NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
END OF YEAR EXAMINATIONS 2016

SUBJECT : CHEMISTRY 5073 DATE : 4 th October 2016

LEVEL : SECONDARY 3 EXPRESS DURATION : 2 Hr

INSTRUCTIONS TO CANDIDATES

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. Write your name, class and index number on the **cover page of this Booklet** and the **Optical Answer Sheet** in the spaces provided. **On the Optical Answer Sheet, it is also required that you WRITE and SHADE your index number (please ask the invigilator if you are not sure).**

2. Answer **ALL** questions in **Section A** on the **Optical Answer Sheet** provided.

3. Answer **ALL** questions in **Section B** in the spaces provided in this booklet.

4. Answer only 3 questions in Section C in the spaces provided. **The last question is in the form of an either/or and only one of the alternatives should be attempted.**

5. Calculators may be used where necessary. **Where numerical answers are not exact, give answers to three (3) significant figures.**

6. Submit the **Optical Answer Sheet** and **this booklet** SEPARATELY at the end of the examination.

For Examiner's Use Only						
Section	A [20 m]	B [50 m]	C [30 m]	Total [100 m]	Grade	Target Grade
Score						
	Teacher's comments, if any:					
						Parent's signature

This paper consists of 28 printed pages, including this cover page and the Periodic Table.

Section A (20 marks)

Each question is provided with **four** possible answers (**A**, **B**, **C** and **D**). Select the most appropriate answer and **shade** your choice on the **Optical Answer Sheet** provided.

1 A student takes 2 g samples of calcium carbonate and adds them to 20 cm^3 samples of dilute hydrochloric acid at different temperatures. She measures how long it takes for the effervescence to stop.

Which apparatus does she use?

	balance	stopwatch	filter funnel	measuring cylinder	thermometer
A	✓	✓	✓	✓	✗
B	✓	✓	✗	✓	✓
C	✓	✗	✓	✓	✓
D	✗	✓	✓	✗	✓

2 A sample of a drug is analysed by using a chemical test for aspirin and measuring its melting point. The chemical test is positive but the melting point is 130°C not 135°C as it should be.

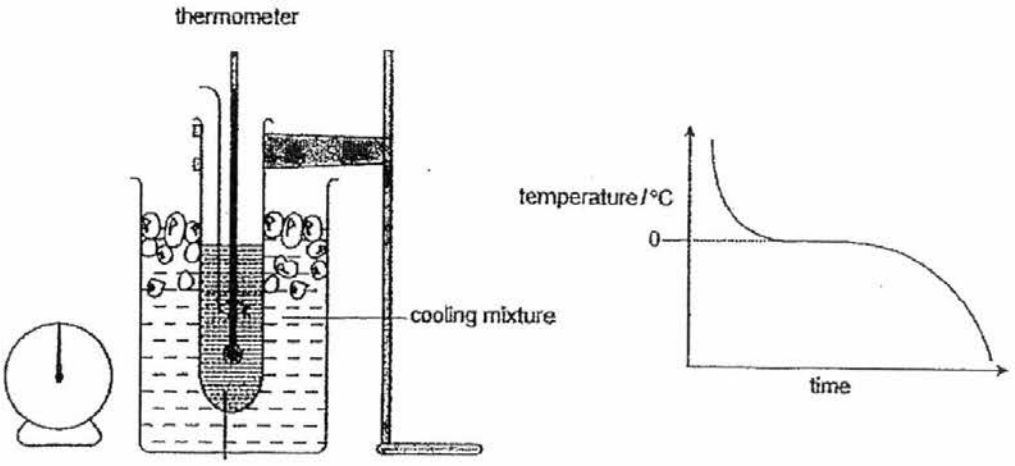
What is correct?

	the sample contains aspirin	**the sample has an impurity**
A	yes	yes
B	yes	no
C	no	yes
D	no	no

3 What could be the boiling point of water containing dissolved sodium chloride?

	boiling point/ °C
A	95
B	100
C	103
D	250

4 The diagrams show a cooling experiment and the results.



What liquid could X be?

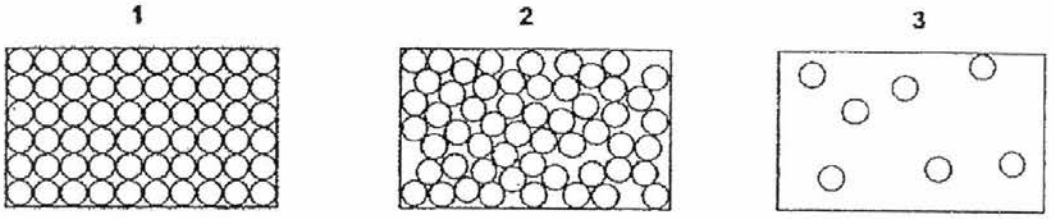
A sodium chloride solution

B pure water

C alcohol

D mercury

5 Diagrams 1, 2 and 3 represent the three states of matter.



For which states can diffusion be demonstrated by using simple laboratory apparatus?

A 1 only

B 1 and 2

C 2 and 3

D 1, 2 and 3

6 The diagrams show models of molecules.

X Y Z

Which molecules could the above models represent?

	X	Y	Z
A	helium	chlorine	water
B	helium	hydrogen chloride	carbon monoxide
C	hydrogen	chlorine	water
D	hydrogen	hydrogen chloride	carbon monoxide

7 Two gases, P and Q were separately released in a laboratory on a cold day. The experiment was repeated on a hot day. The time taken for the gases to reach the opposite end of the laboratory was recorded for each experiment.

