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| 1. Given the following reaction in acidic media:                 Fe2+ + Cr2O72– → Fe3+ + Cr3+  answer the following question: The coefficient for water in the balanced reaction is:   |  |  |  | | --- | --- | --- | |  | a. | 1 | |  | b. | 3 | |  | c. | 5 | |  | d. | 7 | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 2. For the reaction of sodium bromide with chlorine gas to form sodium chloride and bromine, the appropriate half-reactions are (ox = oxidation and re = reduction):   |  |  |  | | --- | --- | --- | |  | a. | ox:    Cl2 + 2e– → 2Cl–;       re:    2Br– → Br2 + 2e– | |  | b. | ox:    2Br– → Br2 + 2e–;       re:    Cl2 + 2e– → 2Cl– | |  | c. | ox:    Cl + e– → Cl–;             re:    Br → Br– + e– | |  | d. | ox:    Br + 2e– → Br2–;         re:    2Cl– → Cl2 + 2e– | |  | e. | ox:    2Na+ + 2e– → 2Na;     re:    2Cl– → Cl2 + 2e– |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/16/2017 7:05 AM | |

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| 3. How many electrons are transferred in the following reaction when it is balanced in acidic solution? SO32–(*aq*) + MnO4–(*aq*) → SO42–(*aq*) + Mn2+(*aq*)   |  |  |  | | --- | --- | --- | |  | a. | 6 | |  | b. | 2 | |  | c. | 10 | |  | d. | 5 | |  | e. | 3 |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 4. Ammonium metavandate reacts with sulfur dioxide in acidic solution as follows (hydrogen ions and H2O omitted):  *x*VO3– + *y*SO2 → *x*VO2+ + *y*SO42–  The ratio *x* : *y* is   |  |  |  | | --- | --- | --- | |  | a. | 1 : 1 | |  | b. | 1 : 2 | |  | c. | 2 : 1 | |  | d. | 1 : 3 | |  | e. | 3 : 1 |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| The following reaction occurs in aqueous acid solution:            NO3– + I– → IO3– + NO2 |

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| 5. In the balanced equation the coefficient of NO3– is:   |  |  |  | | --- | --- | --- | |  | a. | 2 | |  | b. | 3 | |  | c. | 4 | |  | d. | 5 | |  | e. | 6 |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-1 | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 6. In the balanced equation the coefficient of water is:   |  |  |  | | --- | --- | --- | |  | a. | 1 | |  | b. | 2 | |  | c. | 3 | |  | d. | 4 | |  | e. | 5 |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-1 | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 7. When the equation Cl2 → Cl– + ClO3– (basic solution) is balanced using the smallest whole-number coefficients, the coefficient of OH– is:   |  |  |  | | --- | --- | --- | |  | a. | 1 | |  | b. | 12 | |  | c. | 3 | |  | d. | 4 | |  | e. | 6 |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 8. The following reaction occurs in basic solution:                 F2 + H2O → O2 + F–  When the equation is balanced, the sum of the coefficients is:   |  |  |  | | --- | --- | --- | |  | a. | 10 | |  | b. | 11 | |  | c. | 12 | |  | d. | 13 | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 9. When the equation for the following reaction in basic solution is balanced, what is the sum of the coefficients?                 MnO2 + HO2– → MnO4–   |  |  |  | | --- | --- | --- | |  | a. | 11 | |  | b. | 31 | |  | c. | 14 | |  | d. | 9 | |  | e. | 18 |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 10. The reaction below occurs in basic solution. In the balanced equation, what is the sum of the coefficients?                 Zn + NO3– → Zn(OH)42– + NH3   |  |  |  | | --- | --- | --- | |  | a. | 12 | |  | b. | 15 | |  | c. | 19 | |  | d. | 23 | |  | e. | 27 |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 11. The following reaction occurs in basic solution: Ag+ + Cu → Ag + Cu2+When the equation is balanced, the sum of the coefficients is:   |  |  |  | | --- | --- | --- | |  | a. | 4 | |  | b. | 5 | |  | c. | 6 | |  | d. | 7 | |  | e. | none of the above |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 12. When the following reaction is balanced in acidic solution, what is the coefficient of I2?                 IO3– + I– → I2   |  |  |  | | --- | --- | --- | |  | a. | 1 | |  | b. | 2 | |  | c. | 3 | |  | d. | 4 | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 13. Balance the following oxidation–reduction reaction using the half-reaction method.                 Cr2O72– + I2 → Cr3+ + IO3–  In the balanced equation, the coefficient of water is:   |  |  |  | | --- | --- | --- | |  | a. | 4 | |  | b. | 17 | |  | c. | 11 | |  | d. | 7 | |  | e. | 6 |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 14. For the redox reaction 2Fe2+ + Cl2 → 2Fe3+ + 2Cl– which of the following are the correct half-reactions?   |  |  | | --- | --- | | I. | Cl2 + 2e– → 2Cl– | | II. | Cl → Cl– + e– | | III. | Cl2 → 2Cl– + 2e– | | IV. | Fe2+ → Fe3+ + e– | | V. | Fe2+ + e– → Fe3+ |   ​   |  |  |  | | --- | --- | --- | |  | a. | I and IV | |  | b. | I and V | |  | c. | II and IV | |  | d. | II and V | |  | e. | III and IV |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/1/2017 1:35 AM | |

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| 15. What is the oxidation state of Hg in Hg2Cl2?   |  |  |  | | --- | --- | --- | |  | a. | +2 | |  | b. | –1 | |  | c. | –2 | |  | d. | +1 | |  | e. | 0 |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | assigning oxidation number | chemical reactions | Chemistry | general chemistry | oxidation-reduction reaction | types of chemical reactions | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 16. How many electrons are transferred in the following reaction?                 2ClO3– + 12H+ + 10I– → 5I2 + Cl2 + 6H2O   |  |  |  | | --- | --- | --- | |  | a. | 12 | |  | b. | 5 | |  | c. | 2 | |  | d. | 30 | |  | e. | 10 |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing chemical equation | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 17. How many electrons are transferred in the following reaction?                Cd + 2HCl → CdCl2 + H2   |  |  |  | | --- | --- | --- | |  | a. | 0 | |  | b. | 1 | |  | c. | 2 | |  | d. | 4 | |  | e. | not enough information given |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/1/2017 1:39 AM | |

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| 18. When the equation for the following reaction in basic solution is balanced, what is the sum of the coefficients?                 MnO4–(*aq*) + CN–(*aq*) → MnO2(*s*) + CNO–(*aq*)   |  |  |  | | --- | --- | --- | |  | a. | 13 | |  | b. | 8 | |  | c. | 10 | |  | d. | 20 | |  | e. | 11 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 19. The following unbalanced equation represents a reaction that occurs in basic solution:                 MnO42– + C2O42– → MnO2 + CO32–  How many moles of MnO42– are required to produce 1 mole of CO32–?   |  |  |  | | --- | --- | --- | |  | a. | 4 | |  | b. | 3 | |  | c. | 2 | |  | d. | 1 | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 20. The following questions refer to a galvanic cell that utilizes the following reaction (unbalanced):   |  |  |  | | --- | --- | --- | |  |  | (AuCl4)–(*aq*) + Cu(*s*) → Au(*s*) + Cl–(*aq*) + Cu2+(*aq*) |   Determine the number of electrons transferred during the reaction (when balanced).   |  |  |  | | --- | --- | --- | |  | a. | 2 | |  | b. | 3 | |  | c. | 4 | |  | d. | 6 | |  | e. | 9 |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| Consider a galvanic cell based in the reaction Fe2+ + Cr2O72– → Fe3+ + Cr3+ in acidic solution. |

