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NAME	CLASS	INDEX No.
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ST. PATRICK'S SCHOOL END OF YEAR EXAMINATIONS 2016

SUBJECT : CHEMISTRY 5073 DATE : 4th October 2016
 LEVEL : SECONDARY 3 EXPRESS DURATION : 2 Hr

INSTRUCTIONS TO CANDIDATES

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

- 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).**
- Answer **ALL** questions in **Section A** on the **Optical Answer Sheet** provided.
- Answer **ALL** questions in **Section B** in the spaces provided in this booklet.
- 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.**
- Calculators may be used where necessary. **Where numerical answers are not exact, give answers to three (3) significant figures.**
- 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 cm³ 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	✓	✓	✓	✓	x
B	✓	✓	x	✓	✓
C	✓	x	✓	✓	✓
D	x	✓	✓	x	✓

- 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.

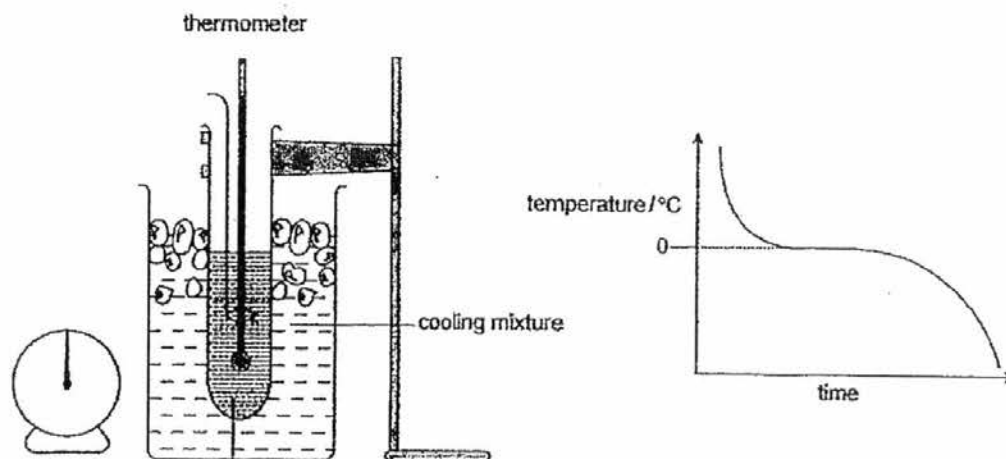
What is correct?

	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?

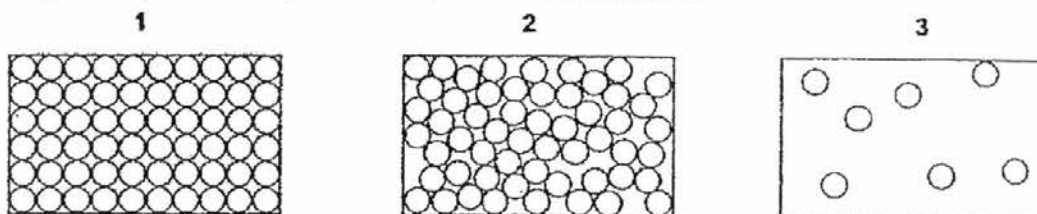
	boiling point/ °C
A	95
B	100
C	103
D	250

- 4 The diagrams show a cooling experiment and the results.



What liquid could X be?

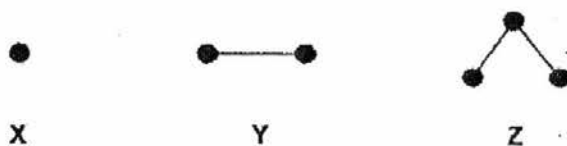
- A sodium chloride solution
 - B pure water
 - C alcohol
 - D mercury
- 5 Diagrams 1, 2 and 3 represent the three states of matter.



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.



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.

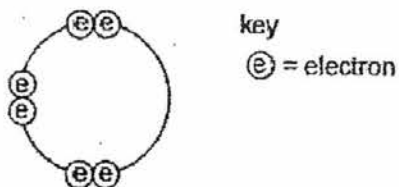
The M_r of gas P was 34 and the M_r of Q was 64. Which gas on which day would reach the end of the laboratory in the shortest time?