The M_r of gas P was 34 and the M_r of Q was 64.Which gas on which day would reach the end of the laboratory in the shortest time?

	gas	day
A	P	cold
B	P	hot
C	Q	cold
D	Q	hot

8 The symbol of an element is $^{75}_{33}As$. How many electrons does an ion of this element contain?

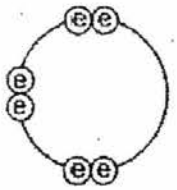
A 30

B 33

C 36

D 42

9 Element X has six electrons in its outer shell.



How could the element react?

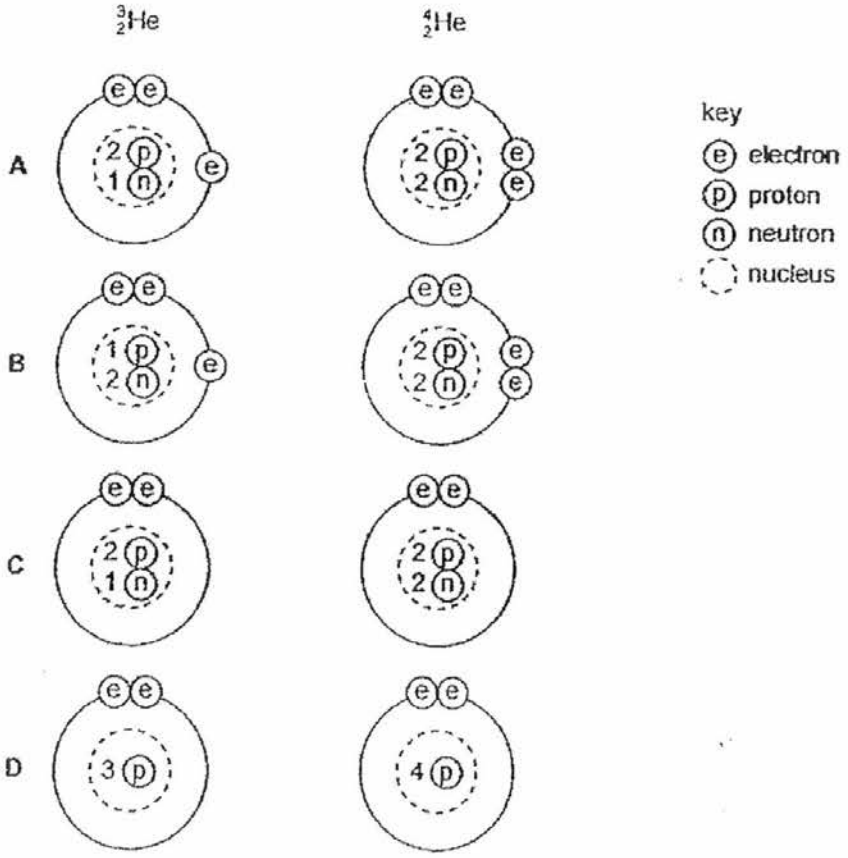
A by gaining two electrons to form a positive ion

B by losing six electrons to form a negative ion

C by sharing two electrons with two electrons from another element to form two covalent bonds

D by sharing two electrons with two electrons from another element to form four covalent bonds

10 Two isotopes of helium are $^{3}_{2}He$ and $^{4}_{2}He$. Which two diagrams show the arrangement of particles in these two isotopes?



11 Which numbers are added together to give the nucleon number of an ion?

A number of electrons + number of neutrons

B number of electrons + number of protons

C number of electrons + number of protons + number of neutrons

D number of protons + number of neutrons

12 Which statement describes the changes in the elements from left to right across a period of the Periodic Table?

A The ability to conduct electricity increases.

B The metallic properties decreases.

C The number of valence electrons decreases.

D The number of neutrons in an atom decreases.

13 Element X forms an acidic, covalent oxide.
Which row in the table shows how many electrons there could be in the outer shell of an atom of X?

	1	2	6	7
A	✓	✗	✗	✗
B	✓	✓	✗	✗
C	✗	✗	✗	✓
D	✗	✗	✓	✓

14 Which statement describes the trends going down group VII of the Periodic Table?

A The boiling point and melting point both decrease.

B The boiling point and melting point both increase.

C The boiling point decreases but the melting point increases.

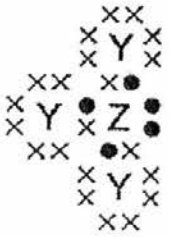
D The boiling point increases but the melting point decreases.

15 Astatine is an element in Group VII of the Periodic Table. It has only ever been produced in very small amounts.

What is the best description of its likely properties?

	colour	state	reaction with aqueous potassium iodide
A	black	solid	no reaction
B	black	liquid	brown colour
C	green	solid	no reaction
D	yellow	liquid	brown colour

16 The diagram shows the outer shell electron arrangement of compound J that contains the elements Y and Z.



What type of compound is J?

A an alloy

B a macromolecule

C covalent

D ionic

17 The relative atomic mass of oxygen is 16 and that of hydrogen is 1.

This means that ...(i)... of oxygen has the same mass as ...(ii)... of hydrogen.

Which words correctly complete the gaps?

