PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 26

Total Marks : 46

Max. Time : 46 min.

Topic : Electro Chemistry

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.12	(3 marks, 3 min.)	[36, 36]
Multiple choice objective ('–1' negative marking) Q.13	(4 marks, 4 min.)	[4, 4]
Comprehension ('–1' negative marking) Q.14 to Q.15	(3 marks, 3 min.)	[6, 6]

1. In Galvanic cell :
(A) Chemical reaction produces electrical energy
(B) Electrical energy produces chemical reaction
(C) Reduction occurs at anode
(D) Oxidation occurs at cathode

2. The standard oxidation potentials, E°, for the half-reaction are as
$Zn = Zn^{2+} + 2e^-$; $E° = + 0.76$ V
$Fe = Fe^{2+} + 2e^-$; $E° = + 0.41$ V the $E°_{cell}$ is :

$Fe^{+2} + Zn \rightleftharpoons Zn^{2+} + Fe$ is :

(A) –0.35 V (B) + 0.35 V (C) +1.17 V (D) – 1.17 V

3. From the following E° values of half cells -

(i) $A + e^- \rightarrow A^-$; E° = – 0.24 V (ii) $B^- + e^- \rightarrow B^{2-}$; E° = + 1.25 V

(iii) $C^- + 2e^- \rightarrow C^{3-}$; E° = –1.25 V (iv) $D + 2e^- \rightarrow D^{2-}$; E° = + 0.68 V

What combination of two half cells would result in a cell with the largest potential

(A) (ii) and (iii) (B) (ii) and (iv) (C) (i) and (iii) (D) (i) and (iv)

4. The Ni/Ni^{2+} and F^-/F_2 electrode potentials are listed as +0.25 V and –2.87 V respectively (with respect to the standard hydrogen electrode). The cell potential when these are coupled under standard conditions is
(A) 2.62 V and dependent on the reference electrode chosen.
(B) 3.12 V and independent of the reference electrode chosen.
(C) 3.12 V and dependent on the reference electrode chosen.
(D) 2.62 V and independent of the reference electrode chosen.

5. E° for some half cell reactions are given below
$Sn^{+4} + 2e^- \longrightarrow Sn^{2+}$; E° = 0.151 V
$2Hg^{2+} + 2e \longrightarrow Hg_2^{+2}$; E° = 0.92 V
$PbO_2 + 4H^+ + 2e^- \longrightarrow Pb^{2+} + 2H_2O$; E° = 1.45 V
based on the given data which statement is correct.
(A) Sn^{4+} is a stronger oxidising agent than Pb^{+4}
(B) Sn^{2+} is a stronger reducing agent than Hg_2^{2+}
(C) Hg^{2+} is a stronger oxidising agent than Pb^{4+}
(D) Pb^{+2} is a stronger reducing agent than Sn^{2+}

6. For the cell prepared from electrode A and B, electrode A : $\frac{Cr_2O_7^{2-}}{Cr^{3+}}$, E^0_{red} = +1.33 V and electrode B : $\frac{Fe^{3+}}{Fe^{2+}}$, E^0_{red} = 0.77 V, which of the following statement is **not correct?**

(A) The electrons will flow from B to A (in the outer circuit) when connections are made.
(B) The standard emf of the cell will be 0.56 V.
(C) A will be positive electrode.
(D) None of the above.

7. The standard reduction potentials at 25°C for the following half reactions are given against each -

$Zn^{2+}(aq) + 2e^- \rightleftharpoons Zn(s)$, –0.762 V
$Cr^{3+}(aq) + 3e^- \rightleftharpoons Cr(s)$, –0.740 V
$2H^+ + 2e^- \rightleftharpoons H_2(g)$, 0.00 V
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$, 0.77 V

Which is the strongest reducing agent -
(A) Zn (B) Cr (C) $H_2(g)$ (D) $Fe^{3+}(aq)$

8. Hydrogen gas will not reduce -
(A) heated cupric oxide (B) heated feric oxide
(C) heated stannic oxide (D) heated aluminium oxide

[$E^\circ_{Sn^{+4}/Sn^{+2}} = 0.15V$; $E^\circ_{Cu^{+2}/Cu^{+}} = +0.167V$; $E^\circ_{Fe^{+3}/Fe^{+2}} = +0.771V$; $E^\circ_{Al^{+3}/Al} = -1.67V$]

