Name:		Index Number:		Class:	

CATHOLIC HIGH SCHOOL
Preliminary Examination 3
Secondary 4

A

CHEMISTRY

5073/2

Paper 2

17 September 2014

1 hour 45 minutes

Additional Materials: Answer Paper

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any rough working. You may use a calculator.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE ON THE MARGINS.
A copy of the Periodic Table is printed on page 13.

Section A
Answer all questions in the spaces provided.

For examiner's use only: **Section A / 50**

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

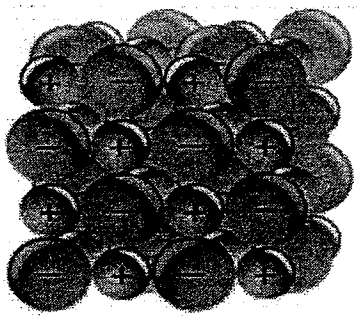
This document consists of **13** printed pages, **including** this cover page.
Page 12 has been intentionally left blank.

[Turn over]

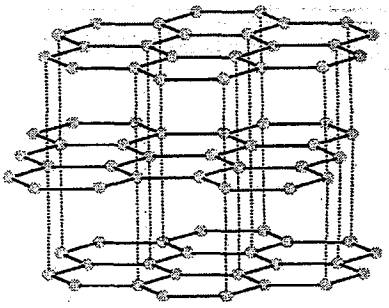
Section A (50 marks)

Answer all questions in the spaces provided.

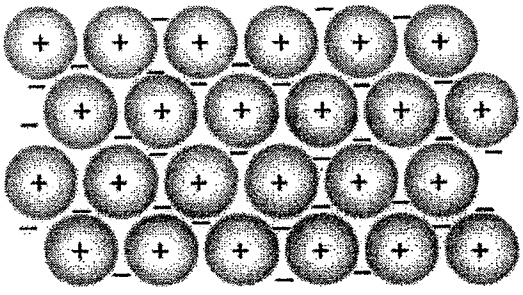
A1 Four structures of solids are shown below.



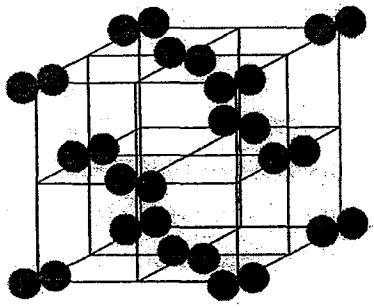
Structure A



Structure B



Structure C



Structure D

Use the letters **A**, **B**, **C** and **D** to answer parts **(a)** to **(e)**. Each letter can be used once, more than once, or not at all.

(a) Which of the above structures best represents lithium bromide? **[1]**

_____

(b) Which of the above structures best represents iodine? **[1]**

_____

(c) State all the structures above which represent substances that conduct electricity because of the presence of mobile electrons. **[1]**

_____

Question 1 continues...

(d) Which of the structures represents the material that is best used as the anode during the electroplating of copper? **[1]**

_____

(e) Some of the structures represent substances that have high melting points. State the letters of **two** of these structures and explain why they have high melting points, in terms of the bonding present in them. **[4]**

Structure: _____

Explanation: _____

_____

_____

_____

Structure: _____

Explanation: _____

_____

_____

_____

[Total marks: 8]

A2

A "barium meal" is used in radiology to improve X-ray images of the gastrointestinal tract (the gut). It also helps to observe digestion and to detect ulcers and tumours in the stomach.

The "barium meal" is administered to the patient as follows:

(i) The patient takes some citric acid and sodium hydrogen carbonate ($NaHCO_3$) tablets. This produces a salt (sodium citrate), water and an acidic gas which helps to expand the stomach and gut walls.

(ii) The patient drinks a suspension of barium sulfate, which will not be absorbed by the body.

(iii) Barium sulfate prevents X-rays from passing through and thus images can be clearly seen.

(a) State the word or phrase in the information given above which tells you that barium sulfate is insoluble in water. **[1]**

_____

(b) Describe a chemical test to confirm the identity of the gas produced in step **(i)**. **[2]**

_____

_____

(c) Describe briefly how a pure, dry sample of barium sulfate can be prepared in the laboratory. Include the names of the reagents in your answer. **[3]**

_____

_____

_____

_____

_____

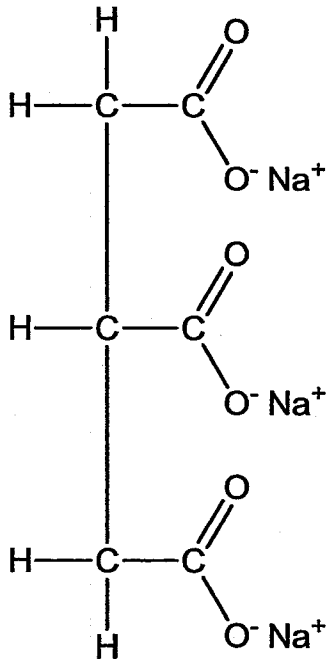
Question 2 continues...

