metodo de la variacion del nº de oxidacion.

1º.- los iones elementales el nº de oxidacion es el nº de la carga que tenga el ion. ejemplo Sn^{+4}

2.- el nº oxid. de un elemento libre, cero ejemplo, S, O_2, Cl_2 C

3.- el H en los compuestos y en los iones tiene el nº de oxid. +1 excepto los hidruros metalicos que actuan con -1 ejemplo CaH_2

4.- el oxigeno sus compuestos o iones tiene nº oxid. -2, excepto: el F_2O, el nº de oxidacion de O es +2, y los peroxidos, tales como el H_2O_2 y el Na_2O_2 en los cuales el nº de oxidacion es -1.

5. ejemplo

$H_3\overset{+5}{As}O_4$

Ajuste: disolucion acida.

1º buscar agente oxidante o agente reductor

1'5º añadir tantos moles a el agente reductor

2º añadir H^+ o OH^- depende de la disolución

3º ajusta el hidrogeno con tanta agua que sea necesario.

$$8H^+ + 5Fe^{+2} + MnO_4^- \rightarrow 5Fe^{+3} + Mn^{+2} + 4H_2O$$

(+9 → +17)

a — aumenta 1 — disminuye 5

$$8H^+ + 5Fe^{+2} + MnO_4^- \rightarrow 5Fe^{+3} + Mn^{+2} + 4H_2O$$

(+9 → +17)

aumenta 1 — disminuye 5.

$Fe^{+2} + MnO_4^- \rightleftharpoons Fe^{+3} + Mn^{+2}$

ecuacion oxidacion

$Fe^{+2} \rightleftharpoons Fe^{+3} + e^-$

ecuacion reducción

$MnO_4^- \rightleftharpoons Mn^{+2}$

$MnO_4^- \rightleftharpoons Mn^{+2} + 4H_2O$

$5e^- + 8H^+ + MnO_4^- \rightleftharpoons Mn^{+2} + 4H_2O$

$5Fe^{+2} \rightarrow 5Fe^{+3} + 5e^-$

$5Fe^{+2} + 8H^+ + MnO_4^- \rightleftharpoons Mn^{+2} + 4H_2O + 5Fe^{+3}$

$4H^+ + FeS + 3NO_3^- \rightleftharpoons 3NO + SO_4^{-2} + Fe^{+3} + 2H_2O$ disolucion acida.

disminuye 3

aumentada 8 aumenta 1

aumento 9

AS_2^{-3}

$AS_2S_3 + 3NO_3^-$

$28\ As_2S_3 + 3NO_3^- \rightleftharpoons 3NO + 3SO_4^{2-} + 5H_3AsO_4$ disolucion acida.

disminuye 3

aumenta 24 aumentado 4

28

$4 + 84 = 88$

$28 + 36 + 24\ 18^-$

$4H_2O + 10H^+ + 3As_2S_3 + 28NO_3^- \rightleftharpoons 28NO + 9SO_4^{-2} + 6H_3AsO_4 + 5H_2O$

17.25. $6H_2O + 5Sn^{+2}(OH)_4^{-2} + 2Mn^{+7}O_4^- \rightleftharpoons 2Mn^{+2}O_2 + 5Sn^{+4}(OH)_6^{-2} + 2OH^-$

$a = 5$

$a : 2$

$20 = 30 + 2$

$6 + 20 + 8 = 4 + 30 + 2$

$34 = 36$

17.25. $Sn(OH)_4^{-2} + MnO_4^- \rightleftharpoons MnO_2 + Sn(OH)_6^{-2}$

$2H_2O + Sn(OH)_4^{-2} \rightleftharpoons Sn(OH)_6^{-2} + 2H^+$

$2H^+ + 2OH^- \rightleftharpoons 2H_2O$

$Sn(OH)_4^{-2} + 2OH^- \rightleftharpoons Sn(OH)_6^{-2} + e^-$

$4H^+ + MnO_4^- \rightleftharpoons MnO_2 + 2H_2O$

$4H_2O \rightleftharpoons 4H^+ + 4OH^-$

$MnO_4^- + 2H_2O \rightleftharpoons MnO_2 + 4OH^-$

$3e^- + 4H^+$

$Sn(OH)_4^{-2} + MnO_4^- + 2H_2O + 2OH^- \rightleftharpoons Sn(OH)_6^{-2} + MnO_2 + 4OH^-$

17.26. $4OH^- + 2HS_2O_4^- + 3AsO_4^{3-} \rightleftharpoons 3AsO_2^- + 6SO_4^{-2} + 3H_2O$

