

## 21 • Electrochemistry

### PRACTICE QUIZ

- In the galvanic cell, reduction occurs at the \_\_\_\_\_, and in the electrolytic cell, reduction occurs at the \_\_\_\_\_.
  - anode, anode
  - cathode, cathode
  - anode, cathode
  - cathode, anode
  - none of these
- What product is formed at the anode when molten NaCl is electrolyzed?
  - O<sub>2</sub>
  - H<sub>2</sub>
  - NaCl
  - Cl<sub>2</sub>
  - Na
- What is produced at the cathode when concentrated brine (NaCl solution) is electrolyzed?
  - H<sub>2</sub>O
  - Na
  - NaCl
  - OH<sup>-</sup>
  - O<sub>2</sub>
- What product is produced at the anode when aqueous CuBr<sub>2</sub> is electrolyzed?
  - Cu
  - Br<sub>2</sub>
  - O<sub>2</sub>
  - H<sub>2</sub>
  - OH<sup>-</sup>
- Which of the following is true for an electrolytic cell?
  - positive ions move toward the anode.
  - fairly large volumes of liquid may have excess positive charge.
  - oxidation sometimes occurs without any reduction occurring.
  - reduction occurs at the cathode.
  - electron flow in the external circuit is from the cathode to the anode.
- What is the cell potential of the Zn/Cu cell, at 25°C, under the conditions given below?  
 $\text{Zn(s)} + \text{Cu}^{2+} (1.00 \text{ M}) \rightarrow \text{Cu(s)} + \text{Zn}^{2+} (0.100 \text{ M})$ 
  - 1.07 V
  - 1.13 V
  - 1.10 V
  - 0 V
  - 0.55 V
- How many moles of copper will be deposited from a CuSO<sub>4</sub> solution by a current of 12.0 amp flowing for 8.0 hours? 1 F = 96,500 C.
  - 0.50 mol
  - 48 mol
  - 1.8 mol
  - 3.6 mol
  - 1.2 mol
- How many grams of Na will be deposited from molten NaCl by a current of 3.0 amp flowing for 4.0 hours? 1 Faraday = 96,500 C.
  - 13 g
  - 10 g
  - 0.050 g
  - 22 g
  - 1.1 g
- When copper is purified in an electrolytic cell, the anode is made of \_\_\_\_\_ and the cathode is made of \_\_\_\_\_.
  - platinum, platinum
  - platinum, copper
  - iron, copper
  - copper, platinum
  - copper, copper
- The Down's Cell is used for the commercial production of which of the following?
  - Na
  - Mg
  - O<sub>2</sub>
  - Al
  - Ca

11. A standard 12 V car battery contains how many single cells?
- 1
  - 2
  - 12
  - 6
  - 3
12. The anode in a dry cell is composed of
- graphite
  - MnO<sub>2</sub>
  - NH<sub>4</sub>Cl
  - Zn
  - Cu
13. How many minutes would it take to plate 1 lb (454 g) Al using a current of 2000 amp? 1 F = 96,500 C.
- 812 min.
  - 13.5 min.
  - 40.6 min.
  - 62.7 min.
  - 0.306 min.
14. How long will it take to plate 0.100 g Cu from a Cu(NO<sub>3</sub>)<sub>2</sub> solution if a current of 8.0 amp is used? 1 F = 96,500 C.
- 9.0 s
  - 38 s
  - 304 s
  - 19 s
  - none of these
15. How long will it take to plate 0.50 g Na from molten NaCl if a current of 30.0 amp is used? 1 F = 96,500 C
- 69.9 s
  - 12.9 s
  - 3.8 s
  - 0.38 s
  - 25.7 s
16. How many grams of Al will be deposited from molten AlCl<sub>3</sub> by a current of 15.0 amp flowing for 24.0 hr? 1 F = 96,500 C
- 0.0335 g
  - 121 g
  - 0.538 g
  - 363 g
  - 1090 g
17. What is the function of a salt bridge?
- functions as anode
  - functions as cathode
  - maintains electrical neutrality
  - keeps level of liquid equal in both half cells
  - adds taste
18. Two coulometers, one containing AgNO<sub>3</sub> solution, the other a solution of an unknown metal with a 2+ charge, are connected in series. After 4.00 amp of current is passed through the coulometers, 11.00 g of silver and 6.05 g of M are deposited. What is M? 1 F = 96,500 C
- Ag
  - Ni
  - Mg
  - Sn
  - Au
19. Two coulometers, one containing AgNO<sub>3</sub> solution, the other a solution of an unknown metal, M, are connected in series. After a current is passed through the coulometers, 5.00 g silver is deposited and 6.00 g of M. What is the equivalent weight of M?
- 64.5 g
  - 30.0 g
  - 45.0 g
  - 89.9 g
  - 129 g
20. A solution of unknown pH is placed in the hydrogen compartment of a galvanic cell, with the H<sub>2</sub> pressure maintained at 1 atm. The other half-cell compartment consists of a Cu/Cu<sup>2+</sup> electrode with [Cu<sup>2+</sup>] = 1.00 M. If the overall cell potential at 25°C is +0.65 V, what is the pH of the solution?
- 10.48
  - 16.72
  - 5.49
  - 10.98
  - 5.24

