

Electrochemistry

Galvanic cell or voltaic cell

1. Identify the location of oxidation in an electrochemical cell.

- a) the anode
- b) the cathode
- c) the electrode
- d) the salt bridge

2. Which one of the following is not a function of a salt bridge?

- a) To allow the flow of cations from one solution to the other
- b) To allow the flow of anions from one solution to the other
- c) To allow the electrons to flow from one solution to the other
- d) To maintain electrical neutrality of the two solutions.

3. If the salt bridge is removed suddenly from a working cell, the voltage

- a) Increases
- b) decreases
- c) Drops to zero
- d) May increase or decrease depending upon cell reaction

4. A cell is formed by the combination of a standard Mg electrode and a standard Zn electrode. Their reduction potentials are respectively -2.36V and -0.76V . The emf of the cell is

- a) $+1.6\text{V}$
- b) -1.6V
- c) $+3.12\text{V}$
- d) none of these

5. Copper has less SRP than silver (placed above silver in the electrochemical series). So if a copper electrode is combined with a silver electrode to form a cell, then the cell operates.

- a) Copper is oxidised
- b) silver is oxidized
- c) Silver gains electrons
- d) silver loses electrons.

6. The reduction potentials of three elements A, B and C are -2.37V , -0.76V , and $+0\text{V}$ respectively. Then from the aqueous solution.

- a) C displaces hydrogen
- b) C is bases than A & B
- c) A displaces B but not C
- d) A displaces B and C.

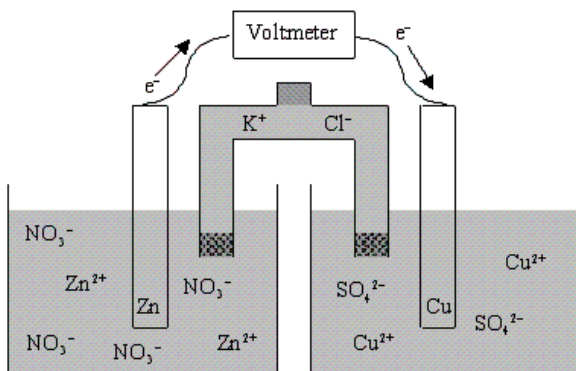
7. Which one of the following conditions will increase the voltage of the cell, represented by the equation $\text{Cu(s)} + 2\text{Ag}^+(\text{aq}) \rightleftharpoons \text{Cu}^{2+}(\text{aq}) + 2\text{Ag(s)}$:

- a) Increase in the concentration of Cu^{2+} ions
- b) Increase in the concentration of Ag^+ ions
- c) Increase in the dimensions of copper electrode
- d) Increase in the dimensions of silver electrode

8. Which of the following statements is true for a voltaic (galvanic) cell?

- a) The electron flow is from the anode to the cathode through external circuit.
- b) The electron flow is from the positive electrode to the negative electrode.
- c) The electron flow is from the negative cathode to the positive anode through salt bridge.
- d) The electron flow is through the salt bridge.

9. Which of the following statements is true concerning the voltaic cell shown below?



- a) $[Zn^{2+}]$ increases with time, and $[Cl^-]$ increases with time.
- b) $[Zn^{2+}]$ decreases with time, and $[Cl^-]$ increases with time.
- c) $[Zn^{2+}]$ decreases with time, and $[Cl^-]$ decreases with time.
- d) $[Zn^{2+}]$ decreases with time, and $[NO_3^-]$ increases with time.