$a = 2$

$a = 3$

33

$4H_2O + HS_2O_4^- \rightleftharpoons 2SO_4^{-2} + 9H^+$

$9H^+ + 9OH^- \rightleftharpoons 9H_2O$

$4H^+ + AsO_4 \rightleftharpoons AsO_2^- + 2H_2O$

$4H_2O \rightleftharpoons 4H^+ + 4OH^-$

$HS_2O_4^- + 9OH^- \rightleftharpoons 2SO_4^{-2} + 5H_2O + 6e^-$

$5e^- + AsO_4 + 2H_2O \rightleftharpoons AsO_2^- + 4OH^-$

$5HS_2O_4^- + 45OH^- + 6AsO_4 + 12H_2O \rightleftharpoons 10SO_4^{-2} + 25H_2O + 6AsO_2^- + 24OH^-$

$5HS_2O_4^- + 21OH^- + 6AsO_4 \rightleftharpoons 10SO_4^{-2} + 13H_2O + 6AsO_2^-$

17.20. $2H_2O + \overset{+2}{Fe}(OH)_2^{-2} + O_2^{0} \rightleftharpoons 2\overset{+3}{Fe}(OH)_3^{-3}$

d = 2

a: 1

17.19. $4OH^- + 2H\overset{+4}{P}O_3^{-} + BrO^- \rightleftharpoons Br^- + 2\overset{+5}{P}O_4^{-3} + 3H_2O$

d: 2

a = 1

$H_2O + Fe(OH)_2 \rightleftharpoons Fe(OH)_3 + H^+$ e^- e^- $H^+ + H_2O + O_2 \rightleftharpoons Fe(OH)_3$

$H_2O + Fe(OH)_2 + H_2O + O_2 \rightleftharpoons Fe(OH)_3 + Fe(OH)_3$

$Fe(OH)_2 + 2H_2O + O_2 \rightleftharpoons 2Fe(OH)_3$

17.21. $\overset{+2}{Ni}(OH)_2^{-2} + \overset{+1}{Br}O^- \rightleftharpoons Br^- + NiO_2^{-2}$

d = 2

0

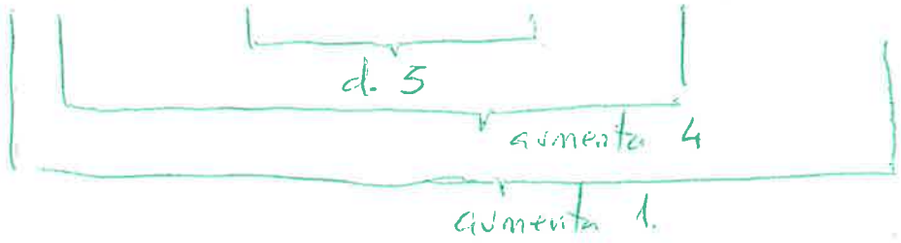
$Ni(OH)_2 \rightleftharpoons NiO_2 + 2H^+ + 2e^-$ $2e^-\ 2H^+\ BrO^- \rightleftharpoons Br^- + H_2O$

$2Ni(OH)_2 + \cancel{4H^+} + 2BrO^- \rightleftharpoons 2NiO_2 + \cancel{4H^+} + 2Br^- + 2H_2O$

$$\boxed{Ni(OH)_2 + BrO^- \rightleftharpoons NiO_2 + Br^- + H_2O}$$

17.10 $2H^+ + Sn^{+2}S_2^{+2}O_3^{-2} + Mn^{+7}O_4^- \rightleftharpoons Mn^{+2} + 2SO_4^{-2} + Sn^{+3} + H_2O$

1 2 −1 −4+3+2 1−1



$5H_2O + SnS_2O_3 \longrightarrow 2SO_4^{-2} + Sn^{+3} + 10H^+ + 9e^-$

$5e^- + 8H^+ + MnO_4^- \longrightarrow Mn^{+2} + 4H_2O$

$25H_2O + 5SnS_2O_3 + 72H^+ + 9MnO_4^- \longrightarrow 10SO_4^{-2} + 5Sn^{+3} + 50H^+ + 9Mn^{+2} + 36H_2O$

(72 − 50 = 22)

$5SnS_2O_3 + 9MnO_4^- + 22H^+ \rightleftharpoons 10SO_4^{-2} + 5Sn^{+3} + 9Mn^{+2} + 11H_2O$

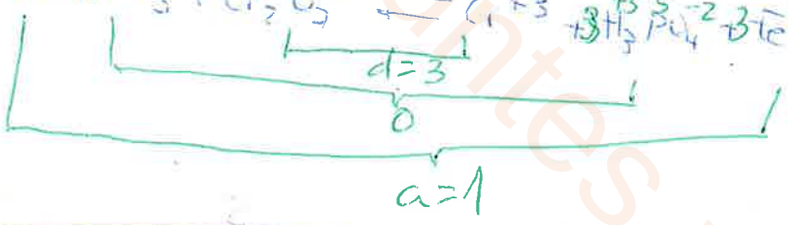
15 + 36

51

17.11 $8H^+ + 3Fe^{+2}H^{+1}P^{+3}O_3^{-2} + Cr_2^{6}O_7^{-2} \rightleftharpoons Cr^{+3} + 3H_3^{+3}P^{+5}O_4^{-2} + 3Fe^{+3} + H_2O$

12 + 1

6



$8H^+ + 3FeHPO_3 + Cr_2O_7^{-2} \rightleftharpoons Cr^{+3} + 3H_3PO_4 + 3Fe^{+3} + H_2O$

17.12.

