**Chapter 19 electrochemistry worksheet**

|  |  |  |
| --- | --- | --- |
| 4. | When the following oxidation–reduction reaction in acidic solution is balanced, what is the lowest whole-number coefficient for H+, and on which side of the balanced equation should it appear?  Cr2O72–(*aq*) + CH2O(*aq*) Cr3+(*aq*) + HCOOH(*aq*) | |
| A) | 1, reactant side |
| B) | 2, product side |
| C) | 6, product side |
| D) | 8, reactant side |
| E) | 14, reactant side |

|  |  |  |
| --- | --- | --- |
| 9. | Which of the following statements is true for a voltaic (galvanic) cell? | |
| A) | The electron flow is from the positive electrode to the negative electrode. |
| B) | The electron flow is from the anode to the cathode. |
| C) | The electron flow is from the oxidizing agent to the reducing agent through an external circuit. |
| D) | The electron flow is from the negative cathode to the positive anode. |
| E) | The electron flow is through the salt bridge. |

|  |  |  |
| --- | --- | --- |
| 12. | A lead storage battery involves the following two half-reactions:  PbSO4(*s*) + 2e– → Pb(*s*) + SO42–(*aq*); *E*° = –0.36 V  PbO2(*s*) + 4H+(*aq*) + SO42–(*aq*) + 2e– → PbSO4(*s*) + 2H2O(*l*); *E*° = 1.69 V  During the discharge reaction of the lead storage battery at 1.0 *M* concentrations, the cell potential and the reducing agent are, respectively, | |
| A) | –2.05 V and Pb. |
| B) | –2.05 V and PbO2. |
| C) | 2.05 V and Pb. |
| D) | 2.05 V and PbO2. |
| E) | 1.33 V and Pb. |

|  |  |  |
| --- | --- | --- |
| 19. | Which reaction would be most likely to occur at the anode of a voltaic cell? | |
| A) | 2H2O(*l*)  2H2(*g*) + O2(*g*) |
| B) | PbSO4(*s*) + 2e–  Pb(*s*) + SO42–(*aq*) |
| C) | 2H2O(*l*) + 2e–  H2(*g*) + 2OH–(*aq*) |
| D) | PbSO4(*s*)  Pb2+(*aq*) + SO42–(*aq*) |
| E) | 2H2O(*l*)  O2(*g*)+ 4H+(*aq*) + 4e– |

|  |  |  |
| --- | --- | --- |
| 21. | Which of the following statements is true concerning the voltaic cell shown below? | |
| A) | Cu is the anode having a mass that increases with time. |
| B) | Cu is the anode having a mass that decreases with time. |
| C) | Cu is the cathode having a mass that increases with time. |
| D) | Cu is the cathode having a mass that decreases with time. |
| E) | The mass of the Cu electrode neither increases nor decreases with time. |

|  |  |  |
| --- | --- | --- |
| 28. | Which of the following is not part of a voltaic cell? | |
| A) | salt bridge |
| B) | power strip |
| C) | anode |
| D) | cathode |
| E) | external circuit |

|  |  |  |
| --- | --- | --- |
| 32. | A zinc–copper voltaic cell is represented as follows:  Zn(*s*) | Zn2+(1.0 *M*) || Cu2+(1.0 *M*) | Cu(*s*)  Which of the following statements is false? | |
| A) | The mass of the zinc electrode decreases during discharge. |
| B) | The copper electrode is the anode. |
| C) | Electrons flow through the external circuit from the zinc electrode to the copper electrode. |
| D) | Reduction occurs at the copper electrode during discharge. |
| E) | The concentration of Cu2+ decreases during discharge. |

|  |  |  |
| --- | --- | --- |
| 51. | Given:  2H+(*aq*) + 2e–  H2(*g*); *E*° = 0.00 V  Na+(*aq*) + e–  Na(*s*); *E*° = –2.71 V  F2(*g*) + 2e–  2F–(*aq*); *E*° = 2.87 V  Al3+(*aq*) + 3e–  Al(*s*); *E*° = –1.66 V  Pb2+(*aq*) + 2e–  Pb(*s*); *E*° = –0.13 V  Under standard-state conditions, which is the strongest reducing agent? | |
| A) | H+ |
| B) | Na |
| C) | F– |
| D) | Al3+ |
| E) | Pb2+ |

|  |  |  |
| --- | --- | --- |
| 75. | Given:  Cr3+(*aq*) + 3e–  Cr(*s*); *E*° = –0.74 V  Fe2+(*aq*) + 2e–  Fe(*s*); *E*° = –0.41 V  What is the standard Gibbs free-energy change for the following reaction?  2Cr(*s*) + 3Fe2+(*aq*)→ 3Fe(*s*) + 2Cr3+(*aq*) | |
| A) | –504 kJ |
| B) | –191 kJ |
| C) | 191 kJ |
| D) | 63.7 kJ |
| E) | 1060 kJ |

|  |  |  |
| --- | --- | --- |
| 81. | What is the equilibrium constant (*K*) at 25°C for the following cell reaction?  Sn + Pb2+(*aq*) Sn2+(*aq*) + Pb(*s*); *E*°cell = 0.014 V | |
| A) | 1.7 |
| B) | 3.0 |
| C) | 0.014 |
| D) | 1.0 |
| E) | 0.40 |

**Answer Key**

|  |  |  |
| --- | --- | --- |
| 4. | | D |
| 9. | | B |
| 12. | | C |
| 19. | | E |
| 21. | | C |
| 28. | | B |
| 32. | B |
| 51. | | B |
| 75. | | B |
| 81. | | B |