



**TEMASEK**  
JUNIOR COLLEGE

PRELIMINARY EXAMINATIONS

HIGHER 1

CANDIDATE  
NAME

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CIVICS  
GROUP

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CENTER  
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INDEX  
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**CHEMISTRY**

**8872/02**

Paper 2

**1 September 2015**

**2 hours**

Candidates answer section A on the Question Paper.

Additional Materials:      Answer Paper, Graph Paper  
   Data Booklet

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**READ THESE INSTRUCTIONS FIRST**

Write your Civics Group, centre number, index number and name on all the work you hand in.  
Write in dark blue or black pen.  
You may use an HB pencil for any diagrams or graphs.  
Do not use staples, paper clips, glue or correction fluid.

**Section A**

Answer **all** questions.

**Section B**

Answer **two** questions on separate answer paper.

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

For Examiner's Use	
A1	/ 10
A2	/ 10
A3	/ 10
A4	/ 10
Section B	/ 40
Paper 1	/ 30
Total	

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This document consists of **16** printed pages.

- 1 (a) An acidified solution of  $\text{KClO}_2$  oxidises  $\text{Fe}^{2+}(\text{aq})$  to  $\text{Fe}^{3+}(\text{aq})$ . When 0.150 g of  $\text{KClO}_2$  reacted with  $0.500 \text{ mol dm}^{-3} \text{ Fe}^{2+}(\text{aq})$  in the presence of  $\text{H}^+(\text{aq})$ ,  $11.30 \text{ cm}^3$  of  $\text{Fe}^{2+}(\text{aq})$  was needed for complete reaction.

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- (i) Suggest the final oxidation state of chlorine after complete reaction. Show your workings clearly.

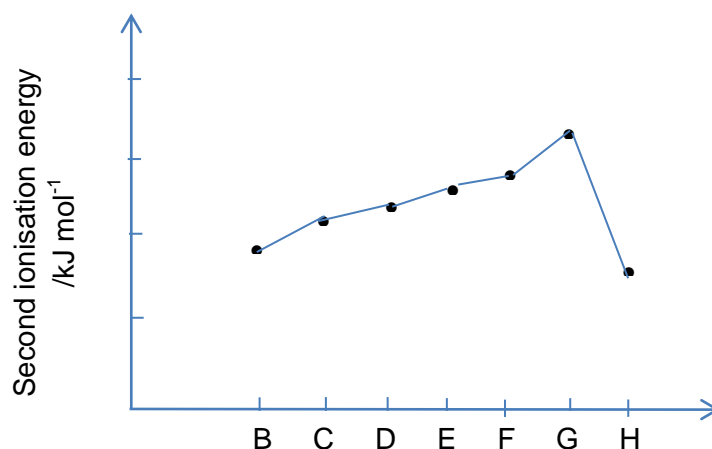
- (ii) State the full electronic configuration of  $\text{Fe}^{3+}$ .

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[4]

- (b) The research student was given the second ionisation energies of seven consecutive elements in the Periodic Table as shown below:

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- (i) Define, with the aid of an equation, what is meant by *second ionisation energy of element B*.

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- (ii) With reference to the graph above, deduce the Group of the *Periodic Table* to which **B** is likely to belong. Explain your answer.

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[4]

- (c) When the student passed a beam of protons through an electric field, it deflected  $12^\circ$  towards the negative plate.

Under identical conditions, the student passed a beam of doubly charged particles **J** through the electric field. The angle of deflection was found to be  $1.5^\circ$  towards the positive plate.

Identify the ion **J**.

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[2]

[Total: 10]

- 2 (a) Acid rain has harmful effects on aquatic animals, plants and infrastructure. It contains sulfuric acid formed from sulfur trioxide. Sulfur trioxide is produced upon atmospheric oxidation of sulfur dioxide from coal burning.

(i) Write an equation for the formation of sulfuric acid from sulfur trioxide.

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Even before the existence of acid rain, unpolluted rain water was slightly acidic due to dissolved  $\text{CO}_2$ . The solubility of *pure* carbon dioxide gas in water is  $88 \text{ cm}^3$  per  $100 \text{ cm}^3$  of water under room conditions.

(ii) Given that air contains 0.033% by volume of carbon dioxide, calculate the concentration in  $\text{mol dm}^{-3}$  of carbon dioxide dissolved in unpolluted rain water.

Dissolved carbon dioxide forms carbonic acid in water, causing the pH of unpolluted rain water to be 5.63.

(iii) Calculate the  $[\text{H}^+]$  in unpolluted rain water.

Some fishes and shellfish die at low pH values. Lakes with limestone-rich soil can maintain a relatively stable pH even when acid rain falls due to the  $\text{HCO}_3^-/\text{CO}_3^{2-}$  buffer system.

(iv) With aid of an equation, explain how lakes with limestone-rich soil maintain a relatively stable pH in presence of acid rain.

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[6]

- (b)** Oxides and halides of Period 3 elements have many applications.

A farmer intends to add a magnesium-containing compound to his farmland to correct magnesium deficiency and raise soil pH.

- (i)** Suggest whether the farmer should add magnesium oxide or magnesium chloride to his farmland.

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- (ii)** Explain your answer in **(b)(i)** by describing the reactions of the compound suggested with water and acid. Write equations where appropriate and state the pH of the solution formed when the compound is dissolved in water.