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

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

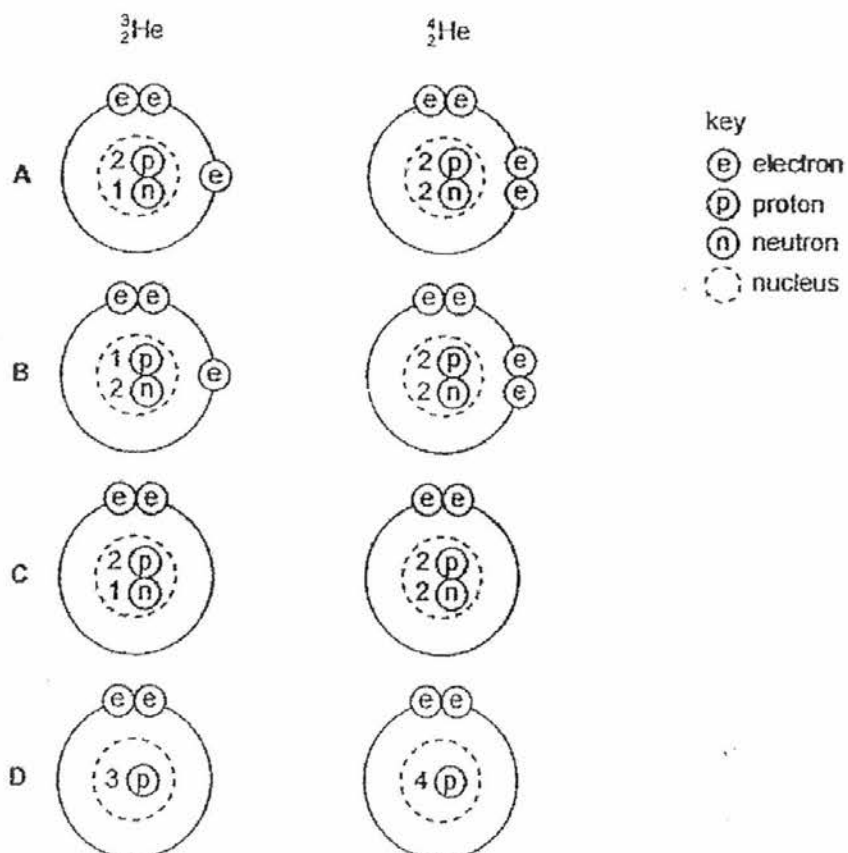
- A** 30
- B** 33
- C** 36
- D** 42

- 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 ${}^3_2\text{He}$ and ${}^4_2\text{He}$. 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	✓	x	x	x
B	✓	✓	x	x
C	x	x	x	✓
D	x	x	✓	✓

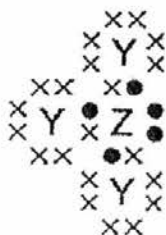
- 14 Which statement describes the trends going down group VII of the Periodic Table?
- A The boiling point and melting point both decrease.
 - B The boiling point and melting point both increase.
 - C The boiling point decreases but the melting point increases.
 - D The boiling point increases but the 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?

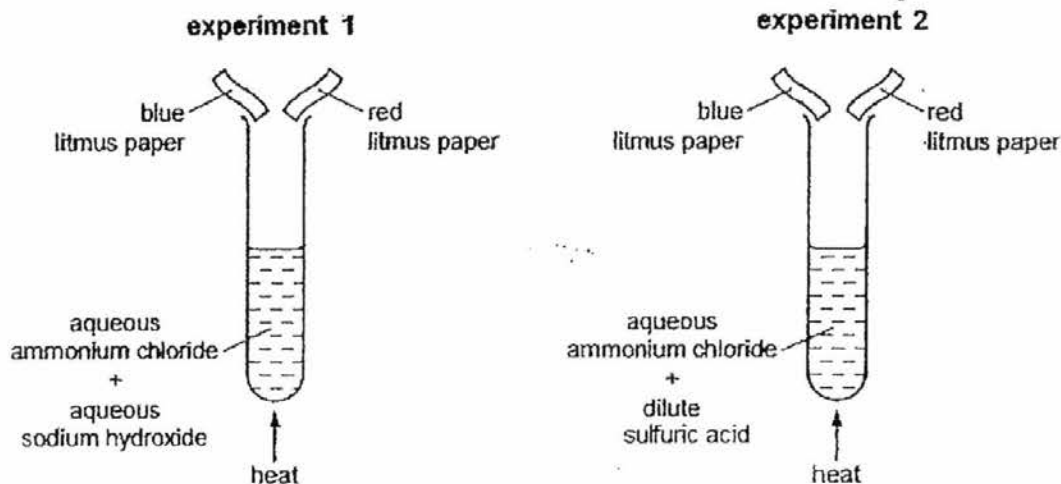
	(i)	(ii)
A	an atom	thirty two molecules
B	an atom	eight molecules
C	a molecule	sixteen atoms
D	a molecule	eight atoms