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| 21. What is the coefficient of Fe3+ in the balanced equation?   |  |  |  | | --- | --- | --- | |  | a. | 6 | |  | b. | 2 | |  | c. | 3 | |  | d. | 4 | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-2 | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 22. Calculate the voltage of the standard cell carrying out this reaction.   |  |  |  | | --- | --- | --- | |  | a. | 0 | |  | b. | 0.21 V | |  | c. | –0.21 V | |  | d. | 0.56 V | |  | e. | –0.56 V |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-2 | | *KEYWORDS:* | calculating cell emfs | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 23. Which energy conversion shown below takes place in a galvanic cell?   |  |  |  | | --- | --- | --- | |  | a. | electrical to chemical | |  | b. | chemical to electrical | |  | c. | mechanical to chemical | |  | d. | chemical to mechanical | |  | e. | mechanical to electrical |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.2 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 24. Which of the following reactions is possible at the anode of a galvanic cell?   |  |  |  | | --- | --- | --- | |  | a. | Zn → Zn2+ + 2e– | |  | b. | Zn2+ + 2e– → Zn | |  | c. | Zn2+ + Cu → Zn + Cu2+ | |  | d. | Zn + Cu2+ → Zn2+ + Cu | |  | e. | two of these |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.2 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | construction of voltaic cells | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 25. Which of the following is true for the cell shown here? Zn(*s*) | Zn2+(*aq*) || Cr3+(*aq*) | Cr(*s*)   |  |  |  | | --- | --- | --- | |  | a. | The electrons flow from the cathode to the anode. | |  | b. | The electrons flow from the zinc to the chromium. | |  | c. | The electrons flow from the chromium to the zinc. | |  | d. | The chromium is oxidized. | |  | e. | The zinc is reduced. |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.2 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | construction of voltaic cells | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 26. The anode in a voltaic cell and in an electrolytic cell is   |  |  |  | | --- | --- | --- | |  | a. | positive in both cells | |  | b. | the site of oxidation and of reduction, respectively | |  | c. | the site of reduction and of oxidation, respectively | |  | d. | the site of oxidation in both cells | |  | e. | the site of reduction in both cells |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.2 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | construction of voltaic cells | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 27. Which statement is always true of the cathode in an electrochemical cell?   |  |  |  | | --- | --- | --- | |  | a. | It is considered the “negative” electrode. | |  | b. | It is considered the “positive” electrode. | |  | c. | Reduction occurs here. | |  | d. | Metal is plated out here. | |  | e. | Negative ions flow toward the cathode. |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.2 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | construction of voltaic cells | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 28. A strip of copper is placed in a 1 *M* solution of copper nitrate and a strip of silver is placed in a 1 *M* solution of silver nitrate. The two metal strips are connected to a voltmeter by wires and a salt bridge connects the solutions. The following standard reduction potentials apply:   |  |  |  | | --- | --- | --- | |  | Ag+(*aq*) + e– → Ag(*s*) | *ε*° =  +0.80 V | |  | Cu2+(*aq*) + 2e– → Cu(*s*) | *ε*° = +0.34 V |   Which of the following statements is *false*?   |  |  |  | | --- | --- | --- | |  | a. | Electrons flow in the external circuit from the copper electrode to the silver electrode. | |  | b. | The silver electrode increases in mass as the cell operates. | |  | c. | There is a net general movement of silver ions through the salt bridge to the copper half-cell. | |  | d. | Negative ions pass through the salt bridge from the silver half-cell to the copper half-cell. | |  | e. | Some positive copper ions pass through the salt bridge from the copper half-cell to the silver half-cell. |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | construction of voltaic cells | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 29. You are told that metal X is a better reducing agent than metal Y. This must mean that:   |  |  |  | | --- | --- | --- | |  | a. | X+ is a better oxidizing agent than Y+. | |  | b. | X+ is a better reducing agent than Y+. | |  | c. | Y is a better oxidizing agent than X. | |  | d. | Y+ is a better reducing agent than X+. | |  | e. | Y+ is a better oxidizing agent than X+. |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | strength of oxidizing and reducing agents | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 30. Which of the following species cannot function as an oxidizing agent?   |  |  |  | | --- | --- | --- | |  | a. | S(*s*) | |  | b. | NO3–(*aq*) | |  | c. | Cr2O72–(*aq*) | |  | d. | I–(*aq*) | |  | e. | MnO4–(*aq*) |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 31. Which of the following is the strongest oxidizing agent?   |  |  |  |  | | --- | --- | --- | --- | |  | MnO4– + 4H+ + 3e*–* → MnO2 + 2H2O |  | *ε*° = 1.68 V | |  | I2 + 2e– → 2I– |  | *ε*° = 0.54 V | |  | Zn2+ + 2e*–* → Zn |  | *ε*° = –0.76 V |  |  |  |  | | --- | --- | --- | |  | a. | MnO4– | |  | b. | I2 | |  | c. | Zn2+ | |  | d. | Zn | |  | e. | MnO2 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | strength of oxidizing and reducing agents | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 32. Which metal, Al or Ni could reduce Zn2+ to Zn(*s*) if placed in a Zn2+(*aq*) solution?   |  |  |  |  | | --- | --- | --- | --- | |  | Zn2+ + 2e– → Zn |  | *ε*° = –0.76 V | |  | Al3+ + 3e– → Al |  | *ε*° = –1.66 V | |  | Ni2+ + 2e– → Ni |  | *ε*° = –0.23 V |  |  |  |  | | --- | --- | --- | |  | a. | Al | |  | b. | Ni | |  | c. | Both Al and Ni would work. | |  | d. | Neither Al nor Ni would work. | |  | e. | Cannot be determined. |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | tabulating standard electrode potentials | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 33. Which of the following is the best reducing agent?   |  |  |  |  | | --- | --- | --- | --- | |  | Cl2 + 2e– → 2Cl– |  | *ε*° = 1.36 V | |  | Mg2+ + 2e– → Mg |  | *ε*° = –2.37 V | |  | 2H+ + 2e*–* → H2 |  | *ε*° = 0.00 V |  |  |  |  | | --- | --- | --- | |  | a. | Cl2 | |  | b. | H2 | |  | c. | Mg | |  | d. | Mg2+ | |  | e. | Cl- |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | strength of oxidizing and reducing agents | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 34. Consider the galvanic cell shown below (the contents of each half-cell are written beneath each compartment):    0.50 *M* Br2          0.20 *M* Cr3+   0.10 *M* Br–  The standard reduction potentials are as follows:            Cr3+(*aq*) + 3e– → Cr(*s*)             *ε*° = –0.727 V           Br2(*aq*) + 2e– → 2Br–(*aq*)         *ε*° = +1.090 V  What is *ε*° for this cell?   |  |  |  | | --- | --- | --- | |  | a. | 1.817 V | |  | b. | 0.363 V | |  | c. | –0.363 V | |  | d. | 4.724 V | |  | e. | 1.316 V |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | calculating cell emfs | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 35. Consider the galvanic cell shown below (the contents of each half-cell are written beneath each compartment):    0.50 *M* Br2          0.20 *M* Cr3+   0.10 *M* Br–  The standard reduction potentials are as follows:            Cr3+(*aq*) + 3e– → Cr(*s*)             *ε*° = -0.73 V           Br2(*aq*) + 2e– → 2Br–(*aq*)         *ε*° = +1.09 V  Which of the following statements about this cell is false?   |  |  |  | | --- | --- | --- | |  | a. | This is a galvanic cell. | |  | b. | Electrons flow from the Pt electrode to the Cr electrode. | |  | c. | Reduction occurs at the Pt electrode. | |  | d. | The cell is not at standard conditions. | |  | e. | To complete the circuit, cations migrate into the left half-cell and anions migrate into the right half-cell from the salt bridge. |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | construction of voltaic cells | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| 36. Refer to the galvanic cell below (the contents of each half-cell are written beneath each compartment):  0.10 *M* MnO4–       0.40 *M* Cr3+ 0.20 *M* Mn2+          0.30 *M* Cr2O72– 0.010 *M* H+            0.010 *M* H+  The standard reduction potentials are as follows:  MnO4– + 8H+ + 5e*–* → Mn2+ + 4H2O, *ε*° = 1.506 V Cr2O72– + 14H+ + 6e*–* → 2Cr3+ + 7H2O, *ε*° = 1.330 V  What is the value of *ε*°cell?   |  |  |  | | --- | --- | --- | |  | a. | –0.176 | |  | b. | 2.836 | |  | c. | 0.176 | |  | d. | 0.676 | |  | e. | 6.200 |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:30 PM | | *DATE MODIFIED:* | 3/4/2016 4:30 PM | |

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| Refer to the galvanic cell below (the contents of each half-cell are written beneath each compartment):  0.10 *M* MnO4–       0.40 *M* Cr3+ 0.20 *M* Mn2+          0.30 *M* Cr2O72– 0.010 *M* H+            0.010 *M* H+  The standard reduction potentials are as follows:  MnO4– + 8H+ + 5e*–* → Mn2+ + 4H2O, *ε*° = 1.51 V Cr2O72– + 14H+ + 6e*–* → 2Cr3+ + 7H2O, *ε*° = 1.33 V |

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| 37. When current is allowed to flow, which species is oxidized?   |  |  |  | | --- | --- | --- | |  | a. | Cr2O72– | |  | b. | Cr3+ | |  | c. | MnO4– | |  | d. | Mn2+ | |  | e. | H+ |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-3 | | *KEYWORDS:* | Chemistry | construction of voltaic cells | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 38. When current is allowed to flow, which species is reduced?   |  |  |  | | --- | --- | --- | |  | a. | Cr2O72– | |  | b. | Cr3+ | |  | c. | MnO4– | |  | d. | Mn2+ | |  | e. | H+ |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-3 | | *KEYWORDS:* | Chemistry | construction of voltaic cells | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 39. What is the oxidation state of Cr in Cr2O72–?   |  |  |  | | --- | --- | --- | |  | a. | +7 | |  | b. | +6 | |  | c. | +12 | |  | d. | –1 | |  | e. | –2 |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-3 | | *KEYWORDS:* | assigning oxidation number | chemical reactions | Chemistry | general chemistry | oxidation-reduction reaction | types of chemical reactions | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 40. What is the value of *Q*, the reaction quotient, for this cell reaction?   |  |  |  | | --- | --- | --- | |  | a. | 6.7 × 1040 | |  | b. | 1.5 × 10–41 | |  | c. | 1.5 × 10–4 | |  | d. | 6.7 × 103 | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-3 | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 41. In which direction do electrons flow in the external circuit?   |  |  |  | | --- | --- | --- | |  | a. | left to right | |  | b. | right to left | |  | c. | no current flows; the cell is at equilibrium | |  | d. | cannot be determined. | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-3 | | *KEYWORDS:* | Chemistry | construction of voltaic cells | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 42. In the balanced cell reaction, what is the stoichiometric coefficient for H+?   |  |  |  | | --- | --- | --- | |  | a. | 5 | |  | b. | 6 | |  | c. | 30 | |  | d. | 22 | |  | e. | 2 |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-3 | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 43. How many electrons are transferred in the balanced reaction (i.e., what will be the value of *n* in the Nernst equation)?   |  |  |  | | --- | --- | --- | |  | a. | 5 | |  | b. | 6 | |  | c. | 30 | |  | d. | 22 | |  | e. | 2 |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-3 | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 44. What is the cell potential at 25°C as read on the digital voltmeter?   |  |  |  | | --- | --- | --- | |  | a. | 0.18 V | |  | b. | 2.58 V | |  | c. | 0.10 V | |  | d. | 0.59 V | |  | e. | 0.26 V |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-3 | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 45. A cell is set up with copper and lead electrodes in contact with CuSO4(*aq*) and Pb(NO3)2(*aq*), respectively, at 25°C. The standard reduction potentials are:                 Pb2+ + 2e– → Pb     *ε*° = –0.13 V                Cu2+ + 2e– → Cu     *ε*° = +0.34 V  If the Pb2+ and Cu2+ are each 1.0 *M*, the potential of the cell, in volts, is:   |  |  |  | | --- | --- | --- | |  | a. | 0.47 V | |  | b. | 0.92 V | |  | c. | 0.22 V | |  | d. | 0.58 V | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | calculating cell emfs | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 46. Consider an electrochemical cell with a zinc electrode immersed in 1.0 *M* Zn2+ and a silver electrode immersed in 1.0 *M* Ag+.            Zn2+ + 2e– → Zn            *ε*° = –0.760 V           Ag+ + e– → Ag               *ε*° = 0.800 V  Calculate *ε*° for this cell.   |  |  |  | | --- | --- | --- | |  | a. | 0.040 V | |  | b. | –0.040 V | |  | c. | 1.560 V | |  | d. | –1.560 V | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | calculating cell emfs | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 47. The galvanic cell described by Zn(*s*) | Zn2+(*aq*) | Cu2+(*aq*) | Cu(*s*) has a standard cell potential of 1.101 volts. Given that Zn(*s*) → Zn2+(*aq*) + 2e– has an oxidation potential of 0.755 volts, determine the reduction potential for .   |  |  |  | | --- | --- | --- | |  | a. | 1.856 V | |  | b. | –1.856 V | |  | c. | –0.346 V | |  | d. | 0.346 V | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/16/2017 6:02 AM | |