$Hg_4Fe(CN)_6 + ClO_3^- \rightleftharpoons Cl^- + NO + CO_2 + Fe^{+3} + Hg^{+2}$

$18H_2O + Hg_4Fe(CN)_6 \rightleftharpoons 6NO + 6CO_2 + Fe^{+3} + 4Hg^{+2} + 36H^+ + 47e^- \quad \times 6$

$6e^- + 6H^+ + ClO_3^- \rightleftharpoons Cl^- + 3H_2O \quad \times 47$

66H+

$108H_2O + 6Hg_4Fe(CN)_6 + 282H^+ + 47ClO_3^- \rightleftharpoons$

$\rightleftharpoons 36NO + 36CO_2 + 6Fe^{+3} + 24Hg^{+2} + 216H^+ + 47Cl^- + 141H_2O$

33 H_2O

$6Hg_4Fe(CN)_6 + 47ClO_3^- + 66H^+ \rightleftharpoons 36NO + 36CO_2 + 6Fe^{+3} + 24Hg^{+2} + 47Cl^- + 33H_2O$

$141 = 33 + 72 + 36 = 141$

(17.2) $H_2S^{-2} + Fe^{+3} \rightleftharpoons Fe^{+2} + S$

oxidación e. reducción

$e^- + Fe^{+3} \longrightarrow Fe^{+2}$

$H_2S \longrightarrow S$

$H_2S \longrightarrow S + 2H^+ + 2e^-$

$2Fe^{+3} + H_2S \longrightarrow 2Fe^{+2} + S + 2H^+$

17.3

$H_2O + H_2SO_3 \rightleftharpoons SO_4^{2-} + 4H^+ + 2e^- \quad e^- + H^+ + HNO_2 \rightleftharpoons NO + H_2O$

$H_2O + H_2SO_3 \rightleftharpoons SO_4^- + 4H^+$

$2H^+ + 2HNO_2 \rightleftharpoons 2NO + 2H_2O$

$\cancel{H_2O} + H_2SO_3 + 2H^+ + 2HNO_2 \rightleftharpoons SO_4^- + \cancel{4H^+}\,2H^+ + 2NO + \cancel{2H_2O}\,H_2O$

$H_2SO_3 + 2HNO_2 \rightleftharpoons SO_4^- + 2NO + H_2O + 2H^+$

−12 −6

(17.9) $Sb_2S_3 + NO_3^- \rightleftharpoons NO_2 + SO_4^{-2} + O_5Sb_2$

17.27. $PH_3 + CrO_4^{-2} \rightleftharpoons Cr(OH)_4^- + P$

$PH_3 \rightleftharpoons P + 3H^+$ $\quad 4H^+ CrO_4^{-2} \rightleftharpoons Cr(OH)_4^-$

$3H^+ + 3OH^- \rightleftharpoons 3H_2O$ $\quad 4H_2O \rightleftharpoons 4H^+ + 4OH^-$

$3e^- + CrO_4^{-2} + 4H_2O \rightleftharpoons Cr(OH)_4^- + 4OH^-$

$PH_3 + 3OH^- \rightleftharpoons P + 3H_2O + 3e^-$

$$PH_3 + CrO_4^{-2} + 4H_2O + 3OH^- \rightleftharpoons P + Cr(OH)_4^- + 3H_2O + 4OH^-$$

17.28. $H_2PO_2^- + CNO^- \rightleftharpoons CN^- + HPO_3^-$

$H_2O + H_2PO_2^- \rightleftharpoons HPO_3^- + 3H^+$ $\quad 2H^+ + CNO^- \rightleftharpoons CN^- + H_2O$

$3H^+ + 3OH^- \rightleftharpoons 2H_2O$ $\quad 2H_2O \rightleftharpoons 2H^+ + 2OH^-$

$H_2PO_2^- + 3OH^- \rightleftharpoons HPO_3^- + 2H_2O + 3e^-$ $\quad 2e^- + CNO^- + H_2O \rightleftharpoons CN^- + 2OH^-$

$2H_2PO_2^- + 3CNO^- + 6OH^- + 3H_2O \rightleftharpoons 2HPO_3^- + 3CN^- + 6OH^- + 4H_2O$

$$2H_2PO_2^- + 3CNO^- \rightleftharpoons 2HPO_3^- + 3CN^- + H_2O$$

17.29. $ClO^- \rightleftharpoons Cl^- + ClO_3^-$

$2H^+ + ClO^- \rightleftharpoons Cl^- + H_2O$ $\quad 2H_2O + ClO^- \rightleftharpoons ClO_3^- + 4H^+$

$2H_2O \rightleftharpoons 2H^+ + 2OH^-$ $\quad 4H^+ + 4OH^- \rightleftharpoons 4H_2O$

