CANDIDATE NAME _____ CLASS_____

DUNMAN HIGH SCHOOL (SENIOR HIGH)

YEAR 6 PRELIMINARY EXAMINATION 2008

H2 CHEMISTRY

9746/02

Paper 2 Structured

17 September 2008

1 hour 30 minutes

Additional materials:
Data Booklet

INSTRUCTIONS TO CANDIDATES

1 Write your **name** and **class** on this question paper.

2 Answer **ALL** questions.

3 Write your answers in the spaces provided on the question paper.

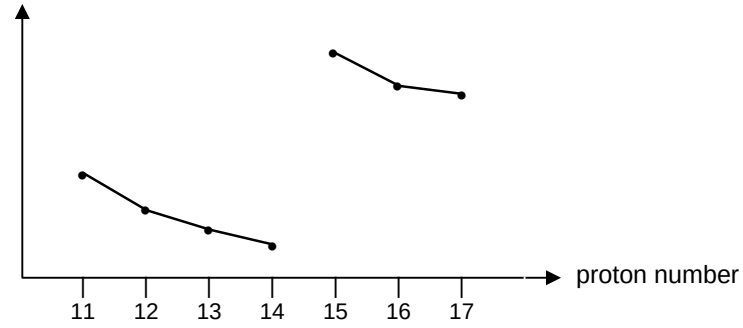
4 A *Data Booklet* is provided.

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

6 You may use a calculator.

FOR EXAMINER'S USE							
Question No.	**1**	**2**	**3**	**4**	**5**	**Total**	**%**
Marks	/17	/12	/12	/9	/10	/[60]	

1(a) The graph below shows the trend in a particular property of Period 3 elements.



(i) Label on the y–axis of the graph, the property represented.

(ii) Briefly explain the trend of this property.

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[4]

(b) One student, Mr Piah, is given three aqueous solutions of the oxides of three Period 3 elements. He adds the indicator, thymol blue, to the three unknown solutions separately and noted the colours of the solutions.

(i) With reference to the pH range and colour of thymol blue indicator, identify each of these solutions in the spaces provided below.

pH range	pH < 1.2	2.8 < pH < 8.0	pH > 9.6
colour of thymol blue	red	yellow	blue

solution	colour observed	identity of oxide
1	green	
2	blue	
3	red	

(ii) Briefly outline the reaction of these oxides with water, supporting your answer with appropriate equations.

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[4]

(c) **(i)** Solid barium amide, $Ba(NH_2)_2$ decomposes when heated to form a high melting point solid, barium nitride, Ba_3N_2, and ammonia gas as the only products. Given that the variation in thermal stability of Group II amides parallels that of Group II nitrates, explain qualitatively whether magnesium amide, $Mg(NH_2)_2$, decomposes at a higher temperature than barium amide.

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(ii) Magnesium hydroxide is used as an antacid to neutralise stomach acid and as a laxative. It is a sparingly soluble compound with solubility product value of 1.0×10^{-11}. Calculate the solubility of $Mg(OH)_2$ in:

(1) Pure water

(2) 0.050 mol dm^{-3} of NaOH

(iii) One of the clearest ways in which atomic properties influence chemical behavior appears in the diagonal relationships of elements. One such example is beryllium and aluminium, from Group II and III respectively. Their oxides show similar chemical behaviour towards acids and bases. Write balanced equations to show the reactions of beryllium oxide with the following:

NaOH (aq) : .....

HC*l* (aq) : .....

[9]

[Total: 17]

2(a) The lithium–manganese (IV) oxide cell is one of the most common consumer batteries, popularly referred to as the lithium cell. It uses inexpensive materials and is suitable for long–life, low–cost applications. The electrolyte used is a lithium salt soaked in an organic solvent.

(i) Complete the following anode and cathode reactions:

Anode: $Li \rightarrow$ ..... + ...

Cathode: $Li^+ + MnO_2 +$ ..... $\rightarrow LiMnO_2$

(ii) Given that the typical cell voltage for the lithium cell is 3.0 V, calculate the E^θ value of the cathode reaction, using relevant data from the *Data Booklet*.

(iii) Suggest a reason why a water–based electrolyte is ***not*** used in this cell.

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(iv) With reference to the anode reaction in part **(i)**, state one advantage of using lithium as an electrode.

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[5]

(b) **(i)** By using relevant data from the *Data Booklet*, show that solid manganese (IV) oxide ***cannot*** oxidise dilute hydrochloric acid.

(ii) Suggest two ways to enable the reaction in part **(i)** to occur.

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[3]

(c) Describe with the aid of a labelled diagram, how you would measure the standard electrode potential E^{θ}, of the Mn^{2+}/Mn system.

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.....[4]

[Total: 12]

3(a) Squalene is a natural unsaturated hydrocarbon found in high concentration in the livers of sharks. It is widely used in cosmetics as a moisturiser. Traditionally, squalene is obtained primarily from sharks, though there are botanic sources as well, such as rice bran and olives. In recent years, many cosmetic manufacturing companies are moving away from the use of shark–based squalene and switching to plant–based squalene instead.

(i) Suggest two reasons why these companies are switching to use plant–based squalene.