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| 48. The following question refers to a galvanic cell that utilizes the following reaction (unbalanced):            (AuCl4)–(*aq*) + Cu(*s*) → Au(*s*) + Cl–(*aq*) + Cu2+(*aq*)  Given the following information, determine the standard cell potential:   |  |  | | --- | --- | | Species | Standard Reduction Potential (V) | | Au3+(*aq*) | 1.4980 | | Cu2+(*aq*) | –0.3388 |   ​   |  |  |  | | --- | --- | --- | |  | a. | 1.1592 V | |  | b. | 1.8368 V | |  | c. | 3.8164 V | |  | d. | 0.8204 V | |  | e. | 4.1552 V |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | calculating cell emfs | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/1/2017 2:02 AM | |

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| 49. Choose the correct statement given the following information:   |  |  | | --- | --- | |  |  | |  |  |  |  |  |  | | --- | --- | --- | |  | a. | Fe2+(*aq*) is more likely to be oxidized than Fe2+ complexed to CN–. | |  | b. | Fe3+(*aq*) is more likely to be reduced than Fe3+ complexed to CN–. | |  | c. | Both A and B are true. | |  | d. | Complexation of Fe ions with CN– has no effect on their tendencies to become oxidized or reduced. | |  | e. | None of these is true. |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | strength of oxidizing and reducing agents | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 50. The following question refers to the following system:            3Ag(*s*) + NO3–(*aq*) + 4H+(*aq*) → 3Ag+(*aq*) + NO(*g*) + 2H2O(*l*)   |  |  |  | | --- | --- | --- | | Anode reaction: | Ag → Ag+(*aq*) + e– | *ε*° = –0.7990 V | | Cathode reaction: | NO3–(*aq*) + 4H+(*aq*) + 3e– → NO(*g*) + 2H2O(*l*) | *ε*° = 0.9637 V |   ​  Determine the standard cell potential.   |  |  |  | | --- | --- | --- | |  | a. | –1.7627 V | |  | b. | 0.1647 V | |  | c. | 2.0921 V | |  | d. | 3.5254 V | |  | e. | 0.5876 V |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | calculating cell emfs | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/1/2017 3:57 AM | |

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| 51. Which of the following would be the best oxidizing agent?   |  |  |  | | --- | --- | --- | |  | a. | Cl2 | |  | b. | Fe | |  | c. | Na | |  | d. | Na+ | |  | e. | F– |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | strength of oxidizing and reducing agents | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 52. Copper will spontaneously reduce which of the following?   |  |  |  | | --- | --- | --- | |  | a. | Fe2+ and Ag+ | |  | b. | Fe2+ | |  | c. | Ag+ | |  | d. | Al3+ | |  | e. | Fe2+ and Al3+ |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | tabulating standard electrode potentials | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 53. Determine the standard potential, *ε*°, of a cell that employs the reaction:  Fe + Cu2+ → Cu + Fe2+.   |  |  | | --- | --- | | **Reaction** | ***ε*° (volts)** | |  | –0.435 | |  | +0.340 |   ​   |  |  |  | | --- | --- | --- | |  | a. | –0.095 | |  | b. | –0.775 | |  | c. | 0.095 | |  | d. | 0.775 | |  | e. | –0.190 |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | calculating cell emfs | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/1/2017 4:01 AM | |

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| 54. Of Sn2+, Ag+, and/or Zn2+, which could be reduced by Cu?   |  |  |  | | --- | --- | --- | |  | a. | Sn2+ | |  | b. | Ag+ | |  | c. | Zn2+ | |  | d. | Two of them could be reduced by Cu. | |  | e. | All of them could be reduced by Cu. |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | tabulating standard electrode potentials | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 55. You wish to plate out zinc metal from a zinc nitrate solution. Which metal, Al or Ni, could you place in the solution to accomplish this?   |  |  |  | | --- | --- | --- | |  | a. | Al | |  | b. | Ni | |  | c. | Both Al and Ni would work. | |  | d. | Neither Al nor Ni would work. | |  | e. | Cannot be determined. |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | tabulating standard electrode potentials | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 56. Which of the following is the best reducing agent?   |  |  |  | | --- | --- | --- | |  | a. | Cl2 | |  | b. | H2 | |  | c. | Mg | |  | d. | Mg2+ | |  | e. | Cl– |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | strength of oxidizing and reducing agents | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 57. What is the cell reaction for the voltaic cell Al(*s*) | Al3+(*aq*) || Br–(*aq*) | Br2(*g*) | Pt?   |  |  |  | | --- | --- | --- | |  | a. | Al(*s*) + 2Br–(*aq*)Br2(*g*) + Al3+(*aq*) | |  | b. | 2Al3+(*aq*) + 6Br–(*aq*)2Al(*s*) + 3Br2(*g*) | |  | c. | Al(*s*) + 3Br2(*g*)Al3+(*s*) + 2Br–(*aq*) | |  | d. | 2Al(*s*) + 3Br2(*g*)2Al3+(*aq*) + 6Br–(*aq*) | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | cell notation | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/16/2017 9:20 AM | |

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| 58. What is the balanced chemical equation corresponding to the following cell diagram?  Cs(*s*) | Cs+(*aq*) || Ca2+(*aq*) | Ca(*s*)   |  |  |  | | --- | --- | --- | |  | a. | 2Cs(*s*) + 2Cs+(*aq*) → Ca2+(*aq*) + Ca(*s*) | |  | b. | Ca(*s*) + 2Cs+(*aq*) → 2Cs(*s*) + Ca2+(*aq*) | |  | c. | 2Cs(*s*) + Ca(*s*) → 2Cs+(*aq*) + Ca2+(*aq*) | |  | d. | Ca2+(*aq*) + Ca(*s*) → 2Cs(*s*) + 2Cs+(*aq*) | |  | e. | 2Cs(*s*) + Ca2+(*aq*) → 2Cs+(*aq*) + Ca(*s*) |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | cell notation | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/16/2017 9:23 AM | |

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| 59. Which of the following cell diagrams represents a galvanic cell? (*ε*°red(Cd2+/Cd) = –0.403V, *ε*°red(H+/H2) = 0.00 V)   |  |  |  | | --- | --- | --- | |  | a. | Pt(*s*), H2(*g*) | H+(*aq*) || Cd2+(*aq*) | Cd(*s*) | |  | b. | Cd(*s*) | Cd2+(*aq*) || H+(*aq*) | H2(*g*), Pt(*s*) | |  | c. | Cd(*s*), H2(*g*) | H+(*aq*) || Cd2+(*aq*) | Pt(*s*) | |  | d. | Pt(*s*) | Cd2+(*aq*) || H+(*aq*) | H2(*g*), Cd(*s*) | |  | e. | Cd(*s*) | Pt(*s*) || H+(*aq*), Cd2+(*aq*) | H2(*g*) |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | cell notation | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 60. The following has a potential of 0.16 V:  2Cu2+(*aq*) + H2(g) → 2H+(*aq*) +  (aq)  If the concentrations of the ions were 1.0 *M* and the pressure of H2 were 1.0 atm, then *ε*° for the half-reaction  Cu2+(*aq*)+ 2*e*- → (*aq*) would be   |  |  |  | | --- | --- | --- | |  | a. | –0.16 V | |  | b. | –0.08 V | |  | c. | 0.08 V | |  | d. | 0.16 V | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/16/2017 9:31 AM | |

