## Mark Scheme 2816/01 June 2006

CHAISTER CONCEDES IN

		3	(e)	(d)		(c)	(b)	1 (a)	Question	Abbreviations, annotations and conventions used in the Mark Scheme	2816/01
	Volume brine = 4.5 x 10 <sup>10</sup> /4 = 1.125 x 10 <sup>10</sup> dm <sup>3</sup> √ ecf moles Cl <sub>2</sub> /4  i.e. 1.12 ~ 1.13 x 10 <sup>10</sup> dm <sup>3</sup>	Amount Cl <sub>2</sub> produced = $1.6 \times 10^{12}/71$ or $2.25 \times 10^{10}$ mol $\checkmark$ Amount NaCl required = $2 \times 2.25 \times 10^{10}$ or $4.5 \times 10^{10}$ mol $\checkmark$ ecf moles $2 \times Cl_2$	$K_{\rho}$ decreases so equilibrium goes to the left/more $\mathrm{Cl}_2$ / less $\mathrm{Cl}_2$	Equilibrium moves to the side with fewer molecules which is  left/more Cl <sub>2</sub> / less Cl   relieves the increased pressure/ minimises change/minimises this effect   (i.e. attempts to explain in terms of le Chatelier)	(ii) $K_p = \frac{3^2}{85} = 0.11/0.106  \text{V}  \text{kPa}  \text{V}$ (calc: 0.1058823529) Could be ecf from incorrect $K_p$ expression. $pCl_2/pCl_1^2$ gives 9.4 kPa <sup>-3</sup> . 2 $pCl/pCl_2$ , gives 0.0706 / 0.071 no units. $pCl/pCl_2$ gives 0.0353 / 0.035 no units. no units must be specified.	(I) $K_p = \frac{pCl(g)^2}{pCl_2(g)} \checkmark$ state symbols not required	Mole fraction of Cl (g) 3.0/88.0 or 0.034 √ (calc. 0.034090909)	The contribution of a gas to the total pressure in a gas mixture / pressure exerted by the gas alone / mole fraction x total pressure / x P V	Expected Answers	nd  NOT ** separates marking points  NOT ** answers which are not worthy of credit  ** words which are not essential to gain credit  () ** words which are not essential to gain credit  ** (underlining) key words which must be used to gain cledit  edf ** error carried forward  AVV ** alternative wording  ora ** or reverse argument	Mark Scheme
Total: 11	3		(1)	72	፮	Ξ	[17]	<b>3</b>	Marks	ng point	June 2006

72

71

 $\exists$ 

 $k = \frac{7.10}{[O_2][NO]^2} = \frac{7.10}{0.0010 \times 0.0010^2} = 7.10 \times 10^9 \text{ V}$ 

 $\widehat{\Xi}$ 

rate =  $k[O_2][NO]^2 \checkmark$ 

NO:
Exp 3 has 3 x [NO] as Exp. 3: rate has increases by 9 \( \), so order = 2 with respect to NO \( \)

**4** 

Ξ

<u>6</u>

3

The slowest step V

units; dm6 mol-2 s-1

[1] [2]

2

€

2NO<sub>2</sub> → NO + NO<sub>3</sub> √
NO<sub>3</sub> + CO → NO<sub>2</sub> + CO<sub>2</sub> √
(or similar stage involving intermediates)
4NO<sub>2</sub> + O<sub>2</sub> + 2H<sub>2</sub>O → 4HNO<sub>3</sub> √

N from +4 to +5 O from 0 to −2 ✓ Could be below equation

Total: 13 2 â

Question 2 (a)	Abbreviations, annotations and conventions used in the Mark Scheme
Expected Answers (change in) concentration/mass/volume with time	= alternative and acceptable answers for the same marking point = separates marking points NOT = answers which are not worthy of credit   words which are not essential to gain credit = undefining, key words which must be used to gain credit ed = error carried forward AW = alternative wording ora = or reverse argument
Mark	oint

9

 $O_2$ : Exp 2 has 4 x  $[O_2]$  as Exp. 1: rate increases by 4  $^{\checkmark}$ , so order = 1 with respect to  $O_2$   $^{\checkmark}$ 

