CHEMISTRY

NCERT - FULL MARKS CHEMISTRY(TAMIL)

ELECTRO CHEMISTRY

Examples

1. If 50 milli ampere of current is passed through copper coulometer for 60 min, calculate the amount of copper deposited.

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2. 0.1978 g of copper is deposited by a current of 0.2 ampere in 50 minutes. What is the electrichemical equivalent of copper ?

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3. What current strength in amperes will be required to liberate 10 g of iodine from potassium iodide solution in one hour ?

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4. An electric current is passed through three cells in series containing respectively solutions of copper sulphate, silver nitrate and potassium iodide. What weights of silver and iodine will be liberated while 1.25 g of copper is being deposited ?

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5. The resistance of a 0.01 N solution of an electrolyte was found to 210 ohm at $25^{\circ}C$ using a conductance cell with a cell constant

$0.88 cm^{-1}$. Calculate the specific conductance and equivalent conductance of the solution.

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6. Specific conductance of 1 M KNO_3 solution is observed to be 5.55×10^{-3} mho cm^{-1}. What is the equivalent conductance of KNO_3 when one litre of the solution is used?

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7. Equivalent conductivity of acetic acid at infinite dilution is 39.7 and for 0.1 M acetic acid the equivalent conductance is $5.2\ \text{mho.cm}^2.\ \text{gm.equiv.}^{-1}$. Calculate degree of dissociation, H^+ ion concentration and dissociation constant of the acid.

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8. Find the degree of dissociation of HF in 1 M aqueous solution. The value of K for the ionic equilibrium $HF = H^+ + F^-$ is 7.2×10^{-4}.

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9. The hydrogen ion concentration of a fruit juice is $3.3 \times 10^{-2} M$. What is the pH of the juice ? Is it acidic or basic ?

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10. If a solution has a pH of 7.41, determine its H^+ concentration.

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11. pH of a solution is 5.5 at $25^{\circ} C$. Calculate its $\left[OH^{-}\right]$

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12. Calculate the pH of $0.001\ \mathrm{M}\ \mathrm{HCl}$ solution

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13. Find the pH of a buffer solution containing 0.20 mole per litre CH_3COONa and 0.15 mole per litre CH_3COOH, K_a for acetic acid is 1.8×10^{-5}

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14. The Ka of propionic acid is 1.34×10^{-5}. What is the pH of a solution containing 0.5 M propionic acid and 0.5 M sodium proportionate ? What happens to the pH of the solution when volume is doubled by adding water ?

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Self Evaluation A Choose The Correct Answer

1. The new sources of energy is termed as .....

A. neutralisation

B. hydrolysis

C. electrolysis

D. ionisation

Answer:

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2. Faraday's laws of electrolysis are related to .....

A. Dalton

B. Faraday

C. Kekule

D. Avogadro

Answer:

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3. When 5 coulomb of charge, flows through a circuit for 20 seconds. Calculate the current?

A. equivalent weight

B. molecular weight

C. electrochemical equivalent

D. one gram

Answer:

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4. Explain Faraday's laws of electrolysis.

A. atomic number of the cation

B. atomic number of the anion

C. equivalent weight of the electrolyte

D. speed of the cation

Answer:

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5. The specific conductance of a 0.01 M solution of KCl is $0.0014\ \text{ohm}^{-1}\ \text{cm}^{-1}$ at $25^\circ C$. Its equivalent conductance is .....

A. $14\ \text{ohm}^{-1}\text{cm}^2 eq^{-1}$

B. $140\ \text{ohm}^{-1} cm^2 eq^{-1}$

C. $1.4\ \text{ohm}^{-1} cm^2 eq^{-1}$

D. $0.14\ \text{ohm}^{-1} cm^2 eq^{-1}$

Answer:

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6. The equivalent conductivity of CH_3COOH at $25^\circ C$ is $80\ \text{ohm}^{-1}cm^2eq^{-1}$ and at infinite dilution $400\ \text{ohm}^{-1}\ \text{cm}^2eq^{-1}$. The degree of dissociation of CH_3COOH is .....

A. 1

B. 0.2

C. 0.1

D. 0.3

Answer:

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7. Why is it necessary to use acetic acid and not sulphuric acid for acidification of sodium extract for testing sulphur by lead acetate test?

