

# Electrolysis, Electrode Potentials & Cells

## Mark Scheme 5

<b>Level</b>	International A Level
<b>Subject</b>	Chemistry
<b>Exam Board</b>	CIE
<b>Topic</b>	Electrochemistry
<b>Sub-Topic</b>	Electrolysis, Electrode Potentials & Cells
<b>Paper Type</b>	Theory
<b>Booklet</b>	Mark Scheme 5

**Time Allowed:** 66 minutes

**Score:** /55

**Percentage:** /100

**Grade Boundaries:**

A*	A	B	C	D	E	U
>85%	777.5%	70%	62.5%	57.5%	45%	<45%

1	(a)	(i) Ammeter/galvanometer	[1]
		Clock/watch/timer ( <b>or</b> rheostat)	[1]
		(For items above 2 in number, e.g. voltmeter, penalise [1])	
	(ii)	Diagram to show ammeter (allow symbol) in circuit, and complete circuit with $\ominus$ terminal of power pack connected to LH electrode	[1]
			[1]
	(iii)	Volume/amount of hydrogen/gas	[1]
		Time	[1]
		Current/amps/ammeter reading (ignore extra measurements)	[1]
			<b>Part (a): [7]</b>
	(b)	$F = L \times e$	[1]
	(ii)	$L = 9.63 \times 10^4 / 1.6 \times 10^{-19} = 6.02 \times 10^{23}$ ( <b>must</b> show working)	[1]
		<b>Allow 6.0 but not 6 or 6.01</b>	<b>Part (b): [2]</b>
			<b>Total: [9]</b>

2 (a)  $M_r(\text{AgBr}) = 108 + 79.9 = 187.9$  [1]

moles =  $2.5 \times 10^{-12}/187.9 = 1.33 \times 10^{-14}$

no. of ions =  $1.33 \times 10^{-14} \times 6 \times 10^{23} = 8.0 \times 10^9$  ions (correct ans = [2]) [1]

2

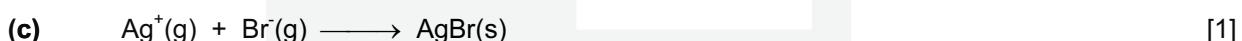
- (b) A: platinum      C: voltmeter  
B:  $\text{H}^+(\text{aq})$  or  $\text{HCl}(\text{aq})$  or  $\text{H}_2\text{SO}_4(\text{aq})$       D: silver (wire)  
(ignore concentration) [4 x [1]]

(ii) (As  $[\text{Ag}^+]$  decreases), the potential will decrease/become more negative [1]

(iii)  $K_{\text{sp}} = [\text{Ag}^+][\text{Br}^-] = (7.1 \times 10^{-7})^2 = 5.0(41) \times 10^{-13} \text{ mol}^2\text{dm}^{-6}$  [1]

units [1]

7



(ii) LE =  $\Delta H_f$  - (all the rest)  
=  $-100 - (731 + 285 + 112 - 325)$   
(=) =  $-100 - 731 - 285 - 112 + 325$   
=  $-903 \text{ kJ mol}^{-1}$  (-[1] for each error of sign or maths) [2]

(iii) LE( $\text{AgCl}$ ) should be higher/more negative,  
due to size/radius of  $\text{Cl}^-$  being less than that of  $\text{Br}^-$  (both) [1]

4

(d) **more** energy needed, since  $r_{\text{Cl}^-} < r_{\text{Br}^-}$  or ionised electron nearer to nucleus  
or less shielding etc. or in terms of I.E.( $\text{Cl}$ ) > I.E.( $\text{Br}$ ) [1]

