CANDIDATE NAME _____ CG_____

DUNMAN HIGH SCHOOL (SENIOR HIGH)

YEAR 6 PRELIMINARY EXAMINATION 2009

H1 CHEMISTRY 8872/02

Paper 2 **22 September 2009**

2 hours

Additional materials:
Answer Paper
Data Booklet

INSTRUCTIONS TO CANDIDATES

1 Write your **name** and **class** on all the work you hand in.

2 Write in dark blue or black pen on both sides of the paper.

3 You may use a soft pencil for any diagrams, graph or rough working.

4 The number of marks is given in brackets [ ] at the end of each question or part question.

5 You may use a calculator.

6 At the end of the examination, fasten all your work securely together.

Section A

Answer **all** questions.

Section B

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

FOR EXAMINER'S USE	
Question	***Marks***
1	**/6**
2	**/8**
3	**/11**
4	**/15**
Paper 2 Section A	**/40**
5	**/20**
6	**/20**
7	**/20**
Paper 2 Section B	**/40**
Paper 1	**/30**
Total	**/110**
Grade	

This document consists of **13** printed pages and **1** blank page.

[Turn over

Section A

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

1 Antimony (Sb), with atomic number 51 has been known since about 4000BC. Nowadays, its main use is to harden and to strengthen lead alloys.

A typical sample of antimony consists of two isotopes and has the following composition by mass: ^{121}Sb, 57.25%, ^{123}Sb, 42.75%.

(a) (i) Calculate the *relative atomic mass* of the antimony sample.

(ii) Define the term *relative atomic mass*.

[3]

Antimony is produced in two–stage process from the sulphide ore, Sb_2S_3.

The ore is first roasted in oxygen to form the oxide.

$2Sb_2S_3(s) + 9O_2(g) \rightarrow Sb_4O_6(s) + 6SO_2(g)$

The oxide is then reduced with carbon.

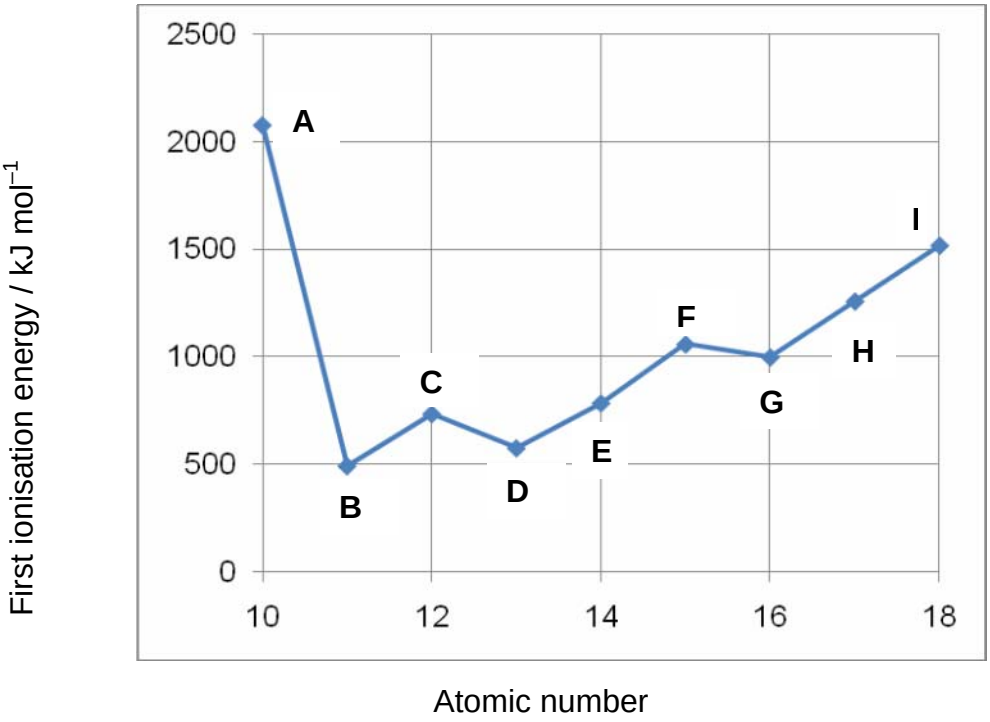
$Sb_4O_6(s) + 3C(s) \rightarrow 4Sb(s) + 3CO_2(g)$

(b) Showing your working clearly, calculate the volume of carbon dioxide that would be produced by the processing of 3400 g of Sb_2S_3. [Assume that 1 mole of gas occupies 24 dm^3 under experimental conditions.]