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				(d)		(c)		3	(E)	3 (a)	Question	Abbreviations, annotations and conventions used in the Mark
	Of $Mg + 2H^* \rightarrow Mg^{2^*} + H_2 \checkmark \checkmark$	Mg + 2HCl → MgCl <sub>2</sub> + H <sub>2</sub> $\checkmark$ Mg + 2CH <sub>3</sub> COOH → (CH <sub>3</sub> COO) <sub>2</sub> Mg + H <sub>2</sub> $\checkmark$	[H*] in $CH_3COOH < [H*]$ in $HCV$ $CH_3COOH$ is a weaker acid than $HCI$ (ora) $\checkmark$	HCl and CH <sub>3</sub> COOH have same number of moles/ release same number of moles H* / 1 mole of each acid produce ½ mol of H <sub>2</sub> √	For CH <sub>3</sub> COOH, [H] = $\sqrt{(K_4 \times [\text{CH}_3\text{COOH}])} / \sqrt{(1.70 \times 10^{-6} \times 0.045)} \checkmark$ [H] = $8.75 \times 10^{-4} \text{ mol dm}^{-3} \checkmark$ pH = $-\log 8.75 \times 10^{-4} = 3.058/3.06 \checkmark \text{ (accept 3.1)}$	For HCl, pH = −log[H*] ✓ {or with values}.  Could be awarded below  = −log 0.045 = 1.35 ✓ (accept 1.3)	CH <sub>3</sub> COOH is more acidic ORA $\checkmark$ $C_8H_6OH(aq) + CH_5COOH(aq) = C_8H_6OH_2^*(aq) + CH_3COO^*(aq) \checkmark$	CH <sub>3</sub> COOH is the stronger acid/ K, CH <sub>3</sub> COOH is greater/	H <sub>2</sub> SO <sub>3</sub> (aq) + CH <sub>3</sub> COOH(aq)   acid 1 base 2 ✓ base 1 acid 2 ✓ for labels on each side of equation	nt of dissociation/ionisation v	Expected Answers	allemative and acceptable answers for the same marking point separates marking points NOT se answers which are not worthy of credit seconds which are not essential to gain credit cunderlining) key words which must be used to gain credit ed serior camed forward AVV setmentive wording ora or reverse argument
Total: 14		Z			[5]		[2]		[2]	[1]	Marks	oint

Abbreviations, i = alternative and accepitable answers for the same merking point annotations and in the Mark conventions (i) = superales marking point (ii) used in the Mark (iii) = survivers which are not worthy of credit (iii) = survivers which are not essential to gain credit (iii) = survivers which are not essential to gain credit (iii) = survivers which are not essential to gain credit (iii) = survivers (iii) = surviv	Total: 7		
= alternative and acceptable answers for the same marking points   NOT			
= alternative and acceptable answers for the same marking points   NOT = answers which are not essential to gain credit   () = words which are not essential to gain credit   error carried forward   AW = alternative wording   ora = or reverse argument   NH <sub>4</sub> Cl   NH <sub>4</sub> Cl   NH <sub>4</sub> *     NH <sub>4</sub> Cl   Provides NH <sub>4</sub> *     NH <sub>4</sub> Cl   Provides NH <sub>4</sub> *     NH <sub>4</sub> Cl   Provides NH <sub>4</sub> *     NH <sub>4</sub> Cl   NH <sub>4</sub> * + Cl ✓   equilibrium:   NH <sub>4</sub> * = NH <sub>3</sub> + H*     NH <sub>4</sub> * removes added alkali / OH ✓   NH <sub>4</sub> * removes added acid or H* /   OR     if equilibrium 1 has been used:   H* removes added alkali / OH ✓   Could be from an equation   A correct equilibrium statement:   Any of the following ✓   on addition of alkali, NH <sub>4</sub> * + OH * moves to left on addition of acid,     NH <sub>4</sub> * + H <sub>2</sub> O = NH <sub>4</sub> * + OH * moves to left on addition of acid,		# NH3 + H*	
= alternative and acceptable answers for the same marking points  NOT = answers which are not essential to gain credit () = ewords which are not essential to gain credit () = ewords which are not essential to gain credit () = ewords which are not essential to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument  Expected Answers  Buffer A buffer minimises changes in pH ✓  Role of NH <sub>4</sub> Cl NH <sub>4</sub> Cl provides NH <sub>4</sub> * / NH <sub>4</sub> Cl provides NH <sub>4</sub> * / NH <sub>4</sub> Cl → NH <sub>4</sub> * + Cl ✓  Role of NH <sub>4</sub> Cl → NH <sub>4</sub> * + Cl ✓  Role of NH <sub>4</sub> Cl → NH <sub>4</sub> * + Cl ✓  NH <sub>4</sub> Cl → NH <sub>4</sub> * + Cl ✓  NH <sub>4</sub> Cl → NH <sub>4</sub> * + Cl ✓  NH <sub>4</sub> Cl → NH <sub>4</sub> * + Cl ✓  NH <sub>4</sub> removed: ✓ NH <sub>3</sub> + H <sub>2</sub> O → NH <sub>4</sub> * + OH ✓  NH <sub>4</sub> removes added alkali / OH ✓  Could be from an equation  A correct equilibrium 2 has been used: OH removes added acid or H* / Could be from an equation  A correct equilibrium statement: Any of the following ✓  on addition of alkali, NH <sub>4</sub> * = NH <sub>3</sub> + H* moves to right	Ξ	$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$ moves to left on addition of acid.	
= alternative and acceptable answers for the same marking points    NOT = answers which are not worthy of credit   NOT = answers which are not worthy of credit   () = words which are not worthy of credit   () = words which are not worthy of credit   () = words which are not worthy of credit   () = error carried forward which must be used to gain credit   answers	[6]	A correct equilibrium statement:  Any of the following \( \)  on addition of alkali,  NH <sub>4</sub> \( = \) NH <sub>3</sub> + H* moves to right	
= alternative and acceptable answers for the same marking points    NOT = soparates marking points		How acid is removed: ✓  NH <sub>3</sub> removes added acid or H* / OR  if equilibrium 2 has been used: OH <sup>-</sup> removes added acid / H* ✓ Could be from an equation	
= alternative and acceptable answers for the same marking pints    Separates marking points		How alkali is removed: V  NH4* removes added alkali / OH*  OR  if equilibrium 1 has been used:  H* removes added alkali / OH* V  Could be from an equation	
= alternative and acceptable answers for the same marking p			
= alternative and acceptable answers for the same marking points = separates marking points () = answers which are not worthy of credit () = words which are not essential to gain credit = (underthing) key words which must be used to gain credit edf = error carried forward AW = alternative wording ora = or reverse argument  Expected Answers  Buffer A buffer minimises changes in pH ✓		Role of NH₄CI NH₄CI provides NH₄⁺ / NH₄CI → NH₄⁺ + CГ ✓	
= alternative and acceptable answers for the same marking points = separates marking points   NOT = answers which are not worthy of credit		A buffer minimises changes in pH	•
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			annotations and conventions used in the Mark
	oint	= alternative and acceptable answers for the same marking p	Abbreviations,