(d) Suggest why barium chloride should not be taken by the patient in place of barium sulfate. **[1]**

_____

_____

(e) Sodium citrate is formed in step **(i)**. It has the following structure:



By referring to the structure of sodium citrate, draw the structure of citric acid. **[1]**

[Total marks: 8]

A3 The following information was found on a 100PLUS can:

NUTRITIONAL INFO

Serving per package: 1 Serving size: 325ml

	Per serving	Per 100ml
Energy	370 kj	113 kj
	88 kcal	27 kcal
Total fat	0 g	0 g
Protein	0 g	0 g
Carbohydrate	22.1 g	6.8 g
- Sucrose	15.6 g	4.8 g
- Glucose	6.5 g	2.0 g
Sodium	156 mg	48 mg
Potassium	46 mg	14 mg
Calcium	2 mg	0.6 mg
Chloride	127 mg	39 mg
Phosphate	55 mg	17 mg

Ingredients: Carbonated water, sucrose, glucose, citric acid, sodium citrate, sodium chloride, potassium phosphate, citrus flavouring, preservative (sodium benzoate E211) and calcium phosphate.

These substances exist as **aqueous ions** in the mixture (1 g = 1000 mg)

(a) The "citrus flavouring" found in the ingredients of 100PLUS is artificially made in the laboratory. Suggest a homologous series of organic compounds that this artificially-flavoured compound could belong to: _____ **[1]**

(b) Calcium ions and phosphate (V) ions, PO_4^{3-}, are found in 100PLUS. State the chemical formula of calcium phosphate. **[1]**

_____

(c) Suggest the name or formula of a positive ion which is also found in 100PLUS, but not listed in the table above: _____ **[1]**

(d) Calculate the concentration of potassium ions in **mol/dm^3** per can (serving) of 100PLUS. **[2]**

Question 3 continues...

(e) By referring to the masses of sodium and chloride ions in the table, show by calculation that there are compounds of sodium other than sodium chloride.

[2]

(f) A student wanted to remove **all** the chloride ions in a can (serving) of 100PLUS by adding 1 mol/dm^3 of aqueous lead(II) nitrate to form a precipitate of lead(II) chloride.

(i) What is the **minimum** volume of aqueous lead(II) nitrate he should add? **[2]**

(ii) The student then proceeded to add excess aqueous lead(II) nitrate and found that the mass of the precipitate formed was larger than expected. Suggest why. **[1]**

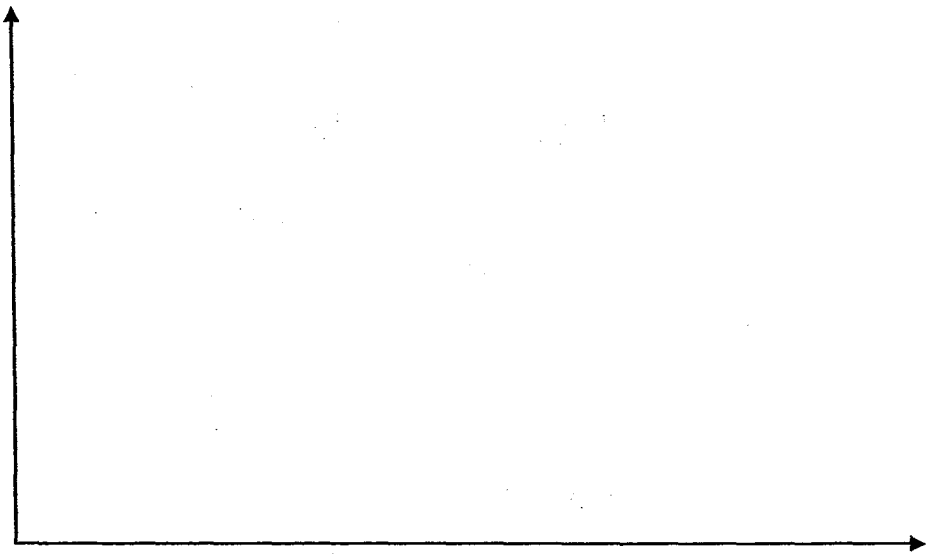
_____

Question 3 continues...

