

UNIT 5B – CHEMICAL REACTIONS II (REDOX REACTIONS)

**WASHINGTON LATIN PUBLIC CHARTER SCHOOL
CHEMISTRY 2019-20**

UNIT 5B PRACTICE TEST – CHEMICAL REACTIONS II: REDOX REACTIONS

Answer all questions
Recommended time = 50 minutes
BAHATI NJEMA!

Name:	
Score for Q1 - 3 (open response)	/31
Bonus (Submits quiz on time and in correct format)	/9
Total	/40

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1	Chromium, aluminium, iron and silver are all metals. Chromium lies between iron and zinc in the reactivity series and tends to form Cr ³⁺ ions. Chromium, aluminium and iron are all found in nature as their oxide ores Cr ₂ O ₃ (chromite), Al ₂ O ₃ (bauxite) and Fe ₂ O ₃ (haematite)		
	(a)	Explain what you would observe when a piece of chromium, and a piece of silver, are dropped separately into beakers containing hydrochloric acid. Give equations for any reactions occurring and explain the reason for your observations.	
		Cr dissolves in HCl and you will see fizzing/bubbles/effervescence $2\text{Cr} + 6\text{HCl} \rightarrow 2\text{CrCl}_3 + 3\text{H}_2$ or $2\text{Cr} + 6\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 3\text{H}_2$ Ag does not react with HCl Cr is above H in the reactivity series Ag is below H in the reactivity series	1 1 2 1 1 1
	(b)	One way of extracting chromium is by heating chromite with carbon.	
	(i)	Write a possible equation for this reaction.	
		$\text{Cr}_2\text{O}_3 + 3\text{C} \rightarrow 2\text{Cr} + 3\text{CO}$ or $2\text{Cr}_2\text{O}_3 + 3\text{C} \rightarrow 4\text{Cr} + 3\text{CO}_2$	2
	(ii)	Suggest why this reaction is not good for the environment	
		CO is toxic or CO ₂ is a greenhouse gas	1
	(c)	Aluminium is not extracted in this way. It is extracted by the electrolysis of molten bauxite. This extraction is much more expensive than the extraction of iron.	
	(i)	Write a half-equation for the reaction taking place at the cathode of this cell.	
		$\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$ Note: the cathode is the electrode at which reduction happens	1
	(ii)	Write a half-equation for the reaction taking place at the anode of this cell.	
		$2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-$ Note: the anode is the electrode at which oxidation happens	2
	(iii)	Suggest why this extraction is so expensive.	
		Lots of energy needed to melt the Al ₂ O ₃ and lots of electricity needed	1
	(iv)	Explain why aluminium is not extracted by heating bauxite with carbon.	
		Al is above C in the reactivity series so there would be no reaction	1
		TOTAL	15

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2.	One of the first Galvanic cells invented was called a LeClanché cell. The simplified electrode half-equations for this cell are as follows: Zn electrode: $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$ MnO ₂ electrode: $\text{MnO}_2 + 2\text{H}_2\text{O} + \text{e}^- \rightarrow \text{Mn}^{3+} + 4\text{OH}^-$ The two solutions are separated by a diaphragm, which acts as a salt bridge. The MnO ₂ electrode is actually made of graphite coated with a layer of MnO ₂ .		
	(a)	Write an equation for the overall cell reaction.	
		$2\text{MnO}_2 + 4\text{H}_2\text{O} + \text{Zn} \rightarrow 2\text{Mn}^{3+} + 8\text{OH}^- + \text{Zn}^{2+}$ Note: must multiply reduction half-equation by 2 so e's cancel	2
	(b)	Identify the positive electrode, the negative electrode and the direction of electron flow between the electrodes	
		positive electrode: MnO ₂ Note: reduction consumes e's and makes the electrode +ve	1
		negative electrode: Zn Note: oxidation releases e's and makes the electrode -ve	1
		direction of electron flow: From Zn (-) to MnO ₂ (+)	1
	(c)	Explain why the MnO ₂ electrode is not made of pure MnO ₂ .	
		MnO ₂ does not have delocalised electrons so doesn't conduct electricity	1
	(d)	Suggest which ion moves through the diaphragm, and in what direction.	
		OH ⁻ ions from the MnO ₂ /cathode/+ve electrode/reduction compartment to the Zn/anode/-ve electrode/oxidation Note: +ve charge always accumulates in the anodic solution and -ve charge always accumulates in the cathodic solution, so negative ions always have to move across to balance this out	1 1
	(e)	Which common battery still uses a modified version of the LeClanché cell?	
		Alkali battery	1
	(f)	State the main disadvantage of this cell.	
		Non-rechargeable	1
	TOTAL	10	

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3.	Brine is a common substance widely used in food preservation. Brine is a saturated solution of aqueous sodium chloride. The electrolysis of brine produces three useful products.		
	(a)	Write the equation for the reaction occurring at the cathode during the electrolysis of brine.	
		$2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-$ or $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	1
	(b)	Write the equation for the reaction occurring at the anode during the electrolysis of brine.	
		$2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$	1
	(c)	Hence write an overall equation for the electrolysis of brine.	
		$2\text{H}_2\text{O} + 2\text{Cl}^- \rightarrow \text{Cl}_2 + \text{H}_2 + 2\text{OH}^-$ or $2\text{H}^+ + 2\text{Cl}^- \rightarrow \text{H}_2 + \text{Cl}_2$ or $2\text{H}_2\text{O} + 2\text{NaCl} \rightarrow \text{Cl}_2 + \text{H}_2 + 2\text{NaOH}$	1
	(d)	As the electrolysis takes place, the composition of the electrolyte solution changes. Explain what happens to the electrolyte solution and hence identify the third useful substance produced by the electrolysis of brine.	
		Sodium hydroxide/NaOH is produced NaCl gradually turns into NaOH Because Cl^- ions are being removed and replaced with OH^- ions	1 1 1
		TOTAL	6