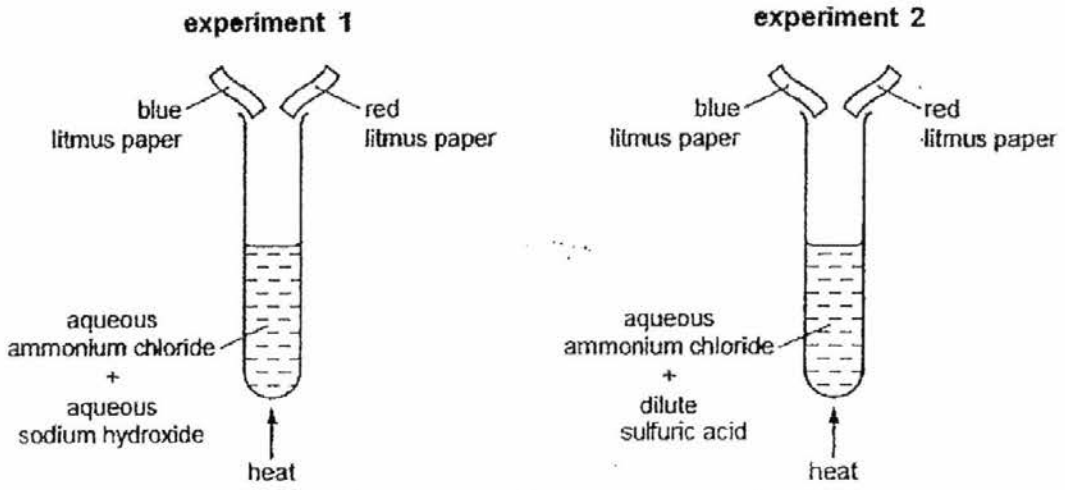
	(i)	(ii)
A	an atom	thirty two molecules
B	an atom	eight molecules
C	a molecule	sixteen atoms
D	a molecule	eight atoms

18 An oxide of element X dissolves in water to form a solution of pH 5.

Which line in the table is correct?

	type of element	type of oxide
A	metallic	acidic
B	metallic	basic
C	non-metallic	acidic
D	non-metallic	basic

19 The diagrams show two experiments.



What happens to the pieces of litmus paper?

	experiment 1	experiment 2
A	blue to red	both pieces bleached
B	blue to red	no change
C	red to blue	both pieces bleached
D	red to blue	no change

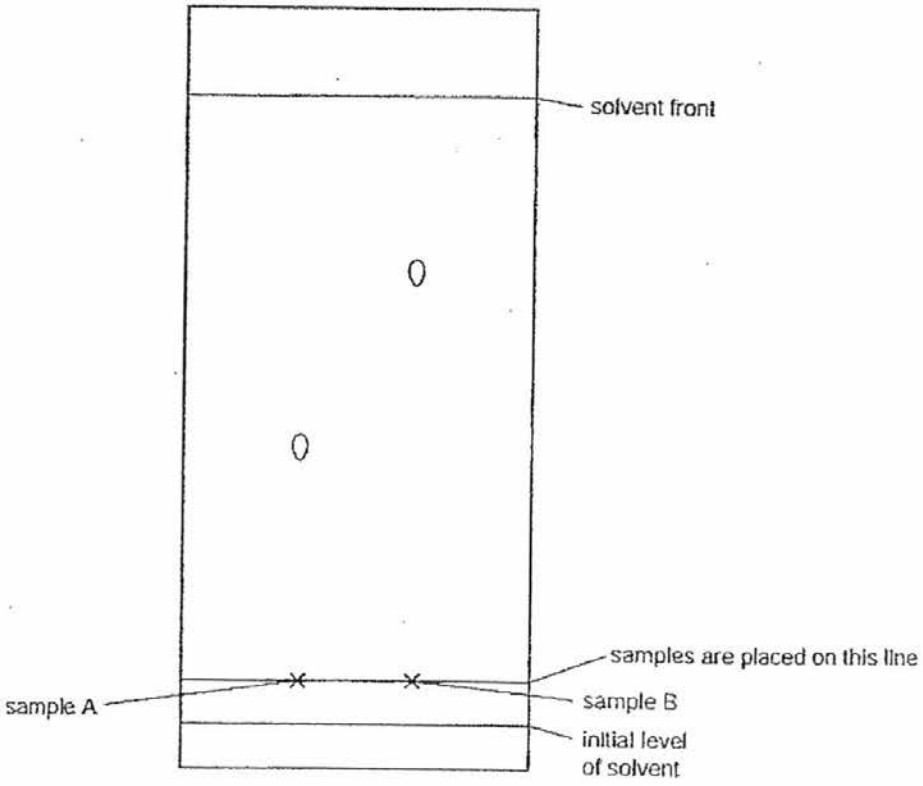
20 Which element is most likely to be a transition metal?

	melting point in °C	valency/valencies of oxide	colour of oxide
A	98	1	white
B	328	2	yellow
C	651	3 and 4	white
D	1240	2,4 and 6	black

Section B (50 marks)

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

B1 (a) Enzymes are biological catalysts. They are used both in research laboratories and in industry.
Enzymes called proteases can hydrolyse proteins to amino acids. The amino acids can be separated and identified by chromatography. The diagram below shows a typical chromatogram.



(i) Some R_f values for amino acids are: [2]

glutamic acid = 0.4
glycine = 0.5
alanine = 0.7
leucine = 0.9

Identify the two amino acids on the chromatogram.

A : _____ B : _____

(ii) Explain why the chromatogram must be exposed to a locating agent before R_f values can be measured. [1]