(g) The energy which a can (serving) of 100PLUS provides comes from the breaking down of the carbohydrates (sucrose and glucose) in our bodies. This can be represented by the unbalanced equation:

$$C_xH_yO_z + O_2 \rightarrow CO_2 + H_2O \qquad \Delta H < 0$$

Draw an energy profile diagram of the above reaction. Label clearly the axes, reactants, products, activation energy and enthalpy change. **[3]**



(h) Explain why the reaction in part **(g)** is an exothermic reaction, in terms of bond-breaking and bond-forming. **[2]**

_____

_____

_____

[Total marks: 15]

A4 Petrol and naphtha are two fractions obtained from the fractional distillation of petroleum. They contain the following hydrocarbons:

Fraction	Hydrocarbons
Petrol	Alkanes containing 5 to 8 carbon atoms
Naphtha	Alkanes containing 9 to 12 carbon atoms

(a) Describe how petroleum is separated by fractional distillation. **[3]**

(b) Octane is one of the alkanes found in petrol. Octane contains 8 carbon atoms and can be cracked to form propane and another hydrocarbon **X**.

(i) Write a balanced chemical equation for this reaction, stating the actual molecular formula of **X**. **[1]**

(ii) Describe how propane and **X** can be distinguished from each other by using aqueous bromine. **[2]**

(c) A different hydrocarbon, **Y**, is known to belong to either the petrol or naphtha fractions.
A student wishes to find out which fraction **Y** belongs to by comparing the physical properties of **Y** and octane.
State a relevant physical property, other than relative molecular mass, and describe how this property can be used to determine which fraction **Y** belongs to. **[2]**

(d) Methane is also found in petroleum fractions.
Methane is able to undergo a reaction with chlorine and fluorine to form CCl_2F_2.

(i) State the **type** of reaction methane undergoes to form CCl_2F_2, and state the condition required. **[2]**

_____

_____

(ii) Draw a dot-and-cross diagram to represent the bonding in CCl_2F_2. Show only the outermost electrons. **[2]**

(iii) Describe how CCl_2F_2 affects the environment and state one harmful effect it causes. **[2]**

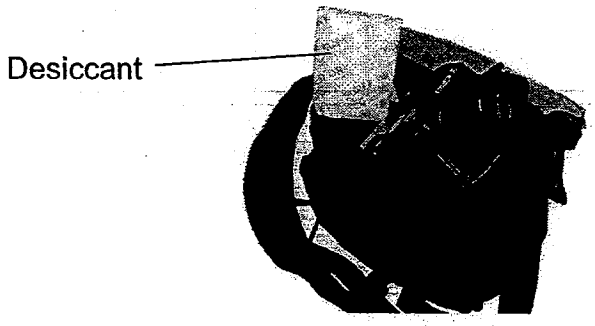
_____

_____

_____

[Total marks: 14]

A5 Desiccants are dehydrating agents which absorb water vapour from the surroundings. Desiccants have important applications, e.g. in the storing of electronic equipment such as cameras:



The desiccant absorbs moisture, preventing fungal growth on the camera lens. Common desiccants include silica gel, phosphorus pentoxide and calcium oxide.

(a) Silica gel is a form of silicon dioxide and can absorb up to 25% of its own mass of water before it becomes saturated. Suggest how saturated silica gel can be recycled. **[1]**

_____

_____

(b) Phosphorus pentoxide (P_4O_{10}) can be manufactured by burning red phosphorus (P_4) in oxygen. Construct a balanced chemical equation for this reaction. **[1]**

_____

(c) Phosphorus pentoxide is a very powerful desiccant and absorbs water readily. However, it becomes corrosive after absorbing moisture.
Explain why phosphorus pentoxide becomes corrosive after absorbing moisture. **[2]**

_____

_____

_____

(d) Phosphorus pentoxide reacts with calcium oxide. State the name of this type of reaction. **[1]**

_____

[Total marks: 5]

- End of Section A –

The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 H hydrogen 1										4 He helium 2
7 Li lithium 3	9 Be beryllium 4											11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	64 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	– Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
133 Cs caesium 55	137 Ba barium 56	139 La lanthanum 57 *	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	– Po polonium 84	– At astatine 85	– Rn radon 86
– Fr francium 87	– Ra radium 88	– Ac actinium 89 †															

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

140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	– Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	162 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
232 Th thorium 90	– Pa protactinium 91	238 U uranium 92	– Np neptunium 93	– Pu plutonium 94	– Am americium 95	– Cm curium 96	– Bk berkelium 97	– Cf californium 98	– Es einsteinium 99	– Fm fermium 100	– Md mendelevium 101	– No nobelium 102	– Lr lawrencium 103