[3]

[Total: 6]

2 The figure shows a plot of first ionisation energy against atomic number for the elements of atomic number 10 to 18. (The letters are not the chemical symbols for the elements concerned.)



(a) Write an equation to define the first ionisation energy of **A**.

[1]

(b) Describe the **general trend** of the ionisation energies from **B** to **I** as shown in the graph above.

[2]

(c) Explain briefly why the first ionisation energy of **D** is less than **C**.

[2]

(d) Draw the shape of the orbital from which electron is lost when

(i) Element **B** forms a singly charged ion,

(ii) Element **H** forms a singly charged ion.

[2]

(e) Give the full electronic configuration of the element labeled **F**.

[1]

[Total:8]

3 Each of these elements in Period 3 will react with oxygen given suitable conditions.

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

(a) Which element(s) can exist

(i) as diatomic molecules at room temperature,

(ii) as macromolecular structures?

[2]

(b) Two elements form chlorides with formulae of the type XCl_3. Draw the dot–and–cross diagram for these two chlorides, state the shapes and suggest values for the bond angles.

[4]

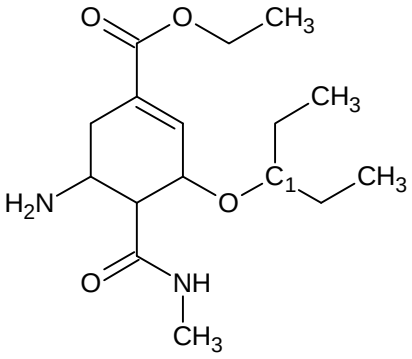
(c) **(i)** One element form chloride of the type YCl_2 which reacts with water to give a slightly acidic solution. Name the element, and account for the pH value of YCl_2 in water. Write a balanced equation to illustrate your answer.

(ii) One element forms a chloride of the type ZCl_4, which reacts with water to give a strongly acidic solution. Name the element and write a balanced equation for the chloride reacting with water.

[5]

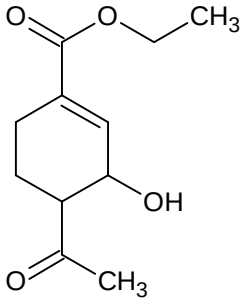
[Total: 11]

4 Oseltamivir (Tamiflu) is an antiviral drug that slows the spread of non–resistant strains of the influenza virus between cells in the body. It blocks the action of a viral enzyme called neuraminidase and has since been indicated for the treatment of H5N1 and H1N1 infection. The standard adult dosage is 75 mg twice daily. Compound **Z** is a derivative of oseltamivir that maybe investigated for antiviral activities.



oseltamivir

M_r : 312.4



Z

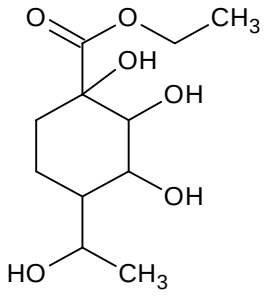
(a) (i) A male adult patient has been put on a 5–day oseltamivir treatment. Calculate the total number of moles of oseltamivir taken by this patient over this period of treatment.

(ii) Describe the hybridisation, geometry and bond angle about C_1 atom.

[4]

(b) (i) Name the functional groups present in Compound **Z**.

(ii) Compound **X** can be synthesised from **Z** using 2 consecutive reactions. Give the reagents and conditions for both reactions. Name the type of reactions involved.



X

Step I: Reagent: .....

Condition: .....

Type of reaction: .....

Step II: Reagent: .....

Condition: .....

Type of reaction: .....

[5]

(c) (i) Draw the products formed when Compound **Z** is reacted with dilute HC*l* under reflux.