_____

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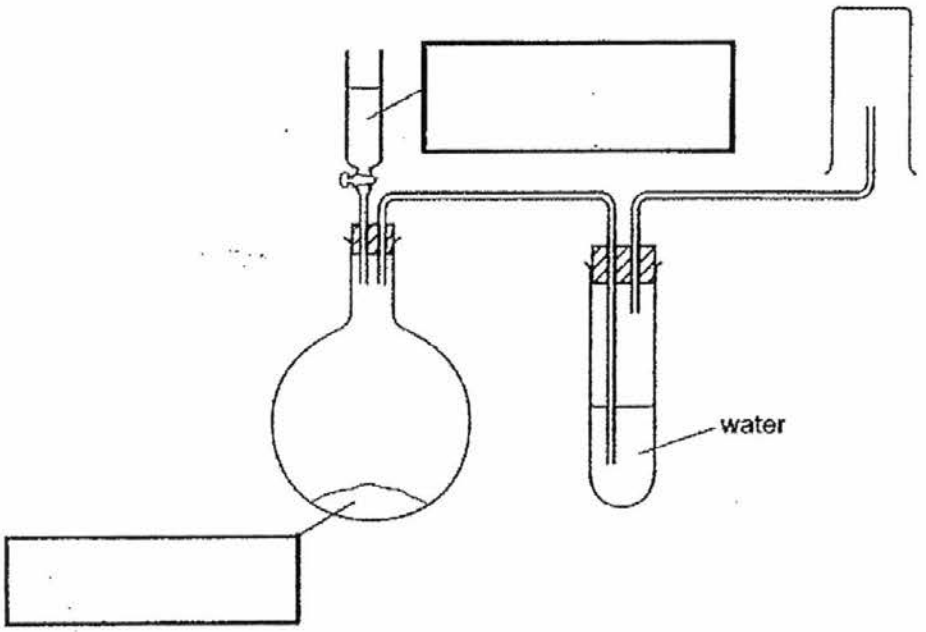
(b) When liquid nitrogen boils the following change occurs. [2]

$$N_2\,(l) \rightarrow N_2\,(g)$$

The boiling point of nitrogen is very low. Suggest an explanation.

B2 A sample of soluble sulfur dioxide can be prepared by adding dilute hydrochloric acid to sodium sulfite and warming the mixture. Study the diagram of the apparatus used.



(a) Fill in the boxes to show the chemicals used. [2]

(b) Show by using an arrow, on the diagram, where heat is applied. [1]

(c) Identify and explain two mistakes in the diagram. [4]

mistake 1: _____

explain: _____

mistake 2: _____

explain: _____

B3 Selenium and sulfur are in Group VI. They have similar properties.

The electron configuration of a selenium atom is 2. 8.18. 6

(a) Selenium forms a compound with potassium. Draw a 'dot and cross' diagram of this compound. Draw **only** the valence shell electrons. [2]

Use o to represent an electron from an atom of potassium.
Use x to represent an electron from an atom of selenium.

(b) Draw a 'dot and cross' diagram of the compound selenium chloride. [2]
Draw **only** the valence shell electrons.

Use x to represent an electron from an atom of selenium.
Use o to represent an electron from an atom of chlorine.

(c) Selenium dioxide behaves like sulfur dioxide and reacts with sodium hydroxide in the reaction shown.

$$SeO_2 + 2\ NaOH \rightarrow Na_2SeO_3 + H_2O$$

(i) Name the type of reaction. Explain. [2]

_____

_____

(ii) Predict the pH of the solution formed when selenium dioxide dissolves in water. [1]

_____

B4 (a) Rock phosphate (calcium phosphate) is obtained by mining. It reacts with concentrated sulfuric acid to form the fertiliser, superphosphate.

(i) Predict the formula of each of these phosphates. [2]

fertiliser	**ions**	**formula**
calcium phosphate	Ca^{2+} and PO_4^{3-}	----------
calcium superphosphate	Ca^{2+} and $H_2PO_4^-$	----------

(ii) Balance the chemical equation and write the ionic equation for the reaction of calcium phosphate with sulfuric acid [2]

___ $Ca_3(PO_4)_2$ (s) + ___ H_2SO_4 (aq) → ___ $CaSO_4$ (s) + ___ H_3PO_4 (aq)

ionic equation:

_____

(b) In an experiment, 25.0cm^3 of aqueous sodium hydroxide, 0.4mol / dm^3, was neutralised by 20.0cm^3 of aqueous oxalic acid, $H_2C_2O_4$.

$$2NaOH + H_2C_2O_4 \rightarrow Na_2C_2O_4 + 2H_2O$$

(i) Calculate the number of moles of NaOH in 25.0cm^3 of 0.4 mol/ dm^3 solution. [1]

(ii) Calculate the number of moles of $H_2C_2O_4$ in 20 cm^3 of solution. [2]

(iii) Calculate the concentration, mol/ dm^3, of the aqueous oxalic acid. [1]

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B5 (a) Four bottles were known to contain aqueous ammonia, dilute hydrochloric acid, sodium hydroxide solution and vinegar, which is dilute ethanoic acid. The bottles had lost their labels. The pH values of the four solutions were 1, 4, 10 and 13. [2]

Complete the table.

solution	pH
aqueous ammonia	
dilute hydrochloric acid	
sodium hydroxide solution	
vinegar	

(b) When nitric acid is added to water the following reaction occurs. [2]

$$HNO_3 + H_2O \rightarrow NO_3^- + H_3O^+$$

Give the name and the formula of the particle which is transferred from nitric acid to water.

Name:_____ Formula: _____

(c) This question is concerned with the following oxides.
(You may use the oxides once, more than once or not at all.)

aluminium oxide Al_2O_3

calcium oxide CaO

carbon dioxide CO_2

carbon monoxide CO

magnesium oxide MgO

sulfur dioxide SO_2

(i) Which two oxides will react with hydrochloric acid but not with aqueous sodium hydroxide? [1]

_____

(ii) Which two oxides will react with aqueous sodium hydroxide but not with hydrochloric acid? [1]

(iii) Which of the above oxides will react both with hydrochloric acid and with aqueous sodium hydroxide? [1]

(iv) Which of the above oxides will react neither with hydrochloric acid nor with aqueous sodium hydroxide? [1]

B6 The first three elements in Group IV are carbon, silicon, germanium.

(a) Draw the element germanium which has a diamond-type structure. [1]

(b) Unlike diamond, graphite is soft and is a good conductor of electricity.

