

## Galvanic Cells Chemistry Questions with Solutions

**Q1:** What is the unit of equivalent conductance?

- a.  $\Omega^{-1} \text{ cm}^{-1}$
- b.  $\Omega^{-1} \text{ cm}^{-2}$
- c.  $\Omega^{-1} \text{ cm}^2$
- d. None of the above

**Answer:** (c.)

**Explanation:** Since Equivalent conductivity = Specific conductance x Volume  
Hence, units of Equivalent conductivity =  $\Omega^{-1} \text{ cm}^{-1} \times \text{cm}^3 = \Omega^{-1} \text{ cm}^2$

**Q2.** In an electrochemical cell:

- a. Potential energy decreases
- b. Kinetic energy decreases
- c. Chemical energy gets converted into electrochemical energy
- d. Potential energy gets converted into electrical energy

**Answer:** (c.)

**Explanation:** In an electrochemical cell the chemical energy gets converted into electrochemical energy

**Q3.** What happens when a lead storage battery gets discharged?

- a. Sulphuric acid is consumed
- b. Lead sulphate is consumed
- c. Lead is formed
- d.  $\text{SO}_2$  gas is evolved

**Answer:** (a.)

**Explanation:** When a lead storage battery gets discharged, acid is consumed releasing water.

**Q4.** A SHE has a zero potential because

- a. H is the lightest element
- b. H is easier to oxidise
- c. An H-atom has only 1 electron
- d. This electrode potential is assumed to be zero

**Answer:** (d.)

**Explanation:** This is because SHE is taken as a reference electrode. Hence, SHE's potential is assumed to be zero.

**Q5.** Write the Nernst Equation for a single electrode.

**Answer:** Let us assume a half-cell reaction:  $M^{n+} + ne^- \rightarrow M$

The Nernst equation for this equation can be derived as:

$$E_{M^{n+}/M} = E_{M^{n+}/M}^{\circ} - (2.303RT / nF) \log([M] / [M^{n+}]) = E_{M^{n+}/M}^{\circ} - (2.303RT / nF) \log(1 / [M^{n+}])$$

**Q6.** Which electrodes are used in fuel cells?

**Answer:** Hydrogen electrode and oxygen electrode

**Q7.** What is overvoltage?

**Answer:** The voltage required for the deposition of metals on the cathode is just the same as the standard electrode potential. However, some electrochemical processes are kinetically too slow to be carried at the same voltage. Hence, some extra voltage is required other than the theoretical value of standard electrode potential to pace up these reactions. This extra required voltage is called the overvoltage.

**Q8.** Why does a cell stop working after some time?

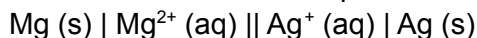
**Answer:** As the electrochemical cell involves a set of oxidation-reduction reactions going on inside, the concentrations of the electrolytic solutions keep changing with time. The change in concentration of the electrolytes brings about a change in their respective potentials. Hence, when the electrode potential of the two cells becomes equal, the cell stops working.

**Q9.** Mention 2 advantages of a hydrogen-oxygen fuel cell over an ordinary cell.

**Answer:** The advantages of hydrogen-oxygen fuel cell over an ordinary cell are:

- They do not cause any pollution
- They have higher efficiency than the ordinary cell (60-70%).

**Q10.** State the major factor that will influence the electrode potential of the following cell:



**Answer:** The major factors that will influence the potential of the given cell are temperature and the concentrations of the  $Mg^{2+}$  and  $Ag^{+}$  ions.

**Q11.** Why is Chromium used for coating Iron?

**Answer:** This is because chromium does not corrode easily and hence, forms a protective layer on iron which is a highly corrosive metal.

**Q12.** What is the electrolyte that is used in a dry cell?

**Answer:** The electrolyte used involves a paste of  $\text{NH}_4\text{Cl}$ ,  $\text{MnO}_2$  and carbon.

**Q13.** What is the EMF when the cell reactions attain an equilibrium?

**Answer:** Zero

**Q14.** What flows inside the internal circuits of the galvanic cells?

**Answer:** Ions

**Q15.** How can you determine whether the given electrolyte is a strong electrolyte or weak electrolyte?

**Answer:** If the aqueous solution of the given electrolyte conducts electricity to a large extent, then, it must be a strong electrolyte. However, if the aqueous solution of the given electrolyte conducts electricity to a small extent, then, it must be a weak electrolyte.

## Practise Questions on Galvanic Cells

**Q1.** The conductivity cell containing a 0.001 M KCl solution at 298 K has a resistance of 1500  $\Omega$ . What is the cell constant?

The conductivity of the 0.001 M KCl solution at 298 K is  $0.146 \times 10^{-3} \text{ S cm}^{-1}$ .

**Answer:** Cell constant = conductivity / conductance = conductivity x resistance  
Hence, cell constant =  $0.146 \times 10^{-3} \text{ S cm}^{-1} \times 1500 \Omega = 0.219 \text{ cm}^{-1}$ .

**Q2.** How much electricity (Faraday) is required to produce 20 g of calcium from molten calcium chloride ( $\text{CaCl}_2$ )?

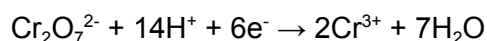
**Answer:** The reaction for the formation of calcium from molten  $\text{CaCl}_2$  is:



Thus, 1 mole Ca require electricity = 2F = energy required by 40 g Calcium

Hence, 20 g Ca will require  $2\text{F} / 2 = 1\text{F}$  electricity.

**Q3.** What amount of electricity (in Coulombs) is required to reduce 1 mole of  $\text{Cr}_2\text{O}_7^{2-}$  in the following reaction?



**Answer:** As from the given equation, 1 mole of  $\text{Cr}_2\text{O}_7^{2-}$  requires 6F of electricity for its conversion into  $\text{Cr}^{3+}$ .

$$6F = 6 \times 96500 \text{ C} = 579000 \text{ C}$$

Hence, 579000 C electricity is required for the reduction of  $\text{Cr}_2\text{O}_7^{2-}$  to  $\text{Cr}^{3+}$ .

**Q4.** Suggest any two materials that can be used in place of hydrogen in a fuel cell.

**Answer:** The two materials that can replace hydrogen in a fuel cell are methane and methanol.

**Q5.** Why does the conductivity of a solution decrease with dilution?

**Answer:** This is because the conductivity of the solution arises due to the conductance of the ions present in the unit volume of the solution. When the solution is diluted, the number of ions per unit volume of the solution decreases. Hence, on dilution, the conductivity of the solution decreases.

