Electrochemical cells

1. Shelby compares a Voltaic cell to an electrolytic cell. The statement below that is **false** is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| a | Both cells have oxidation happening at the anode |
| b | In a voltaic cell, anions go the anode, while in the electrolytic cell, anions go to the cathode |
| c | In an electrolytic cell electrical energy is converted to chemical energy, while in a voltaic cell, chemical energy is converted to electrical energy. |
| d | A Voltaic cell is considered 'spontaneous' while an electrolytic cell is considered 'non-spontaneous'. |

1. In a spontaneous cell, the electrons leave the \_\_\_\_\_\_\_ and travel in \_\_\_\_\_\_\_\_ to reach the \_\_\_\_\_\_\_\_\_\_.

|  |  |  |  |
| --- | --- | --- | --- |
| a | Cathode | Internal circuit | Anode |
| b | Anode | Internal circuit | Cathode |
| c | Cathode | External circuit | Anode |
| d | Anode | External circuit | Cathode |

1. In an electrolytic cell, \_\_\_\_\_\_\_\_\_\_\_\_ travel to the anode and \_\_\_\_\_\_\_\_\_\_\_\_ travel to the cathode in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ circuit.

|  |  |  |  |
| --- | --- | --- | --- |
| a | Anions | Cations | External |
| b | Cations | Anions | External |
| c | Anions | Cations | Internal |
| d | Cations | Anions | internal |

1. An electrolytic cell Zn(s) \ Zn2+(aq) \\ Sn2+(aq) \\ Sn(s) has 1.0 solutions.

The net voltage of this cell is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ V

|  |  |
| --- | --- |
| a | -0.90 |
| b | -0.62 |
| c | +0.62 |
| d | +0.90 |

1. Which cell is capable of recharging a 1.25 V battery?

|  |  |
| --- | --- |
| a | Cu(s) / Cu2+ // Ag+(aq) / Ag(s) |
| b | Al(s) / Al3+(aq) // Sn2+(aq) / Sn(s) |
| c | Co(s) / Co2+(aq) // Pb2+(aq) / Pb(s) |
| d | Fe(s) / Fe2+(aq) // Ni2+(aq) / Ni(s) |

1. The Eo value for the reaction that takes place when Cl2(g) is added to 1.0 solution of NaI(aq) will be \_\_\_\_\_\_\_\_\_\_\_\_\_ V

|  |  |
| --- | --- |
| a | -1.90 |
| b | -0.82 |
| c | +0.82 |
| d | +1.90 |

1. Jon and Steve experimented with the following combination of reactants in a laboratory. Which combination will be non-spontaneous under standard conditions?

|  |  |
| --- | --- |
| a | Ag+(aq) + H2(g) |
| b | Cr(s) + Sn2+(aq) |
| c | Ba(s) + Fe2+(aq) |
| d | Al(s) + Ca2+(aq) |

1. For the reaction, Fe(s) + Sn4+(aq) 🡪 Sn2+(aq) + Fe2+(aq), a **true** statement is \_\_\_

|  |  |
| --- | --- |
| a | Sn4+(aq) caused Fe(s) to be reduced |
| b | Fe(s) causes Sn4+(aq) to be reduced |
| c | Sn2+(aq) is the oxidizing agent |
| d | Fe(s) is the oxidizing agent |

1. In a Voltaic cell, reduction occurs \_\_\_\_\_\_\_.

|  |  |
| --- | --- |
| a | In the salt bridge |
| b | At the cathode |
| c | At the anode |
| d | In the porous cup |

1. In an electrolytic cell, oxidation occurs \_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| a | In the salt bridge |
| b | At the cathode |
| c | At the anode |
| d | In the porous cup |

1. When a car battery produces electricity to start the engine, the battery is behaving as

|  |  |
| --- | --- |
| a | An electrolytic cell |
| b | A voltaic cell |
| c | A system in which only oxidation is occurring |
| d | A system in which only reduction is occurring |

1. In a functioning Voltaic cell, electrons travel in the \_\_\_\_\_\_ circuit from the \_\_\_\_\_\_ to the \_\_\_\_\_\_\_\_.

|  |  |  |  |
| --- | --- | --- | --- |
| a | Internal | Anode | Cathode |
| b | Internal | Cathode | Anode |
| c | External | Anode | Cathode |
| d | external | Cathode | Anode |

1. Which statement about electrochemical cells is **false**?

|  |  |
| --- | --- |
| a | Anions go the anode, while cations go the cathode |
| b | Oxidation occurs at the anode, reduction at the cathode |
| c | Chemical energy will always be converted to electrical energy. |
| d | Eo for the cell will be negative. |