(i) Explain why graphite has these properties. [2]

(ii) Give a use of graphite that depends on one of these properties. [1]

property

use

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(c) Carbon dioxide and silicon(IV) oxide have similar formulae but different types of structure.

(i) Give the formulae of these oxides. [1]

(ii) How are their structures different? [2]

(iii) Carbon formed the hydride called methane, CH_4. Predict the formula of the hydride formed by germanium. [1]

B7 (a) The Group I metals show trends in both their physical and chemical properties.

(i) How do their melting points vary down the group? [1]

(ii) Which element in the Group has the highest density? [1]

(iii) All Group I metals react with cold water. Write a balanced chemical equation for the reaction of rubidium with water. Include the state symbols. [2]

(b) Complete the table below on the trends **down** Group I and Group VII. [1]

Groups	Reactivity
I	
VII	

(c) Colourless potassium bromide will give a brown colour if reacted with chlorine gas. Explain. [2]

_____

_____

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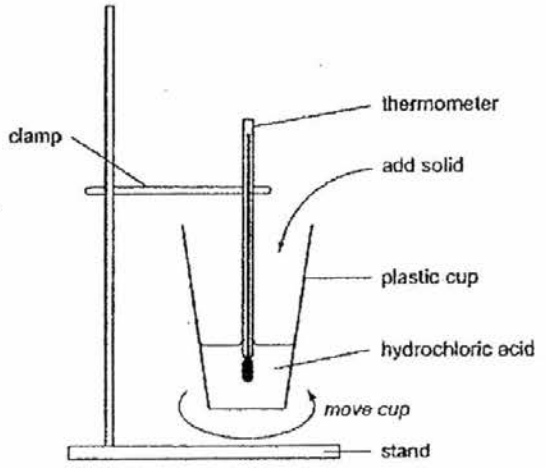
Section C (30 marks)

Answer **ALL 3** questions from this section.

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

C1 A student investigated the temperature changes that occur when two solid compounds A and B, react with hydrochloric acid. The apparatus below was used.



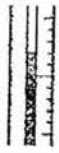
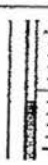
Experiment 1
By using a measuring cylinder, 30cm^3 of hydrochloric acid was added to the plastic cup. The timer was started, and some of the solid A was added to the cup. Immediate effervescence occurred. The mixture was stirred by moving the cup until the effervescence stopped. More of A was then added and the student continued adding A in this way until all of solid A had been added.

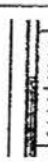
Experiment 2
Experiment 1 was repeated using solid B.

The results of the experiments are shown in the tables.

Table of results

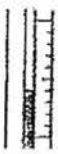
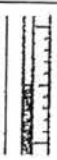
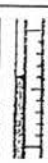
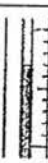
Experiment 1

time/min	0.0	0.5	1.0	1.5	2.0	2.5
thermometer diagram						
temperature / °C	22	24	26	28	29	30

3.0	3.5	4.0	4.5	5.0
				
30	29	28	27	26

Experiment 2

time/min	0.0	0.5	1.0	1.5	2.0	2.5
thermometer diagram						
temperature / °C	22	19	17	15	14	13

3.0	3.5	4.0	4.5	5.0
				
13	14	15	16	17

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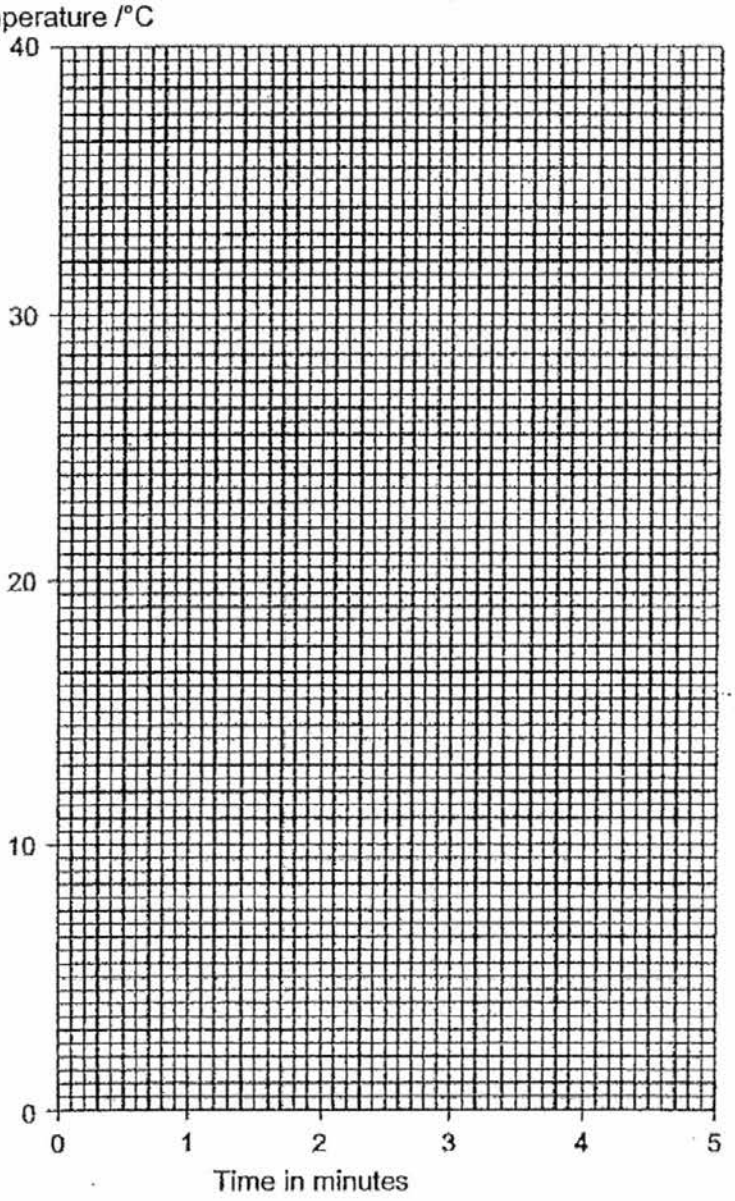
(a) Plot the results from both experiments on the grid below. For each set of results draw a smooth line graph. Indicate clearly which line represents Experiment 1 and which line Experiment 2. [3]