A. increases

B. decreases

C. does not change

D. becomes zero

Answer:

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8. Attempt titrating an amino acid against a weak base and discover the number of dissociating (ionizable) functional groups in the amino acid.

A. it has low vapour pressure

B. it is only partially ionised

C. it is completely ionised

D. it has low density

Answer:

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9. Which one of the following formulae represents Ostwald's dilution law for a binary electrolyte whose degree of dissociation is α and concentration C.

A. $K = \frac{(1-\alpha)C}{\alpha}$

B. $K = \frac{\alpha^2 C}{1-\alpha}$

C. $K = \frac{(1-\alpha)C}{\alpha^2}$

D. $K = \frac{\alpha^2 C}{(1-\alpha)C}$

Answer:

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10. State Ostwald's dilution law.

A. CH_3COOH

B. $NaCl$

C. $NaOH$

D. H_2SO_4

Answer:

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11. Which one of the following relationship is correct ?

A. $pH = \frac{1}{[H^+]}$

B. $pH = \log_{10}[H^+]$

C. $\log_{10} pH = [H^+]$

D. $pH = \log_{10} \cdot \frac{1}{[H^+]}$

Answer:

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12. When 10^{-6} mole of a monobasic strong acid is dissolved in one litre of solvent, the pH of the solution is .....

A. 6

B. 7

C. less than 6

D. more than 7

Answer:

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13. When pH of a solution is 2, the hydrogen ion concentration in moles litre^{-1} is .....

A. 1×10^{-12}

B. 1×10^{-2}

C. 1×10^{-7}

D. 1×10^{-4}

Answer:

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14. The pH of a solution containing 0.1 N NaOH solution is

A. 1

B. 10^{-1}

C. 13

D. 10^{-13}

Answer:

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15. A chemical reaction which involves addition of oxygen is called as _____.

A. buffer solution

B. true solution

C. isohydric solution

D. ideal solution

Answer:

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16. The hydrogen ion concentration of a buffer solution consisting of a week acid and its salts is given by

A. $\left[H^{+}\right] = K_a \frac{[\text{Acid}]}{[\text{Salt}]}$

B. $\left[H^{+}\right] = K_a[\text{Salt}]$

C. $\left[H^{+}\right] = K_a[\text{Acid}]$

D. $\left[H^{+}\right] = K_a \frac{[\text{Salt}]}{[\text{Acid}]}$

Answer:

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17. Indicators used in acid-base titrations are .....

A. strong organic acids

B. strong organic bases

C. weak organic acids or weak organic bases

D. non-electrolysis

Answer:

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18. For the titration between oxalic acid and sodium hydroxide, the indicator used in .....

A. potassium permanganate

B. phenolphthalein

C. litmus

D. methyl orange

Answer:

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Self Evaluation B Answer In One Or Two Sentences

1. Obtain an expression for electrical conductor.

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2. Define Faraday.

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3. Define electrochemical equivalent.

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4. What are insulators. Give examples.

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5. State Ostwald's dilution law.

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6. What is common ion effect. Give examples.

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7. What is a buffer action ?

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8. What are indicators ?

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9. The resistance of a 0.01 N solution of an electrolyte was found to 210 ohm at $25^{\circ}C$ using a conductance cell with a cell constant $0.88cm^{-1}$. Calculate the specific conductance and equivalent conductance of the solution.

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10. What is Henderson equation ?

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Self Evaluation C Answer Not Exceeding Sixty Words

1. Write an account of the Arrhenius theory of electrolytic dissociation.

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2. What is electrolysis?

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3. State Ostwald's dilution law.

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4. Explain buffer action with example.

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5. Derive Henderson equation.

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6. State and explain Kohlrausch's law.

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Self Evaluation D Solve The Problems

1. What is the electrochemical equivalent of a substance when 150 gm of it is deposited by 10 ampere of current passed for 1 sec?

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2. The electrochemical equivalent of an electrolyte is 2.35 gm $amp^{-1}\sec^{-1}$. Calculate the amount of the substance deposited when 5 ampere is passed for 10 sec.

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3. To 1 M solution of $AgNO_3$, 0.75 F quantity of current is passed. What is the concentration of the electrolyte, $AgNO_3$ remaining in the solution?

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4. 0.5 F of electric current was passed though 5 molar solutions of $AgNO_3, CuSO_4$ and $AlCl_3$ connected in series. Find out the concentration of each of the electrolyte after the electrolysis ?