(ii) Describe a chemical test to distinguish the products from **(c)(i)**. State the observations with each compound and write balanced equation(s) for reaction(s) involved.

[6]

[Total:15]

Section B

Answer **two** questions from this section on separate answer paper.

5 (a) A monobasic acid **HA,** extracted from a fruit has a pH of 3.5

(i) Calculate the concentration, in mol dm^{-3}, of hydrogen ions in the acid **HA**.

(ii) 25.0 cm^3 of a sample of the acid **HA** was titrated with 0.25 mol dm^{-3} aqueous NaOH. 21.25 cm^3 of the aqueous NaOH was required to reach equivalence point.
Calculate the concentration, in mol dm^{-3}, of the acid **HA**.

(iii) Based on your answers to **(a)(i)** and **(a)(ii)** above, what can you deduce about the strength of the acid **HA**? Give a reason for your deduction.

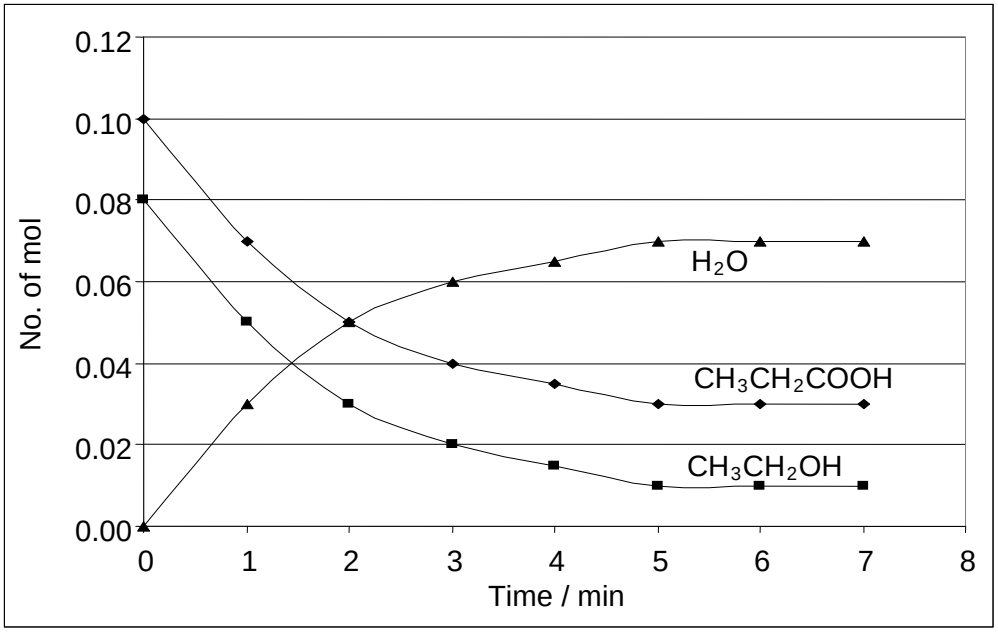
(iv) Suggest a suitable indicator for the above titration.

[5]

(b) Propanoic acid is a weak acid that undergoes esterification with ethanol to form the ester, ethylpropanoate.

$$CH_3CH_2COOH(l) + CH_3CH_2OH(l) \rightleftharpoons CH_3CH_2COOCH_2CH_3(l) + H_2O(l)$$

The graph below shows the change in number of moles of the reactants and products in the reaction mixture. The changes in the number of moles of $CH_3CH_2COOCH_3CH_2$ and H_2O with time are the same.



(i) Write an expression to define K_c for the equilibrium.

(ii) State the time at which equilibrium is established.

(iii) Calculate the value of K_c.

(iv) Given that the forward reaction is exothermic, state and explain the effect on the yield of the ester and the value of K_c, when the temperature is increased.

[6]

(c) A mixture of propanoic acid and its salt, sodium propanoate, is often used in food products as a *buffer* to regulate the acidity of the products.

(i) Explain what is meant by a *buffer* solution.

(ii) Explain, using suitable equations, how a solution of propanoic acid and sodium propanoate acts as a buffer system.

[4]

(d) **(i)** Identify and draw the types of structural isomerism that ethyl propanoate can exhibit.