9. Four colourless salt solutions are placed in separate test tubes and a strip of copper is dipped in each. Which solution finally turns blue ? (use data from electrochemical series)
(A) $Pb(NO_3)_2$ (B) $AgNO_3$ (C) $Zn(NO_3)_2$ (D) $Cd(NO_3)_2$

10. Red hot carbon will remove oxygen from the oxide XO and YO but not from ZO. Y will remove oxygen from XO. Use this evidence to deduce the order of activity of the three metals X, Y, and Z putting the most active first :
(A) XYZ (B) ZYX (C) YXZ (D) ZXY

11. Which statement about standard reduction potentials is correct
(A) $E^\circ_{H^+/H_2}$ = Zero at all temperature
(B) $E^\circ_{D^+/D_2}$ = zero at 298 K
(C) A redox reaction is feasible if sum of SRP of oxidant and that of reductant is a positive quantity
(D) $K_2Cr_2O_7$ (acid) is stronger oxidising agent than $KMnO_4$ (acid)

[Given : $E^\circ_{MnO_4^-/Mn^{2+}}$ = 1.51 V ; $E^\circ_{Cr_2O_7^{2-}/Cr^{3+}}$ = 1.33 V]

12. The temperature defining the standard electrode potential is
(A) 298 K (B) 273 K (C) 373 K
(D) any temperature can be selected but it must remain constant and species must be in their standard states.

13. The standard reduction potentials of some half cell reactions are given below :

$PbO_2 + 4H^+ + 2e^- \rightleftharpoons Pb^{2+} + 2H_2O$ E^0 = 1.455 V
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$ E^0 = 1.51 V
$Ce^{4+} + e^- \rightleftharpoons Ce^{3+}$ E^0 = 1.61 V
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$ E^0 = 1.71 V

Pick out the correct statement :
(A) Ce^{+4} will oxidise Pb^{2+} to PbO_2 (B) MnO_4^- will oxidise Pb^{2+} to PbO_2
(C) H_2O_2 will oxidise Mn^{+2} to MnO_4^- (D) PbO_2 will oxidise Mn^{+2} to MnO_4^-

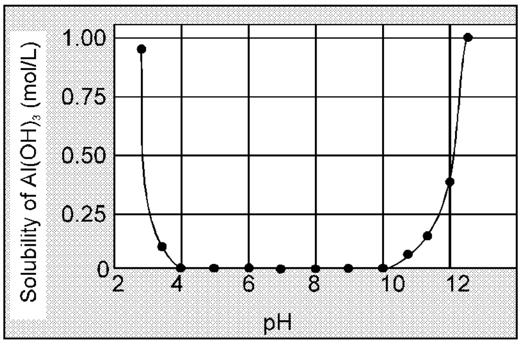
Comprehension # (Q.14 to Q.15)

Amphoteric oxides, such as aluminium oxide, are soluble both in strongly acidic and in strongly basic solutions :

In acid : $A\ell_2O_3(s) + 6H_3O^+ (aq) \rightleftharpoons 2A\ell^{3+} (aq) + 9\ H_2O\ (\ell)$

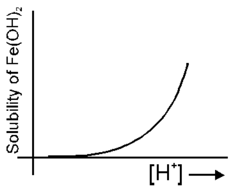
In base : $A\ell(OH)_3(s) + OH^- (aq) \rightleftharpoons A\ell(OH)_4^- (aq)$

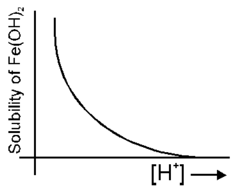
Dissolution of $Al(OH)_3$ in excess base is just a special case of the effect of complex-ion formation on solubility. $Al(OH)_3$ dissolves because excess OH^- ions convert it to the soluble complex ion $Al(OH)_4^-$ (aluminate ion). The effect of pH on the solubility of $A\ell(OH)_3$ is shown in figure.

