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Class: 12
Subject: Chemistry
Topic: Electrochemistry
No. of Questions: 20
Duration: 60 Min
Maximum Marks: 60

1. The concept that an acid is a proton donor and a base is a proton acceptor was introduced by
   a. Arrhenius
   b. Bronsted – Lowry
   c. Lewis
   d. Faraday

   Ans. B

2. The number of H^+ ion is 1 mole of water 25°C is
   a. 10^{-7}
   b. 107
   c. 6.022×10^{23}
   d. $6.022´10^{16}$

   Ans. D

   Solution:

$$[H+] \text{ in water } = 10^{-7} \text{ moles at } 25°C$$
$$1 \text{ mole of ions } = 6.022 \times 10^{23} \text{ ions}$$
$$10^{-7} \text{ moles } = 6.022 \times 10^{16} \text{ ions}$$

3. What is the pH of a solution where hydroxyl ion concentration is 2×10^{-2}
   a. 2
   b. 12
   c. 12.301
   d. 1.699

   Ans. c

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Solution:

$$pOH = -\log 2\times10^{-2} = 2 - \log 2 = 1.699$$
$$pH = 14 - 1.699 = 12.301$$

4. Salts of metal A and B were separately electrolysed. Atomic mass of A is 108 and that of B is 64. At the end of electrolysis the mass of A and B deposited were 5.4g and 1.6 g respectively. The valencies of A and B are
   a. 2, 1
   b. 1, 2
   c. 1, 1
   d. 2, 2

   Ans. B

$$\frac{\text{Mass of A}}{\text{Eq. mass of A}} = \frac{\text{Mass of B}}{\text{Eq. mass of B}}$$

$$\text{Eq. mass of A \& B respectively are } \frac{108}{\text{Valency of A}} \text{ and } \frac{64}{\text{Valency of B}}$$

$$\frac{\frac{5.4}{1108}}{\text{Valencey of A}} = \frac{\frac{1.6}{64}}{\text{Valencey of B}} \quad \text{On simplicati on we get } \frac{\text{Valency of A}}{\text{Valencey of B}} = \frac{1}{2}$$

So valencies are in the ratio 1 : 2

5. When 9.65 coulombs of electricity is passed through a solution of silver nitrate (atomic mass of Ag = 108.0 gmol-1). The amount of silver deposited is
   a. 6.4 mg
   b. 10.8 mg
   c. 21.2 mg
   d. 16.2 mg

   Ans. B
   Solution:

$$96{,}500 \quad - \quad 108$$
$$9.65 \quad\quad\quad ?$$

$$\text{Mass of Ag} = \frac{108\times9.65}{96500} = 0.0108\ \text{g} = 10.8\ \text{mg}$$

6. What is the pH of the solution obtained by mixing 250 cm^3 45of a solution of pH 3 and 750 cm3 of a solution pH 5
   a. 45
   b. 4
   c. 3.3
   d. 3.6

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Ans. D

Solution:

Amt of $[H^+]$ present in 250 cm^3 and 750 cm^3 of solution of pH 3 and pH 5 are

$\frac{10^{-3} \times 250}{1000}$ and $\frac{10^{-5} \times 250}{1000}$ respectively

The total volume of the solution is one litre and it contains $\left(\frac{10^{-5} \times 250}{1000} + \frac{10^{-5} \times 250}{1000}\right)$

moles of H^+, that is

$[H^+] = 2.575 \times 10^{-4}$ mol. dm^{-3}

$\therefore pH = -\log 2.575 \times 10^{-4} = 4 - \log 2.575$

$= 4 - 0.41 = 3.59$ or 3.6

7. Electrolysis of KCl. MgCl2 6H2O gives
   a. potassium only
   b. magnesium only
   c. magnesium and chlorine
   d. potassium and magnesium

   Ans. C

8. An example for a Lewis acid is
   a. calcium chloride
   b. aluminium chloride
   c. magnesium chloride
   d. zinc chloride

   Ans. B

9. The E.M.F. of a galvanic cell constituted with the electrodes Zn^{2+} / Zn (- 0.76 V) and cu^{2+} / Cu (0.34 V) is
   a. 0.42 V
   b. 1.1 V
   c. -1.1 V
   d. -0.42 V

   Ans. B

   Solution:

   Cell is $Zn^{2+} / Zn // Cu^{2+} / Cu$ $\quad \therefore E_{Cell} = E_{Cu} - E_{Zn} = 1.1\,V$

10. An example for a strong electrolyte is
    a. ammonium hydroxide
    b. Urea
    c. Sodium acetate
    d. Sugar

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Ans. C
Solution:
All salts are strong electrolytes. So sodium acetate is a strong electrolyte. NH_4OH is a weak electroylte. Urea and sugar are nonelectrolytes

11. Which of the following is not an example of a Lewis acid?
    a. $AlCl_3$
    b. $FeCl_3$
    c. BF_3
    d. CH_3COOH