$2e^- + ClO^- + H_2O \rightleftharpoons Cl^- + 2OH^-$ $\quad ClO^- + 4OH^- \rightleftharpoons ClO_3^- + 2H_2O + 4e^-$

$4ClO^- + 2ClO^- + 4H_2O + 8OH^- \rightleftharpoons 2ClO_3^- + 4Cl^- + 8OH^- + 4H_2O$

$$4ClO^- + 2ClO^- \rightleftharpoons 2ClO_3^- + 4Cl^-$$

17.31. $V \rightleftharpoons H_2 + HV_6O_{17}^{3-}$

$2H^+ + V \rightleftharpoons H_2$

$2H_2O \rightleftharpoons 2H^+ + 2OH^-$

$2e^- + V + 2H_2O \rightleftharpoons H_2 + 2OH^-$

$17H_2O + 6V \rightleftharpoons HV_6O_{17}^{-3} + 33H^+$

$33H^+ + 33OH^- \rightleftharpoons 16H_2O$

$6V + 33OH^- \rightleftharpoons HV_6O_{17}^{-3} + 16H_2O + 30e^-$

$30V + 28H_2O + 12V + 60OH^- \rightleftharpoons 30H_2 + 60OH^- + 2HV_6O_{17}^{-3} + 32H_2O$

$$42V + 6OH^- + 28H_2O \rightleftharpoons 30H_2 + 2HV_6O_{17}^{-3}$$

$Cu_2S + SO_4^{2-} \rightleftharpoons Cu^{2+} + H_2SO_3$

ecuación oxidación

$Cu_2S \longrightarrow 2Cu^{+2} + H_2SO_3$

$3H_2O + Cu_2S \longrightarrow 2Cu^{+2} + H_2SO_3$

$3H_2O + Cu_2S \longrightarrow 2Cu^{+2} + H_2SO_3 + 4H^+$

$3H_2O + Cu_2S \longrightarrow 2Cu^{+2} + H_2SO_3 + 4H^+ + 8e^-$

$6H_2O + 2Cu_2S \longrightarrow 4Cu^{+2} + 2H_2SO_3 + 8H^+ + 16e^-$

ecuación reducción

$SO_4^{-2} \longrightarrow H_2SO_3$

$SO_4^{-2} \longrightarrow H_2SO_3 + H_2O$

$4H^+ + SO_4^{-2} \longrightarrow H_2SO_3 + H_2O$

$2e^- + 4H^+ + SO_4^{-2} \longrightarrow H_2SO_3 + H_2O$

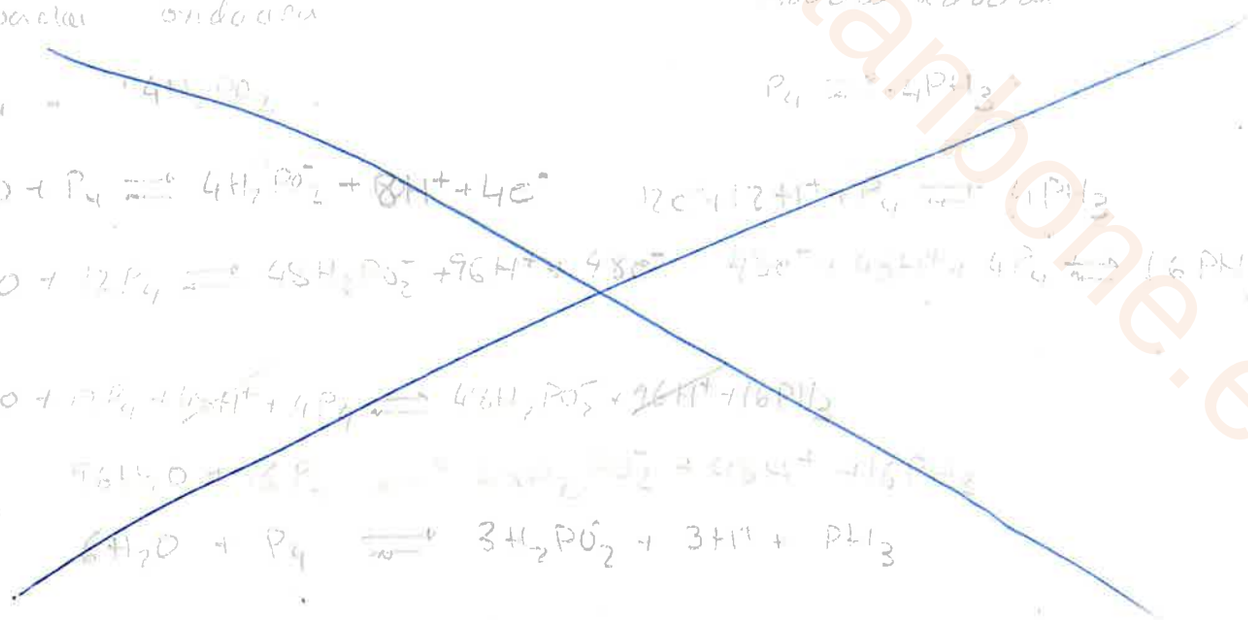
$16e^- + 32H^+ + 8SO_4^{-2} \longrightarrow 8H_2SO_3 + 8H_2O$