1. Jason and Kyle read the line notation for a **Voltaic cell**.

Zn(s) \ Zn2+(aq) \\ Cu2+(aq) \ Cu(s)

They decide that the Zn(s) acts as the \_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_, while Cu(s) acts as the \_\_\_\_\_\_\_\_\_

|  |  |  |  |
| --- | --- | --- | --- |
| a | Anode | Oxidizing agent | Cathode |
| b | Anode | Reducing agent | Cathode |
| c | Cathode | Oxidizing agent | Anode |
| d | Cathode | Reducing agent | Anode |

1. Consider the seven statements given below.

|  |  |
| --- | --- |
| 1 | Oxidation occurs at the anode where electrons are lost. |
| 2 | Oxidation occurs at the cathode where electrons are gained. |
| 3 | Reduction occurs at the anode where electrons are lost. |
| 4 | The oxidizing agent undergoes reduction at the cathode. |
| 5 | The reducing agent undergoes oxidation at the anode. |
| 6 | The oxidation number of the reducing agent goes up as oxidation occurs. |
| 7 | The oxidation number of the oxidizing agent goes down as reduction occurs. |

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Choose the **FALSE** statement(s) from the statements listed above.

|  |  |
| --- | --- |
| a | 1,4,5,6,7 |
| b | 2,3,6 |
| c | 2,3 |
| d | 6,7 |

1. Consider the seven statements given below.

|  |  |
| --- | --- |
| 1 | Oxidation occurs at the anode where electrons are lost. |
| 2 | Oxidation occurs at the cathode where electrons are gained. |
| 3 | Reduction occurs at the anode where electrons are lost. |
| 4 | The oxidizing agent undergoes reduction at the cathode. |
| 5 | The reducing agent undergoes oxidation at the anode. |
| 6 | The oxidation number of the reducing agent goes up as oxidation occurs. |
| 7 | The oxidation number of the oxidizing agent goes down as reduction occurs. |

The total number of TRUE statements given above is \_\_\_\_\_\_\_

|  |  |
| --- | --- |
| a | 2 |
| b | 4 |
| c | 5 |
| d | 6 |

1. Consider the seven statements given below.

|  |  |
| --- | --- |
| 1 | Oxidation occurs at the anode where electrons are lost. |
| 2 | Oxidation occurs at the cathode where electrons are gained. |
| 3 | Reduction occurs at the anode where electrons are lost. |
| 4 | The oxidizing agent undergoes reduction at the cathode. |
| 5 | The reducing agent undergoes oxidation at the anode. |
| 6 | The oxidation number of the reducing agent goes up as oxidation occurs. |
| 7 | The oxidation number of the oxidizing agent goes down as reduction occurs. |

The total number of FALSE statements given above is \_\_\_\_\_\_\_

|  |  |
| --- | --- |
| a | 2 |
| b | 4 |
| c | 5 |
| d | 6 |

1. If the oxidizing agent is higher on the reduction table than the reducing agent, then the cell is called a \_\_\_\_\_\_\_\_\_ cell and the net voltage will be \_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| a | Voltaic | Positive |
| b | Electrolytic | Negative |
| c | Voltaic | Negative |
| d | Electrolytic | Positive |

1. Samantha and Ashleigh study the line notation for an electrochemical cell.

C(s) \ Cr2+(aq) \\ Fe3+(aq)\ C(s)

They predict **the reaction** at the cathode of this cell to be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| a | Fe3+(aq) + e-🡪 Fe2+(aq) |
| b | Cr2+(aq) +2e- 🡪Cr(s) |
| c | Cr2+(aq) 🡪 Cr3+(aq) + e- |
| d | Fe3+(aq) + 3e- 🡪 Fe(s) |

1. Colbe and Mike write a series of statements about electrochemical cells. Some of their statements are true for both Voltaic and Electrolytic cells some are true only for one type of cell, and some are not true for either type of cell.

Consider the statements given below.

|  |  |
| --- | --- |
| Number | Statement |
| 1 | Reduction happens at the cathode. |
| 2 | Electrons travel in the external circuit of the cell. |
| 3 | Anions travel to the cathode and cations travel to the anode. |
| 4 | Electrical energy is converted to chemical energy. |
| 5 | The reducing agent is higher on the reduction table than the oxidizing agent. |
| 6 | Electrons are gained at the anode. |
| 7 | Metals are plated at the anode. |
| 8 | The cathode has a positive charge. |

The **TOTAL** number of statements that is /are true **ONLY**  for electrolytic cells is/are \_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| a | 1 |
| b | 2 |
| c | 3 |
| d | 4 |

1. Colbe and Mike write a series of statements about electrochemical cells. Some of their statements are true for both Voltaic and Electrolytic cells some are true only for one type of cell, and some are not true for either type of cell.