total: 14

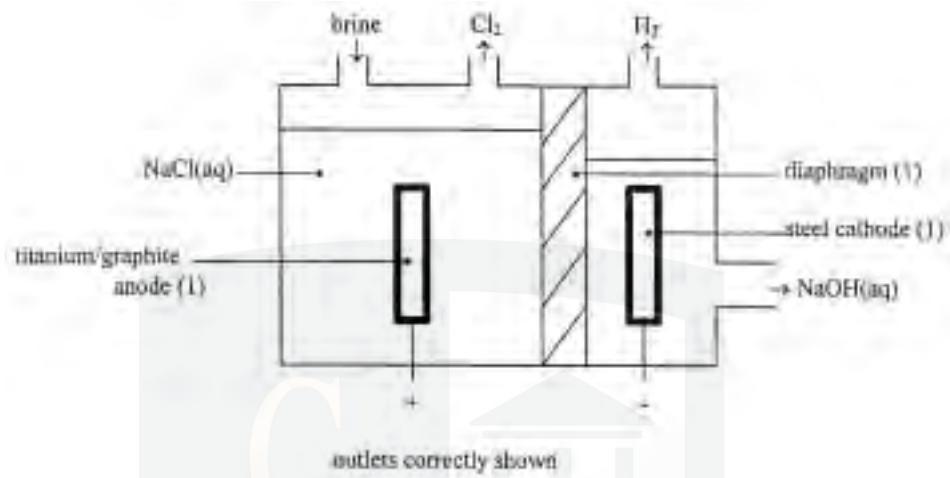
- 3 (a)  $Mg^{2+} + 2e^- \longrightarrow Mg$  [1]
- (b) chlorine/Cl<sub>2</sub> [1]
- (c) smaller A<sub>r</sub>  
larger (atomic/ionic) radius/size [1]  
[1]
- (d) (i) the energy change when **1 mol** of solid compound  
is formed from its **gaseous ions** [1]  
[1]
- (ii)  $Mg^{2+}(g) + 2Cl^-(g) \longrightarrow MgCl_2(s)$  charges + balancing  
state symbols [1]  
[1]
- (e) (i) LE (MgCl<sub>2</sub>) is greater than LE (NaCl)  
(because) Mg<sup>2+</sup> has higher charge / smaller radius than Na<sup>+</sup> [1]  
[1]
- (ii) LE (MgCl<sub>2</sub>) is greater than LE (CaCl<sub>2</sub>)  
(because) Mg<sup>2+</sup> is smaller than Ca<sup>2+</sup> [1]  
[1]
- (f) LE = 349 – 122 – 494 – 107 – 411  
= -785 (kJ mol<sup>-1</sup>) [3]

correct answer = [3], with – [1] for one error. OR mark as follows:

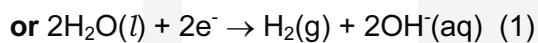
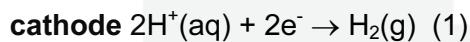
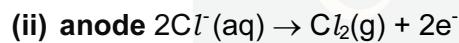
- |   |     |
|---|-----|
| use of all 5 ΔH values, with x1 multipliers | [1] |
| correct signs for all ΔH values             | [1] |
| negative sign in answer                     | [1] |

Total = [15]

4 (a) (i)



[4]



[2]



[2]

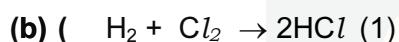


[1]

CHEMISTRY ONLINE  
— TUITION —

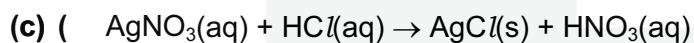
(v) manufacture of

soap	detergents	
paper	degreasing fluids	
rayon	aluminium	
glass	dyes	
bleach/NaClO/Javel/Jik/Jenola		any 2 [1]

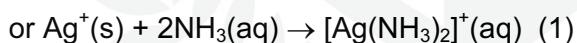
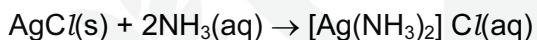
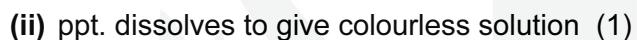


thus bonding goes from covalent to ionic

[2]



white ppt. forms (1)



Correct state symbols in either (i) or (ii) (1)

[5]

[Total 17]