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

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

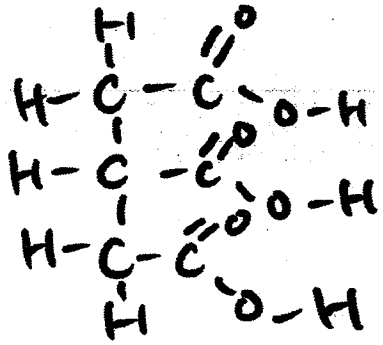
2014 Prelim 3 Answers

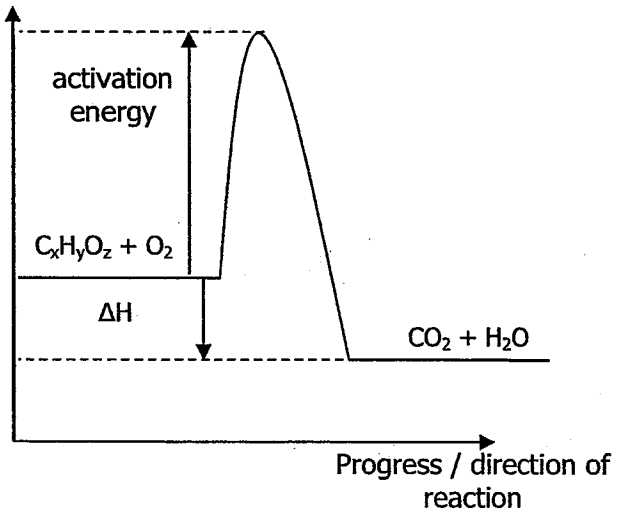
Paper 1

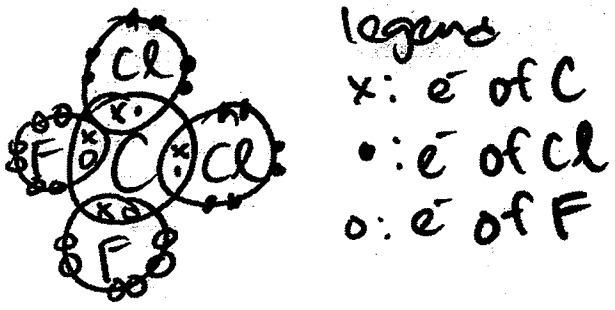
1 A	2 C	3 C	4 B	5 A	6 D	7 C	8 D	9 B	10 C
11 C	12 C	13 C	14 B	15 A	16 B	17 D	18 B	19 C	20 B
21 D	22 D	23 A	24 C	25 D	26 B	27 C	28 B	29 D	30 A
31 B	32 A	33 C	34 D	35 B	36 B	37 D	38 D	39 C	40 C

Paper 2 Section A

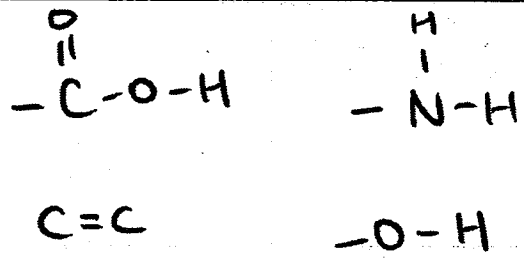
	Marking scheme
A1a)	A
b)	D
c)	B, C
d)	C
e)	ANY TWO: • Structure A • Strong electrostatic forces of attraction between ions **AND** • requiring a lot of heat/energy to overcome • Structure B • Strong covalent bonds between atoms **AND** • requiring a lot of heat/energy to overcome • Structure C • Strong electrostatic forces between positive ions and sea of mobile, delocalised electrons **AND** • requiring a lot of heat/energy to overcome
A2a)	Suspension
b)	Bubble the gas into limewater. Gas forms a white precipitate with limewater
c)	• Add aqueous barium nitrate to aqueous sodium sulphate • Filter the mixture and collect residue • Wash residue with distilled water **AND** • Press dry between sheets of filter paper **OR** • React barium carbonate with dilute nitric acid. Add dilute sulfuric acid • Filter and collect residue • Wash with distilled water and press dry

