**Student Name**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**CHEMISTRY**

**Unit 3**

**Targeted Evaluation Tasks for School Assessed Coursework 5**



**2017 Response to structured questions for Outcome 2**

Recommended writing time\*: 60 minutes

Total number of marks available: 50 marks

**TASK BOOK**

\*The recommended time is a guide for the time students should take to complete this task. Teachers may wish to alter this time and can do so at their own discretion.

**Conditions and restrictions**

* Students are permitted to bring into the room for this task: pens, pencils, highlighters, erasers, sharpeners and rulers. This task is open book
* Students are NOT permitted to bring into the room for this task: blank sheets of paper and/or white out liquid/tape.
* Students are permitted one approved scientific calculator and chemistry Data Book

**Materials supplied**

* Question and answer book of 6 pages.

**Instructions**

* Print your name in the space provided on the top of the front page.
* All written responses must be in English.
* Show answers and all working out in the space provided.

**Key knowledge covered in this task**

|  |
| --- |
| Application of Faraday’s Laws |
| Writing of balanced half-equations and overall equations |
| Electrolysis of molten and aqueous solutions |
| Comparison of electrolytic cell with galvanic cell |
| Use of electrochemical series |

**Key skills required for this task**

|  |
| --- |
| Analyse and evaluate data |
| Communicate and explain scientific concepts |
| Develop aims and questions |
| Draw evidence based conclusions |

**Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the room for this task.**

**SECTION A – Experimental Investigation**

**Instructions for Section A**

This task is a response to a set of questions on electrolysis.

Students will complete the questions below that test your understanding of electrolysis. You can refer to your texts and notes if required. The questions cover all aspects of electrolysis and also compare an electrolytic cell with a galvanic cell.

You have 60 minutes to complete this task.

**Preliminary discussion**

Electrolytic cells are redox processes but they require the use of a power supply as the reactions are not spontaneous ones. The electrochemical series is helpful in predicting the products of electrolysis.

**Molten solutions**

Electrolysis is conducted on a molten solution of nickel chloride, NiCl2. The electrodes chosen are inert.

**Questions**

**1. a**. Explain how you prepare a molten solution.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**b**. Why are molten solutions only used as a last resort in commercial industry?

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2 + 2 = 4 marks

**2**. Complete the template below for this electrolysis.

Anode: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Cathode: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Overall equation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Minimum voltage required \_\_\_\_\_\_\_\_\_\_\_\_ Polarity of the anode: \_\_\_\_\_\_\_\_\_\_\_\_

1 + 1 + 1 + 1 + 1 = 5 marks

**3**. Describe your observations at the

**a**. anode \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**b**. cathode \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1 + 1 = 2 marks

**4**. A current of 12.2 amps runs for 22 and half minutes. Calculate the

**a**. mass of metal obtained

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**b**. volume of gas obtained at 355 0C and 1 atm pressure.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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3 + 3 = 6 marks

**Aqueous solutions**

Electrolysis is conducted on a 0.1 M aqueous solution of NiCl2. The electrodes are inert.

**5**. A number of possible reactants are present. List the relevant half-equations for each.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**b**. Select the half-equations for the two actual reactants and use these to write an overall

equation for this electrolysis.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**c**. Describe what you will see at each electrode during the electrolysis.

2 + 2 + 2 = 6 marks

**6**. The same current is run through this cell as in question 4. What volume of gas is

produced at the anode if the temperature and pressure are unchanged?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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3 marks

**7**. The 0.1 M solution is swapped for a 4.0 M solution of NiCl2.

**a**. Write a balanced half-equation for the reaction that will now occur at the anode.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**b**. Write a balanced overall equation for the cell.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1 + 1 = 2 marks

**8**. The anode of the 0.1 M solution is now changed to a nickel anode.

Complete the template below for this cell.

Anode: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Cathode: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Overall equation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3 marks

**9**. Calculate the mass change at each electrode if a current of 10.0 amps is run for 10.0

minutes.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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3 marks

**Galvanic cell compared to electrolytic cell.**

Given the following half-equations

I2(l) + 2e ⇄ 2I-(aq) 0.54 V

Cu2+(aq) + 2e ⇄ Cu(s) 0.34 V

|  |  |
| --- | --- |
| Galvanic cell | Electrolytic cell |
| Select two reactants from the half-equations above that will react in a galvanic cell. They are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Draw the cell required to make this galvanic cell work.  Half-equations:  Anode \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Cathode \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Overall equation \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Complete the following:  Oxidation at the \_\_\_\_\_\_\_\_\_\_\_\_\_\_.  Reduction at the \_\_\_\_\_\_\_\_\_\_\_\_\_\_.  The anode is \_\_\_\_\_\_\_\_\_\_\_\_\_. (polarity)  Electrons flow from \_\_\_\_\_\_ to \_\_\_\_\_\_\_\_.  Products formed are  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Voltage produced \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Select two reactants from the half-equations above that will react in an electrolytic cell. They are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Draw the cell required to make this electrolytic cell work.  Half-equations:  Anode \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Cathode \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Overall equation \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Complete the following:  Oxidation at the \_\_\_\_\_\_\_\_\_\_\_\_\_\_.  Reduction at the \_\_\_\_\_\_\_\_\_\_\_\_\_\_.  The anode is \_\_\_\_\_\_\_\_\_\_\_\_\_. (polarity)  Electrons flow from \_\_\_\_\_\_ to \_\_\_\_\_\_\_\_.  Products formed are  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Voltage required \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

Total 16 marks

**END OF TASK BOOK**