$2Cu_2S + 6H_2O + 32H^+ + 8SO_4^- \rightleftharpoons 4Cu^{+2} + 2H_2SO_3 + 8H^+ + 8H_2SO_3 + 8H_2O$

$2Cu_2S + 8SO_4^- + 24H^+ \rightleftharpoons 4Cu^{+2} + 10H_2SO_3 + 2H_2O$

$$\boxed{Cu_2S + 4SO_4^- + 12H^+ \rightleftharpoons 2Cu^{2+} + 5H_2SO_3 + H_2O}$$

$P_4 \rightleftharpoons H_2PO_2^- + PH_3$



disolución básica

$$P_4 \rightleftharpoons 4H_2PO_2^-$$

$$8H_2O + P_4 \rightleftharpoons 4H_2PO_2^-$$

$$8H_2O + P_4 \rightleftharpoons 4H_2PO_2^- + 8H^+$$

$$8H^+ + 8OH^- \rightleftharpoons 8H_2O$$

$$P_4 + \cancel{8H^+} + 8OH^- \rightleftharpoons 4H_2PO_2^- + \cancel{8H^+}$$

$$P_4 + 8OH^- \rightleftharpoons 4H_2PO_2^- + 4e^-$$

$$P_4 \rightleftharpoons 4PH_3$$

$$12H^+ + P_4 \rightleftharpoons 4PH_3$$

$$12H_2O \rightleftharpoons 16H^+ + 12OH^-$$

$$12e^- + P_4 + 12H_2O \rightleftharpoons 4PH_3 + 12OH^-$$

$$12P_4 + 96OH^- \rightleftharpoons 48H_2PO_2^- \qquad 4P_4 + 48H_2O \rightleftharpoons 16PH_3 + 48OH^-$$

$$12P_4 + 96OH^- + 4P_4 + 48H_2O \rightleftharpoons 48H_2PO_2^- + 16PH_3 + 48OH^-$$

$$16P_4 + \cancel{96}OH^- + 48H_2O \rightleftharpoons 48H_2PO_2^- + 16PH_3 + \cancel{48OH^-}$$

$$16P_4 + 48OH^- + 48H_2O \rightleftharpoons 48H_2PO_2^- + 16PH_3$$

$$\boxed{P_4 + 3OH^- + 3H_2O \rightleftharpoons 3H_2PO_2^- + PH_3}$$

disolucion basica.

$$\cancel{HPO_3^- \rightleftharpoons PO_4^{-3}}$$

$$HPO_3^- + H_2O_2 \rightleftharpoons PO_4^{-3}$$

$$HPO_3^- \rightleftharpoons PO_4^{-3}$$

$$H_2O + HPO_3^- \rightleftharpoons PO_4^{-3}$$

$$H_2O + HPO_3^- \rightleftharpoons PO_4^{-3} + 3H^+$$

$$3H^+ + 3OH^- \rightleftharpoons 3H_2O$$

$$HPO_3^- + 3OH^- \rightleftharpoons PO_4^{-3} + 2H_2O + e^-$$

$$2HPO_3^- + 6OH^- \rightleftharpoons 2PO_4^{-3} + 4H_2O$$

$$H_2O_2 \rightleftharpoons 2OH^-$$

$$H_2O_2 \rightleftharpoons H_2O$$

$$H_2O_2 \rightleftharpoons 2H_2O$$

$$\cancel{2H^+} + H_2O_2 \rightleftharpoons 2H_2O$$

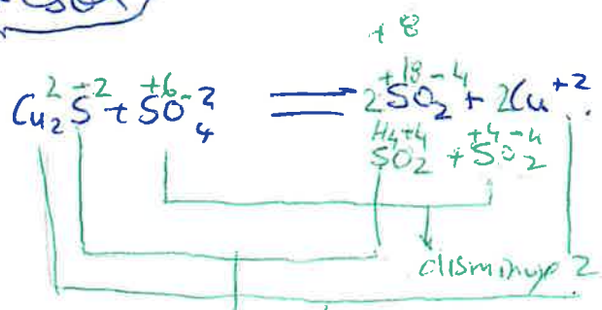
$$2\cancel{H_2O} \rightleftharpoons 2H^+ + 2OH^-$$

$$2e^- + H_2O_2 \rightleftharpoons 2OH^-$$

$$2HPO_3^- + 6\cancel{OH^-} + H_2O_2 \rightleftharpoons 2PO_4^{-3} + 4H_2O + 2\cancel{OH^-}$$