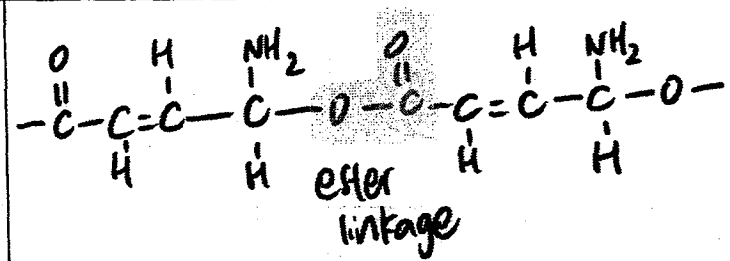
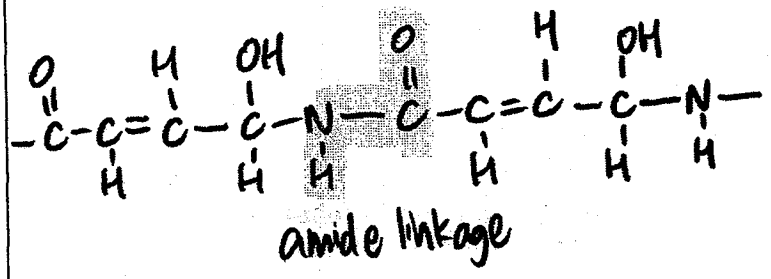
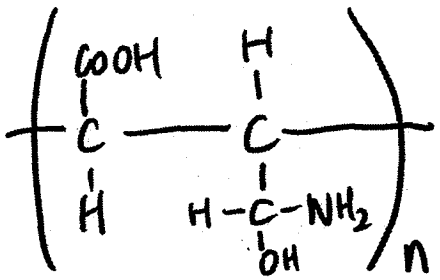
d)	Barium chloride is <u>soluble</u> and can be <u>absorbed</u> by the body
e)	
A3a)	Esters
b)	$Ca_3(PO_4)_2$
c)	H^+ / hydrogen
d)	No. of mol of potassium ions = (46/1000) / 39 = 0.00118 mol Concentration = 0.00118 / (325/1000) = 0.00363 mol/dm^3 (3sf)
e)	No. of mol of sodium ions = (156/1000) / 23 = 0.00678 mol **AND** No. of mol of chloride ions = (127/1000) / 35.5 = 0.00358 mol For every mol of NaCl, no. of mol of Na^+ = no. of mol of Cl^-. Since there are <u>more mol of Na^+ ions than Cl^-</u>, there are other compounds of sodium.
fi)	No. of mol of chloride ions = (127/1000) / 35.5 = 0.00358 mol No. of mol of lead (II) ions needed to form a precipitate with all chloride ions = 0.00358/2 = 0.00179 mol No. of mol of lead (II) nitrate = no. of mol of lead (II) ions = 0.00179 mol

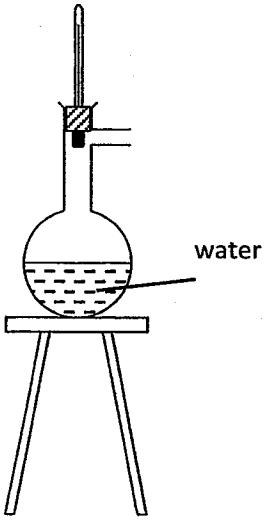
	Volume of lead (II) nitrate = (0.00179/1) x 1000 = 1.79 cm^3
fii)	Lead (II) phosphate is also insoluble and is formed as a precipitate
g)	 Correct shape, i.e. energy of products less than reactants • Labels • Activation energy • Enthalpy change • Reactants and products
h)	• Energy released when bonds in CO_2 and H_2O are formed • Is greater than • Energy absorbed to break bonds in $C_xH_yO_x$ and O_2
A4a)	• Whole mixture is heated into a vapour • Vapour is passed into a fractionating column where the column is cooler at the top and hotter at the bottom • Each fraction condenses according to its different boiling points • The smaller hydrocarbons are collected at the top, the larger ones at the bottom
bi)	$C_8H_{18} \rightarrow C_3H_8 + C_5H_{10}$
ii)	Bubble propane and X into separate test tubes of aqueous bromine X turns brown aqueous bromine colourless while aqueous bromine remains brown when propane is bubbled

c)	ANY ONE: Melting/boiling poin If Y has a higher melting/boiling point, it belongs to naphtha. If it has a lower melting/boiling point, it belongs to petrol Flammability If Y is more flammable, it belongs to petrol. If it is less flammable, it belongs to naphtha Viscosity If Y is more viscous, it belongs to naphtha. If it is less viscous, it belongs to petrol
di)	Substitution. Ultraviolet light
ii)	
iii)	It will decompose under ultraviolet light to form chlorine atoms, which breaks down ozone to oxygen, increasing the amount of ultraviolet radiation Skin cancer / eye cataract
A5a)	Heat saturated silica gel to evaporate the water
b)	$P_4 + 5O_2 \rightarrow P_4O_{10}$
c)	Phosphorus pentoxide is an oxide of phosphorus, a non-metal Oxides of non-metals tend to be acidic, dissolving in water to form acids
d)	Neutralisation / acid-base

