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| **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 Cr3+ ions.  Chromium, aluminium and iron are all found in nature as their oxide ores Cr2O3 (chromite), Al2O3 (bauxite) and Fe2O3 (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  2Cr + 6HCl 🡪 2CrCl3 + 3H2 or 2Cr + 6H+ 🡪 2Cr3+ + 3H2  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. | | 2  1 |
| (i) | Write a possible equation for this reaction. |
|  | Cr2O3 + 3C 🡪 2Cr + 3CO or 2Cr2O3 + 3C 🡪 4Cr + 3CO2 |
| (ii) | Suggest why this reaction is not good for the environment |
|  | CO is toxic or CO2 is a greenhouse gas |
| (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. | 1  2  1  1 |
|  |  |  | Al3+ + 3e- 🡪 Al  Note: the cathode is the electrode at which reduction happens |
|  |  | (ii) | Write a half-equation for the reaction taking place at the anode of this cell. |
|  |  |  | 2O2- 🡪 O2 + 4e-  Note: the anode is the electrode at which oxidation happens |
|  |  | (iii) | Suggest why this extraction is so expensive. |
|  |  |  | Lots of energy needed to melt the Al2O3 and lots of electricity needed |
|  |  | (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 |
|  |  |  | 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: Zn 🡪 Zn2+ + 2e-  MnO2 electrode: MnO2 + 2H2O + e- 🡪 Mn3+ + 4OH-  The two solutions are separated by a diaphragm, which acts as a salt bridge.  The MnO2 electrode is actually made of graphite coated with a layer of MnO2. | | |  |
| (a) | Write an equation for the overall cell reaction. | |  |
|  | 2MnO2 + 4H2O + Zn 🡪 2Mn3+ + 8OH- + Zn2+  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 | | 1  1  1 |
| positive electrode: | MnO2  Note: reduction consumes e’s and makes the electrode +ve |
| negative electrode: | Zn  Note: oxidation releases e’s and makes the electrode -ve |
|  | direction of electron flow: | From Zn (-) to MnO2 (+) |
| (c) | Explain why the MnO2 electrode is not made of pure MnO2. | | 1 |
|  | MnO2 does not have delocalised electrons so doesn’t conduct electricity | |
| (d) | Suggest which ion moves through the diaphragm, and in what direction. | | 1  1 |
|  | OH- ions  from the MnO2/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 | |
| (e) | Which common battery still uses a modified version of the LeClanché cell? | | 1 |
|  | Alkali battery | |
| (f) | State the main disadvantage of this cell. | | 1 |
|  | Non-rechargeable | |
| 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. | 1 |
|  | 2H2O + 2e- 🡪 H2 + 2OH- or 2H+ + 2e- 🡪 H2 |
| (b) | Write the equation for the reaction occurring at the anode during the electrolysis of brine. | 1 |
| 2Cl- 🡪 Cl2 + 2e- |
| (c) | Hence write an overall equation for the electrolysis of brine. |
|  | 2H2O + 2Cl- 🡪 Cl2 + H2 + 2OH-  or 2H+ + 2Cl- 🡪 H2 + Cl2  or 2H2O + 2NaCl 🡪 Cl2 + H2 + 2NaOH | 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. | 1  1  1 |
| Sodium hydroxide/NaOH is produced  NaCl gradually turns into NaOH  Because Cl- ions are being removed and replaced with OH- ions |
| TOTAL | | 6 |