- 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?

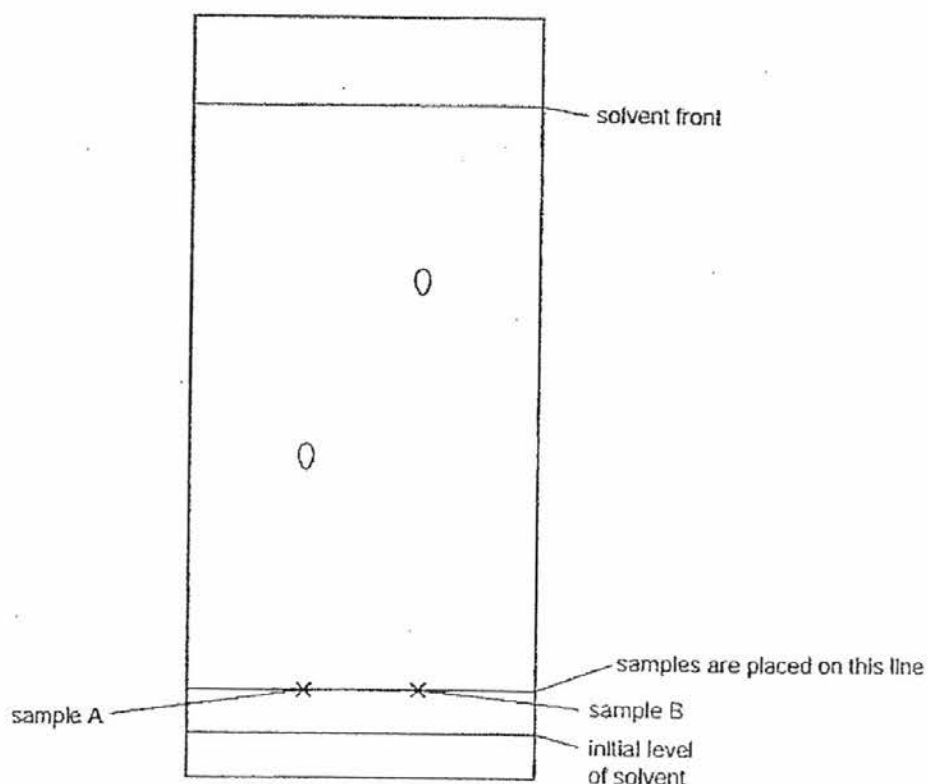
	melting point in °C	valency/valencies of oxide	colour of oxide
A	98	1	white
B	328	2	yellow
C	651	3 and 4	white
D	1240	2,4 and 6	black

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.

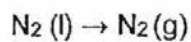
A:

B:

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

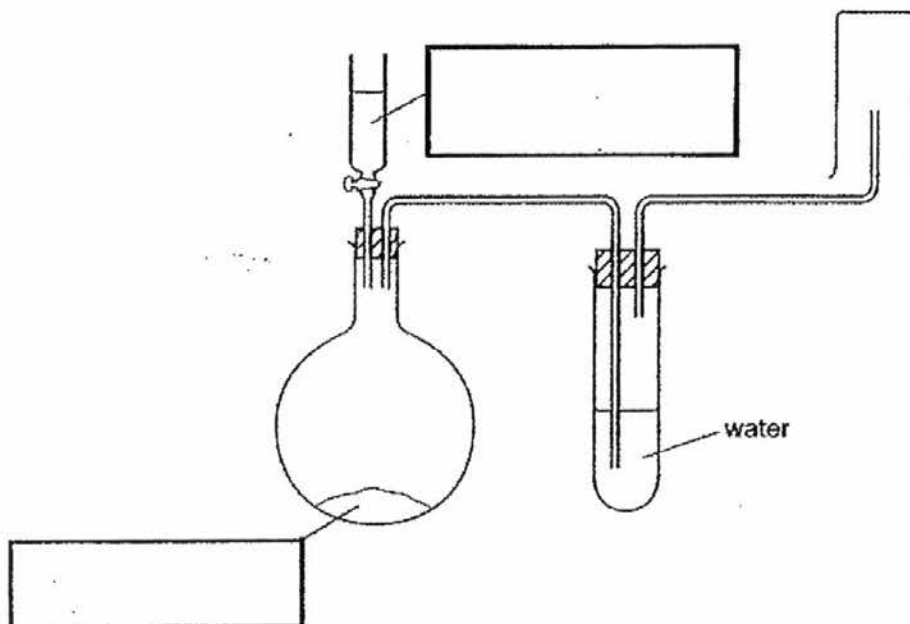
(b) When liquid nitrogen boils the following change occurs.

[2]



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.

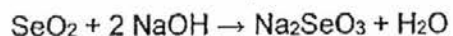
(b) Draw a 'dot and cross' diagram of the compound selenium chloride. Draw **only** the valence shell electrons.

[2]

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.



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

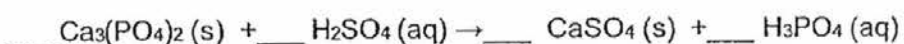
- (ii) Predict the pH of the solution formed when selenium dioxide dissolves in water. [1]

- 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]

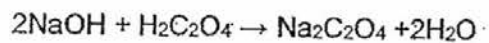
fertiliser	ions	formula
calcium phosphate	Ca^{2+} and PO_4^{3-}	_____
calcium superphosphate	Ca^{2+} and H_2PO_4^-	_____

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



ionic equation:

- (b) In an experiment, 25.0cm³ of aqueous sodium hydroxide, 0.4mol / dm³, was neutralised by 20.0cm³ of aqueous oxalic acid, H₂C₂O₄.



- (i) Calculate the number of moles of NaOH in 25.0cm³ of 0.4 mol/ dm³ solution. [1]
- (ii) Calculate the number of moles of H₂C₂O₄ in 20 cm³ of solution. [2]
- (iii) Calculate the concentration, mol/ dm³, of the aqueous oxalic acid. [1]

- 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]



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

- (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]

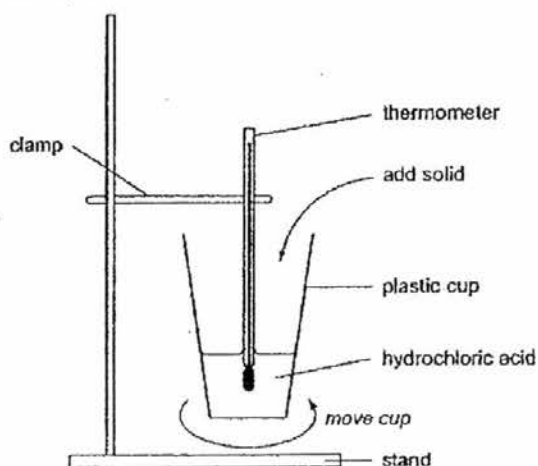
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Section C (30 marks)

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, 30cm³ 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