Paper 2 Section B

	Marking scheme
B6ai)	• The rate of the reaction doubles when the concentration of Br_2 doubles. • From experiment 1 and 2, the rate of reaction increases from 0.007 mol/dm^3 s to 0.014 mol/dm^3 s when the concentration increases from 0.001 mol/dm^3 to 0.002 mol/dm^3
aii)	First order reaction
bi)	• The rate of the reaction increases by 4 times when the concentration of $C_6H_5NH_2$ doubles. • From experiment 3 and 4, the rate of reaction increases from 0.021 mol/dm^3 s to 0.084 mol/dm^3 s when the concentration increases from 0.001 mol/dm^3 to 0.002 mol/dm^3
bii)	Second order reaction
c)	0.028 mol/dm^3 s
d)	• Increased concentration increases the number of particles per unit volume • Increase in frequency of effective/successful collisions • Increases the speed of reaction
e)	I do not agree as sulfuric acid only acts as an oxidising agent in step 2. **In step 1:** • Sulfuric acid is not an oxidising agent. • There is no change in the oxidation state of any element. **In step 2:** • Sulfuric acid is an oxidising agent. • It causes the oxidation state of bromine to increase from -1 in HBr to 0 in Br_2
f)	Sulfur dioxide is produced. It will dissolve in rainwater to form acid rain, corroding limestone/metallic buildings.
B7a)	
bi)	A process where two or more monomers react to form a large molecule and a small molecule such as water is eliminated.

bii)	 
c)	
EITHER **B8a)**	The student is correct if the metal is a group I metal as all group I chlorides are soluble. Mobile ions are present OR The student is incorrect if the metal is silver metal as AgC*l* is insoluble. No mobile ions are present
b)	X: negative terminal Y: positive terminal
ci)	Electrode P : $2H^+(aq) + 2e^- \rightarrow H_2(g)$ Effervescence of a colourless gas will be seen.
cii)	Hydrogen ions are discharged/reduced at the cathode and hydroxide ions are discharged/oxidised at the anode. The rate at which hydrogen ions are discharged at the cathode is the same as the rate at which hydroxide ions are discharged at the anode. **OR** the concentration of hydrogen and hydroxide ions remains equal at the end of electrolysis.
d)	**$2H^+(aq) + 2e^- \rightarrow H_2(g)$** No. of mol of H_2 gas produced = 300 / 24000

	= 0.0125 mol No. of mol of H_2: No. of mole of e^- 1 : 2 0.0125 mol : 0.025 mol **$Li^+(l) + e^- \rightarrow Li(s)$** No. of mol of Li: No. of mole of e^- 1 : 1 0. 025 mol : 0.025 mol Relative atomic mass of metal M = 0.175 / 0.025 = 7 Metal M is Lithium.
OR B8	
a)	Mercury, nickel, zinc, magnesium
bi)	• (Grey) Magnesium dissolves • Green solution turns colourless • Silvery solid forms
bii)	$Mg (s) + Ni^{2+} (aq) \rightarrow Mg^{2+} (aq) + Ni (s)$
ci)	
cii)	$ZnO + H_2O \rightarrow ZnO + H_2$
ciii)	Green solid turns silver. ($NiO + H_2 \rightarrow Ni + H_2O$) Green nickel(II) oxide has been reduced by hydrogen to form silver nickel metal.

civ)	$ZnO + H_2O \rightarrow ZnO + H_2$ No. of mol of Zn used = 10 / 65 = 0.15385 mol No. of mol of Zn: No. of mole of H_2 produced 1 : 1 0.15385 mol : 0.15385 mol $NiO + H_2 \rightarrow Ni + H_2O$ Mass of Ni produced = 18 – 10 = 8g No. of mol of Ni produced = 8 / 59 = 0.13559 mol No. of mol of Ni: No. of mole of H_2 used 1 : 1 0. 13559 mol : 0. 13559 mol No. of mole of excess H_2 = 0.15385 – 0.13559 = 0.01826 mol Volume of = 0.01826 x 24 = 0.438 dm^3 (438 cm^3)

Name:		Index Number:		Class:	

CATHOLIC HIGH SCHOOL
Preliminary Examination 3
Secondary 4

B

CHEMISTRY

5073/2

Paper 2

17 September 2014

1 hour 45 minutes

Additional Materials: Answer Paper

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Section B
Answer all questions in the foolscap paper provided.

For examiner's use only: **Section B / 30**

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This document consists of **7** printed pages, **including** this cover page.
Page 8 has been intentionally left blank.

[Turn over]

Section B (30 marks)

Answer all three questions in this section on foolscap paper. The last question is in the form of an either/or and only one of the alternatives should be attempted.

B6 This is a question about the two methods that can be used to manufacture HBr.

Method 1: Reaction of amine with bromine

Reaction: $C_6H_5NH_2 + 3Br_2 \rightarrow C_6H_2NH_2Br_3 + 3HBr$

The initial rate of this reaction was determined using different concentrations of the reactants as shown in the following experiments.

Experiment No.	Concentration of $C_6H_5NH_2$ (mol/dm^3)	Concentration of Br_2 (mol/dm^3)	Initial rate of reaction (mol/dm^3 s)
1	0.001	0.001	0.007
2	0.001	0.002	0.014
3	0.001	0.003	0.021
4	0.002	0.003	0.084
5	0.003	0.003	0.189

Table 1

From the data in *Table 1*, changes in the concentration of each reactant affect the rate of reaction differently. Knowing how the rate is affected by the concentration of each reactant will allow us to predict the rate of reaction.

