## YISHUN JUNIOR COLLEGE 2009 JC2 PRELIMINARY EXAMINATIONS H1 CHEMISTRY MARK SCHEME

## Paper1

1	2	3	4	5	6	7	8	9	10
С	В	В	Α	С	D	С	С	В	С
11	12	13	14	15	16	17	18	19	20
Α	D	D	С	В	С	Α	Α	В	С
21	22	23	24	25	26	27	28	29	30
D	Α	A	В	D	С	С	Α	Α	D

## Paper 2 Section A

1

(a)	(i)	Electrons	[1]
	(ii)	Electrostatic forces of attractions between the electrons and protons	[1]
	(iii)	Protons and neutrons	[1]

(b) (i)		species	protons	neutrons	electrons	[1]
		<sup>23</sup> <sub>11</sub> Na	11	12	11	[1]
		<sup>16</sup> 80	8	8	8	- [1]
		<sup>18</sup> <sub>8</sub> O <sup>2-</sup>	8	10	10	-
	(ii)	Na <sub>2</sub> O + 2HNO <sub>3</sub>	$\rightarrow$ 2NaNO <sub>3</sub> +	H <sub>2</sub> O	1	່ [1]

(iii) Let x % = abundance of oxygen-16  

$$16.5 = \frac{(16.0 \times x) + (18 \times (100 - x))}{100}$$

$${}^{16}_{8}O = 75\%$$

$${}^{18}_{8}O = 25\%$$
[1]

(iv) A lot of energy is required to remove all 5 electrons in nitrogen [1] and 6 electrons in oxygen to form a stable octet.

(b) 
$$\overset{\delta^{+}}{H} \cdot \overset{\delta^{-}}{O} \cdot \overset{\circ}{O} \cdot \cdot \overset{\circ}{H}$$
 [1]

(c) Hydrogen peroxide is simultaneously oxidized and reduced in this [1] reaction. Oxidation state of oxygen atom in hydrogen peroxide increase from -1 to 0 to oxygen and decrease from -1 to -2 in water.

(ii) 1 mol of vanadium donates 2 mol of electrons to hydrogen [1] peroxide.

Original oxidation state of vanadium is +3 [1]

)	(i)		Na	Mg	Al	Р	
		formula	NaCl	MgCl <sub>2</sub>	AICI <sub>3</sub>	PCI <sub>3</sub>	
						PCl₅	[1]
		pН	7	6.5	2	1	[1]
	(ii)	PCI <sub>3</sub> + 3H <sub>2</sub> O	$\rightarrow$ H <sub>3</sub> PO <sub>3</sub> + 3	HCI			[1]
		or					
		$PCI_5 + 4H_2O$	$\rightarrow$ H <sub>3</sub> PO <sub>4</sub> + 5	HCI			

(b) The lattice energy of MgO is more exothermic than NaCl. [1]

 $Mg^{2+}$  and  $O^{2-}$  have higher charge than  $Na^+$  and  $CI^-$ . Hence the **[1]** attraction between  $Mg^{2+}$  and  $O^{2-}$  is stronger than  $Na^+$  and  $CI^-$ .

(c) (i) AIF<sub>3</sub> is an ionic compound and a lot of energy is required to [1] overcome the strong electrostatic forces of attractions between the Al<sup>3+</sup> and F<sup>-</sup> ions.

 $AlCl_3$  is a simple covalent molecule and less energy is required [1] to overcome the weak van der Waals forces of attraction between the  $AlCl_3$  molecules.

[1]

[1]

(ii) H CI H−N:→Al−CI H CI

4

(a)

	С	Н	0
%	69.8	11.6	18.6
No. of moles	5.81	11.6	1.16
	5	10	1

Empirical formula =  $C_5H_{10}O$ 

 $M_r = 86 = 5 \times 12.0 + 10 \times 1.0 + 1 \times 16.0$ 

Molecular formula =  $C_5 H_{10} O$  [1]

- (b) (i) A contains a C=C double bond [1]
  - (ii) A contains a –OH group / is an alcohol [1]



- (d) 1. Presence of restricted rotation about the C C bond due to the [1] presence of  $\pi$  bond;
  - 2. No two similar groups is bonded to the C with the double bond [1]



## Section B

[1]



(b)	(i)	order of reaction w.r.t PABA is 1	[1]
		order of reaction w.r.t ethanol is 1	[1]
		order of reaction w.r.t sulfuric acid is 0	[1]
		Rate equation: Rate= k[PABA][Ethanol]	[1]

(ii) 
$$k = 0.0200 \text{ mol}^{-1} \text{dm}^3 \text{s}^{-1}$$
 [1]

Award if both value and unit are correct.