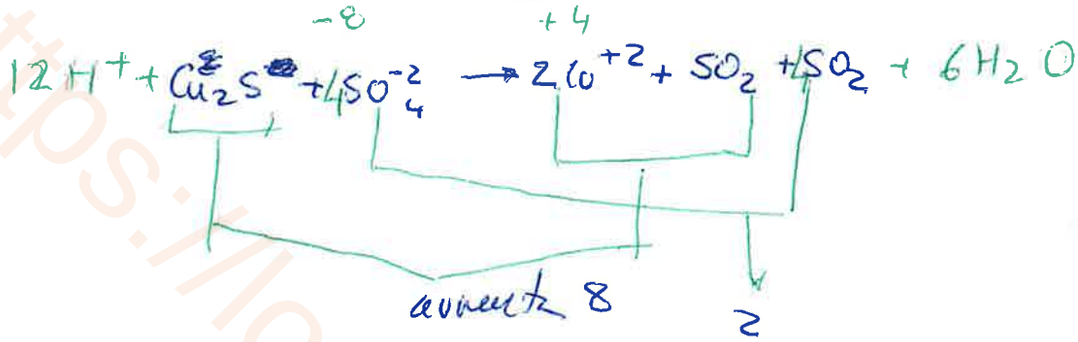
$$\boxed{2HPO_3 + 4OH^- + H_2O_2 \rightleftharpoons 2PO_4^{-3} + 4H_2O}$$

$Cu_2S + SO_4^{-2}$

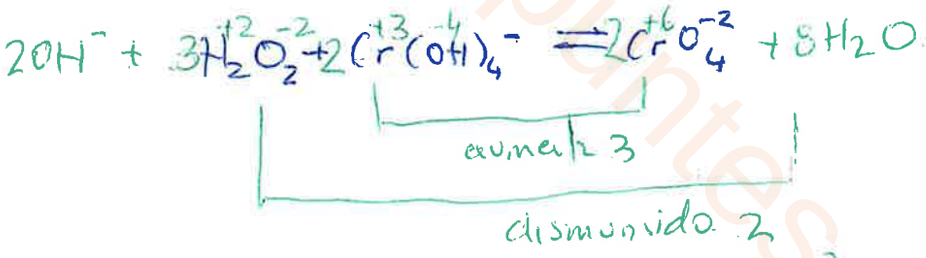


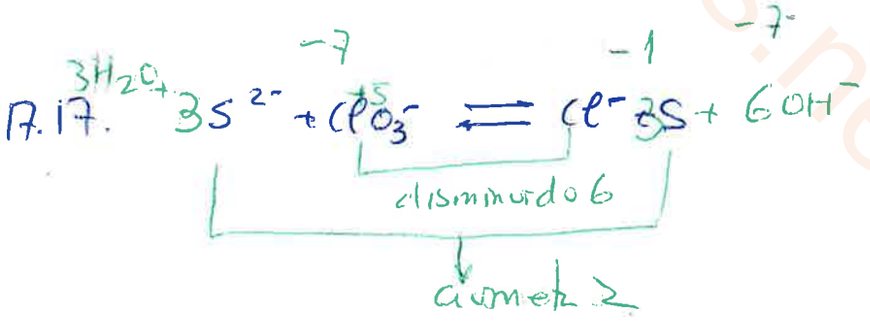
aumenta 8
disminuye 2

16
6 + 8 + 2



disolución básica.





17.13 / 17.13

$Fe_2Fe(CN)_6 + NO_3^- \rightleftharpoons 7NO + 6CO_2 + 3Fe^{+3}$

$18H_2O + Fe_2Fe(CN)_6 + NO_3^- \rightleftharpoons 7NO + 6CO_2 + 3Fe^{+3} + 36H^+$

basica.

17.18.

$CN^- + IO_3^- \rightleftharpoons I^- + CNO^-$

$H_2O + CN^- \rightleftharpoons CNO^- + 2H^+$

$2H^+ + 2OH^- \rightleftharpoons 2H_2O$

$CN^- + 2OH^- \rightleftharpoons CNO^- + H_2O + 2e^-$ (−3, −1)

$6H^+ + IO_3^- \rightleftharpoons I^- + 3H_2O$

$6H_2O \rightleftharpoons 6H^+ + 6OH^-$ (−7)

$6e^- + IO_3^- + 3H_2O \rightleftharpoons I^- + 6OH^-$ (−1) × 6

$IO_3^- + 3H_2O \rightleftharpoons I^- + 6OH^-$ × 2

$6CN^- + 12OH^- + 2IO_3^- + 6H_2O \rightleftharpoons 6CNO^- + 6H_2O + 2I^- + 12OH^-$

$6CN^- + 2IO_3^- \rightarrow 6CNO^- + 2I^-$

$$\boxed{3CN^- + IO_3^- \rightarrow 3CNO^- + I^-}$$

−1, −4, −3

17.19.