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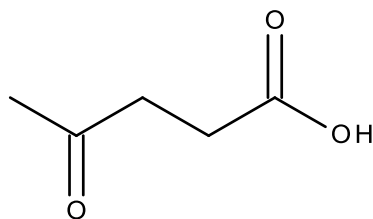
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[4]

[Total: 10]

- 3 (a) Levulinic acid is a keto-acid which is derived from degradation of cellulose and is a potential precursor to biofuels.



- (i) Arrange pentanoic acid, levulinic acid and pentan-1-ol in order of increasing  $pK_a$ , explaining your answer.

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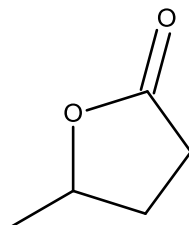
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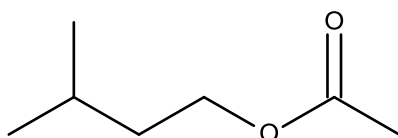
- (ii) Carboxylic acids are often used as precursors in the synthesis of esters.

Devise a 2-step synthesis to convert levulinic acid to the cyclic ester shown below. Suggest the reagent and conditions used in each step and the structural formula of the intermediate formed.



[6]

- (b) Another ester, isopentyl acetate, is responsible for the smell associated with bananas. It is used as flavouring in a variety of processed foods such as cakes and sweets.



Isopentyl acetate

- (i) Draw the structure of the organic compounds formed when isopentyl acetate is heated with NaOH(aq).



- (ii) Isopentyl acetate is found to be only slightly soluble in water. In terms of structure and bonding, suggest an explanation for this.

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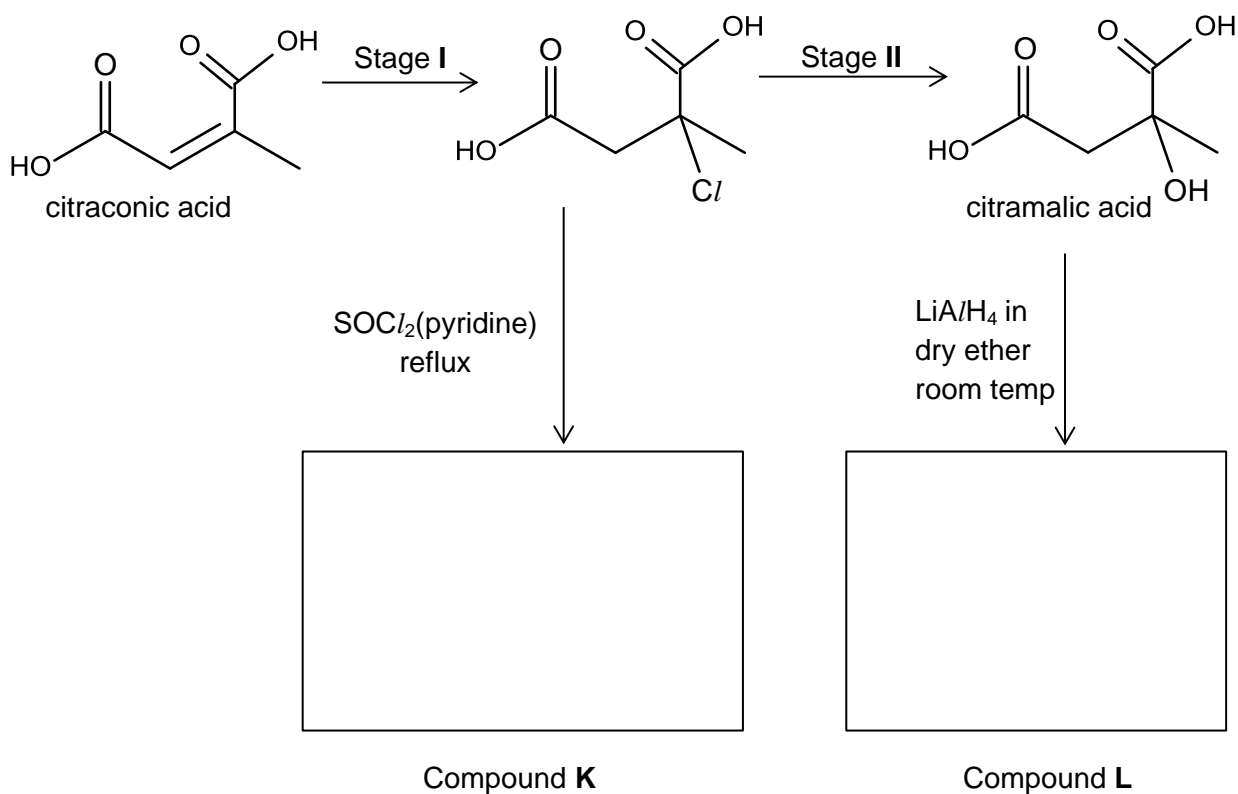
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[4]

[Total: 10]

- 4 Citramalic acid can be obtained from citraconic acid. Citraconic acid is used as a fire retardant. The following reaction scheme shows some of the reactions of citraconic acid.



- (a) State the functional groups present in citramalic acid.

[1]

- (b) State the reagents and conditions needed for Stages I and II.

	Reagents and Conditions
Stage I	
Stage II	

[3]

- (c) State the type of reaction for Stage I and Stage II.

Stage I : .....

Stage II: .....

[2]

- (d) Draw the structures of the organic compounds **K** and **L** in the boxes in the scheme.

[2]

- (e) Draw the displayed formula for the stereoisomers of citraconic acid.

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[2]

[Total: 10]