21. What is the cell potential, at 25°C, for the cell that runs with the reaction given below?  
 $\text{Pb(s)} + \text{Fe}^{+2} (0.20 \text{ M}) \rightarrow \text{Fe(s)} + \text{Pb}^{+2} (0.50 \text{ M})$   
 a. -0.33 V                      d. -0.36 V  
 b. -0.31 V                      e. -0.26 V  
 c. -0.30 V
22. An electrolytic cell is constructed by dipping a zinc metal electrode into a 6.0 M ZnSO<sub>4</sub> solution for one half-cell and by dipping a zinc metal electrode into a 0.0100 M ZnSO<sub>4</sub> solution for the other half-cell. This is called a concentration cell. What is E<sub>cell</sub> for this cell at 25°C?  
 a. 1.10 V                      d. 0.85 V  
 b. 0.164 V                      e. 0 V  
 c. 0.082 V
23. What is the equilibrium constant, at 25°C, for the reaction,  $\text{Cu}^+ + \text{Ag} \rightarrow \text{Ag}^+ + \text{Cu}$ ?  
 a.  $5 \times 10^{-23}$                       d.  $3 \times 10^{-10}$   
 b.  $2 \times 10^{-5}$                       e.  $3 \times 10^{-57}$   
 c.  $2 \times 10^{-8}$
24. What is  $\Delta G^\circ$  for the reaction,  $2\text{H}_2\text{O} + 2\text{K} \rightarrow 2\text{K}^+ + 2\text{OH}^- + \text{H}_2$ , at 25°C?  
 a. -403 kJ                      d. -362 kJ  
 b. -724 kJ                      e. -202 kJ  
 c. -243 kJ
25. What is  $\Delta G^\circ$  for the reaction,  $\text{Mg} + 2\text{H}^+ \rightarrow \text{Mg}^{+2} + \text{H}_2$ , at 25°C?  
 a. -459 kJ                      d. +459 kJ  
 b. 0 kJ                      e. +109 kJ  
 c. -109 kJ
26. What is  $\Delta G^\circ$  for the reaction,  $\text{Mn}^{+2} + 2\text{Fe}^{+2} \rightarrow \text{Mn} + 2\text{Fe}^{+3}$ , at 25°C?  
 a. 50.2 kJ                      d. 347 kJ  
 b. 49.6 kJ                      e. 174 kJ  
 c. 0.0 kJ
27. What is the standard cell potential, E°<sub>cell</sub>, for the reaction,  
 $\text{Cl}_2(\text{g}) + 2\text{Cu(s)} \rightarrow 2\text{Cu}^+(\text{aq}) + 2\text{Cl}^-(\text{aq})$   
 a. +0.32 V                      d. +1.02 V  
 b. -0.32 V                      e. +0.84 V  
 c. -1.02 V
28. What is the standard cell potential,  
 $\text{PbSO}_4(\text{s}) + 2\text{OH}^-(\text{aq}) + \text{H}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{Pb(s)} + \text{SO}_4^{2-}(\text{aq})$   
 a. +1.19 V                      d. -0.47 V  
 b. -1.19 V                      e. +0.47 V  
 c. 0.00 V
29. What is the standard cell potential, E°<sub>cell</sub>, for the reaction,  $\text{Pb}^{+2} + 2\text{Fe}^{+2} \rightarrow 2\text{Fe}^{+3} + \text{Pb}^0$ ?  
 a. -0.90 V                      d. -0.64 V  
 b. +0.90 V                      e. -1.67 V  
 c. +1.67 V
30. With which of the following will Br<sub>2</sub> react spontaneously if all species are at 1.0 M concentration (also called “unit concentration”)?  
 a. Cl<sup>-</sup>    b. Pb    c. I<sub>2</sub>    d. F<sup>-</sup>  
 e. none of these
31. Which of the following is most easily oxidized?  
 a. Li<sup>+</sup>    b. F<sub>2</sub>    c. H<sub>2</sub>    d. F<sup>-</sup>  
 e. Li
32. When an unknown half-cell electrode is connected to the negative terminal of a potentiometer, and a hydrogen electrode to the positive terminal, the potentiometer reads 0.54 V. What is the E° for the unknown?  
 a. -1.08 V                      d. -0.54 V  
 b. +0.54 V                      e. 0.00 V