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| 61. Consider the following electrode potentials:   |  |  | | --- | --- | | Mg2+ + 2*e*– → Mg | *ε*° = –2.37 V | | V2+ + 2*e*– → V | *ε*° = –1.19 V | | Cu2+ + *e*– → Cu+ | *ε*° = 0.16 V |   Which one of the reactions below will proceed spontaneously from left to right?   |  |  |  | | --- | --- | --- | |  | a. | Mg2+ + V → V2+ + Mg | |  | b. | Mg2+ + 2Cu+ → 2Cu2+ + Mg | |  | c. | V2+ + 2Cu+ → V + 2Cu2+ | |  | d. | V + 2Cu2+ → V2+ + 2Cu+ | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 62. What is *ε*°cell for the following electrochemical equation? (*ε*°red(Ag+/Ag) = 0.8 V, *ε*°red(Mg2+/Mg) = –2.372 V)  2Ag(*s*) + Mg2+(*aq*) → 2Ag+(*aq*) + Mg(*s*)   |  |  |  | | --- | --- | --- | |  | a. | –0.772 V | |  | b. | –3.972 V | |  | c. | –3.172 V | |  | d. | 3.172 V | |  | e. | 3.972 V |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | calculating cell emfs | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 63. Which of the following cell reactions would require the use of an inert electrode?   |  |  |  | | --- | --- | --- | |  | a. | Ba(*s*) + 2Ag+(*aq*) → Ba2+(*aq*) + 2Ag(*s*) | |  | b. | 3Fe(*s*) + 2Au3+(*aq*) → 3Fe2+ + 2Au(*s*) | |  | c. | 3Rb+(*aq*) + Al(*s*) → 3Rb(*s*) + Al3+(*aq*) | |  | d. | Zn(*s*) + 2MnO2(*s*) + 2NH4+(*aq*) → Zn2+(*aq*) + Mn2O3(*s*) + 2NH3(*aq*) + H2O(*l*) | |  | e. | Cu(*s*) + 2Ag+(*aq*) → 2Ag(*s*) + Cu2+(*aq*) |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | construction of voltaic cells | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 64. Given:  2H+(*aq*) + 2e– → H2(*g*);  0.00 V  Rb+(*aq*) + e– → Rb(*s*);  –2.98 V F2(*g*) + 2e– → 2F–(*aq*);  2.87 V Al3+(*aq*) + 3e– → Al(*s*);  –1.66 V Pb2+(*aq*) + 2e– → Pb(*s*);  –0.13 V  Under standard-state conditions, which is the strongest reducing agent?   |  |  |  | | --- | --- | --- | |  | a. | H+ | |  | b. | Rb | |  | c. | F– | |  | d. | Al3+ | |  | e. | Pb2+ |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | strength of oxidizing and reducing agents | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/1/2017 12:17 AM | |

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| 65. Which of the following statements is true concerning the electrochemical cell depicted below?  Ba | Ba2+(*aq*) || Mn2+(*aq*) | Mn Ba2+(*aq*) + 2e– → Ba(*s*); –2.91 V  Mn2+(*aq*) + 2e– → Mn(*s*); –1.19 V   |  |  |  | | --- | --- | --- | |  | a. | The cell reaction is spontaneous with a standard cell potential of 1.72 V. | |  | b. | The cell reaction is spontaneous with a standard cell potential of 4.1 V. | |  | c. | The cell reaction is nonspontaneous with a standard cell potential of –1.72 V. | |  | d. | The cell reaction is nonspontaneous with a standard cell potential of –4.1 V. | |  | e. | The cell is at equilibrium. |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | calculating cell emfs | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 66. Which of the following statements is true concerning the electrochemical cell depicted below?  Sr | Sr2+(*aq*) || Li+(*aq*) | Li Sr2+(*aq*) + 2e– → Sr(*s*); *ε*° = –2.9 V  Li+(*aq*) + e– → Li(*s*); *ε*° = –3.04 V   |  |  |  | | --- | --- | --- | |  | a. | The cell reaction is spontaneous with a standard cell potential of 5.94 V. | |  | b. | The cell reaction is nonspontaneous with a standard cell potential of –5.94 V. | |  | c. | The cell reaction is nonspontaneous with a standard cell potential of –0.14 V. | |  | d. | The cell reaction is spontaneous with a standard cell potential of 0.14 V. | |  | e. | The cell is at equilibrium. |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | calculating cell emfs | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/9/2017 6:25 AM | |

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| 67. The reduction potentials for Au3+ and Ni2+ are as follows:  Au3+ + 3e*–* → Au, *ε*° = +1.50 V Ni2+ + 2e– → Ni, *ε*° = –0.227 V  Calculate Δ*G*° (at 25°C) for the reaction:  2Au3+ + 2Ni → 3Ni2+ + 2Au   |  |  |  | | --- | --- | --- | |  | a. | kJ | |  | b. | kJ | |  | c. | kJ | |  | d. | kJ | |  | e. | kJ |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 68. Tables of standard reduction potentials are usually given at 25°C. *ε*° depends on temperature. Which of the following equations describes the temperature dependence of *ε*°?   |  |  |  | | --- | --- | --- | |  | a. |  | |  | b. |  | |  | c. |  | |  | d. |  | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Difficult | | *REFERENCES:* | 18.4 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 69. For a reaction in a voltaic cell both Δ*H*° and Δ*S*° are positive. Which of the following statements is true?   |  |  |  | | --- | --- | --- | |  | a. | *ε*°cell will increase with an increase in temperature. | |  | b. | *ε*°cell will decrease with an increase in temperature. | |  | c. | *ε*°cell will not change when the temperature increases. | |  | d. | Δ*G*° > 0 for all temperatures. | |  | e. | None of the above statements is true. |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.4 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 70. For a certain reaction, Δ*H*° = –71.8 kJ and Δ*S*° = –213 J/K. If *n* = 3, calculate *ε*° for the reaction at 25°C.   |  |  |  | | --- | --- | --- | |  | a. | 0.0288 V | |  | b. | 0.467 V | |  | c. | 0.266 V | |  | d. | 0.0862 V | |  | e. | 0.230 V |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/17/2017 2:32 AM | |

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| 71. The standard free energies of formation of several species are:   |  |  | | --- | --- | |  | kJ/mol | | H+(*aq*) | 0 | | H2O(*l*) | –237.0 | | CH3OH(*aq*) | –163.0 | | HCOOH(*aq*) | –351.1 | | e– | 0 |   What is the standard reduction potential of methanoic acid in aqueous solution (i.e., for HCOOH + 4H+ + 4e– → CH3OH + H2O)?   |  |  |  | | --- | --- | --- | |  | a. | 0.126 V | |  | b. | 0.506 V | |  | c. | –0.717 V | |  | d. | –0.126 V | |  | e. | 1.946 V |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/17/2017 2:39 AM | |

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| 72. A fuel cell designed to react grain alcohol with oxygen has the following net reaction:  C2H5OH(*l*) + 3O2(*g*) → 2CO2(*g*) + 3H2O(*l*)  The maximum work one mole of alcohol can yield by this process is 1320 kJ. What is the theoretical maximum voltage this cell can achieve?   |  |  |  | | --- | --- | --- | |  | a. | 0.760 V | |  | b. | 1.14 V | |  | c. | 2.01 V | |  | d. | 2.28 V | |  | e. | 13.7 V |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Difficult | | *REFERENCES:* | 18.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 73. Consider the following reduction potentials:            Cu2+ + 2e– → Cu                      *ε*° = 0.342 V           Pb2+ + 2e– → Pb                       *ε*° = –0.130 V  For a galvanic cell employing the Cu, Cu2+ and Pb, Pb2+ couples, calculate the maximum amount of work that would accompany the reaction of one mole of lead under standard conditions.   |  |  |  | | --- | --- | --- | |  | a. | –40.9 kJ | |  | b. | –45.5 kJ | |  | c. | –91.1 kJ | |  | d. | No work can be done. The system is at equilibrium. | |  | e. | None of these. |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 74. Determine Δ*G*° for a cell that utilizes the following reaction:            Cl2(*g*) + 2Br–(*aq*) → 2Cl–(*aq*) + Br2(*l*)  The standard reduction for the chlorine gas is 1.360 volts and the standard reduction for the bromine liquid is about 1.075 volts.   |  |  |  | | --- | --- | --- | |  | a. | –470 kJ | |  | b. | –27.5 kJ | |  | c. | –235 kJ | |  | d. | –55.0 kJ | |  | e. | –24.5 kJ |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 75. For a particular reaction in a galvanic (voltaic) cell Δ*S*° is negative. Which of the following statements is true?   |  |  |  | | --- | --- | --- | |  | a. | *ε* will increase with an increase in temperature. | |  | b. | *ε* will decrease with an increase in temperature. | |  | c. | *ε* will not change when the temperature increases. | |  | d. | Δ*G*° > 0 for all temperatures. | |  | e. | None of the above statements is true. |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Difficult | | *REFERENCES:* | 18.4 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 76. Under standard conditions, which of the following operations results in a spontaneous chemical reaction taking place?   |  |  |  | | --- | --- | --- | |  | a. | A piece of aluminum metal is placed in an aqueous solution of potassium nitrate. | |  | b. | Iodine crystals are added to an aqueous solution of sodium chloride. | |  | c. | A piece of silver metal is placed in an aqueous solutions of copper(II) nitrate. | |  | d. | Chlorine gas is bubbled through an aqueous solution of sodium bromide. | |  | e. | At least two of the above (A-D) result in a spontaneous chemical reaction. |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.4 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 77. A common car battery consists of six identical cells, each of which carries out the reaction:  Pb + PbO2 + 2HSO4– + 2H+ → 2PbSO4 + 2H2O  The value of for such a cell is 2.043 V. Calculate Δ*G*° at 25 °C for the reaction.   |  |  |  | | --- | --- | --- | |  | a. | –197.1 kJ | |  | b. | –98.56 kJ | |  | c. | –394.2 kJ | |  | d. | –788.5 kJ | |  | e. | –591.4 kJ |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 78. What is Δ*G*° for the following electrochemical equation? (*ε*°red(Ag+/Ag) = 0.800 V, *ε*°red(Ba2+/Ba) = –2.912 V)  2Ag(*s*) + Ba2+(*aq*) → 2Ag+(*aq*) + Ba(*s*)   |  |  |  | | --- | --- | --- | |  | a. | –716 kJ/mol | |  | b. | 358 kJ/mol | |  | c. | 716 kJ/mol | |  | d. | 1433 kJ/mol | |  | e. | –1433 kJ/mol |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.4 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| Consider an electrochemical cell with a zinc electrode immersed in 1.0 *M* Zn2+ and a nickel electrode immersed in 0.10 *M* Ni2+.   |  |  | | --- | --- | | Zn2+ + 2e- → Zn | *ε*° = –0.76 V | | Ni2+ + 2e- → Ni | *ε*° = –0.23 V | |