(b) (i) Find the temperature of the reaction mixture for solid A and solid B at 2 minute 15 seconds. [2]

solid A: _____

solid B: _____

(ii) Describe the trends of the results obtained from your graph. [1]

(c) Suggest what type of compound is A. Explain. [2]

(d). The plastic cup and final reaction mixture are left for one hour. [2]
Predict the temperature at this time for solid A and hydrochloric acid.
Explain.

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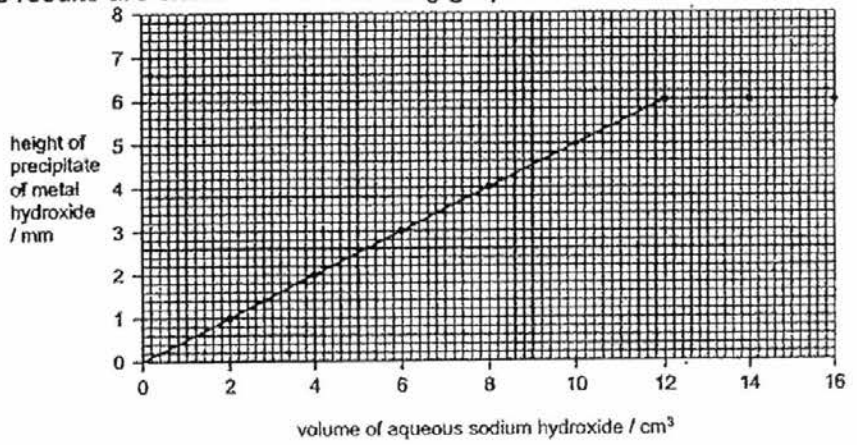
C2 (a) Iron (III) hydroxide and aluminium hydroxide are **insoluble**. Aluminium hydroxide dissolves in excess aqueous sodium hydroxide but **not** iron (III) hydroxide.

Excess aqueous sodium hydroxide were added to 4.0 cm^3 of aqueous iron(III) chloride. Both solutions had a concentration of 1.0 mol/dm^3. After each addition, the height of the solid deposits of iron(III) hydroxide was measured.

The results are shown on the following graph.



(i) Name the type of chemical reaction described above. [1]

(ii) If 4.0 cm^3 of 1.0 mol/dm^3 aluminium chloride had been used instead of iron(III) chloride, the shape of the graph would be different. How is the shape of this graph different at the end of the experiment and why? [2]

(b) Name two suitable reagents to form barium sulfate, an insoluble salt. [1]

(c) Magnesium hydroxide reacts with phosphoric acid to form magnesium phosphate and water.

$$3Mg(OH)_2 + 2H_3PO_4 \rightarrow Mg_3(PO_4)_2 + 6H_2O$$

(i) Define relative molecular mass. [1]

(ii) Calculate the **percentage purity** of a sample of $Mg(OH)_2$ if 2.568 g sample of $Mg(OH)_2$ required 2.523 g H_3PO_4 to react. [3]

(iii) A sample of 15.0 g $Mg(OH)_2$ was reacted with an **excess** of H_3PO_4. Calculate the **percentage yield** of $Mg_3(PO_4)_2$ if 15.5 g of $Mg_3(PO_4)_2$ is obtained. [2]

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EITHER

C3 (a) A student prepared solution **Q** which contained 0.125 mol/dm^3 of aqueous iron (II) sulfate dissolved in dilute sulfuric acid. Solution **Q** was left in the laboratory for five days and a small portion of it was converted to iron(III) sulfate.

On the fifth day, a student carried out titration to determine the actual concentration of iron(II) sulfate in solution **Q** by titrating it with potassium manganate(VII) solution. It was found that 24.50 cm^3 of 0.02 mol/dm^3 potassium manganate(VII) solution reacted with 25.0 cm^3 of solution **Q**.

The ionic equation for the reaction above is

$$5Fe^{2+}(aq) + MnO_4^-(aq) + 8H^+(aq) \rightarrow Mn^{2+}(aq) + 4H_2O(aq) + 5Fe^{3+}(aq)$$

(i) From the titration results, calculate the concentration of iron (II) sulfate in solution **Q** on the fifth day. [2]

(ii) Hence, calculate the % of iron (II) sulfate in solution **Q** that had been changed to iron (III) sulfate. [2]

(iii) 0.681 g of iron (II) sulfate crystals $FeSO_4.yH_2O$ was found to have reacted completely with 24.50 cm^3 of 0.02 mol/dm^3 potassium manganate(VII) solution. Find the value of **y**. [2]

(b) Chloroform, $CHCl_3$, reacts with chlorine, Cl_2, to form carbon tetrachloride, CCl_4, and hydrogen chloride, HCl.

In an experiment 25 g of chloroform and 25 g of chlorine were mixed.

(i) Write a balanced chemical equation for the reaction. [1]

(ii) What is the limiting reagent? Show your working and explain. [2]

(iii) Hence, calculate the mass of carbon tetrachloride formed. [1]

OR

C3 (a) Titanium is a transition element. It is isolated by the following reactions.

titanium ore → titanium(IV) oxide → titanium(IV) chloride → titanium
TiO_2 $TiCl_4$ Ti

(i) Why is it usually necessary to include a number in the name of the compounds of transition elements? [1]

(ii) Complete **A** and **B** in the table which shows some of the properties of titanium and its uses. The first line has been completed as an example. [2]

property	related use
soluble in molten steel	making steel titanium alloys
..... **A**	making aircraft and space vehicles
resistant to corrosion, especially in sea water	..... **B** .....