$HPO_3^- + BrO^- \rightleftharpoons Br^- + PO_4^{-3}$ (+2, −1, −3)

$H_2O + HPO_3^- \rightleftharpoons PO_4^{-3} + 3H^+$

$3H^+ + 3OH^- \rightleftharpoons 3H_2O$

$HPO_3^- + 3OH^- \rightleftharpoons PO_4^{-3} + 2H_2O + e^-$

$2H^+ + BrO^- \rightleftharpoons Br^- + H_2O$

$2H_2O \rightleftharpoons 2H^+ + 2OH^-$

$2e^- + BrO^- + H_2O \rightleftharpoons Br^- + 2OH^-$

$2HPO_3^- + 6OH^- \,(4OH^-) + BrO^- + H_2O \rightleftharpoons 2PO_4^{-3} + 4H_2O \,(3H_2O) + Br^- + 2OH^-$

$$\boxed{2HPO_3^- + BrO^- + 4OH^- \rightleftharpoons 2PO_4^{-3} + Br^- + 3H_2O}$$

ecuación Redox.

metodo de las semireacciones (oxida + reduce)

pierde electro. gana electrones.

- $H_2SO_3 + MnO_4^- \rightleftharpoons SO_4^= + Mn^{+2}$

ecuación de oxidación

$H_2SO_3 \longrightarrow SO_4^=$

1er paso ajuste oxigeno

$H_2SO_3 + H_2O \longrightarrow SO_4^=$

2do paso ajustar los hidrogeno

$H_2SO_3 + H_2O \longrightarrow SO_4^= + 4H^+$

3er paso ajustar las cargas añadidas electrones

$H_2SO_3 + H_2O \longrightarrow SO_4^= + 4H^+ + 2e^-$

ecuación reducción

$MnO_4^- \longrightarrow Mn^{+2}$

1er paso ajuste oxigeno

$MnO_4^- \longrightarrow Mn^{+2} + 4H_2O$

$8H^+ + MnO_4^- \longrightarrow Mn^{+2} + 4H_2O$

$5e^- + 8H^+ + MnO_4^- \longrightarrow Mn^{+2} + 4H_2O$

$5H_2SO_3 + 5H_2O \longrightarrow 5SO_4^= + 20H^+ + 10e^-$ +

$10e^- + 16H^+ + 2MnO_4^- \longrightarrow 2Mn^+ + 8H_2O$

$5H_2SO_3 + \cancel{5H_2O} + \cancel{16H^+} + 2MnO_4^- \longrightarrow 5SO_4^= + \cancel{20H^+} + 2Mn^+ + \cancel{8H_2O}$

(H_2O sobre la flecha; $4H^+$ sobre la flecha)

$5H_2SO_3 + 2MnO_4^- \longrightarrow 5SO_4^= + 4H^+ + 2Mn^+ + 3H_2O$

ajustar.

$$P_4S_3 + NO_3^- \rightleftharpoons H_3PO_4 + SO_4^{2-} + NO.$$

ecuación oxidación

$$P_4S_3 \longrightarrow 4H_3PO_4 + 3SO_4^{-2}$$

1er paso ajustar oxigeno

$$28H_2O + P_4S_3 \longrightarrow 4H_3PO_4 + 3SO_4^{-2}$$

2do paso ajustar Hidrogeno

$$28H_2O + P_4S_3 \longrightarrow 4H_3PO_4 + 3SO_4^{-2} + 44H^+$$

ecuación reducción

$$NO_3^- \longrightarrow NO$$

$$NO_3^- \longrightarrow NO + 2H_2O$$

$$4H^+ + NO_3^- \longrightarrow NO + 2H_2O$$

ajustar cargas

$$28H_2O + P_4S_3 \longrightarrow 4H_3PO_4 + 3SO_4^{-2} + 44H^+ + 38e^- \qquad 3e^- + 4H^+ + NO_3^- \longrightarrow NO + 2H_2O$$

$$84H_2O + 3P_4S_3 \longrightarrow 12H_3PO_4 + 9SO_4^{-2} + 132H^+ + 114e^-$$

$$114e^- + 152H^+ + 38NO_3^- \longrightarrow 38NO + 76H_2O$$

$$\overset{4H_2O}{\cancel{84H_2O}} + 3P_4S_3 + \overset{20H^+}{152H^+} + 38NO_3^- \longrightarrow 12H_3PO_4 + 9SO_4^{-2} + \cancel{132H^+} + 38NO + \cancel{76H_2O}$$

$$3P_4S_3 + 8H_2O + 20H^+ + 38NO_3^- \longrightarrow 12H_3PO_4 + 9SO_4^{-2} + 38NO$$

16.17. $Cd(OH)_2$ contiene 4 veces mas moles OH^- que de cd.

¿cuantos moles OH^- ~~estan~~ pe ~~=~~ }

p.s = $1'6 \cdot 10^{-14}$.

$Cd^+ = \frac{x}{4}$ $OH^- = x$

$K_{ps} = [Cd^+][OH^-]^2$

$1'6 \cdot 10^{-14} = \left[\frac{x}{4}\right] \cdot [x]^2$

$1'6 \cdot 10^{-14} = \frac{x^3}{4}$ $x = 4 \cdot 10^{-5}$ moles OH^- por litro.