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(ii) A 0.100 mol sample of squalene reacted with 14.4 dm^3 of hydrogen, measured at r.t.p, to form saturated hydrocarbon $C_{30}H_{62}$. Calculate how many double bonds there are in each molecule of squalene. Hence, suggest the molecular formula of squalene.

(iii) Briefly describe how the saturated hydrocarbon $C_{30}H_{62}$ reacts with chlorine to form $C_{30}H_{61}Cl$ and state the type of reaction involved.

(iv) While the reaction in part **(iii)** proceeds readily with chlorine, reaction with iodine is slow and reversible. Explain the difference using appropriate data from the *Data Booklet*.

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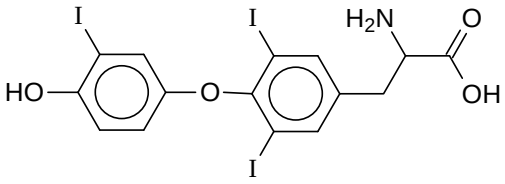
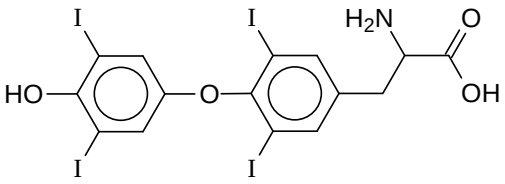
[9]

(b) Thyroid hormones, triiodothyronine and thyroxine, are typically present in the ovaries of sharks. These hormones carry iodine, the heaviest known element needed by living organisms.



triiodothyronine



thyroxine

Describe a chemical test to distinguish between triiodothyronine and thyroxine.

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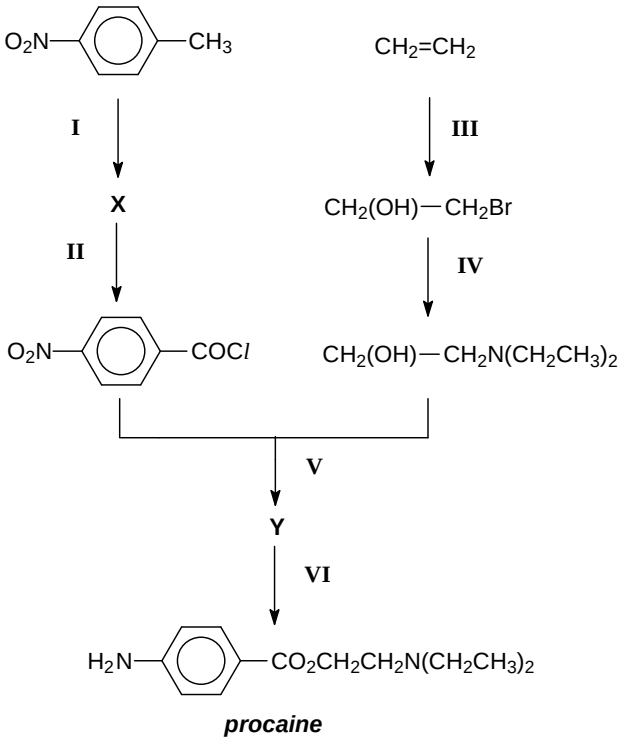
[Total: 12]

4 Procaine is a complex organic molecule, synthesised as the first injectable man–made local anaesthetic, once frequently used in dentistry.

The following illustrates a possible pathway for the synthesis of Procaine using 4–nitromethylbenzene and ethene as starting reactants.



procaine

(a) State the reagents and conditions for the following steps:

I : .....

III : .....

IV : .....

VI : ..... [4]

(b) Draw the structural formula of compounds **X** and **Y**.

X: **Y**:

[2]

(c) Procaine undergoes neutral hydrolysis to yield two organic products, one of which is 4–aminobenzoic acid.

(i) Draw the structural formula of the other organic product.

(ii) Which of the hydrolysis products exhibit a higher degree of basic strength? Explain your answer.

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[3]

[Total: 9]

5(a) The table below compares the physical properties of some organic compounds:

compound	melting point / °C	solubility in water	solubility in organic solvents
$CH_3CH(Cl)COOH$	–13	Soluble	Soluble
$CH_3CH(OH)COOH$	26	Soluble	Soluble
$CH_3CH(NH_2)COOH$	295	Soluble	Insoluble
$CH_3COO^-Na^+$	325	Soluble	Insoluble

(i) Account for the difference in melting points between $CH_3CH(Cl)COOH$, $CH_3CH(OH)COOH$, $CH_3CH(NH_2)COOH$ and $CH_3COO^-Na^+$.

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(ii) Draw the structure of $CH_3CH(NH_2)COOH$ in solution that accounts for its physical properties.

[5]

(b) Sodium ethanoate, $CH_3COO^-Na^+$ is a common product of organic chemistry reactions. In the table below, suggest two organic compounds, each with different functional group that would produce sodium ethanoate via different types of reaction. State the necessary reagents and conditions used and identify ***one*** other product formed (if any) in each reaction.

structural formula of compound	*reagents & conditions*	*products*	
			$CH_3COO^-Na^+$
	type of reaction:		
	type of reaction:		

[5]

[Total: 10]