A _____

B _____

(iii) The titanium ore contains the following composition by mass: [3]

36.8% iron, 31.6% titanium and the remainder is oxygen.

Using an appropriate table, determine the empirical formula of this titanium compound.

(b) A student describes transition elements as having giant metallic lattice of atoms surrounded by a 'sea of immobile electrons'.

(i) Is the statement above correct? Explain. [2]

_____

_____

_____

(ii) Draw the kind of bonding in transition elements. [2]

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	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.).

ST. PATRICK'S SCHOOL
YEAR END 2016

SUBJECT : **Chemistry 5073**
LEVEL : **3 Express**
DATE : **2016**
DURATION : **2 hrs**

SECTION A (20m)

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

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

SECTION B (50m)

Calculations: No statement at all, 0 marks
Some statements, -1m

					tl
B1	(a)	i	A is glutamic acid (1) B is alanine (1) Accept names only, NOT R_f values **Spelling incorrect: incorrect**	2	5
		ii	because acids are colourless or to make them visible (1) or to show positions of the samples or distance travelled	1	
	(b)		weak intermolecular (or between molecules) forces / Van der Waals forces between molecules / low amount of energy required to break weak intermolecular forces between molecules; (1) **Independent marking**	2	
B2	(a)		boxes completed correctly to show position of hydrochloric acid (1) and sodium sulfite (1)	2	7
	(b)		arrow underneath flask (1)	1	
	(c)		Mistake 1 passed through water(1) explain: SO_2 is soluble in water (1) Mistake 2 :collected by upward delivery (1) explain: SO_2 is denser than air (1) mistake and explain: dependent and go together: then mark	4	

			awarded **concepts correct, marks awarded**		
B3	(a)		Correct ionic diagram of $2K^+$ with brackets (1) Correct ionic diagram of Se^{2-} with brackets (1) **Wrong use of symbols(dot and cross): OK**	2	7
	(b)		Correct covalent diagram of $SeCl_2$ (2) 0 or 2 m only **No chemical symbols (-1m)**	2	
	(c)	(i)	Neutralization (1) **2nd mark dependent on 1st mark** **selenium dioxide behaves like an acid (1/2)** **selenium dioxide an acidic oxide behaves like an acid (1)** **incorrect if wrong concept**	2	
		(ii)	pH less than 7 **(any no less than 7)**	1	
B4	a	i	$Ca_3(PO_4)_2$ (1) $Ca(H_2PO_4)_2$ (1)	2	8
		ii	___$Ca_3(PO_4)_2$ (s) +**3** H_2SO_4 (aq) → **3** $CaSO_4$ (s) + **2** H_3PO_4 (aq) (1) ionic eqn: $Ca_3(PO_4)_2$ (s) + $3SO_4^{2-}$ (aq)→**3** $CaSO_4$ (s) +**2** PO_4^{3-} (aq)(1) **no state symbols: incorrect**	2	
	b	i	moles of NaOH = 25/1000 x 0.4 = 0.01	1	
		ii	Mark conseq to (i) NaOH:$H_2C_2O_4$ 2mole: 1mole (1) moles of acid = 0.01/2 = 0.005 (1)	2	
		iii	Mark conseq to (ii) concentration of acid = 0.005 x 1000/20 = 0.25 mol/dm^3(1) **(no unit, -1/2m)**	1	
B5	(a)		ammonia 10 hydrochloric acid 1 sodium hydroxide 13 ethanoic acid 4 **(1/2m each)**	2	8
	(b)		proton / hydrogen **ion** [1] H^+ **independent** **hydrogen : incorrect**	2	
	(c)	i	CaO and MgO (no ½m)	1	

		ii	CO_2 and SO_2 (no ½m)	1	
		iii	Al_2O_3	1	
		iv	CO	1	
B6	(a)		4 Ge atoms around 1 Ge Diagram: Looks tetrahedral or stated to be **(at least 2 layers)**	1	8
	(b)	i	Graphite has layers that can move/slip (1) **(If weak Van der Waals forces between layers only (1/2))** Graphite has delocalised/free/mobile electrons (1)	2	
	(b)	ii	Property **(only soft and good conductor)** and use (must be together) soft lubricant or pencils OR good conductor electrodes or in electric motors	1	
	(c)	i	CO_2 and SiO_2 or XO_2 **(no 1/2m)**	1	
		ii	CO_2 molecular or simple molecules or simple covalent (1) SiO_2 macromolecular or giant covalent/giant molecular (1) **independent**	2	
		iii	GeH_4	1	
B7	(a)	i	decrease down group;	1	7
		ii	francium	1	
		iii	$2Rb (s) + 2H_2O (l) \rightarrow 2RbOH (aq) + H_2 (g)$ State symbols :1m if only chemical equation is balanced and correct.	2	
	(b)	i	**Groups** / **Reactivity** **I** / **Increases (1/2)** **VII** / **Decreases (1/2)**	1	
		ii	Displaces/Displacement reaction (1) **(independent)** Chlorine is more reactive (1) **Ignore displaces bromine**	2	

Section C (30m)

