & electrons while $MgCl_2$ has mobile ions 1m – relate the mobility of ions to ability to conduct electricity
7	(a) Mole ratio $Pb(NO_3)_2$: $ZnSO_4$ is 1:1 Hence, the number of moles of $Pb(NO_3)_2$ is <u>0.0250 mol</u>. [1] Volume of $Pb(NO_3)_2$ = 0.0250 / 0.1 = 0.25 dm^3 = <u>250 cm^3</u> [1]	1m: 0.0250 mol of $Pb(NO_3)_2$; can be embedded within calculation 1m: Vol. of $Pb(NO_3)_2$ = 250 cm^3
	(b) $PbSO_4$: <u>dilute sulfuric acid</u> and <u>aqueous lead(II) nitrate</u> or $Zn(NO_3)_2$: <u>dilute nitric acid</u> and <u>zinc carbonate</u>	Both correct – 1m

Qn	Suggested Answers	Marks allocation
	(c) **$PbSO_4$** • Mix a fixed volume of aq. lead(II) nitrate with excess sulfuric acid. Stir until no more precipitate of lead(II) sulfate forms. • Filter to collect the precipitate, lead(II) sulfate • Wash the precipitate with a small amount of distilled water. • Dry precipitate in between sheets of filter paper. **$Zn(NO_3)_2$** • Add zinc carbonate in excess to a fixed volume of dilute nitric acid. • Filter to remove unreacted zinc carbonate and collect filtrate, zinc nitrate solution. • Heat the zinc nitrate solution until a saturated solution is obtained. • Leave the saturated zinc nitrate solution to cool and crystallise. • Then wash with a little cold distilled water and dry in between sheets of filter paper	5 points – 4m 4 points – 3m 3 points – 2m 2 points – 1m
8	(a) **X** shown clearly on graph at 2 min. (b) decrease of; 7°C (–7°C) (c) reaction is endothermic as the temperature of mixture decreases with time, thus heat energy is absorbed from the surroundings.	1m 1m 1m: identify endo 1m: 2 pts for the supporting reason.
9	(a) (i) A , glucose solution (ii) B, ethanol (iii) C, acidified potassium manganate (VII) (iv) D, ethanoic acid (v) E, ethene (b) $C_2H_4 + H_2 \rightarrow C_2H_6$ (c)(i) poly(ethene) (ii)  (iii) Poly(ethene) is non-biodegradable and will cause land pollution, as it will be difficult to dispose.	1m 1m 1m 1m 1m 1m 1m 1m 1m

Qn	Suggested Answers	Marks allocation
Section B (20 marks)		
10	(a)(i) Name of element: Sodium (example) / Argon (example) The electronic structure of sodium is 2.8.1, which means it has one valence electron and 3 electron shells. Hence, it is placed in Group I, Period 3. The electronic structure of fluorine is 2.7, which means it has seven valence electrons and 2 electron shells. Hence, it is placed in group VII, Period 2.	1m: name a correct element in Period 3 1m: write the electronic structure accurately 1m: link the number of valence electron to group number and electron shells to period
	(a)(ii) Moving across from Group I to VII, - there is a decrease in metallic properties and an increase in non-metallic properties; - elements changes from metallic to non-metallic Reason: The number of valence electrons increase. Hence, the elements ability to lose electrons decreases (less metallic) while the ability to gain electrons increase (more non-metallic).	1m – accurate description of the trend 1m: recognise that number of valence electrons increase across period 1m: ability to lose/gain electrons change accordingly.
	(b) Reaction 1: Both metals can react with dilute acid Both elements react with acid to produce salt and hydrogen gas [1] Reaction 2: Both metals can react with oxygen Both elements react with oxygen to form metal oxides. [1] Chemical equation: $Mg\ (s) + 2HCl\ (aq) \rightarrow MgCl_2\ (aq) + H_2\ (g)$ $2Na\ (s) + 2HCl\ (aq) \rightarrow 2NaCl\ (aq) + H_2\ (g)$ *or* $2Mg\ (s) + O_2\ (g) \rightarrow 2MgO\ (s)$ $4Na\ (s) + O_2\ (g) \rightarrow 2Na_2O\ (s)$	1m for each reaction described 1m: balanced chemical equation 1m: state symbols included are accurate

Qn	Suggested Answers	Marks allocation
11	(a) From the results, the volume of carbon dioxide formed in the first 2 minutes is 240 cm^3. However, between the 6th and 8th minutes, only about 20 cm^3 of carbon dioxide is formed. Finally, between 10th and 14th minutes, only 6 cm^3 of carbon dioxide is formed. Hence, we can see that the rate of reaction is decreasing over time.	1m: state that rate of reaction is decreasing 1m: use at least 3 sets of data to show the decreasing trend.
	(b) The rate of reaction is the fastest at the beginning.[1] As reaction progress, there is lesser reacting particles, hence the frequency of effective collisions decreases, resulting in a decreasing speed of reaction. [1] 1m: – recognize that speed of reaction is fast at beginning due to ready available reacting particles 1m: recognize that reacting particles decrease over time, resulting in decreasing speed of reaction	2m
	(c) Number of moles of marble chips = 5/100 = 0.05 mol Number of moles of HCl = 2 x (60/1000) = 0.120 mol 0.05 mol of $CaCO_3$ will require (0.05 x 2) = 0.100 mol of HCl. However, there is 0.120 mol of acid available, hence marble chips, $CaCO_3$ will be used up first.	Both correct: 1m 1m : statement to show that $CaCO_3$ is the limiting reagent. (Deduct 1m if missing)
	(d) Number of moles of CO_2 = 0.06 mol Volume of $CO_2(g)$ = 0.06 x 24 = 1.44 dm^3	1m (can be embedded) 1m
	(e) (i) Graph A – gentler gradient, end slightly later, volume of gas will be halved (less) ; acid is now the limiting reagent (ii) Graph B – steeper gradient, same volume of gas obtained, end slightly earlier	1m 1m

Qn	Suggested Answers	Marks allocation
12	(a) (i) Calcium reacts readily with (cold) water to produce metal hydroxide and hydrogen gas. However, zinc does not react with water but only with steam to produce metal oxide and hydrogen gas Hence, calcium is more reactive than zinc and is placed above zinc in the reactivity series of metal.	1m – able to state the difference in the condition of water 1m – using the reaction with water to state that Ca is more reactive than Zn 1m: Hence, Ca is above Zn in the reactivity series of metals.
	(ii) $Zn + H_2O \rightarrow ZnO + H_2$ or $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$	1m : Correct reactants and products 1m: balanced equation.
	(b) Carbon is more reactive than iron, hence it is able to displace iron from iron oxide. However, carbon is less reactive than calcium and it is unable to displace calcium from its oxide	1m 1m
	(c)(i) Iron, being more reactive [1m] than copper, will react more readily with oxygen and water [1m]. Hence iron rusts faster than normal.	2m
	(c)(ii) - Percentage of copper on earth is less than iron/ less abundant - Copper has a higher monetory value than iron.	1m