Ans. D

12. Identify a species which is not a Bronsted acid but is a Lewis acid
    a. BF_3
    b. H_3O^+
    c. NH_3
    d. HCl

Ans. A
Solution:
Proton donor is a Bronsted acid and electron pair acceptor is a Lewis acid. BF3 does not donate a proton but can accept a pair of electrons from donors into its empty orbital

13. The precipitate of CaF_2 ($K_5 = 1.7 \times 10^{-10}$) is formed when equal volumes of the following are mixed
    a. 10^{-4} M Ca_2 + + 10^{-4} MF
    b. 10^{-2} M Ca_2+ + 10^{-3} MF
    c. 10^{-5} M Ca_2+ + 10^{-3} MF
    d. 10^{-3} M Ca_2+ + 10^{-5} MF

Ans. B
Solution:
The equilibriu m maintained by CaF_2 in solution is $CaF_2 \Leftrightarrow Ca^{2+} + 2F^-$

Hence $K = [Ca^{2+}][F^-]^2$

The ionic product va lue in the four cases are

1. $(10^{-4})(10^{-4}) - 10^{-12}$ 2. $(10^{-2})(10^{-3})^2 = 10^{-8}$

3. $(10^{-5})(10^{-3}) = 10^{-11}$ 4. $(10^{-3})(10^{-5})^2 = 10^{-13}$

The value of ionic product exceeds that of K_s only in case of combinatio n 2, and hence a precipitat e is fomed

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14. The equivalent conductance at infinite dilution of NaCl, HCl and sodium acetate at 298 K are 126.45, 426.16 and 91.0 ohm^{-1} cm^2 respectively. The value of equivalent conductance of acetic acid at the same temperature is
    a. 643.61 ohm^{-1} cm2 eq^{-1}
    b. 299.71 ohm^{-1} cm2 eq^{-1}
    c. 517.16 chm^{-1} cm2 eq^{-1}
    d. 390.71 ohm^{-1}cm2 eq^{-1}

    Ans. D

    Solution:

$$\Lambda_\infty\ CH_3COOH = \lambda_{CH_3COO^-} + \lambda_{H+}$$
$$= (\lambda_{CH_3COO^-} + \lambda_{Na^+}) + (\lambda_{H^+} + \lambda_{Cl^-}) - (\lambda_{Na^+} + \lambda_{Cl^-})$$
$$= \Lambda_{\infty CH_3COONa} + \Lambda_{\infty H} - +(\lambda_{H^+} + \lambda_{Cl^-}) - (\lambda_{Na^+} + \lambda_{Cl^-})$$
$$= 91 + 426.16 - 126.45 = 390.71\ \text{ohm}^{-1}\ \text{cm}^2\ \text{eq}^{-1}$$

Note : In SI system a factor 10^{-4} would have been there . Thus

$$= \Lambda_{\infty CH_3COOH} = 91\times10^{-4} + 426.16\times10^{-4} - 126.45\times10^{-4}$$
$$= 390.71\times10^{-4}\ \text{Sm}^2\ \text{eq}^{-1}$$

15. In the salt bridge KCl is used because
    a. KCl is an electrolyte
    b. K^+ and Cl- ions are isoelectronic
    c. K^+ and Cl- ions have same mobility
    d. agar forms good jelly with KCl

    Ans. C

    Solution:

    If two solutions are directly linked while forming a cell, due to diffusion of ions with unequal speed a junction potential develops which adds up to the measured EMF of the cell. Since a salt bridge contains KCl whose ions have same speed, junction potential does not develop

16. Platinum is used as a catalyst in general for
    a. dehydrogenation reactions
    b. oxidation reactions
    c. dehydration reactions
    d. dehydrohalogenation reactions

    Ans. B

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17. The specific conductance of an electrolyte
    a. increases with increase in temperature
    b. decreases on dilution
    c. depends on the nature of the electrolyte
    d. all the above statements are correct

    Ans. D
    Solution:
    When temperature increases mobility increases. Hence option 1 is correct. On dilution the number of ions per unit volume decreases and hence option 2 is also correct. NaCl is a stronger electrolyte than NH4OH Hence in equimolar solution; NaCl provides more number of ions and hence shows more conductance. Hence option 3 also is true. Thus the correct choice is option 4

18. The pH of a solution whose $[H^+]$ is 3.0×10^{-4} M is
    a. 4.45
    b. 3.75
    c. 4.36
    d. 3.523
    Ans. D

19. The hydrogen ion concentration of 0.2 M CH3COOH which is 40% dissociated is
    a. 0.08 M
    b. 0.12 M
    c. 0.8 M
    d. 0.4 M
    Ans. A
    Solution:

$$[H^+] = \alpha\, C = \frac{40}{100} \times 0.2 = 0.08 \text{ mol dm}^{-3}$$

20. Buffer solution can be obtained by mixing aqueous solutions of
    a. CH_3COONa and excess HCl
    b. NaCl and HCl
    c. CH_3COONa and CH_3COOH
    d. CH_3COOH and excess of NaOH

    Ans. C