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5. To one molar solution of a trivalent metal salt, electrolysis was carried out and 0.667 M was the concentration remaining after electrolysis. Calculate the quantity of electricity passed.

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6. A conductance cell has platinum electrodes, each with 5 cm^2 area and separated by 0.5 cm distance. What is the cell constant?

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7. Using a conductivity cell with $0.9\,\mathrm{cm}^{-1}$ cell constant, the conductance was observed to be 2.5×10^{-3} mho for $0.07\,\mathrm{M\,KCl}$ solution. What is the specific conductance of the solution ?

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8. Specific conductance of 1 M KNO_3 solution is observed to be 5.55×10^{-3} mho cm^{-1}. What is the equivalent conductance of KNO_3 when one litre of the solution is used?

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9. Explain why on dilution does the conductivity decrease whereas molar conductivity increases for an electrolytic solution.

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10. The equivalent conductances at infinite dilution of HCl, CH_3COONa and $NaCl$ are 426.16, 91.0 and 126.45 $ohm^{-1}cm^2$ gm equivalent^{-1} respectively. Calculate the equivalent conductance (λ_∞) of acetic acid.

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Example

1. A conductivity cell has two platinum electrodes separated by a distance 1.5 cm and the cross sectional area of each electrode is 4.5 sq cm. Using this cell, the resistance of 0.5 N electrolytic solution was measured as 15 Ω. Find the specific conductance of the solution.

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2. Calculate the molar conductance of 0.025M aqueous solution of calcium chloride at $25^{\circ}C$. The specific conductance of calcium chloride is $12.04 \times 10^{-2} Sm^{-1}$

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3. The resistance of a conductivity cell is measured as 190 Ω using 0.1M KCl solution (specific conductance of 0.1M KCl is 1.3 Sm^{-1}). When the same cell is filled with 0.003M sodium chloride solution, the measured resistance is 6.3 KΩ . Both these measurements are made at a particular temperature. Calculate the specific and molar conductance of NaCl solution.

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4. The net redox reaction of a galvanic cell is given below

$2Cr(s) + 3Cu^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 3Cu(s)$

Write the half reactions and describe the cell using cell notation.

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5. A solution of silver nitrate is electrolysed for 20 minutes with a current of 2 amperes. Calculate the mass of silver deposited at the cathode.

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Evaluate Yourself

1. The resistance of 0.15M solution of an electrolyte is 50 Ω . The specific conductance of the solution is 2.4. Sm^{-1} The resistance

of 0.5 N solution of the same electrolyte measured using the same conductivity cell is 480 Ω . Find the equivalent conductivity of 0.5 N solution of the electrolyte.

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Evaluation

1. The number of electrons that have a total charge of 9650 coulombs is

A. 6.22×10^{23}

B. 6.022×10^{24}

C. 6.022×10^{22}

D. 6.022×10^{-34}

Answer: C

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2. Consider the following half cell reactions

$Mn^{2+} + 2e^- \rightarrow MnE = -1.18v$

$Mn^{2+} \rightarrow Mn^{3+} + eE^- = -1.51V$

The E^- for the reaction $3Mn^{2+} \rightarrow Mn + 2Mn^{3+}$ and the possibility of the forward reaction are respectively .

A. 2.69V and spontaneous

B. -2.69 and non spontaneous

C. 0.33V and Spontaneous

D. 4.18V and non spontaneous

Answer: B

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3. The button cell used is watches function as follows

$$Zn(s) + Ag_2O(s) + H_2O(l) \rightarrow 2Ag(s) + Zn^{2+}(aq) + 2OH^-(aq)$$

the half cell potentials

are

$$Ag_2O(s) + H_2O(l) + 2e^- \rightarrow 2Ag(s) + 2OH^-(aq) E = 0.34V$$

The cell potential will be

A. 0.84 V

B. 1.34 V

C. 1.10V

D. 0.42 V

Answer: C

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4. The molar conductivity of a 0.5 mol dm^{-3} solution of $AgNO^3$ with electrolytic conductivity of 5.76×10^{-3} S cm^{-1} at 298 K is

A. $2.88 Scm^2 mol^{-1}$

B. 11.52 $Scm^2 mol^{-1}$

C. 0.086 S $cm^2 mol^{-1}$

D. 28 .8 $Scm^2 mol^{-1}$

Answer: B

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5.

