



Name _____ Class: _____

Start Time _____ End Time _____ Time Taken _____

Time allowed: 46 minutes

INSTRUCTIONS TO CANDIDATES

- This document is designed to be used as a practice test.
- Complete the test under exam conditions in one sitting.
- Optional: Before marking it, go through the paper with a set of notes and improve your answers.
- Mark the test using the mark scheme make corrections on the paper.
- Complete the table on the front page.
- Improve your notes so that they better reflect your weaknesses.
- Make a note of your strengths and weaknesses for future revision.

Success Criteria	Questions in Paper	Mark	Out of	%	Rank Order
Calculating EMF	1ai, 2, 3a, 5ei		4		
Interpreting notation	1aii		1		
Writing equation from notation	1ai, 4a		3		
Principles of cells	1bii, 4aii, 4aiv, 5a, 5b, 5d		7		
Changing conditions of cells	1bi, 1bii		4		
Using electrochemical series	1c		3		
Writing equation from ECS	2b, 4bii (first mark), 5eii, 6c, 6d		8		
Oxidising and reducing agents	2c, 4bii		4		
Commercial cells	4a, 5e, 6a-c		4		
Oxidation states	4ai, 6a		4		
Writing Notation	4bi		2		
Movement of Electrons	5c		2		
Fuel Cells	6d, 5e		3		
Note that some questions are in two categories, so it doesn't add up to the total.			45		


Q1.

- (a) (i) 0.60 V 1
- (ii) $\text{H}_2\text{O} + \text{H}_2\text{SO}_3 \rightarrow \text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^-$ 1
- (b) (i) $2\text{IO}_3^- + 2\text{H}^+ + 5\text{H}_2\text{O}_2 \rightarrow 5\text{O}_2 + \text{I}_2 + 6\text{H}_2\text{O}$ Species 1
- Balanced 1
- (ii) The concentration of the ions change or are no longer standard or the e.m.f is determined when no current flows 1
- (iii) Unchanged 1
- (iv) Increased 1
- Equilibrium IO_3^-/I_2 displaced to the right 1
- Electrons more readily accepted or more reduction occurs or electrode becomes more positive (Q o L) 1
- (c) VO_2^+ 1
- 5 or V 1
- $\text{V}^{2+} + 2\text{H}_2\text{O} \rightarrow \text{VO}_2^+ + 4\text{H}^+ + 3\text{e}^-$ 1
- [12]**

Q2.

D

[1]
Q3.

- (a) 1.4 V 1
- Allow + or -*
- (b) $2\text{NiO}(\text{OH}) + 2\text{H}_2\text{O} + \text{Cd} \rightarrow 2\text{Ni}(\text{OH})_2 + \text{Cd}(\text{OH})_2$



*Mark for species, Deduct a mark for additional species
(eg OH-) but allow balance mark*

	Balanced	1
	<i>If equation is reversed CE=0</i>	1
(c)	NiO(OH) or Ni(III) or nickel	1
	+3	1
	<i>Allow conseq on wrong species</i>	1

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Q4.

(a)	(i)	Co/Cobalt <i>If Co or Cobalt not given CE = 0 ignore case in symbol for Co</i>	1
		(+) 4	1
		(+) 3	1
		<i>Allow 4 and 3 in either order</i>	1
	(ii)	Li → Li ⁺ + e ⁻ <i>Ignore state symbols Allow e without -ve sign Do not allow equilibrium sign</i>	1
	(iii)	Platinum is a conductor (Platinum is) unreactive/inert <i>Ignore mention of surface area or catalyst Allow 2 marks if two properties given on one answer line Apply list principle to contradictions/wrong answers Do not allow platinum resists corrosion</i>	1
	(iv)	<u>Li</u> reacts with <u>water</u> /forms lithium hydroxide <i>Allow water breaks down (or is electrolysed) on re-charge</i>	1
(b)	(i)	Pt SO ₃ ²⁻ (aq), SO ₄ ²⁻ (aq) ClO ₃ ⁻ (aq), Cl ⁻ (aq) Pt <i>State symbols an ', ' not necessary Allow in place of ', ' NOT ', ' in place of </i>	1



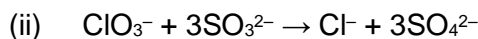
Ignore H⁺ and H₂O

Deduct one mark for each mistake (e.g. Pt missed twice counts as two mistakes)

Allow reverse order for whole cell

Pt | Cl⁻, ClO₃⁻ || SO₄²⁻, SO₃²⁻ | Pt

2



1

Oxidising agent ClO₃⁻

1

Reducing agent SO₃²⁻

1

[12]

Q5.

- (a) It has mobile ions / ions can move through it / free ions

Do not allow movement of electrons.

Allow specific ions provided they are moving but do not react.

1

- (b) Chloride ions react with copper ions / Cu²⁺ **OR** [CuCl₄]²⁻ formed

If incorrect chemistry, mark = 0

1

- (c) The Cu²⁺ ions / CuSO₄ in the left-hand electrode more concentrated

Allow converse.

1

So the reaction of Cu²⁺ with 2e⁻ will occur (in preference at) left-hand electrode / Cu → Cu²⁺ + electrons at right-hand electrode

Allow left-hand electrode positive / right-hand electrode negative.

Also reduction at left-hand electrode / oxidation at right-hand electrode.

Also left-hand electrode has oxidising agent / right-hand electrode has reducing agent.

Allow E left-hand side > E right-hand side

1

- (d) (Eventually) the copper ions / CuSO₄ in each electrode will be at the same concentration

1

- (e) (i) -3.05 (V)

Must have minus sign.

-3.05 only.

1

- (ii) LiMnO₂ → Li + MnO₂ correct equation



Allow 1 for reverse equation.

Allow multiples.

1

Correct direction

If Li^+ not cancelled but otherwise correct, max = 1

If electrons not cancelled, CE = 0

$\text{LiMnO}_2 \rightarrow \text{Li} + \text{MnO}_2$ scores 2

$\text{Li}^+ + \text{LiMnO}_2 \rightarrow \text{Li}^+ + \text{Li} + \text{MnO}_2$ scores 1

$\text{Li} + \text{MnO}_2 \rightarrow \text{LiMnO}_2$ scores 1

1

- (iii) Electricity for recharging the cell may come from power stations burning (fossil) fuel

Allow any reference to burning (of carbon-containing) fuels.

Note combustion = burning.

1

[9]

Q6.

- (a) MnO_2

1

- (b) allows ions to move/flow/transfer

ignore to allow current/charge to flow

do **not** accept electrons to flow

or

to complete the circuit

or

acts as a salt bridge

1

- (c) $2 \text{Ag} + \text{ZnO} \rightarrow \text{Zn} + \text{Ag}_2\text{O}$

ignore state symbols

1

- (d) $\text{O}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{l}) + 4 \text{e}^- \rightarrow 4 \text{OH}^-(\text{aq})$

ignore state symbols

allow multiples

1

$E^{\ominus} = (+) 0.4(0) \text{ (V)}$

1

- (e) same overall reaction

or

$2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}$

1

[6]