RIVER VALLEY HIGH SCHOOL

YEAR 6 PRELIMINARY EXAMINATION

CANDIDATE NAME									
CLASS	6								
CENTRE NUMBER	S					INDEX NUMBER				

H1 CHEMISTRY 8872/02

Paper 2 **11th September 2012**

2 hours

Candidates answer Section A on the Question Paper.

Additional Materials: Data Booklet

READ THESE INSTRUCTIONS FIRST

Write your name, class, Centre number and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer all the questions.

Section B
Answer two questions on separate answer paper.

A Data Booklet is provided. Do not write anything on it.

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

For Examiner's Use	
Section A	
B6	
B7	
B8	
Total	

This document consists of **13** printed pages.

Section A

Answer **all** the questions in this section in the spaces provided.

1. Below is a list of elements from the third period:

Period 3	Na	Mg	A*l*	Si	P	S	C*l*

(a) Which of these element(s)

(i) have a giant metallic structure

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(ii) have a giant covalent structure **[2]**

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(b) Both phosphorous and silicon can react with chlorine to form PCl_3 and $SiCl_4$ respectively. Draw the dot-and-cross diagram for both compounds, state their shapes and suggest the values of the bond angles **[3]**

[Total : 5]

2. Sulfuric acid is commonly used in various industries as a feedstock for the production of other useful chemicals such as fertilizers, synthetic resin, detergents and insecticide.

(a) The contact process is the current method for producing sulfuric acid for use in various industrial processes. The main reaction of the contact process is shown:

$2SO_2(g) + O_2(g) = 2SO_3(g)$ $\Delta H = -197$ kJ mol^{-1}

An **equimolar** mix of SO_2 and O_2 is introduced into a 1 dm^3 sealed flask.

At equilibrium, 33.3% of O_2 is used up and the total amount of gas ($n_{SO_2} + n_{O_2} + n_{SO_3}$) equals to 0.241 mol

(i) Write down an expression for the K_c of the reaction, stating the units.

(ii) Calculate the value of K_c **[4]**

(b) Unlike sulfuric acid, ethanoic acid, CH_3COOH, is a weak acid.

(i) Explain the term 'weak acid'.

……

……

(ii) Write down the expression for K_a of ethanoic acid **[2]**

[Total : 6]

3. The rate of reaction is affected by factors such as temperature and catalyst.

(a) With the help of an appropriate sketch of the Boltzmann distribution, explain how the increase in temperature speeds up a chemical reaction. **[3]**

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(b) Other than temperature and catalyst, suggest and explain another factor which will affect the rate of reaction. **[2]**

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(c) Aluminium oxide is a common oxide which is insoluble in water and *amphoteric* in nature.

(i) Define the term *amphoteric*

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(ii) Describe two reactions which show the amphoteric behaviour of aluminium oxide.

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(iii) Explain why aluminium oxide is insoluble in water. **[5]**

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[Total : 10]

4. There are some wines that taste better after a period of 'ageing' process. After ageing, the wine is said to taste more flavourful and is more appealing to consumers. One of the many reactions that takes place in the wine is the alcohol (ethanol) reacting with the fruit acids.

Reaction (1):

$$RCOOH(aq) + CH_2CH_3OH(aq) = RCOOCH_2CH_3(aq) + H_2O(l)$$

where RCOOH represents the fruit acids.

The ageing process usually involves placing the wine bottles in a cold environment (about 13 °C) for period of about 1 year. In time, the ester that is produced will give the 'flavour' that aged wine has. However, the wine can be easily 'damaged' if the bottles are exposed to high heat, even for short periods of time. When this happens, the wine becomes sour.

Wine can also be 'damaged' if it is exposed to the air. In this case, the alcohol (ethanol) inside the wine is converted to ethanoic acid by oxygen in the air (where oxygen is converted to water). This event may happen during the bottling stage, where air is unintentionally introduced into the bottle.

(a) (i) *'...placing the wine bottles in a cold environment...*' From this statement, what can you deduce about the enthalpy change of reaction (1)? Explain your answer.