Depending on how the rate is affected by concentrations of each reactant, we can classify reactions into the following two types.

Type of reaction	Characteristic	Example
1. First order reaction with respect to reactant **A**	The *rate* of reaction is *proportional* to the *concentration of* **A**	If you double the concentration of **A**, the rate doubles as well. If you increase the concentration of **A** by a factor of 4, the rate goes up 4 times as well.
2. Second order reaction with respect to reactant **A**	The *rate* of reaction is *proportional* to the *square of the concentration of* **A**	If you doubled the concentration of **A**, the rate would go up 4 times (2^2). If you tripled the concentration of **A**, the rate would increase 9 times (3^2).

Table 2

Method 2: Reaction of solid bromide with concentrated sulfuric acid

Step 1: $Br^- + H_2SO_4 \rightarrow HBr + HSO_4^-$
Step 2: $2HBr + H_2SO_4 \rightarrow Br_2 + 2H_2O + SO_2$

HBr can be obtained from *Step 1*. However, *Step 2* may occur if H_2SO_4 is used in excess.

Method 1

(a) (i) Using information from *Table 1*, describe how the rate of reaction changes as the concentration of Br_2 changes. [2]

(ii) Determine the order of reaction with respect to Br_2. [1]

(b) (i) Using information from *Table 1*, describe how the rate of reaction changes as the concentration of $C_6H_5NH_2$ changes. [2]

(ii) Determine the order of reaction with respect to $C_6H_5NH_2$. [1]

(c) Determine the rate of reaction when concentration of $C_6H_5NH_2$ is 0.002 mol/dm^3 and concentration of Br_2 is 0.001 mol/dm^3. [1]

(d) Use ideas about collisions between particles to explain the effect of concentration on the speed of reaction. [2]

Method 2

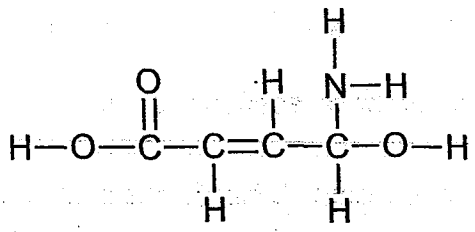
(e) A student claimed that concentrated sulfuric acid functions as an oxidising agent in both steps.

Do you agree with the student? Explain in terms of oxidation states for both steps 1 and 2. [2]

(f) It is not environmentally friendly to produce **HBr** via method 2. Suggest a reason why. [1]

[Total marks: 12]

B7 The structure of an organic compound **Z** is shown below.



(a) Draw all the functional groups in compound **Z**. **[2]**

(b) Under suitable conditions, molecules of compound **Z** undergo condensation polymerisation to form more than one possible polymer.

(i) Define condensation polymerisation. **[2]**

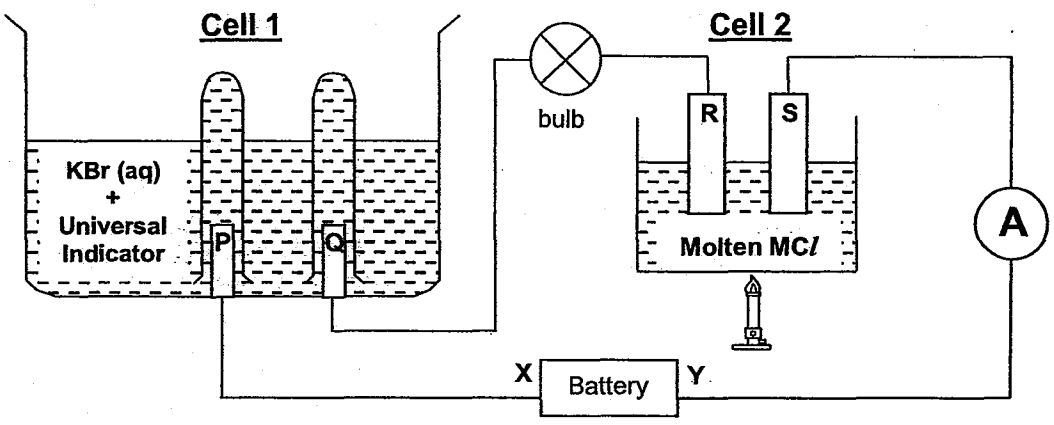
(ii) Draw the structures of **any two** possible **condensation polymers**, showing two repeating units for each polymer.
Circle and label all linkages clearly. **[3]**

(c) Molecules of compound **Z** are also able to undergo addition polymerisation under suitable conditions. Draw the structure of the **addition polymer** formed. **[1]**

[Total marks: 8]

EITHER

B8 The following set-up can be used for the electrolysis of molten metal chloride (**MCl**) and a solution of potassium bromide. The four electrodes **P**, **Q**, **R** and **S** in the circuit are graphite rods. **X** and **Y** are the terminals of the battery.