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Total: 15		
[5]	Therefore A is adipic acid / HOOC(CH <sub>2</sub> )₄COOH ✓	
	molar mass of $A = 2.82/1.93 \times 10^{-2} = 146 \text{ g mol}^{-1} \text{ V}$ (or $M_1$ of $A$ is 146)	
	1.93 x 10 <sup>-2</sup> mol A has a mass of 2.82 g	
	amount of A in 250 cm <sup>3</sup> = 10 x 1.93 x 10 <sup>-3</sup> or 1.93 x 10 <sup>-2</sup> V	
	amount of <b>A</b> in 25.0 cm³ = 0.5 x mol NaOH or 1.93 x 10 <sup>-3</sup> √ (calc: 1.929375 x 10 <sup>-3</sup> )	
	amount of NaOH in titration = 0.175 x 22.05/1000 or 3.86 x 10 <sup>-3</sup> ✓ (calc: 3.85875 x 10 <sup>-3</sup> )	(6)
	$M$ , of gas = 1.833 x 24 = 44 $\checkmark$ (calc 43.992) With these two pieces of evidence, assume that molecular formula = $N_2O$	
	= 4.56 $\cdot$ 2.27 = 2 $\cdot$ 1. Empirical formula = $N_2O$ $\checkmark$ Molecular formula	
	Empirical formula N : O = 63.64/14 : 36.36/16 ✓	(Đ
<u>ਭ</u>	Energy = .059 x 5640 = 332.76 kJ = 332.76/4.18 = 79.6 Calories V (i.e. mol sucrose from (a) x 5640/4.18) If 0.059 is missed, 5640/4.18 = 1349 Calories would score 1 mark	
	$C_{12}H_{22}O_{11}(s) + 12 O_{2}(g) \rightarrow 12 CO_{2}(g) + 11 H_{2}O(f) \checkmark$ Ignore state symbols	3
4	moles sucrose = 0.47 x 43/342 or 0.059 mol	
	mass sucrose = 0.47 x 43 g or 20.21 g v M, of sucrose = 342 v	5 (a) (l)
Marks	Expected Answers	
	AW = alternative wording ora = or reverse argument	
	words which are not essential to gain credit     correct carried financing	used in the Mark Scheme
	-	conventions
oint	<ul> <li>= alternative and acceptable answers for the same marking point</li> <li>separates marking points</li> </ul>	Abbreviations,

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