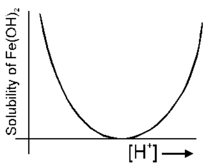


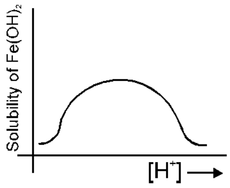
Other examples of amphoteric hydroxides include $Zn(OH)_2$, $Cr(OH)_3$, $Sn(OH)_2$ and $Pb(OH)_2$, which react with excess OH^- ions to form the soluble complex ions $Zn(OH)_4^{2-}$ (zincate ion), $Cr(OH)_4^-$ (chromite ion), $Sn(OH)_3^-$ (stannite ion), and $Pb(OH)_3^-$ (plumbite ion), respectively. By contrast, basic hydroxides, such as $Mn(OH)_2$, $Fe(OH)_2$, and $Fe(OH)_3$, dissolve in strong acid but not in strong base.

14. Which of the following curves best represents the variation of solubility of ferrous hydroxide $Fe(OH)_2$ with the concentration of $[H^+]$ ions in the solution :

(A) 

(B) 

(C) 

(D) 

15. At what maximum pH will 5.0×10^{-3} mol of $Al(OH)_3$ go into 1L solution as Al^{3+}?

Given $K_{sp}\ [Al(OH)_3] = 5.0 \times 10^{-33}$ and for $[Al(OH)_4^-] \rightleftharpoons Al^{3+} + 4OH^-$, $K_{eq} = 1.0 \times 10^{-34}$.

(A) 3.3 (B) 5 (C) 4 (D) 3

Answer Key

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1.	(A)	**2.**	(B)	**3.**	(A)	**4.**	(B)	**5.**	(B)
6.	(D)	**7.**	(A)	**8.**	(D)	**9.**	(B)	**10.**	(B)
11.	(A)	**12.**	(D)	**13.**	(ABC)	**14.**	(A)	**15.**	(C)

Hints & Solutions

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1. Galvanic cells are electro chemical cells which convert chemical energy into electrical energy.

2. $E^o_{cell} = [E^o_A - E^o_C]_{OP} = 0.76 - 0.41 = 0.35$ V.

3. $E^o_{cell} = [E^o_C - E^o_A]_{RP} = 1.25 + 1.25 = 2.50$ V.
$E^o_{cell} = [E^o_C - E^o_A]_{RP} = 1.25 - (-1.25) = 2.50$ V (Maximum value)

4. Electrode potential values depend on reference electrode chosen but not cell potential.

5. $Sn^{2+} \longrightarrow Sn^{+4} + 2e^-$ $\quad E^\circ = -0.15$ V
$Hg_2^{2+} \longrightarrow 2Hg^{2+} + 2e^-$ $\quad E^\circ = -0.92$ V
Sn^{2+}, Hg_2^{2+}

6. $E^o(Cr_2O_7^{2-} \rightarrow Cr^{3+}) = 1.33$V (A)
$E^o (Fe^{3+} \rightarrow Fe^{2+}) = 0.77$V (B)
When these two electrodes are connected, then the electrode with higher reduction potential act as cathode.
So (A) is cathode (B) is anode.
e^- flow from anode to cathode in external circuit.
$E^o_{cell} = 1.33 - 0.77 = 0.56$V
cathode (A) is a +ve electrode in electro chemicall cell.

7. Higher oxidation potential, higher reducing tendency.

8. $E^o_{H^+/H_2} = 0$ V.
Hydrogen gas will reduce those metals which have reduction potential greater than H_2 gas.

9. Cu will reduce to those metal which have higher reduction potential than Cu.
So, Ag^+ has higher potential.

10. As carbon can reduce XO and YO but not ZO, SRP of X and Y are more than carbon. Y can reduce XO,which means SRP of X is more than Y. Hence the order of SRP is
SRP of X > SRP of Y > SRP of C > SRP of Z.
More active metal has lesser SRP.
So the order of activity of metals is Z > Y > X **Ans.**

11. (A) It is a convention that SRP of standard hydrogen electrode is zero at all tempertures.
(B) is incorrect.
(C) the difference should be +ve quantity.
(D) $KMnO_4$ is stronger oxidising agent (SRP values).

12. Any temperature can be selected.

13. From given SRP values.

14. On increasing concentration of $[H^+]$ ions the solubility of basic hydroxide $Fe(OH)_2$, will increase.