Electrolyte	KCl	KNO_3	HCl	NaOAC	NaCl
Λ_m (S cm^2 mol^{-1})	149.9	145.0	426.2	91.0	126.5

Calculate $A^{\circ}_{\mathrm{HoAC}}$ using appropriate molar conductances of the electrolytes listed above at infinite dilution in water at 25° C .

A. 517.2

B. 552.7

C. 390.7

D. 217.5

Answer: C

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6. Faradays constant is defined as

A. charge carried by 1 electron

B. charge carried by one mole of electrons

C. charge required to deposit one mole of substance

D. charge carried by 6.22×10^{10} electrons .

Answer: B

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7. How many faradays of electricity are required for the following reaction to occur $MnO_4^- \rightarrow Mn^{2+}$

A. 5F

B. 3F

C. 1 F

D. 7 F

Answer: A

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8. A current strength of 3.86 A was passed through molten Calcium oxide for 41minutes and 40 seconds. The mass of Calcium in grams deposited at the cathode is (atomic mass of Ca is 40g / mol and 1F = 96500C).

A. 4

B. 2

C. 8

D. 6

Answer: B

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9. During electrolysis of molten sodium chloride, the time required to produce 0.1mol of chlorine gas using a current of 3A

is

A. 55 minutes

B. 107.2 minutes

C. 220 minutes

D. 330 minutes

Answer: B

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10. The number of electrons delivered at the cathode during electrolysis by a current of 1A in 60 seconds is (charge of electron = 1.6×10^{-19} C)

A. 6.22×10^{23}

B. 6.022×10^{20}

C. 3.75×10^{20}

D. 7.48×10^{23}

Answer: C

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11. Which of the following electrolytic solution has the least specific conductance

A. 2N

B. $0.002N$

C. 0.02N

D. 0.2N

Answer: B

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12. While charging lead storage battery

A. $PbSO_4$ on cathode is reduced to Pb

B. $PbSO_4$on anode is oxidised to PbO_2

C. $PbSO_4$ on anode is reduced to Pb

D. $PbSO_4$ on cathode is oxidised to Pb

Answer: C

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13. Among the following cells

I) Leclanche cell

II) Nickel – Cadmium cell

III) Lead storage battery

IV) Mercury cell

Primary cells are

A. I and IV

B. I and III

C. III and IV

D. II and III

Answer: D

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14. Zinc can be coated on iron to produce galvanized iron but the reverse is not possible. It is because

A. Zinc is lighter than iron

B. Zinc has lower melting point than iron

C. Zinc has lower negative electrode potential than iron

D. Zinc has higher negative electrode potential than iron

Answer: D

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15. Assertion : pure iron when heated in dry air is converted with a layer of rust. Reason : Rust has the composition Fe_3O_3

A. if both assertion and reason are true and reason is the correct explanation of assertion.

B. if both assertion and reason are true but reason is not the correct explanation of assertion.

C. assertion is true but reason is false

D. assertion is true but reason is false

Answer: D

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16. In $H_2 - O_2$fuel cell the reaction occur at cathode is

A. $O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$

B. $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

C. $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

D. $H^+ + e^- \rightarrow 1/2H_2$

Answer: A

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17. The equivalent conductance of $M/36$ solution of a weak monobasic acid is 6mho cm^2 and at infinite dilution is 400 mho cm^2. The dissociation constant of this acid is

A. 1.25×10^{-6}

B. 6.25×10^{-6}

C. 1.25×10^{-4}

D. 6.25×10^{-6}

Answer: B

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18. A conductivity cell has been calibrated with a 0.01M, 1:1 electrolytic solution (specific conductance (K = $1.25 \times 10^{-3} Scm^{-1}$) in the cell and the measured resistance was 800 Ω Wat 25° C. The cell constant is,

A. $10^{-1}cm^{-1}$

B. $10^{1}cm^{-1}$

C. $1cm^{-1}$

D. 5.7×10^{-12}

Answer: C

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19. In the electrochemical cell: $Zn|ZnSO_4(0.01M)||CuSO_4(1.0M)|Cu$ the emf of this Daniel cell is E_1. When the concentration of $ZnSO_4$ is changed to 1.0M and that $CuSO_4$ changed to 0.01M, the emf changes to E_2. From the followings, which one is the relationship between E_1 and E_2?