(ii) Describe a chemical test to distinguish between the two isomers in **(d)(i)**. Give the reagents and conditions for the test, and describe the observation for each compound.
[Balanced equations are not required.]

[5]

[Total: 20]

6 This question is about ethane and its uses.

(a) Ethane is used in the production of azomethane which is commonly used in cancer research according to the following equation:

$$CH_3CH_3(g) + N_2(g) \rightarrow CH_3–N=N–CH_3(g)$$

(i) Suggest a variable that can be monitored experimentally to study the rate of the reaction, giving your reasoning.

(ii) The following data is obtained in a kinetics study of the formation of azomethane.

experiment	initial $[CH_3CH_3]$ / mol dm^{-3}	initial $[N_2]$ / mol dm^{-3}	initial rate / mol dm^{-3} s^{-1}
1	0.005	0.0012	0.002
2	0.005	0.0024	0.002
3	0.0025	0.0012	0.001

From the above data provided, deduce the order of reaction with respect to ethane and nitrogen.

(iii) Calculate the rate constant for this reaction, stating its units.

(iv) Using relevant bond energy values from the *Data Booklet*, calculate the enthalpy change of this reaction.

(v) With the aid of Maxwell-Boltzmann distribution curve, predict and explain the effect on the rate of this reaction with a decrease in reaction temperature.

[12]

(b) Ethane is considered to be a highly volatile hydrocarbon.

(i) Draw the Lewis structure of ethane, stating its shape.

(ii) Justify the high volatility of ethane in terms of chemical bonding and structure.

[4]

(c) Ethane can also be used to synthesise propanoic acid as shown in the following reaction scheme:

$$CH_3CH_3 \xrightarrow{\textbf{I}} \textbf{P} \xrightarrow{\textbf{II}} \textbf{Q} \xrightarrow{\textbf{III}} CH_3CH_2CO_2H$$

(i) Identify the intermediate compounds **P** and **Q**.

(ii) Suggest the reagents and conditions for steps **II** and **III**.

[4]

[Total: 20]

7 (a) Use the information below to identify the compounds **A** to **I**. Explain your reasoning.

(i) Compounds **A** and **B** each has a relative molecular mass of 60 and an empirical formula of C_3H_8O. During the reaction with acidified potassium dichromate (VI) solution, **A** forms only one organic product, **C**. With the same reagent and heated with distillation, **B** produces compound **D** which can be further oxidised to **E**.

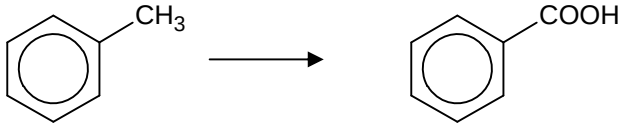
(ii) **F** and **G** each has the molecular formula C_4H_8O. Both produce an orange precipitate with 2,4-dinitrophenylhydrazine but only **F** reacts with an alkaline solution of iodine.

(iii) **H** and **I** each has the molecular formula $C_2H_4O_2$. **H** has an acrid (sharp) smell whereas **I** has a fruity aroma. **H** reacts instantaneously with cold aqueous sodium hydroxide but **I** reacts only when heated under reflux with aqueous alkali.

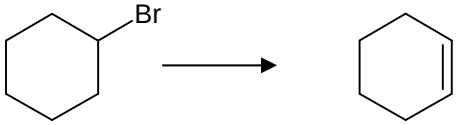
[9]

(b) Many organic reactions can be classified either as substitution, addition, elimination, oxidation or reduction reactions. Suggest reagents and conditions for each of the following transformations, and classify them as far as you can according to the reactions.

(i)



(ii)



(iii) $CH_3CO_2H \longrightarrow CH_3CH_2OH$

(iv) $CH_3CH(OH)CH_3 \longrightarrow CH_3CH(Cl)CH_3$

[8]

(c) The reactant from **b(i)** can further react with bromine, at the *side chain* or *aromatic nucleus,* to give two different organic products, depending on the reaction conditions.
State the two sets of reaction conditions and draw structures of the corresponding organic products.

[3]

[Total: 20]

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