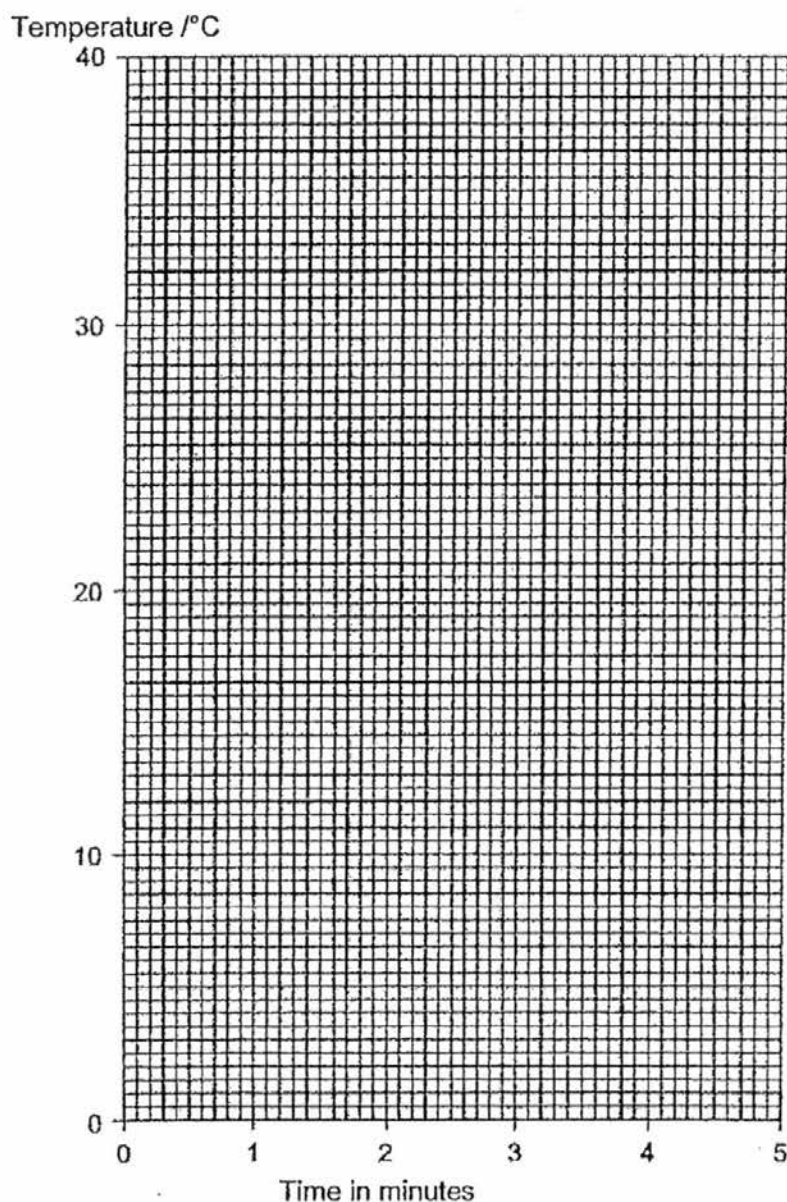
Experiment 1

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	

- (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]

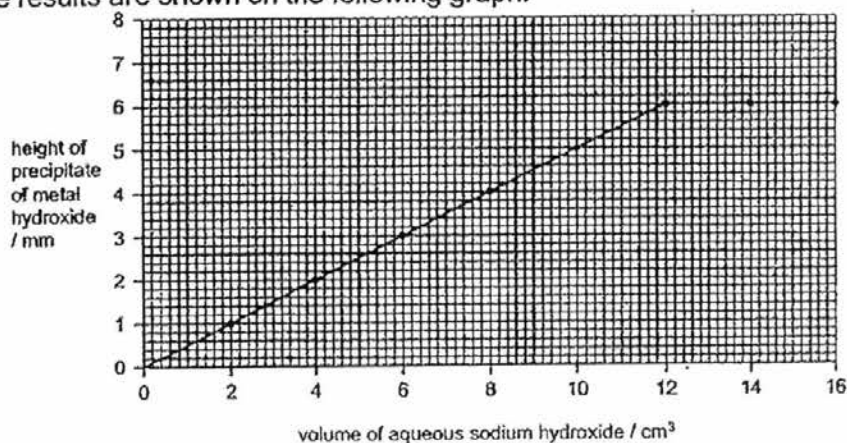
- (d) The plastic cup and final reaction mixture are left for one hour. Predict the temperature at this time for solid A and hydrochloric acid. Explain. [2]

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.

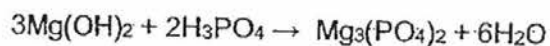


- (i) Name the type of chemical reaction described above. [1]

- (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.