10. According to the following cell notation, which species is undergoing reduction? $Sn | Sn^{2+}(aq) || Mn^{2+}(aq) | MnO_2(s) | Pt(s)$

- a) $Mn^{2+}(aq)$
- b) $Sn^{2+}(aq)$
- c) $Sn(s)$
- d) $MnO_2(s)$

10. In the following electrochemical cell, what is the role of the platinum?

$Cu(s) | Cu^{2+}(aq) || Fe^{3+}(aq), Fe^{2+}(aq) | Pt(s)$

- a) The platinum serves as the anode.
- b) The oxidation of Fe^{2+} takes place at the surface of the platinum as the cell discharges.
- c) The reduction of Fe^{3+} takes place at the surface of the platinum as the cell discharges.
- d) Both a) and c)

11. What is the cell reaction for the following voltaic cell?

$Al(s) | Al^{3+}(aq) || Br^-(aq) | Br_2(g) | Pt(s)$

- a) $2Al(s) + 3Br_2(g) \rightarrow 2Al^{3+}(aq) + 6Br^-(aq)$
- b) $Al(s) + Al^{3+}(aq) \rightarrow Br^-(aq) + Br_2(g)$
- c) $2Al^{3+}(aq) + 6Br^-(aq) \rightarrow 2Al(s) + 3Br_2(g)$
- d) $Al(s) + 3Br_2(g) \rightarrow Al^{3+}(s) + 2Br^-(aq)$

12. In a table of standard reduction potentials, the strongest reducing agents are the _____ species in the half-reactions with the _____ E° values.

- a) Reduced, most negative
- b) oxidized, most positive
- c) reduced, most positive
- d) oxidized, most negative

13. Given:



Which of the following species is the strongest reducing agent?

- a) Mn
- b) Cu
- c) Cr^{3+}
- d) Mn^{2+}

14. For a certain oxidation–reduction reaction, E°_{cell} is positive. This means that

- a) ΔG° is negative and K is greater than 1.
- b) ΔG° is positive and K is less than 1.
- c) ΔG° is positive and K is greater than 1.
- d) ΔG° is negative and K is less than 1.

Conductivity concept

15. Specific conductance is the conductance of

- a) 1m^3 of electrolytic solution
- b) 1cm cube of a solid electrolyte
- c) One gram of the solution of an electrolyte
- d) One gram of the solid electrolyte

16. If the specific conductance & conductance of a solution are same then the cell constant is equal to

- a) 0
- b) 0.5
- c) 1.0
- d) 10.0

The specific conductance of a 0.01M solution of KCl is $1.4 \times 10^{-3} \text{ ohm}^{-1} \text{ cm}^{-1}$ at 298K . Its molar conductance is

- a) 0.14
- b) 1.4
- c) 14.0
- d) 140

17. Which statement is correct about a strong electrolyte?

- a) The molar conductivity decreases significantly as the concentration increases.
- b) It is partially ionized in aqueous solution.
- c) Examples of strong electrolytes include $\text{CH}_3\text{CO}_2\text{H}$ and $\text{Na}[\text{CH}_3\text{CO}_2]$.
- d) The molar conductivity at infinite dilution can be found by extrapolation from a plot of molar conductivity against concentration.

18. The molar conductivities of Cs^+ and $[\text{SO}_4]^{2-}$ are 0.772×10^{-2} and $1.600 \times 10^{-2} \text{ Sm}^2 \text{ mol}^{-1}$ respectively.

What is the molar conductivity of Cs_2SO_4 ?

- a) $3.972 \times 10^{-2} \text{ S m}^2 \text{ mol}^{-1}$
- b) $2.372 \times 10^{-2} \text{ S m}^2 \text{ mol}^{-1}$
- c) $0.828 \times 10^{-2} \text{ S m}^2 \text{ mol}^{-1}$
- d) $3.144 \times 10^{-2} \text{ S m}^2 \text{ mol}^{-1}$

19. Which statement is incorrect about a weak electrolyte?

- a) A weak electrolyte is partially dissociated in aqueous solution.

- b) The molar conductivity of a weak electrolyte remains approximately constant as the concentration increases.
- c) Acetic acid is an example of a weak electrolyte.
- d) At infinite dilution, a weak electrolyte is taken to be fully ionized.