(a) When the heat source was removed from **Cell 2**, no current is observed to flow. A student made the following comment.

Student: 'A current will be observed if we add water into **Cell 2**.'

Is the student correct? Explain your answer. **[2]**

(b) When the switch is on, metal **M** begins to deposit on electrode **R**. Deduce the polarity of the battery at terminals **X** and **Y**. **[1]**

(c) **(i)** With the aid of an ionic equation, describe what would be observed at electrode **P** after the current has flowed for a while. **[2]**

(ii) The colour of the universal indicator remains green throughout the experiment. Explain why this is so. **[2]**

(d) It was known that the electrolyte in **Cell 2** contains a group I metal. After carrying out electrolysis for 30 minutes at a constant current, 300cm^3 of gas is collected at electrode **P** and the gain in mass at electrode **R** is 0.175g. What is the identity of the group I metal? **[3]**

[Total marks: 10]

OR

B8 The reactivity of metals can be compared by their reactions with water, steam and displacement reactions. Some data of the experiments are recorded in the table below.

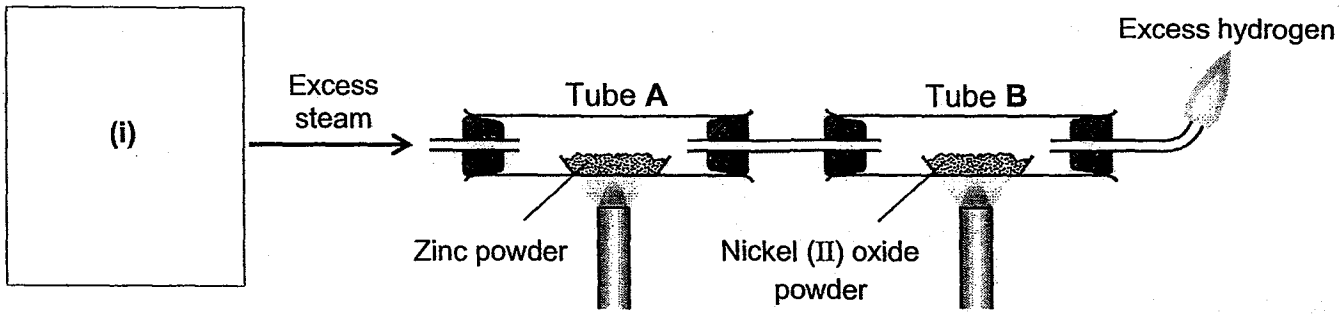
Metals	Displacement reactions	Reaction with water and steam	Observations during reaction with steam
Mercury	Mercury does not displace any of the metals	Has no reaction with steam	Silvery metal remains unchanged
Magnesium	$Mg + Zn(NO_3)_2 \rightarrow Mg(NO_3)_2 + Zn$	Reacts slowly with cold water but burns in steam	Grey solid turns white
Nickel	$Ni + Hg(NO_3)_2 \rightarrow Ni(NO_3)_2 + Hg$	Has no reaction with water, reacts slowly with steam	Silvery solid turns green
Zinc	$Zn + Ni(NO_3)_2 \rightarrow Zn(NO_3)_2 + Ni$	Has no reaction with water, reacts slowly with steam	Grey solid turns yellow when hot

(a) From the table above, arrange the metals in ascending order of their chemical reactivity. **[1]**

(b) **(i)** Solutions containing nickel(II) ions are usually green. What would you expect to see if magnesium is added to nickel(II) nitrate solution? **[1]**

(ii) Write an ionic equation, with state symbols, for the reaction. **[1]**

(c) The apparatus below was set up. Steam was passed into the first tube. The zinc and the nickel(II) oxide were then heated.



(i) Complete the above diagram by drawing a suitable set-up in the box labelled **(i)** to show how you would provide a steady supply of steam for the experiment. **[1]**

(ii) Write an equation for the reaction that occurs in tube **A**. **[1]**

(iii) Nickel lies in between iron and lead in the reactivity series. What would you observe in tube **B**? Explain your answer. **[2]**

(iv) The following data were obtained from the above experiment.

Mass of zinc powder used in tube **A**	10 g
Mass of empty crucible in tube **B**	10 g
Mass of empty crucible + contents after heating in tube **B**	18 g

Determine the volume of excess hydrogen which did not react in tube **B**. **[3]**

[Total marks: 10]

- End of Section B -