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(ii) Hence, explain why "...*the wine can be easily 'damaged' if the bottles are exposed to* ***high heat****, even for* ***short periods of time****... becomes* ***sour*** *to the taste.*", paying particular attention to the underlined phrases. **[5]**

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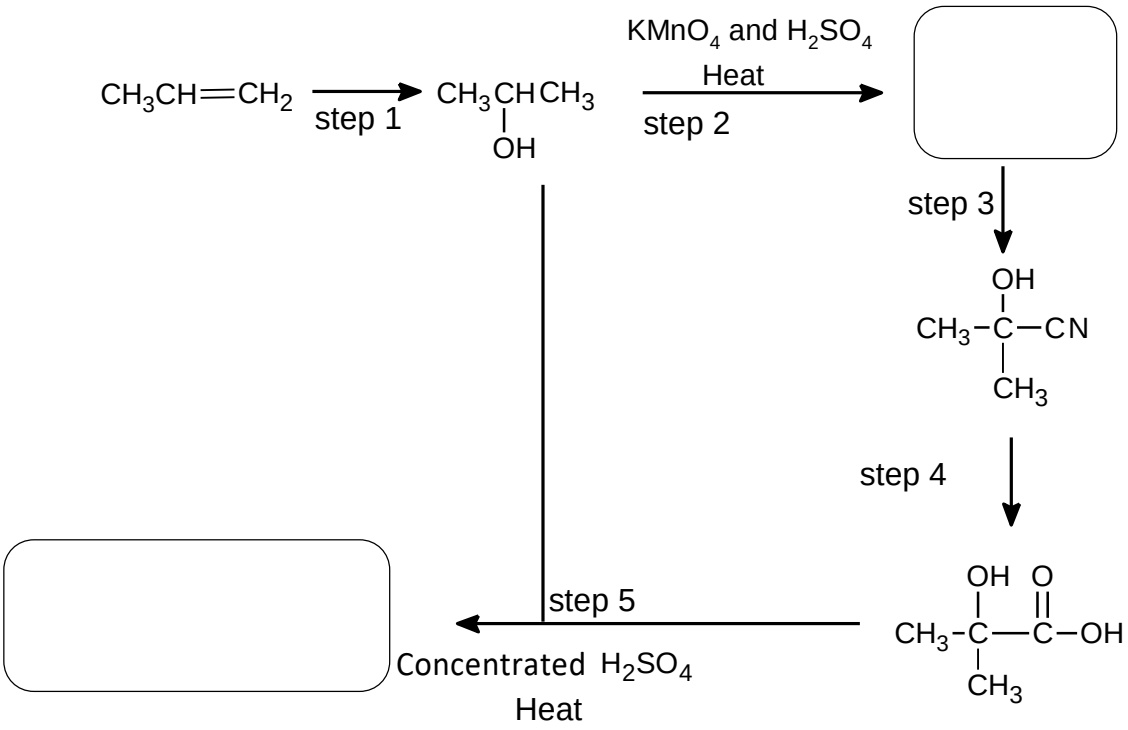
(b) (i) By means of two half equations, write a full balanced equation for the oxidation of ethanol to ethanoic acid.

(ii) During a bottling process, 8 cm^3 of air is introduced accidentally into a 750 cm^3 wine bottle. What is the maximum concentration (in mol dm^{-3}) of ethanoic acid that can be produced?

Assume that ethanol is in excess and air contains 20% oxygen **[4]**

[Total : 9]

5 (a) The diagram below shows the synthesis pathway starting with propene:



(i) State the reagents and conditions for step 1 and 3.

……

……

(ii) Draw the structure of the products of step 2 and 5.

(iii) Name the type of reaction taking place in step 5. **[5]**

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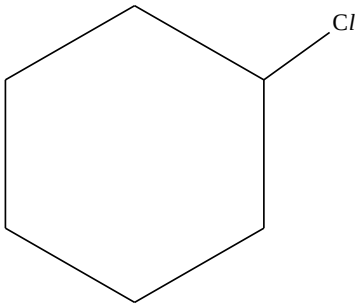
(b) Suggest a simple chemical test to distinguish the following pairs of compounds. Your answers should include the reagents and conditions for each

test and the observations you would expect to see for each compound.

(i)



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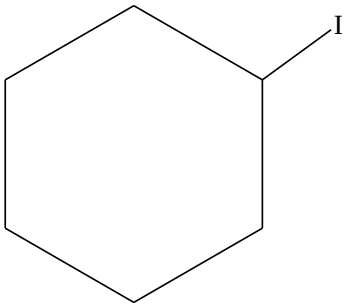

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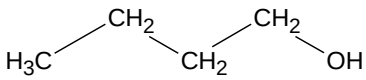
(ii)



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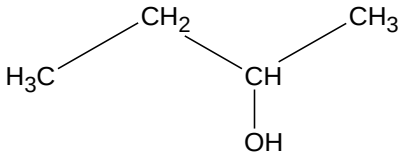

[5]

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[Total : 10]

Section B

Answer **two** of the three questions in this section on separate answer paper.

6 Larger alkane molecules in petroleum can be broken down into smaller molecules in a process called cracking. Cracking is carried out on fractions obtained from fractional distillation of petroleum. An example of cracking is decane, $C_{10}H_{22}$. The reaction is shown below.

$$C_{10}H_{22} \rightarrow C_2H_4 + C_4H_{10} + C_3H_8 + C$$

With the production of alkanes and alkenes, these organic compounds have many different uses and can undergo many different organic reactions to form other products.