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| 79. Calculate the concentration of Ni2+ if the cell is allowed to run to equilibrium at 25°C.   |  |  |  | | --- | --- | --- | |  | a. | 1.10 *M* | |  | b. | 0.20 *M* | |  | c. | 0.10 *M* | |  | d. | 0 *M* | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-4 | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 80. Calculate *ε* at 25°C for the cell shown below, given the following data:   |  |  | | --- | --- | |  | | |  |  | |  |  |   *K*sp for AgCl = 1.6 × 10–10   |  |  |  | | --- | --- | --- | |  | a. | 0.83 V | |  | b. | 0.54 V | |  | c. | 1.01 V | |  | d. | 2.98 V | |  | e. | cannot be determined from the data given |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Difficult | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | construction of voltaic cells | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 81. The following question refers to the following system:            3Ag(*s*) + NO3–(*aq*) + 4H+(*aq*) → 3Ag+(*aq*) + NO(*g*) + 2H2O(*l*)   |  |  |  | | --- | --- | --- | | Anode reaction: | Ag → Ag+(*aq*) + 1e– | *ε*° = –0.7990 V | | Cathode reaction: | NO3–(*aq*) + 4H+(*aq*) + 3e– → NO(*g*) + 2H2O(*l*) | *ε*° = 0.9640 V |   Determine the equilibrium constant at 25°C.   |  |  |  | | --- | --- | --- | |  | a. |  | |  | b. |  | |  | c. |  | |  | d. |  | |  | e. | 3.126 |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | equilibrium constants from emfs | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 82. A galvanic cell consists of a left compartment with a tin electrode in contact with 0.1 *M* Sn(NO3)2(*aq*) and a right compartment with a lead electrode in contact with 1 × 10–3 *M* Pb(NO3)2(*aq*). The relevant reduction potentials are:   |  |  | | --- | --- | | Pb2+ + 2e– → Pb | *ε*° = –0.13 V | | Sn2+ + 2e– → Sn | *ε*° = –0.14 V |   When this cell is allowed to discharge spontaneously at 25°C, which of the following statements is true?   |  |  |  | | --- | --- | --- | |  | a. | Electrons will flow from left to right through the wire. | |  | b. | Pb2+ ions will be reduced to Pb metal. | |  | c. | The concentration of Sn2+ ions in the left compartment will increase. | |  | d. | The tin electrode will be the cathode. | |  | e. | No noticeable change will occur, because the cell is at equilibrium. |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 83. Consider the galvanic cell shown below (the contents of each half-cell are written beneath each compartment):   |  |  |  | | --- | --- | --- | | 0.50 *M* Br2 |  | 0.20 *M* Cr3+ | | 0.10 *M* Br– |  |  |   The standard reduction potentials are as follows:   |  |  | | --- | --- | | Cr3+(*aq*) + 3e– → Cr(*s*) | *ε*° = –0.725 V | | Br2(*aq*) + 2e– → 2Br–(*aq*) | *ε*° = +1.090 V |   What is the value of *ε* for this cell at 25°C?   |  |  |  | | --- | --- | --- | |  | a. | 1.751 V | |  | b. | 1.815 V | |  | c. | 1.829 V | |  | d. | 1.879 V | |  | e. | 2.199 V |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 84. Consider an electrochemical cell with a zinc electrode immersed in a solution of Zn2+ and a silver electrode immersed in a solution of Ag+.   |  |  | | --- | --- | | Zn2+ + 2e– → Zn | *ε*° = –0.76 V | | Ag+ + e– → Ag | *ε*° = 0.80 V |   If is 0.050 *M* and is 12.54 *M*, calculate *ε*.   |  |  |  | | --- | --- | --- | |  | a. | 1.46 V | |  | b. | 1.77 V | |  | c. | 1.35 V | |  | d. | 1.66 V | |  | e. | 1.63 V |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/1/2017 6:09 AM | |

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| 85. Consider an electrochemical cell with a zinc electrode immersed in 1.0 *M* Zn2+ and a nickel electrode immersed in 0.38 *M* Ni2+.   |  |  | | --- | --- | | Zn2+ + 2e– → Zn | *ε*° = –0.76 V | | Ni2+ + 2e– → Ni | *ε*° = –0.23 V |   Calculate *ε* for this cell.   |  |  |  | | --- | --- | --- | |  | a. | 0.54 V | |  | b. | 0.52 V | |  | c. | 0.51 V | |  | d. | 0.53 V | |  | e. | 0.98 V |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 86. A cell is set up with copper and lead electrodes in contact with CuSO4(*aq*) and Pb(NO3)2(*aq*), respectively, at 25°C. The standard reduction potentials are:   |  |  | | --- | --- | | Pb2+ + 2e– → Pb | *ε*° = –0.13 V | | Cu2+ + 2e– → Cu | *ε*° = +0.34 V |   If sulfuric acid is added to the Pb(NO3)2 solution, forming a precipitate of PbSO4, the cell potential:   |  |  |  | | --- | --- | --- | |  | a. | increases | |  | b. | decreases | |  | c. | is unchanged | |  | d. | can't tell what will happen | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 87. A concentration cell is constructed using two Ni electrodes with Ni2+ concentrations of 1.0 *M* and 1.00 × 10–4 *M* in the two half-cells. The reduction potential of Ni2+ is –0.23 V. Calculate the potential of the cell at 25°C.   |  |  |  | | --- | --- | --- | |  | a. | –0.368 V | |  | b. | +0.132 V | |  | c. | –0.132 V | |  | d. | +0.118 V | |  | e. | +0.0592 V |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 88. The standard potential for the reaction A + BC + D is 1.50 volts. The equilibrium constant *K* for this reaction at 25°C is:   |  |  |  | | --- | --- | --- | |  | a. | 2.5 × 1025 | |  | b. | 4.0 × 10–26 | |  | c. | 25.4 | |  | d. | –25.4 | |  | e. | not enough information given |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | equilibrium constants from emfs | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 89. The reduction potentials for Ni2+ and Sn2+ are as follows:  Ni2+ + 2e– → Ni, *ε*° = –0.233 V Sn2+ + 2e– → Sn, *ε*° = –0.140 V  Calculate the equilibrium constant at 25 °C for the reaction:  Sn2+ + NiSn + Ni2+   |  |  |  | | --- | --- | --- | |  | a. |  | |  | b. | 37 | |  | c. | 6.1 | |  | d. |  | |  | e. |  |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | equilibrium constants from emfs | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 90. An excess of finely divided iron is stirred up with a solution that contains Cu2+ ion, and the system is allowed to come to equilibrium. The solid materials are then filtered off and electrodes of solid copper and solid iron are inserted into the remaining solution. What is the value of the ratio [Fe2+]/[Cu2+] at 25°C?  The following standard reduction potentials apply:   |  |  | | --- | --- | | Fe2+(*aq*) + 2e– → Fe(*s*) | *ε*° = –0.44 V | | Cu2+(*aq*) + 2e– → Cu(*s*) | *ε*° = +0.34 V |   ​   |  |  |  | | --- | --- | --- | |  | a. | 1 | |  | b. | 0 | |  | c. | 2.5 × 1026 | |  | d. | 4.4 × 10–27 | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Difficult | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/1/2017 6:13 AM | |

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| 91. An excess of finely divided iron is stirred up with a solution that contains Cu2+ ion, and the system is allowed to come to equilibrium. The solid materials are then filtered off and electrodes of solid copper and solid iron are inserted into the remaining solution. What potential develops between these two electrodes at 25°C?   |  |  |  | | --- | --- | --- | |  | a. | 0 | |  | b. | –0.78 V | |  | c. | 0.592 V | |  | d. | 0.296 V | |  | e. | not enough information given |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Difficult | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 92. The equilibrium constant at 25°C for the reaction Al + 3Cu2+2Al3+ + 3Cu is approximately   |  |  |  | | --- | --- | --- | |  | a. | 10203 | |  | b. | 1034 | |  | c. | 1068 | |  | d. | 10–203 | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | equilibrium constants from emfs | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 93. A concentration cell is constructed with copper electrodes and Cu2+ in each compartment. In one compartment, the [Cu2+] = 1.0 × 10–3 *M* and in the other compartment, the [Cu2+] = 2.0 *M*. Calculate the potential for this cell at 25°C. The standard reduction potential for Cu2+ is +0.34 V.   |  |  |  | | --- | --- | --- | |  | a. | 0.44 V | |  | b. | –0.44 V | |  | c. | 0.098 V | |  | d. | –0.098 V | |  | e. | 0.78 V |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 94. Calculate the solubility product of silver iodide at 25°C given the following data:   |  |  | | --- | --- | |  | *ε*°(V) | | AgI(*s*) + e*–* → Ag(*s*) + I– | –0.15 | | I2(*s*) + 2e*–* → 2I– | +0.54 | | Ag+ + e*–* → Ag(*s*) | +0.80 |   ​   |  |  |  | | --- | --- | --- | |  | a. | 2.9 × 10–3 | |  | b. | 1.9 × 10–4 | |  | c. | 2.1 × 10–12 | |  | d. | 8.4 × 10–17 | |  | e. | 6.1 × 10–26 |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Difficult | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | equilibrium constants from emfs | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/1/2017 6:14 AM | |