(c) Boltzmann curve – 2 marks, every mistake,-1 [2]





From the graph, increase in temperature increases the average energy [1] of the reacting particles. Hence the **proportion of particles with energy equal to orgreater than the activation energy increases** significantly. Therefore the *frequency* of collisions between reacting particles increases. This increases the number of *effective collisions* [1] and consequently the rate of reaction.

(d) (i) heat evolved = 
$$mc\Delta T = 1 \times 200 \times 4.2 \times 13.4 = 11256 \text{ J or } 11.3 \text{ kJ}$$
 [1]

(ii) No of mole of water = 
$$0.025 \text{ mol}$$
 [1]  
Enthalpy change of reaction =  $-11256/0.025 = -450 \text{ kJ mol}^{-1}$  [1]

(e) (i) 
$$HX + H_2O = H_3O^+ + X^-$$
  
 $K_a = \frac{[H_3O^+(aq)][X^-(aq)]}{[HX_{(aq)}]}$ 
[1]  
 $[H_3O]^+ = \sqrt{ka}.[HX] = \sqrt{1.5 \times 10^{-5} \times 0.1} = 1.22 \times 10^{-3} \text{ mol dm}^{-3}$ 
[1]  
 $pH = -\log_{10} [H_3O]^+ = -\log_{10} 1.22 \times 10^{-3} = 2.9$ 
[1]  
(ii) A buffer solution is one that is able to maintain a fairly constant [1]

(ii) A buffer solution is one that is able to maintain a fairly constant [1] pH, even when relatively small amounts of acid or alkali are added to it.

When small amount of 
$$H^+$$
 is added, it is removed by [1]  $H^+ + X^- \rightarrow HX$ 

When small amount of 
$$OH^-$$
 is added, it is removed by  
 $OH^- + HX \rightarrow H_3O + X^-$ 
[1]

6 (a)	(i)	Heat evolved when one mole of liquid ethanol is burnt completely				
			/ In excess oxygen under standard conditions			
		(ii)	$\Delta H = -1411 - (-1367)$	[1]		
			= – 44 kJ mol <sup>-1</sup>	[1]		
		(iii)	Under standard conditions, water and ethanol exist as liquids.	[1]		



(iii) The equilibrium will shift to the right as concentrated H<sub>2</sub>SO<sub>4</sub> is a [1] dehydrating agent thus increasing the yield of the ester.

It also acts as a catalyst and thus increasing the rate of the [1] reaction.

- (c) (i)  $PCI_5 / PCI_3 / SOCI_2$  at room temperature or HCl, heat [1]
  - (ii) Warm the two compounds with NaOH (aq), followed by HNO<sub>3</sub> (aq) [1] and then AgNO<sub>3</sub> (aq)

Chloroethane: White precipitate	[1]
lodoethane: Yellow precipitate	[1]

(d) (i) C: CH<sub>3</sub>CHO [1] D: CH<sub>3</sub>CH(OH)CN [1]



(b) (i) Acids are proton donor, bases are proton acceptor [1] (ii)  $[H^+] = 2 \times 0.1$  [1]  $pH = -\log [0.2] = 0.70$  [1]

 (iii) No of mole of water = 0.025 mol [1]

 heat evolved =  $0.025 \times 126 = 3.15 \text{ kJ}$  [1]

  $\Delta T = 3.15/75 \times 4.2 = 10$  [1]

 The final temperature of the solution is  $35^{\circ}$ C.
 [1]



- (v) another line showing lower Ea, same energy level of products [1] obtained.
- (c)  $CH_2C/COOH$ ,  $CHCl_2COOH$ ,  $Cl_3COOH$  [1]

CC $l_3$ COOH is the strongest acid as it contains the **most number of** [1] electron withdrawing chlorine atoms. This is because the charge on the COO<sup>-</sup> group of CC $l_3$ COO<sup>-</sup>, is dispersed more extensively than in CHC $l_2$ COO<sup>-</sup>and CH $_2$ C/COO<sup>-</sup>