(a) Two of the products that can be formed from ethene are ethanal and ethanol.

(i) Ethanal can be produced from ethene under laboratory conditions via an organic synthesis. Suggest suitable reagents and conditions for each step(s) to produce ethanal.

(ii) The standard enthalpy change of combustion of ethanol can be determined by conducting an experiment in the laboratory.

1. Write an equation for the complete combustion of ethanol.

2. With the aid of a diagram, briefly describe how the enthalpy change of combustion of ethanol can be determined using laboratory apparatus.

3. A student conducted the experiment in the laboratory and the data collected are as follows:

Mass of ethanol used = 0.96g

Volume of water used in heating = 300 cm^3

Initial temperature of water = 28.0 °C

Final temperature of water = 49.6 °C

Using the specific heat capacity value in the data booklet, calculate the standard enthalpy change of combustion of ethanol.

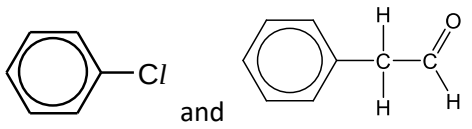
4. The theoretical value for the enthalpy change of combustion for ethanol is -1370 kJ mol^{-1}. Referring to the answer in **a(ii)(3)**, state a reason for the difference obtained.

5. State one use of ethanol. **[12]**

(b) Alkanes produced from cracking are often used as petrol and diesel for motor vehicles. State one example of a pollutant produced from the incomplete combustion of the alkane and its harmful effect on the environment. **[2]**

(c) Distinguish the following pairs of organic compounds. Include reagents, conditions, observations and equations for any reactions in your answers.

(i)



(ii) $CH_3COOC(CH_3)_3$ and $CH_3COOCH_2CH_3$ **[6]**

[Total : 20]

7. Sodium, aluminium and phosphorous are some examples of elements in Period three. Their melting point varies across the period depending on their structures.

(a) **(i)** Sketch a diagram to show the variation in melting point of the elements in Period three.

(ii) Explain the diagram drawn in **(a)(i).**

(iii) Explain, with the help of equations, the reaction of chlorides of, aluminium and phosphorous with water. **[7]**

(b) **(i)** Define catalyst.

(ii) With the help of an energy diagram, explain the function of a catalyst in a reaction. **[3]**

(c) The rate of hydration of organic compound **D** was followed by measuring the concentration of **D** after fixed time intervals. Two experiments were carried out, starting with different concentrations of H^+. The following results were obtained.

Time/min	Experiment 1, with $[H^+] = 0.10$ mol dm^{-3}	Experiment 2, with $[H^+] = 0.05$ mol dm^{-3}
0	0.0050	0 0050
15	0.0040	0.0045
30	0.0032	0.0040
45	0.0026	0.0036
60	0.0021	0.0032
75	0.0017	0.0029
90	0.0014	0.0026

(i) Using the same axes, plot graphs of [**D**] against time for two experiments.

(ii) Using the graphs, determine the order of reaction with respect to H^+ and **D**.

(iii) Hence, write the rate equation for this reaction.

(iv) Calculate the rate constant, including its units. **[10]**

[Total : 20]

8. An organic compound **A** have the molecular formula of $C_6H_{11}Cl$.

When **A** is heated with KOH in ethanol, a mixture of two isomers **B** and **C**, with the formula C_6H_{10}, are produced.

B reacts with hot acidified $KMnO_4$ to give **D**, C_5H_8O, as well as CO_2 and water. Compound **D** does not give a silver mirror with Tollen's reagent, but gives an orange precipitate when added to 2,4-DNPH.

C reacts with hot acidified $KMnO_4$ to give a straight chain compound **E**, $C_6H_{10}O_3$ only. Compound **E** does not give a silver mirror with Tollen's reagent, but gives an orange precipitate when added to 2,4-DNPH. Compound **E** also gives a yellow precipitate and salt **F**, $C_5H_6O_4Na_2$, when mixed with I_2 in NaOH(aq).

(a) By providing appropriate explanation with regards to the reactions, deduce the structure of **A**, **B**, **C**, **D**, **E** and **F**. **[13]**

(b) During the synthesis of compound **A**, an organic compound, 1,2–dichloropropene, is produced as a by-product.

1,2–dichloropropene can exist in two different isomeric form.

(i) Draw the structure of both isomers.

(ii) State and explain which isomeric form is expected to have a higher boiling point. **[5]**

(c) Comparing 2–chloropropanoic acid and 3–chloropropanoic acid: state and explain which compound is the stronger acid. **[2]**

[Total : 20]