Consider the statements given below.

|  |  |
| --- | --- |
| Number | Statement |
| 1 | Reduction happens at the cathode. |
| 2 | Electrons travel in the external circuit of the cell. |
| 3 | Anions travel to the cathode and cations travel to the anode. |
| 4 | Electrical energy is converted to chemical energy. |
| 5 | The reducing agent is higher on the reduction table than the oxidizing agent. |
| 6 | Electrons are gained at the anode. |
| 7 | Metals are plated at the anode. |
| 8 | The cathode has a positive charge. |

The number of statements that are NOT true for any cell is/are \_\_\_\_\_\_

|  |  |
| --- | --- |
| a | 1 |
| b | 2 |
| c | 3 |
| d | 4 |

1. Colbe and Mike write a series of statements about electrochemical cells. Some of their statements are true for both Voltaic and Electrolytic cells some are true only for one type of cell, and some are not true for either type of cell.

Consider the statements given below.

|  |  |
| --- | --- |
| Number | Statement |
| 1 | Reduction happens at the cathode. |
| 2 | Electrons travel in the external circuit of the cell. |
| 3 | Anions travel to the cathode and cations travel to the anode. |
| 4 | Electrical energy is converted to chemical energy. |
| 5 | The reducing agent is higher on the reduction table than the oxidizing agent. |
| 6 | Electrons are gained at the anode. |
| 7 | Metals are plated at the anode. |
| 8 | The cathode has a positive charge. |

The **TOTAL** number of statements that is /are true for both types of cells is/are \_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| a | 1 |
| b | 2 |
| c | 3 |
| d | 4 |

1. **Numerical response question:** Left justify your answer in the boxes provided.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

|  |
| --- |
| Consider the electrochemical cell illustrated below  D:\My Documents\My Pictures\2009-10 (Oct)\scan.jpg  Using the numbers in the diagram, identify   1. Type of cell \_\_\_ 2. Anode \_\_\_ 3. Direction of flow of electrons \_\_\_ 4. Direction of flow of cations \_\_\_ |

1. **Numerical response question:** Left justify your answer in the boxes provided

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

|  |
| --- |
| Students are given the following list of chemical reagents   1. Strip of cadmium metal 2. Strip of nickel metal 3. Carbon rod(s) 4. Strip of zinc metal 5. Strip of copper metal 6. Nickel (II) sulfate solution 7. Cadmium sulfate solution 8. Potassium sulfate solution 9. Zinc sulfate solution   If asked to make the strongest possible Voltaic cell, the student should choose  Anode, Cathode, anion, cation  Box 1 Box 2 Box 3 Box 4 |

1. **Numerical response question:** Left justify your answer in the boxes provided.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| Consider the numbered statements about electrochemical cells given below.   |  |  | | --- | --- | | 1 | Oxidation occurs at the cathode | | 2 | The reducing agent reacts at the anode | | 3 | Anions move through the external wire to the anode | | 4 | Cations move through the electrolyte to the anode | | 5 | Electrons move through the external wire to the cathode | | 6 | Chemical energy is converted to thermal energy | | 7 | Chemical energy is converted to electrical energy | | 8 | Cations move through the internal circuit to the cathode. |   The statements numbered above that apply to both electrolytic cells and voltaic cells are \_\_\_\_, \_\_\_\_, \_\_\_\_, and \_\_\_\_. | | | | | |

1. **Numerical response question:** Left justify your answer in the boxes provided.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

|  |
| --- |
| Match the numbers in the diagram below with their appropriate labels.   1. \_\_\_Reducing Agent, 2. \_\_\_ Cathode, 3. \_\_\_ direction of anion movement, 4. \_\_\_direction of electron movement   D:\My Documents\My Pictures\2009-10 (Oct)\Scan0001.tif |

1. **Numerical response question:** Left justify your answer in the boxes provided

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

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|  |
| --- |
| Consider the numbered statements about electrochemical cells given below.   1. the reaction is spontaneous 2. The cathode is the positive electrode 3. The anode is the positive electrode 4. Electrons travel from the anode to the cathode 5. Electrons travel from the cathode to the anode 6. Anions travel to the anode 7. Anions travel to the cathode 8. Cations travel to the cathode 9. Cations travel to the anode   List the statements numbered above that apply to both electrolytic cells and voltaic cells. Put the numbers in ascending order. |

Solutions:

1. b 23. 7624

2. d 24. 4269

3 c 25. 258 in any order

4. c 26. 3461

5. b 27. 468

6. c

7 d

8 b

9 b

10 c

11 b

12 c

13 c

14 b

15 c

16 c

17 a

18 a

19 a

20 b

21 c

22 b