A. $E_1 < E_2$

B. $E_1 > E_2$

C. $E_2 - 0 \uparrow E_1$

D. $E_1 = E_2$

Answer:

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20. Consider the change in oxidation state of Bromine corresponding to different emf values as shown in the diagram below:

$$BrO_4 \xrightarrow{1.82V} BrO_3 \xrightarrow{1.5V} HBrO \xrightarrow{1.595V} Br_2 \xrightarrow{1.0652V} Br$$

Then the species undergoing disproportional is

A. Br_2

B. BrO_2^-

C. BrO_3^-

D. HBrO

Answer: B

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Evaluation Short Answer

1. The conductivity of a 0.01M solution of a 1 :1 weak electrolyte at 298K is $1.5 \times 10^{-4} Scm^{-1}$.

i) molar conductivity ozf the solution

ii) degree of dissociation and the dissociation constant of the weak electrolyte $\lambda^{\circ}_{\text{cation}} = 248.2 Scm^2 mol^{-1}$

$\lambda^{\circ}_{\text{anion}} = 51.8 Scm^2 mol^{-1}$

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2. Why is AC current used instead of DC in measuring the electrolytic conductance?

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3. 0.1M NaCl solution is placed in two different cells having cell constant 0.5 and 0.25 cm^{-1} respectively. Which of the two will have greater value of specific conductance

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4. A current of 1.608A is passed through 250 mL of 0.5M solution of copper sulphate for 50 minutes. Calculate the strength of Cu^{2+} after electrolysis assuming volume to be constant and the current efficiency is 100%.

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5. Can Fe^{3+} oxidises Bromide to bromine under standard conditions?

Given $E^{\circ}_{Fe^{3+}|Fe^{2+}} = 0.771$

$E^{\circ}_{Br_2|Br^-} = 1.09$ V.

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6. Is it possible to store copper sulphate in an iron vessel for a long time? Given : $E^{\circ}_{Cu^{2+}|Cu} = 0.34V$ and $E^{\circ}_{Fe^{2+}|Fe} = 0.44$V

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7. Two metals M_1 and M_2 have reduction potential values of -V and +yV x respectively. Which will liberate H_2 and H_2SO_4.

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8. Reduction potential of two metals M_1 and M_2 are $E^{\circ}_{M_1^{2+}|M_1} = -2.3V$ and $E^{\circ}_{M_1^{2}|M_2} = 0.2$ V Predict which one is better for coating the surface of iron. Given $E^{\circ}_{Fe^{2+}|Fe} = 0.044V$

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9. Calculate the standard emf of the cell: $Cd\left|Cd^{2+}\right|\left|Cu^{2+}\right|Cu$ and determine the cell reaction. The standard reduction potentials of $Cu^{2+} \mid Cu$ and $Cd^{2+} \mid Cd$ are 0.34V and -0.40 volts respectively. Predict the feasibility of the cell reaction.

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10. In fuel cell H_2 and O_2 react to produce electricity. In the process, H_2 gas is oxidised at the anode and O_2 at cathode. If 44.8 litre of H_2 at 25° C and also pressure reacts in 10 minutes, what is average current produced? If the entire current is used for electro deposition of Cu from Cu^{2+}, how many grams of deposited?

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11. The same amount of electricity was passed through two separate electrolytic cells containing solutions of nickel nitrate and chromium nitrate respectively. If 2.935g of Ni was deposited in the first cell. The amount of Cr deposited in the another cell? Give : molar mass of Nickel and chromium are 58.74 and $52gm^{-1}$ respectively.

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12. 0.1M copper sulphate solution in which copper electrode is dipped at 25 C o . Calculate the electrode potential of copper. [Given : $E^{\circ}_{Cu^{2+}|Cu} = 0.34$]

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13. For the cell Mg (s) $\left|Mg^{2+}(aq)\right|\left|Ag^{+}(aq)\right|Ag(s)$, calculate the equilibrium constant at 25° C and maximum work that work that can be obtained during operation of cell .Given : $E^{\circ}_{Mg^{2+}|Mg} = -273V$ and $E^{\circ}_{Ag^{2+}|Ag} = 0.80$ V

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14. 8.2×10^{12} litres of water is available in a lake. A power reactor using the electrolysis of water in the lake produces electricity at

the rate of $2 \times 10^6 Cs^{-1}$ at an appropriate voltage. How many years would it like to completely electrolyse the water in the lake. Assume that there is no loss of water except due to electrolysis.

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