- (i) Define relative molecular mass.

[1]

-
- (ii) Calculate the **percentage purity** of a sample of $\text{Mg}(\text{OH})_2$ if 2.568 g sample of $\text{Mg}(\text{OH})_2$ required 2.523 g H_3PO_4 to react.

[3]

- (iii) A sample of 15.0 g $\text{Mg}(\text{OH})_2$ was reacted with an **excess** of H_3PO_4 . Calculate the **percentage yield** of $\text{Mg}_3(\text{PO}_4)_2$ if 15.5 g of $\text{Mg}_3(\text{PO}_4)_2$ 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



- (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 $\text{FeSO}_4 \cdot y\text{H}_2\text{O}$ 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.

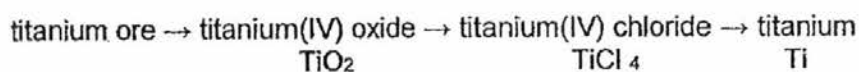
- (i) Write a balanced chemical equation for the reaction. [1]

- (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.



- (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

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Group																			
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0		
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	4 He helium 2	
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	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	127 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	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

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.).

140	Ce		141	Pr		142	Nd		143	Pm		144	Sm		145	Eu		146	Gd		147	Tb		148	Dy		149	Ho		150	Er		151	Tm		152	Yb		153	Lu
58	cerium		59	praseodymium		60	neodymium		61	promethium		62	samarium		63	europlum		64	gadolinium		65	terbium		66	dysprosium		67	holmium		68	erbium		69	thulium		70	ytterbium		71	lutetium
232	Th		231	Pa		238	U		235	Pu		239	Am		241	Cm		244	Bk		247	Cf		250	Es		253	Fm		256	Md		259	No		262	Lr			
90	thorium		91	protactinium		92	uranium		93	neptunium		94	plutonium		95	americium		96	curium		97	berkelium		98	californium		99	einsteinium		100	fermium		101	mendelevium		102	nobelium		103	lawrencium

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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

					<u>tl</u>
B1	(a)	i	A is glutamic acid (1) B is alanine (1) Accept names only, NOT R _f values Spelling incorrect: incorrect	2	<u>5</u>
		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	<u>7</u>
	(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	

1 28

			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	<u>7</u>
	(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	<u>8</u>
		ii	$Ca_3(PO_4)_2(s) + 3H_2SO_4(aq) \rightarrow 3CaSO_4(s) + 2H_3PO_4(aq)$ (1) ionic eq ⁿ : $Ca_3(PO_4)_2(s) + 3SO_4^{2-}(aq) \rightarrow 3CaSO_4(s) + 2PO_4^{3-}(aq)$ (1) no state symbols: incorrect	2	
	b	i	moles of NaOH = $25/1000 \times 0.4 = 0.01$	1	
		ii	Mark conseq to (i) NaOH:H ₂ C ₂ O ₄ 2mole: 1mole (1) moles of acid = $0.01/2 = 0.005$ (1)	2	
		iii	Mark conseq to (ii) concentration of acid = $0.005 \times 1000/20 = 0.25 \text{ mol/dm}^3$ (1) (no unit, -1/2m)	1	
B5	(a)		ammonia 10 hydrochloric acid 1 sodium hydroxide 13 ethanoic acid 4 (1/2m each)	2	<u>8</u>
	(b)		proton / hydrogen ion [1] H^+ independent hydrogen : incorrect	2	
	(c)	i	CaO and MgO (no 1/2m)	1	

		ii	CO ₂ and SO ₂ (no ½m)	1							
		iii	Al ₂ O 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	<u>8</u>						
	(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) <u>and</u> 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	<u>7</u>						
		ii	francium	1							
		iii	2Rb (s)+ 2H ₂ O (l)→ 2RbOH (aq) + H ₂ (g) State symbols :1m if only chemical equation is balanced and correct.	2							
	(b)	i	<table border="1"> <tr> <th>Groups</th> <th>Reactivity</th> </tr> <tr> <td>I</td> <td>Increases (1/2)</td> </tr> <tr> <td>VII</td> <td>Decreases (1/2)</td> </tr> </table>	Groups	Reactivity	I	Increases (1/2)	VII	Decreases (1/2)	1	
Groups	Reactivity										
I	Increases (1/2)										
VII	Decreases (1/2)										
		ii	Displaces/Displacement reaction (1) (independent) Chlorine is more reactive (1) Ignore displaces bromine	2							