20. The highest electrical conductivity of the following aqueous solutions is of

- a) 0.1 M acetic acid
- b) 0.1 M chloroacetic acid
- c) 0.1 M fluoroacetic acid
- d) 0.1 M difluoroacetic acid

Electrolytic cell and Faraday's laws

21. An electric circuit consisted of a beaker containing some sodium chloride solution and two carbon rods connected to a battery with two bits of wire. Which one of the following correctly describes what is moving in the various parts of the circuit.

- a) Electrons are moving in the wire and the carbon rods. Ions are moving in the solution.
- b) Electrons are moving in the wire, the carbon rods and the solution.
- c) Electrons are moving in the wire. Ions are moving in the carbon rods and the solution.
- d) Protons are moving in the wire. Electrons are moving in the carbon rods. Ions are moving in the solution.

22. During an experiment to electrolyse lead (II) bromide, nothing happened until the lead(II) bromide melted. At that point, the bulb in the circuit lit up, and there were signs of a chemical change in the crucible holding the lead (II) bromide. Which one of the following statements explains the reason for this?

- a) There are no electrons in the solid lead(II) bromide. Free electrons are produced by a chemical reaction when the solid melts, and they move through the liquid enabling it to conduct electricity.
- b) For electrolysis to work, ions have to be free to move. In the solid lead(II) bromide, the ions are locked in a rigid lattice. When it melts, they become free to move.
- c) Lead(II) bromide has to be heated to its melting point before it will split up. Molten metallic lead is produced which joins up the two carbon electrodes and completes the circuit.
- d) The electrons in the solid lead(II) bromide are held tightly in the crystal lattice. When the solid melts, the electrons become free to move and the liquid conducts.

23. One faraday will oxidize ____ mole(s) of Cu to Cu²⁺ ions

- a) 0
- b) $\frac{1}{2}$
- c) $\frac{1}{4}$
- d) 1

24. How many grams of copper would be produced by the reduction of Cu²⁺ if 3.0 amperes of current are passed through a copper (II) nitrate solution for one hour?

- a) 18.20
- b) 3.56
- c) 31.8
- d) 63.5

25. 9.65 C of electric current is passed through fused anhydrous magnesium chloride. The magnesium

metal thus, obtained is completely converted into a Grignard reagent. The number of moles of the Grignard reagent obtained is

- a) 5×10^{-4} b) 1×10^{-4} c) 5×10^{-5} d) 1×10^{-5}

26. When electricity is passed through acidulated water, 224ml of hydrogen gas at STP is collected at the cathode in 965sec. The current passed in ampere is

- a) 0.5 b) 1.0 c) 1.5 d) 2.0

Batteries and fuel cells

27. With respect to recharging a primary or secondary cell, of the following statements, which one is correct?

- a) The secondary cell can be recharged by passing current through it in the proper direction
- b) The primary cell can be recharged by passing current through it in the proper direction
- c) The secondary cell can only be recharged by changing the electrodes
- d) The primary cell can only be recharged by changing the electrolyte

28. Which of the following actions will recharge a secondary cell?

- a) Adding more water to the electrolyte
- b) Adding more active ingredient to the electrolyte
- c) Connecting the negative terminal of a voltage source to the cathode of the cell and the positive terminal of the voltage source to the anode of the cell
- d) Connecting the negative terminal of a voltage source to the anode of the cell and the positive terminal of the voltage source to the cathode of the cell.

29. In a fully charged lead-acid cell, what is the composition of the anode, cathode, and electrolyte respectively?

- a) Zinc, carbon, and water
- b) Carbon, lead, sulfuric acid and water
- c) Lead peroxide, sponge lead, sulfuric acid, and water
- d) Nickel, cadmium, potassium hydroxide, and water

30. Corrosion of iron is essentially an electrochemical phenomenon where the cell reactions are

- a) Fe is oxidised to Fe^{3+} and H_2O is reduced to O_2^{2-}
- b) Fe is oxidised to Fe^{2+} and H_2O is reduced to O_2^-
- c) Fe is oxidised to Fe^{2+} and dissolved oxygen in water is reduced to OH^-
- d) Fe is oxidised to Fe^{2+} and H_2O is reduced to O_2