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| 95. Using the following data to calculate *K*sp for PbSO4.   |  |  | | --- | --- | |  | *ε*° | | PbO2 + 4H+ + SO42– + 2e*–* → PbSO4(s) + 2H2O | +1.69 | | PbO2 + 4H+ + 2e*–* → Pb2+ + 2H2O | +1.46 |   ​   |  |  |  | | --- | --- | --- | |  | a. | 4.0 × 10106 | |  | b. | 2.5 × 10–107 | |  | c. | 5.9 × 107 | |  | d. | 1.7 × 10–8 | |  | e. | None of these is within 5% of the correct answer. |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/1/2017 6:15 AM | |

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| 96. In which of the following cases must *ε* be equal to zero?   |  |  |  | | --- | --- | --- | |  | a. | In any cell at equilibrium. | |  | b. | In a concentration cell. | |  | c. | *ε* can never be equal to zero. | |  | d. | Choices A and B are both correct. | |  | e. | None of these. |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | electromotive force | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 97. Which of the following statements is/are correct?   |  |  |  | | --- | --- | --- | |  | a. | The value of *ε*° is equal to zero in a concentration cell, and the value of *ε* is equal to zero in any cell at equilibrium. | |  | b. | The value of *ε*° can be equal to zero in a concentration cell, and the value of *ε* must be equal to zero in a concentration cell. | |  | c. | The values of *ε*° and *ε* are equal to zero in any cell at equilibrium. | |  | d. | *ε*° can never be equal to zero. | |  | e. | At least two of the above choice (A-D) are correct. |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 98. Which of the following statements is true about a voltaic cell for which *ε*°cell = 1.00 V?   |  |  |  | | --- | --- | --- | |  | a. | It has Δ*G*° > 0. | |  | b. | The system is at equilibrium. | |  | c. | It has *K* = 1. | |  | d. | The cathode is at a higher energy than the anode. | |  | e. | The reaction is spontaneous. |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/1/2017 12:25 AM | |

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| 99. If a reducing agent M reacts with an oxidizing agent N+ to give M+ and N, and the equilibrium constant for the reaction is 1.5, then what is the *ε*° value for the oxidation-reduction reaction?   |  |  |  | | --- | --- | --- | |  | a. | 0.010 V | |  | b. | –0.010 V | |  | c. | 0.0052 V | |  | d. | –0.0052 V | |  | e. | 0.021 V |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | equilibrium constants from emfs | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| You make a cell with an aluminum electrode in a solution of aluminum nitrate and a zinc electrode in a solution of zinc nitrate. |

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| 100. If you could increase the concentration of Zn2+, which of the following is true about the cell potential?   |  |  |  | | --- | --- | --- | |  | a. | It would increase. | |  | b. | It would decrease. | |  | c. | It would remain constant. | |  | d. | Cannot be determined. | |  | e. | None of these (A-D). |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-5 | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 101. If you could increase the concentration of Al3+, which of the following is true about the cell potential?   |  |  |  | | --- | --- | --- | |  | a. | It would increase. | |  | b. | It would decrease. | |  | c. | It would remain constant. | |  | d. | Cannot be determined. | |  | e. | None of these (A-D). |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *PREFACE NAME:* | Ref 18-5 | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 102. A concentration cell is constructed using two metal (M) electrodes with M2+ concentrations of 0.10 *M* and 1.00 × 10–5 *M* in the two half-cells. Determine the reduction potential of M2+ given that the potential of the cell at 25°C is 0.118 V.   |  |  |  | | --- | --- | --- | |  | a. | 0 V | |  | b. | +0.118 V | |  | c. | –0.118 V | |  | d. | Cannot be determined with the information given. | |  | e. | None of the above. |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 103. What is *ε* of the following cell reaction at 25°C?  *ε*°cell = 0.460 V.  Cu(*s*) | Cu2+(0.018 *M*) || Ag+(0.17 *M*) | Ag(*s*)   |  |  |  | | --- | --- | --- | |  | a. | 0.282 V | |  | b. | 0.474 V | |  | c. | 0.460 V | |  | d. | 0.466 V | |  | e. | 0.489 V |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 104. For the cell Ni(*s*) | Ni2+ || Ag+ | Ag(*s*), the standard cell potential is 1.03 V. A cell using these reagents was made, and the observed potential was 0.74 V at 25oC. What is a possible explanation for the observed voltage?   |  |  |  | | --- | --- | --- | |  | a. | The Ag+ concentration was larger than the Ni2+ concentration. | |  | b. | The Ni2+ concentration was larger than the Ag+ concentration. | |  | c. | The Ag electrode was twice as large as the Ni electrode. | |  | d. | The volume of the Ni2+ solution was larger than the volume of the Ag+ solution. | |  | e. | The volume of the Ag+ solution was larger than the volume of the Ni2+ solution. |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 105. What is the value of the reaction quotient, *Q*, for the voltaic cell constructed from the following two half-reactions when the Zn2+ concentration is 0.0106 *M* and the Ag+ concentration is 1.27 *M*?  Zn2+(*aq*) + 2e– → Zn(*s*); *ε*° = –0.76 V  Ag+(*aq*) + e– → Ag(*s*); *ε*° = 0.80 V   |  |  |  | | --- | --- | --- | |  | a. | 152 | |  | b. | 120 | |  | c. |  | |  | d. |  | |  | e. |  |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 106. In order to determine the identity of a particular lanthanide metal Dy, a voltaic cell is constructed at 25°C with the anode consisting of the lanthanide metal as the electrode immersed in a solution of 0.0673 *M* DyCl3, and the cathode consisting of a copper electrode immersed in a 1.00 *M* Cu(NO3)2 solution. The two half-reactions are as follows:  Dy(*s*) → Dy3+(*aq*) + 3e– Cu2+(*aq*) + 2e– → Cu(*s*)  The potential measured across the cell is 2.66 V. What is the identity of the metal?   |  |  | | --- | --- | | **Reduction Half-Reaction** | *ε***° (V)** | | Cu2+(*aq*) + 2e– → Cu(*s*) | 0.34 | | Ce3+(*aq*) + 3e– → Ce(*s*) | –2.336 | | Dy3+(*aq*) + 3e– → Dy(*s*) | –2.295 | | Eu3+(*aq*) + 3e– → Eu(*s*) | –1.991 | | Gd3+(*aq*) + 3e– → Gd(*s*) | –2.279 | | Sm3+(*aq*) + 3e– → Sm(*s*) | –2.304 |   ​   |  |  |  | | --- | --- | --- | |  | a. | Ce | |  | b. | Eu | |  | c. | Sm | |  | d. | Dy | |  | e. | Gd |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Difficult | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/1/2017 6:23 AM | |

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| 107. Which of the following statements is true concerning the electrochemical cell described below at 25oC?  Cu | Cu2+(0.394 *M*) || Cu2+(0.258] *M*) | Cu  Cu2+(*aq*) + 2e– → Cu(*s*); *ε*° = 0.34 V   |  |  |  | | --- | --- | --- | |  | a. | The cell reaction is spontaneous with a cell potential of 29.3 mV. | |  | b. | The cell reaction is nonspontaneous with a cell potential of –5.4427448695 mV. | |  | c. | The cell reaction is spontaneous with a cell potential of 5.44 mV. | |  | d. | The cell reaction is nonspontaneous with a cell potential of 29.3 mV. | |  | e. | The cell reaction is spontaneous with a cell potential of 0.34 V. |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Difficult | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/17/2017 4:43 AM | |