(potentiometers are devices that measure voltage. They measure it in the opposite sign of what our E would be. You don't need to know that anymore!)

c. +1.08 V

33. One volt equals

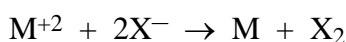
- a. one joule sec      d. one joule/sec  
b. one joule/sec      e. none of these  
c. one joule/coul

34. In a galvanic cell, the anode has a \_\_\_\_\_ charge, and in an electrolytic cell, the anode has a \_\_\_\_\_ charge.

- a. +, +                      d. -, -  
b. +, -                      e. none of these  
c. -, +

35. The equilibrium constant, at 25°C, for the hypothetical reaction below is  $2.2 \times 10^{-6}$ .

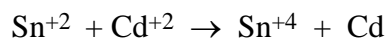
What is  $E^\circ$  for this reaction?



- a. -0.33 V                  d. -0.17 V  
b. +1.10 V                e. +0.55 V  
c. -0.86 V

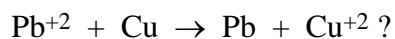
36. The equilibrium constant, at 25°C, for the reaction given below is  $2.5 \times 10^{-19}$ . What is

$E^\circ$  for this reaction?



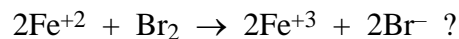
- a. -0.24 V                  d. -1.10 V  
b. -0.48 V                e. -1.27 V  
c. -0.55 V

37. What is the equilibrium constant, at 25°C, for the reaction,



- a.  $7.6 \times 10^{15}$               d.  $7.7 \times 10^6$   
b.  $1.2 \times 10^{-8}$             e.  $1.3 \times 10^{-16}$   
c.  $1.3 \times 10^{-7}$

38. What is the equilibrium constant, at 25°C, for the reaction,



- a.  $8 \times 10^{62}$                 d.  $3 \times 10^5$   
b.  $2 \times 10^{-8}$               e.  $4 \times 10^{-6}$   
c.  $7 \times 10^{10}$

**Answers:**

1. B	11. D	21. A	31. E
2. D	12. D	22. C	32. D
3. D	13. C	23. B	33. C
4. B	14. B	24. A	34. C
5. D	15. A	25. A	35. D
6. B	16. B	26. D	36. C
7. C	17. C	27. E	37. E
8. B	18. D	28. E	38. C
9. E	19. E	29. A	
10. A	20. E	30. B	