

TEMASEK JUNIOR COLLEGE Preliminary Examinations Higher 2

CANDIDATE NAME	
CIVICS GROUP	

CHEMISTRY

Paper 2 Structured Questions

9746/02 17 September 2008 1 hour 30 minutes

Candidates answer on the Question Paper. Additional Materials: Data Booklet

READ THESE INSTRUCTIONS FIRST

Write your Civics Group and candidate name on all the work you hand in. Write in dark blue or black pen. You may use a soft pencil for any diagrams, graphs or rough working. Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer all questions.

You are reminded of the need for good English and clear presentation in your answers. You may lose marks if you do not use appropriate units.

A Data Booklet is provided.

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

For Examiner's Use		
1		
2		
3		
4		
5		
6		
Total		

1 (a) For decades, scientists were puzzled by why dinosaurs suddenly became extinct 65 million years ago. In studying core samples of rock dating back to that period, scientists found an unusual high level of iridium. This possibly came from an iridium-rich asteroid that struck the Earth's surface and the mystery to dinosaurs' extinction was solved.

Iridium exists as two naturally occurring isotopes, iridium-191 and iridium-193.

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

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(ii) The relative atomic mass of iridium is 192.2. Calculate the natural abundance, in percentage, of each isotope.

[3]

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- **(b)** Aqua regia (a mixture of 75% nitric acid and 25% hydrochloric acid by volume) is highly corrosive. Only noble metals like iridium are inert to this solution. A 5 g sample of platinum-iridium alloy required 24.6 cm³ of aqua regia for complete reaction. Platinum was completely oxidised to platinum(IV) ions by nitric acid and 0.5 g of metal was recovered.
 - (i) Find the percentage of each metal in the alloy.

(ii) The concentration of nitric acid used to make aqua regia is 5.0 mol dm⁻³. Assuming that the reaction between the sample and aqua regia is complete, construct the balanced equation for the reaction.

[4]

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[Total: 7]

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- **2** Propene readily undergoes electrophilic addition with bromine to give 1,2-dibromopropane.
 - (a) (i) Calculate the enthalpy change for this reaction.

(ii) By referring to the electrophilic addition mechanism, sketch the reaction pathway diagram for this reaction. Label your graph, showing clearly the intermediate formed and the enthalpy change of the reaction.

Energy	
$\frac{CH_3CH=CH_2 + BI_2}{(or I_2)}$	
	Extent of reaction

(iii) Bromine adds to propene readily under normal conditions whereas iodine adds only at low temperatures. The 1,2-diiodopropane that results is unstable, decomposing back to propene and iodine at room temperature. The enthalpy change for this addition reaction is – 69 kJ mol⁻¹.

Sketch the reaction pathway diagram for iodine addition on the same diagram above labeling your curve clearly.

[5]

For Examiner's Use (b) 1,2-dibromopropane formed from electrophilic addition of bromine to propene undergoes a series of reactions as shown in the flow chart below.



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(iii) Explain why the cream precipitate dissolves upon the addition of concentrated aqueous ammonia.

(iv) Write balanced equation(s) for the reaction between solid **B** and concentrated H₂SO₄. [9] **3 (a)** Trace amounts of elements in a sample can be determined by spectroscopy. In atomic spectroscopy, the concentration of an element in a solution can be determined by its absorbance. The relationship between the concentration of aluminium in a solution and its absorbance is given in the graph below.



0.1 g of a soil sample was made up to 10 cm^3 of solution for the analysis of the amount of aluminium present.

(i) From the graph, determine the concentration of aluminium in the soil sample given that it has an absorbance of 0.360.

.....

(ii) Hence, determine the amount of aluminium in the soil in parts per million.

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(b) Aluminium is the most abundant metallic element in the earth's crust and is often present in bauxite, as aluminium oxide. Bauxite also contains silica (SiO₂) as an impurity. The aluminium oxide is freed from silica (SiO₂) impurities by using aqueous sodium hydroxide.

Explain, with the aid of relevant equation(s), how the addition of aqueous sodium hydroxide separates aluminium oxide from silica.

[3]

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- (c) Aluminium chloride can be made by passing hydrogen chloride or chlorine over heated aluminium. This must be prepared under anhydrous conditions using soda lime to keep out moisture as well as to absorb excess chlorine.
 - Dry chlorine Heat Soda-lime
 - (i) Suggest why the preparation of aluminium chloride must be done under anhydrous conditions.

.....

(ii) At 200°C, aluminium oxide exists as a solid while aluminium chloride exists as a gas. Explain the observations in terms of structure and bonding.

[3]

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[Total: 9]





To study the kinetics of this reaction, 0.001 mol dm⁻³ of ester was reacted with an excess of 0.2 mol dm⁻³ sodium hydroxide. The initial rate was found to be 3.6×10^{-5} mol dm⁻³ min⁻¹.

(a) (i) Determine the rate constant, stating its units. Show clearly how you arrive at the answer.

(ii) Calculate the time taken for the concentration of 4-nitrophenoxide to increase to $0.0005 \text{ mol dm}^{-3}$.

For Examiner's (b) With the aid of an appropriate labelled diagram, explain how a decrease in temperature affects the rate of hydrolysis. Use [3] [Total: 8]

5 (a) (i) For the reaction scheme below, give the reagents and conditions for steps I to IV in the spaces provided, and draw the structures of the organic compounds E and F in the boxes provided.

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(i) Describe one simple chemical test you could carry out to distinguish $ \begin{array}{c} $	For Examiner' Use			
	State clearly how each compound behaves in the test and write an equation for the reaction involved.	I			
	Reagent(s) & conditions:				
	Observations:				
	Equation:				
		[9]			
(b) M Te	Most organic reactions occur in either an aqueous medium or an organic solvent. Tetrachloromethane (CCl_4) was a commonly used organic solvent.				
E	xplain the difference in the reaction of CCl_4 and $SiCl_4$ with water respectively. Write quations for any reactions that occur.				
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6 Methamphetamine, commonly known as 'Ice', is a strong stimulant which is odourless and colourless. It usually comes in crystallized form known as methamphetamine hydrochloride. The reaction scheme below illustrated two possible pathways to synthesize methamphetamine from amphetamine.

Reaction I CH₂C CH₂C CH_3 NH₂ CH_3 CH₃ amphetamine methamphetamine Reaction II LiA/H_4 in dry ether, room temperature Compound X For each reaction, give the reagent(s) and conditions. (a) (i) Reaction I: Reaction II: (ii) What is the structural formula of the compound X formed in Reaction II? (iii) Explain why Reaction I is not a good method to synthesize methamphetamine. [4] For

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(b) Arrange methamphetamine, amphetamine and phenylamine in order of increasing basicity. Give reasons for your answer.

[3]

For Examiner's

- Illegal production of methamphetamine involves the following process. Examiner's Step 1 Step 2 \cap ·CH₃ CH₂C ĊH₃ ĊH₃ phenylacetone Step 3 Н CH₃ ĊH₃ methamphetamine
- (i) Give the reagent(s) and conditions required in Step 1.
- (ii) Phenylacetone reacts with 2,4-dinitrophenylhydrazine in a condensation reaction to give an orange precipitate. In Step 2, phenylacetone will react in a similar manner. Give the structural formula of the reagent used.

(iii) Name the type of reaction in Step 3.

[3]

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Use

[Total: 10]

(C)