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| 108. What is the potential at 25°C for the following cell? Cr | Cr3+(0.015 *M*) || Ag+(0.00020 *M*) | Ag   |  |  | | --- | --- | | Cr3+ + 3e–Cr | *ε*° = –0.73 V | | Ag+ + e–Ag | *ε*° = 0.80 V |  |  |  |  | | --- | --- | --- | |  | a. | 2.09 V | |  | b. | 1.35 V | |  | c. | 0.95 V | |  | d. | 1.71 V | |  | e. | 1.49 V |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 109. Concentration cells work because standard reduction potentials are dependent on concentration.   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | False | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | True / False | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 110. Consider the hydrogen–oxygen fuel cell where:  H2(*g*) + O2(*g*)H2O(*l*)          Δ*G*° = –237.18 kJ/mol H2  Which of the following statements is true?   |  |  |  | | --- | --- | --- | |  | a. | At standard conditions, the maximum work the fuel cell could do on the surroundings is 237.18 kJ/mol. | |  | b. | In the real world, the actual amount of useful work the cell can do is less than 237.18 kJ. | |  | c. | More energy is dissipated as waste heat in the fuel cell than in the reversible pathway. | |  | d. | A, B, and C are all true. | |  | e. | A, B, and C are all false. |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.6 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 111. Which type of battery has been designed for use in space vehicles?   |  |  |  | | --- | --- | --- | |  | a. | lead storage | |  | b. | alkaline dry cell | |  | c. | mercury cells | |  | d. | fuel cells | |  | e. | silver cells |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.6 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 112. Which of the following statements about batteries is false?   |  |  |  | | --- | --- | --- | |  | a. | A battery is a group of galvanic cells connected in series. | |  | b. | Lead storage batteries contain lead at the anode and lead coated with lead dioxide at the cathode. | |  | c. | The alkaline dry cell battery can last longer than a nickel-cadmium battery. | |  | d. | A fuel cell is a galvanic cell for which the reactants are continuously supplied. | |  | e. | Dry cell batteries are used in tape players and portable radios. |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.6 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 113. Which of the following statements about corrosion is false?   |  |  |  | | --- | --- | --- | |  | a. | Patina is the layer of tarnish that gives silver a richer appearance. | |  | b. | The oxidation of most metals by oxygen is spontaneous. | |  | c. | Most metals will develop a thin oxide coating, which protects their internal atoms from oxidation. | |  | d. | A car exposed to the elements will rust faster in the Midwest than in Arizona. | |  | e. | All of these are true. |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.7 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | corrosion | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 114. Which of the following statements is false?   |  |  |  | | --- | --- | --- | |  | a. | Stainless steel contains chromium and nickel, which form protective oxide coatings. | |  | b. | Galvanized steel is coated with zinc to form an oxide coating. | |  | c. | Cathodic protection is a method used to protect steel in buried tanks and pipelines. | |  | d. | Chromium and tin are often used to plate steel by forming a durable oxide coating. | |  | e. | All of these are true. |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.7 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | corrosion | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 115. How many faradays are involved in conversion of a mole of Cu2O to CuO?   |  |  |  | | --- | --- | --- | |  | a. | 1 | |  | b. | 2 | |  | c. | 3 | |  | d. | 4 | |  | e. | 5 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/1/2017 6:29 AM | |

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| 116. How many moles of electrons are produced from a current of 18.0 A in 3.40 hours?   |  |  |  | | --- | --- | --- | |  | a. | 6.34 × 10–4 mol | |  | b. | 2.28 mol | |  | c. | 61.2 mol | |  | d. | 3.35 mol | |  | e. | 9.33 × 103 mol |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 117. A common car battery consists of six identical cells each of which carries out the reaction:            Pb + PbO2 + 2HSO4– + 2H+ → 2PbSO4 + 2H2O  Suppose that in starting a car on a cold morning a current of 125 amperes is drawn for 17.1 seconds from a cell of the type described above. How many grams of Pb would be consumed? (The atomic weight of Pb is 207.19.)   |  |  |  | | --- | --- | --- | |  | a. | 4.59 g | |  | b. | 2.29 g | |  | c. | g | |  | d. | g | |  | e. | g |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/1/2017 6:32 AM | |

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| An antique automobile bumper is to be chrome plated. The bumper, which is dipped into an acidic solution, serves as a cathode of an electrolytic cell. The atomic mass of Cr is 51.996; 1 faraday = 96,485 coulombs. |

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| 118. If oxidation of H2O occurs at the anode, how many moles of oxygen gas will evolve for every 107 grams of Cr(*s*) deposited?   |  |  |  | | --- | --- | --- | |  | a. | 3 | |  | b. | 1 | |  | c. | 12 | |  | d. | 8 | |  | e. | 3 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Difficult | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *PREFACE NAME:* | Ref 18-6 | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 119. If the current is 10.0 amperes, how long will it take to deposit 139 grams of Cr(*s*) onto the bumper?   |  |  |  | | --- | --- | --- | |  | a. | 7.16 h | |  | b. | 1.79 days | |  | c. | 71.6 min | |  | d. | 2.67 min | |  | e. | 2 mo, 25 days, 14 h, and 6 s |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *PREFACE NAME:* | Ref 18-6 | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 120. Copper is electroplated from CuSO4 solution. A constant current of 4.74 amp is applied by an external power supply. How long will it take to deposit 1.00 × 102 g of Cu? The atomic mass of copper is 63.546.   |  |  |  | | --- | --- | --- | |  | a. | 17.8 h | |  | b. | 8.9 min | |  | c. | 1.37 days | |  | d. | 14.22 s | |  | e. | 2.54 h |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/16/2017 7:14 AM | |

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| 121. What quantity of charge is required to reduce 27.2 g of CrCl3 to chromium metal? (1 faraday = 96,485 coulombs)   |  |  |  | | --- | --- | --- | |  | a. | C | |  | b. | C | |  | c. | C | |  | d. | C | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 122. Electrolysis of a molten salt with the formula MCl, using a current of 3.86 amp for 16.2 min, deposits 1.52 g of metal. Identify the metal. (1 faraday = 96,485 coulombs)   |  |  |  | | --- | --- | --- | |  | a. | Li | |  | b. | Na | |  | c. | K | |  | d. | Rb | |  | e. | Ca |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | electrolysis of molten salts | electrolytic cells | general chemistry | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 123. If a constant current of 2.0 amperes is passed through a cell containing Cr3+ for 1.0 hour, how many grams of Cr will plate out onto the cathode? (The atomic mass of Cr is 51.996.)   |  |  |  | | --- | --- | --- | |  | a. | 3.8 g | |  | b. | g | |  | c. | 1.2 g | |  | d. | 11 g | |  | e. | g |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/16/2017 7:15 AM | |

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| 124. If an electrolysis plant operates its electrolytic cells at a total current of 1.9 × 106 amp, how long will it take to produce one metric ton (one million grams) of Mg(*s*) from seawater containing Mg2+? (1 faraday = 96,485 coulombs)   |  |  |  | | --- | --- | --- | |  | a. | 1.1 h | |  | b. | 1.1 days | |  | c. | 34 min | |  | d. | 0.58 h | |  | e. | 0.29 year |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/16/2017 7:16 AM | |

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| 125. Nickel is electroplated from a NiSO4 solution. A constant current of 2.33 amp is applied by an external power supply. How long will it take to deposit 100. g of Ni? The atomic mass of Ni is 58.69.   |  |  |  | | --- | --- | --- | |  | a. | 39.1 h | |  | b. | 19.5 h | |  | c. | 42.9 min | |  | d. | 130.7 s | |  | e. | 2.57 s |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/16/2017 7:16 AM | |

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| 126. A solution of MnO42– is electrolytically reduced to Mn3+. A current of 5.87 amp is passed through the solution for 15.0 minutes. What is the number of moles of Mn3+ produced in this process? (1 faraday = 96,485 coulombs)   |  |  |  | | --- | --- | --- | |  | a. | 0.0547 | |  | b. | 0.164 | |  | c. |  | |  | d. | 0.0182 | |  | e. |  |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/1/2017 8:03 AM | |

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| 127. How many seconds would it take to deposit 29.5 g of Ag (atomic mass = 107.87) from a solution of AgNO3 using a current of 10.00 amp?   |  |  |  | | --- | --- | --- | |  | a. | s | |  | b. | s | |  | c. | s | |  | d. | s | |  | e. | s |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 128. Gold (atomic mass = 197.0) is plated from a solution of chloroauric acid, HAuCl4; it deposits on the cathode. Calculate the time it takes to deposit 0.59 gram of gold, passing a current of 0.10 amperes. (1 faraday = 96,485 coulombs)   |  |  |  | | --- | --- | --- | |  | a. | 24 hours | |  | b. | 2.4 hours | |  | c. | 48 minutes | |  | d. | 16 minutes | |  | e. | none of these |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 129. An unknown metal (M) is electrolyzed. It took 74.1 s for a current of 2.00 amp to plate 0.107 g of the metal from a solution containing M(NO3)3. Identify the metal.   |  |  |  | | --- | --- | --- | |  | a. | La | |  | b. | Bi | |  | c. | Ga | |  | d. | Cu | |  | e. | Rh |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 130. Gold is produced electrochemically from an aqueous solution of Au(CN)2– containing an excess of CN–. Gold metal and oxygen gas are produced at the electrodes. How many moles of O2 will be produced during the production of 1.00 mole of gold?   |  |  |  | | --- | --- | --- | |  | a. | 0.25 | |  | b. | 0.50 | |  | c. | 1.00 | |  | d. | 3.56 | |  | e. | 4.00 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Difficult | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | aqueous electrolysis | Chemistry | electrochemistry | electrolytic cells | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 131. What mass of Cr(*s*) may be deposited from an aqueous CrCl2 solution if a current of 2.50 A is applied to the solution for 365 s? (*ε*°red(Cr2+/Cr) = –0.913 V, *F* = 96485 *C*/mol)   |  |  |  | | --- | --- | --- | |  | a. | 0.491 g | |  | b. | 0.983 g | |  | c. | 0.668 g | |  | d. | 0.245 g | |  | e. | 0.0904 g |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/16/2017 7:17 AM | |