C1	a		check 22^0C , mid- points and peak points (1/2 for each graph) Smooth line graphs (1/2 for each graph)) Labelled Expt 1(1/2) and Expt 2 (1/2)	3	10
	b	i	Solid A: 29-30^{0}C (1) Solid B 12.5- 13.5^{0}C (1) **No unit no no dp, 2dp (-1/2) deduct once only**	2	
		ii	Solid A cause an increase **(1/2)** in the temperature while solid B cause a decrease in the temperature **(1/2)** **Peak/lowest and highest pts: incorrect (looking for trends)**	1	
	c		A is a carbonate, (1) effervescence (1) (dependent) **Either 2m or 0 m**	2	
	d	i	Solid A – value from table 22^0C **No heat lost (1/2)or No gain of heat (1/2)**	2	

C2	a	i	Precipitation reaction (1)	1	**10**
		ii	Zero (1) **Height decreases or goes down to x axis (1/2)** Hydroxide soluble in excess (1) **2nd m depends on the 1st m**	2	
		b	Barium nitrate/barium hydroxide and K/Na/ammonium sulfate or sulfuric acid	1	
	c	i	Average mass of a molecule compared to 1/12 mass of an atom of carbon-12	1	
		ii	No of mole of $Mg(OH)2$ =2.568/ 24 + 2(16+1) = 0.04427 (1/2) No of mole of $H3PO4$ = 2.523/3(1) + 31 +(16x4) =2.523/98 =0.0257 (1/2) $Mg(OH)2$: $H3PO4$ 3 mole : 2mole) (1/2) 3/2 x0.0257 : 0.0257 0.0386 : 0.0257 (1/2) Percentage purity of $Mg(OH)2$ = 0.0386/0.04427 x100 = 87.2% (1)	3	
		iii	No of mole $Mg(OH)_2$ = 15/24+2(16+1) = 0.2586 (1/2) No of mole of $Mg_3(PO4)_2$ = 1/3 x 0.2586 = 0.0862 (1/2) Mr $Mg_3(PO4)_2$ = [3x24+(31+64)2] =262 Mass of $Mg_3(PO4)_2$ = 0.0862 x 262 =22.58 g % yield = 15.5/22.58 x 100= 68.6% (1)	2	
EITHER C3	(a)	(i)	Mole of $KMnO_4$ = 24.5/1000 x 0.02 = 0.00049 (1/2) Mole of iron (II) sulfate = 5 x0.00049 =0.00245 (1/2) Concentration of $FeSO_4$ = 0.00245 x1000/ 25 = 0.098 mol/dm3 (1)	2	**10**
		(ii)	Concentration of iron (II) sulfate = 0.125 - 0.0098 = 0.027 mol/dm3	2	

			(1) % of iron (II) sulfate oxidized in Q = 0.027/0.125 x 100 = 21.6 % (1)		
		(iii)	Mole of $FeSO_4.yH_2O$: Mole of $KMnO_4$ 5 : 1 0.00245 : 0.00049 0.00245 mole = 0.681g 1mole = 278 g (1) Thus, 56 + 32 + 4(16) + y(18) = 278 Y = 7 (1)	2	
	b	(i)	CHCl3 + Cl2 ------> CCl4 + HCl	1	
		(ii)	No of mole of chloroform = 25/ 119.5 =0.209 No of mole of chlorine, Cl2 = 25/71 =0.352 From equation 1 mole of chloroform will react with 1 mole of chlorine 0.209 mole chloroform should react with 0.209 of Cl2 but 0.352 mole of chlorine is used, chlorine is in excess , limiting reagent is chloroform, CHCl3. (2) Calculations incorrect, limiting reagent correct (1m)	2	
		(iii)	No of mole of chloroform formed = 0.209 Mass of carbon tetrachloride formed = 0.209 x [12+ 4(35.5)] = 32.2 g (1)	1	
OR C3	(a)	(i)	a transition element has more than one oxidation state or valency accept different oxidation states/have several charges/different ions/show valency	1	**10**
		(ii)	low density / lightweight / light (1) propellers / fittings on ships replacements / ship building / diving equipment (1)	2	
		(iii)	Calculation correct for 3 columns(2) 2 columns correct 1m	3	

No heading on table. -1m

formula is FeTiO3 accept TiFeO3(1)

element	Fe	Ti	O
% mass	36.8	31.6	31.6
No of mole	36.8/56=0.6571	31.6/48=0.6583	31.6/16=1.975
Divide by smallest no	0.6571/0.6571= 1	o.6583/0.6571=1	1.975/0.6571 =3
Simplest ratio(optio nal)	1	1	3

Empirical formula FeTiO3

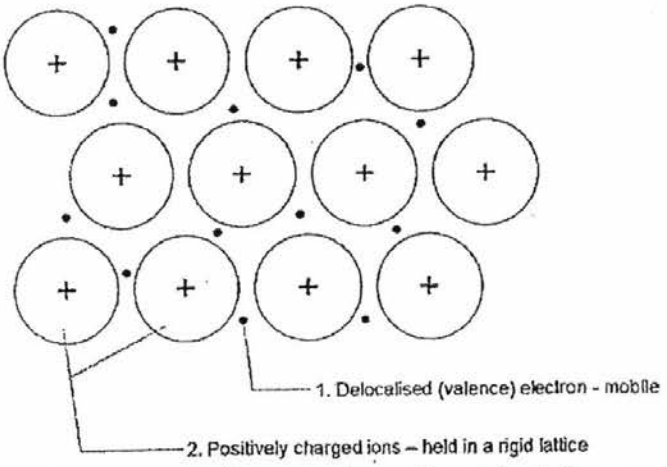
0m if not table method

(b) (i) It has giant metallic lattice of ions /metallic lattice of ions (1) surrounded by a sea of mobile electrons. (1) independent — 2

If yes: 0 mark

(ii) — 2

Metallic Bonding



2m for accurate diagram: **ions /in orderly layers (at least 2 layers)/electrons**

0m or 2m