Section C (30m)

C1	a	check 22°C , 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	<u>10</u>
	b	i	Solid A: 29-30°C (1) Solid B 12.5- 13.5°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°C No heat lost (1/2)or No gain of heat (1/2)	2	

C2	a	i	Precipitation reaction (1)	1	<u>10</u>
		ii	Zero (1) Height decreases or goes down to x axis (1/2) Hydroxide soluble in excess (1) 2 nd m depends on the 1 st 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 $H_3PO_4 = 2.523 / 3(1) + 31 + (16 \times 4) = 2.523 / 98 = 0.0257$ (1/2) $Mg(OH)_2 : H_3PO_4$ 3 mole : 2mole) (1/2) $3/2 \times 0.0257 : 0.0257$ 0.0386 : 0.0257 (1/2) Percentage purity of $Mg(OH)_2 = 0.0386 / 0.04427 \times 100 = 87.2\%$ (1)	3	
		iii	No of mole $Mg(OH)_2 = 15 / 24 + 2(16+1) = 0.2586$ (1/2) No of mole of $Mg_3(PO_4)_2 = 1/3 \times 0.2586 = 0.0862$ (1/2) $Mr Mg_3(PO_4)_2 = [3 \times 24 + (31 + 64) \times 2] = 262$ Mass of $Mg_3(PO_4)_2 = 0.0862 \times 262 = 22.58$ g % yield = $15.5 / 22.58 \times 100 = 68.6\%$ (1)	2	
EITHER C3	(a)	(i)	Mole of $KMnO_4 = 24.5 / 1000 \times 0.02 = 0.00049$ (1/2) Mole of iron (II) sulfate = $5 \times 0.00049 = 0.00245$ (1/2) Concentration of $FeSO_4 = 0.00245 \times 1000 / 25$ = 0.098 mol/dm ³ (1)	2	<u>10</u>
		(ii)	Concentration of iron (II) sulfate = $0.125 - 0.0098 = 0.027$ mol/dm ³	2	

		(1)	% of iron (II) sulfate oxidized in Q = $0.027/0.125 \times 100 = 21.6 \%$ (1)		
		(iii)	Mole of $\text{FeSO}_4 \cdot y\text{H}_2\text{O}$: 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)	$\text{CHCl}_3 + \text{Cl}_2 \longrightarrow \text{CCl}_4 + \text{HCl}$	1	
		(ii)	No of mole of chloroform = $25/119.5 = 0.209$ No of mole of chlorine, $\text{Cl}_2 = 25/71 = 0.352$ From equation 1 mole of chloroform will react with 1 mole of chlorine 0.209 mole chloroform should react with 0.209 of Cl_2 but 0.352 mole of chlorine is used, chlorine is in excess, limiting reagent is chloroform, CHCl_3 . (2) Calculations incorrect, limiting reagent correct (1m)	2	
		(iii)	No of mole of chloroform formed = 0.209 Mass of carbon tetrachloride formed = $0.209 \times [12 + 4(35.5)]$ = 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	$0.6571/0.6571=1$	$0.6583/0.6571=1$	$1.975/0.6571=3$
Simplest ratio(optional)	1	1	3

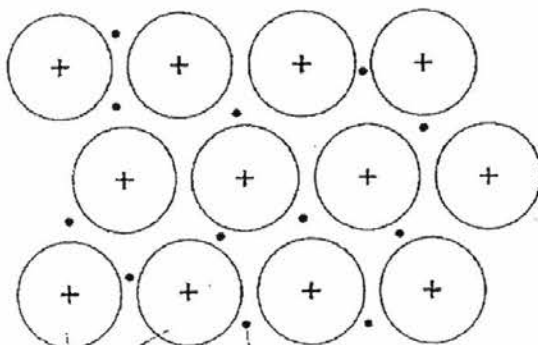
Empirical formula FeTiO₃

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
If yes: 0 mark

(ii)

Metallic Bonding



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

0m or 2m

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END