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| 132. What mass of chromium could be deposited by electrolysis of an aqueous solution of Cr2(SO4)3 for 190 minutes using a constant current of 15.0 amperes?   |  |  |  | | --- | --- | --- | |  | a. | 0.187 g | |  | b. | 276.5 g | |  | c. | 0.512 g | |  | d. | 46.1 g | |  | e. | 30.7 g |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.8 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | True | | *KEYWORDS:* | Chemistry | electrochemistry | electrolytic cells | general chemistry | stoichiometry of electrolysis | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 133. Which of the following are incorrectly paired?   |  |  |  | | --- | --- | --- | |  | a. | Alumina – pure aluminum oxide | |  | b. | Downs cell – electrolyzes molten sodium chloride | |  | c. | Mercury cell – used in preventing contamination of NaOH by NaCl | |  | d. | Hall-Heroult process – uses cryolite in production of aluminum | |  | e. | All of these are correct. |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.9 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | commercial electrolytic processes | electrochemistry | electrolytic cells | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 134. Which of the following used to be more precious than gold or silver, due to difficulties refining it?   |  |  |  | | --- | --- | --- | |  | a. | copper | |  | b. | aluminum | |  | c. | tin | |  | d. | zinc | |  | e. | iron |  |  |  | | --- | --- | | *ANSWER:* | b | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.9 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | commercial electrolytic processes | electrochemistry | electrolytic cells | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 135. What are the products of the chlor-alkali process?   |  |  |  | | --- | --- | --- | |  | a. | sodium and sodium chloride | |  | b. | sodium chloride and chlorine | |  | c. | sodium and chlorine | |  | d. | sodium hydroxide and chlorine | |  | e. | aluminum and cryolite |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.9 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | commercial electrolytic processes | electrochemistry | electrolytic cells | general chemistry | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 136. Balance the following equation: Cr2O72– + I– → Cr3+ + IO3– (acid)   |  |  | | --- | --- | | *ANSWER:* | 8H+ + Cr2O72– + I– → 2Cr3+ + IO3– + 4H2O  Balanced half-reactions: 6e– + 14H+ + Cr2O72– → 2Cr3+ + 7H2O 3H2O + I– → IO3– + 6H+ + 6e– | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 137. Balance the following equation: Zn + As2O3 → AsH3 + Zn2+ (acid)   |  |  | | --- | --- | | *ANSWER:* | 12H+ + 6Zn + As2O3 → 2AsH3 + 6Zn2+ + 3H2O    Balanced half-reactions: Zn → Zn2+ + 2e– 12e– + 12H+ + As2O3 → 2AsH3 + 3H2O | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 138. Balance the following equation: MnO4– + Br– → MnO2 + BrO3– (base)   |  |  | | --- | --- | | *ANSWER:* | H2O + 2MnO4– + Br– → 2MnO2 + BrO3– + 2OH–  Balanced half-reactions: 3e– + 4H+ + MnO4– → MnO2 + 2H2O 3H2O + Br– → BrO3– + 6H+ + 6e– Combine to give (in acid): 2H+ + 2MnO4– + Br– → BrO3– + 2MnO2 + H2O | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 139. Balance the following equation: Bi(OH)3 + SnO22– → Bi + SnO32– (base)   |  |  | | --- | --- | | *ANSWER:* | 2Bi(OH)3 + 3SnO22– → 2Bi + 3SnO32– + 3H2O    Balanced half-reactions: 3e– + 3H+ + Bi(OH)3 → Bi + 3H2O H2O + SnO22– → SnO32– + 2H+ + 2e– | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | half-reaction method | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 140. Consider a galvanic cell with a zinc electrode immersed in 1.0 *M* Zn2+ and a silver electrode immersed in 1.0 *M* Ag+.   |  |  | | --- | --- | | Zn2+ + 2e– → Zn | *ε*° = –0.76 V | | Ag+ + e– → Ag | *ε*° = 0.80 V |   Which of the electrodes is the anode?   |  |  | | --- | --- | | *ANSWER:* | The zinc electrode.  To give a positive cell potential, the overall reaction will be: Zn + 2Ag+ → 2Ag + Zn2+. Oxidation occurs at the anode, and zinc is being oxidized. See Sec. 18.3 of Zumdahl, *Chemistry*. | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Subjective Short Answer | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | construction of voltaic cells | electrochemistry | general chemistry | voltaic cells | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 141. Balance the following redox equation in acidic solution.  What is the coefficient of the water?  CH3OH(aq) + Cr2O72-(aq) → CH2O(aq) + Cr3+(aq)   |  |  |  | | --- | --- | --- | |  | a. | 1 | |  | b. | 2 | |  | c. | 4 | |  | d. | 6 | |  | e. | 7 |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 142. Balance the following redox equation in acidic solution.  What is the coefficient of the H+ ion?  CH3OH(aq) + Cr2O72-(aq) → CH2O(aq) + Cr3+(aq)   |  |  |  | | --- | --- | --- | |  | a. | 1 | |  | b. | 2 | |  | c. | 3 | |  | d. | 4 | |  | e. | 8 |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 143. Balance the following redox equation in acidic solution.  What is the coefficient of the water?  MnO4-(aq) + H2O2(aq) → Mn2+(aq) + O2(g)   |  |  |  | | --- | --- | --- | |  | a. | 2 | |  | b. | 4 | |  | c. | 6 | |  | d. | 8 | |  | e. | 16 |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 144. Balance the following redox equation in acidic solution.  What is the coefficient of the H+ ion?  MnO4-(aq) + H2O2(aq) → Mn2+(aq) + O2(g)   |  |  |  | | --- | --- | --- | |  | a. | 2 | |  | b. | 4 | |  | c. | 6 | |  | d. | 8 | |  | e. | 16 |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 145. Balance the following redox equation in basic solution.  What is the coefficient of the water?  NO2-(aq) + Al(s) → NH3(g) + AlO2-(aq)   |  |  |  | | --- | --- | --- | |  | a. | 1 | |  | b. | 2 | |  | c. | 4 | |  | d. | 6 | |  | e. | 7 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 146. Balance the following redox equation in basic solution.  What is the coefficient of the hydroxide ion?  NO2-(aq) + Al(s) → NH3(g) + AlO2-(aq)   |  |  |  | | --- | --- | --- | |  | a. | 1 | |  | b. | 2 | |  | c. | 4 | |  | d. | 6 | |  | e. | 7 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 147. Balance the following redox equation in basic solution.  What is the coefficient of the water?  MnO4-(aq) + HCOOH(aq) → Mn2+(aq) + CO2(g)   |  |  |  | | --- | --- | --- | |  | a. | 2 | |  | b. | 4 | |  | c. | 6 | |  | d. | 8 | |  | e. | 16 |  |  |  | | --- | --- | | *ANSWER:* | a | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 148. Balance the following redox equation in basic solution.  What is the coefficient of the hydroxide ion?  MnO4-(aq) + HCOOH(aq) → Mn2+(aq) + CO2(g)   |  |  |  | | --- | --- | --- | |  | a. | 2 | |  | b. | 4 | |  | c. | 6 | |  | d. | 8 | |  | e. | 16 |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.1 | | *QUESTION TYPE:* | Multiple Choice | | *HAS VARIABLES:* | False | | *KEYWORDS:* | balancing oxidation-reduction reactions | Chemistry | electrochemistry | general chemistry | half-reaction | | *OTHER:* | Conceptual | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/4/2016 4:31 PM | |

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| 149. The reduction potential to the metal of Ba2+ is -1.57 V.  Given that the cell potential for the reaction 3 Ba(s) + 2 La3+(aq) → 3 Ba2+(aq) + 2 La(s) is 0.52 V, the reduction potential for La3+(aq) is:   |  |  |  | | --- | --- | --- | |  | a. | (0.52 – (3 x -1.57)) / 2 | |  | b. | (0.52) – (-1.57) | |  | c. | (+1.57) + (0.52) | |  | d. | 0.52 – (+1.57) | |  | e. | (-1.57) - (0.52) |  |  |  | | --- | --- | | *ANSWER:* | d | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | calculating cell emfs | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/16/2017 7:19 AM | |

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| 150. A voltaic cell consists of a Cu2+/Cu electrode (*ε*°red = 0.34 V) and an Au3+/Au electrode (*ε*°red = 1.50 V). Calculate [Au3+] if [Cu2+] = 1.20 M and *ε*cell = 1.13 V   |  |  |  | | --- | --- | --- | |  | a. | 0.001 M | |  | b. | 0.002 M | |  | c. | 0.04 M | |  | d. | 0.2 M | |  | e. | 5.0 M |  |  |  | | --- | --- | | *ANSWER:* | c | | *POINTS:* | 1 | | *DIFFICULTY:* | Moderate | | *REFERENCES:* | 18.5 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | Chemistry | dependence of emf on concentration | electrochemistry | general chemistry | Nernst equation | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/16/2017 7:20 AM | |

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| 151. The reduction potential to the metal of Ba2+ is -1.57 V and that of Cu2+ is +0.34 V.  The cell potential for the reaction Ba(s) + Cu2+(aq) → Ba2+(aq) + Cu(s) is therefore:   |  |  |  | | --- | --- | --- | |  | a. | (-1.57) + (0.34) | |  | b. | 2 x (-1.57) + 2 x (0.34) | |  | c. | (+1.57) + (-0.34) | |  | d. | (-1.57) + (+0.34) | |  | e. | (+1.57) + (+0.34) |  |  |  | | --- | --- | | *ANSWER:* | e | | *POINTS:* | 1 | | *DIFFICULTY:* | Easy | | *REFERENCES:* | 18.3 | | *QUESTION TYPE:* | Multi-Mode (Multiple choice) | | *HAS VARIABLES:* | False | | *KEYWORDS:* | calculating cell emfs | Chemistry | electrochemistry | general chemistry | standard cell emfs and standard electrode potentials | voltaic cells | | *OTHER:* | Quantitative | | *DATE CREATED:* | 3/4/2016 4:31 PM | | *DATE MODIFIED:* | 3/17/2017 5:21 AM | |