16.21. AgCl. ps. $2'8 \cdot 10^{-10}$ cuantos moles AgCl se disolv en un litro de KCl 0'01F el KCl esta ionizado al 100%.

$KCl \longrightarrow K^+ + Cl^-$

$AgCl \longrightarrow Ag^+ + Cl^-$

0 0'01

$-x$

$K_{sp} = [Ag^+][Cl^-]$

$[Ag^+] = \frac{K_{SP}}{[Cl^-]} = \frac{2'8 \cdot 10^{-10}}{0'01} = 2'8 \cdot 10^{-8}$ moles Ag^+ por litro.

~~6.~~ $BaSO_4$ en agua $1 \cdot 10^{-5}$ M. Hallar su solubilidad en K_2SO_4 0'1 F.

$K_2SO_4 \longrightarrow SO_4^{=} + K^{+2}$

0'1 0'1 0'1

$K_{sp} = [Ba^{+2}][SO_4^{=}]$ $[Ba^{+2}] = \frac{1 \cdot 10^{-5}\ M}{0'1} = 1 \cdot 10^{-4}$ moles Ba^{+2} por litro

C_4H_{10}

C_4H_{10} $CH_3 - CH_3 - CH_3 - CH$

$-C_4H_9$

$CH_3 - CH - CH_3$

16.8. ion Ag^+ debe hallarse presente para iniciar AgCl. $1\cdot10^{-4}$ moles Cl^- por litro. $2'8\cdot10^{-10}$ producto solubil AgCl.

$Kps = [Ag^+][Cl^-]$

$\frac{Kps}{[Cl^-]} = [Ag^+]$ $[Ag^+] = \frac{2'8\cdot10^{-10}}{1\cdot10^{-4}} = 2'8\cdot10^{-6}$ moles Ag^+ por litro.

16.9. $[OH^-]$ en moles por litro es necesario para iniciar la precipitación $Fe(OH)_3$ a partir de una disolución que contiene 2×10^{-6} moles Fe^{+3} por litro el producto de solubi $Fe(OH_3)$ $6\cdot10^{-38}$ m.

$Kps = [Fe^{+3}]\cdot[OH^-]^3$

$[OH^-]^3 = \frac{Kps}{[Fe^{+3}]} = \frac{6\cdot10^{-38}}{2\cdot10^{-6}} = \sqrt[3]{3\cdot10^{-32}} = 3'1\cdot10^{-11}$ moles OH^- por litro.

16.16. Cd^{+2} CdS era 4 veces mayor que la conc. molar. de S^{-2} el prod. Sol. CdS $6\cdot10^{-27}$. Cuanto es la concentración Cd^{+2}?

$CdS \rightleftharpoons Cd^{++} + S^{--}$

0 4 0

$Cd^+ = x$ $S^{-2} = \frac{x}{4}$

$Kps = [Cd^{+2}][S^{-2}]$

$6\cdot10^{-27} = x\cdot\frac{x}{4}$ $6\cdot10^{-27} = \frac{x^2}{4}$

$x = 1'5\cdot10^{-13}$ moles Cd^+ por litro

16.19. ¿Solubilidad? $AgSCN$ 1×10^{-12}

a) $AgSCN \rightleftharpoons SCN^- + Ag^+$

$K_{ps} = [SCN^-][Ag^+]$

$1 \cdot 10^{-12} = x \cdot x$

$x^2 = 1 \cdot 10^{-12}$ $\quad x = 1 \cdot 10^{-6}$ moles Ag^+ y SCN^- por litro.

c) $Mg(OH)_2$ $8'9 \cdot 10^{-12}$ ¿calcular la solubilidad?

$Mg(OH)_2 \rightleftharpoons 2OH^- + Mg^{+2}$

$K_{ps} = [2OH^-]^2 \cdot [Mg]$

$8'9 \cdot 10^{-12} = 4x^2 \cdot x$

$2x = OH^-$

$x = 1'6 \cdot 10^{-4}$ moles Mg por litro.

d) $Al(OH)_3$ $5 \cdot 10^{-33}$

$Al(OH)_3 \rightleftharpoons 3OH^- + Al^{+3}$

$K_{ps} = [3OH]^2 \cdot [Al^{+3}]$

$5 \cdot 10^{-33} = 9x^2 \cdot x$

$5 \cdot 10^{-33} = 9x^3$

$x = 8'2 \cdot 10^{-12}$ moles Al^{+3} por litro.

d) $Al(OH)_3$ 5×10^{-33}

$$Al(OH)_3 \rightleftharpoons Al^{+3} + 3(OH)^-$$

$$K_{ps} = [Al^{+3}] \cdot [OH^-]^3$$

$$5 \times 10^{-33} = (x) \cdot (3x)^3$$

$$5 \times 10^{-33} = 27x^4$$

$x = 3'6 \cdot 10^{-9}$ moles Al^{+3} por litro

16.20. PbI_2 $1 \cdot 10^{-8}$ el $BaSO_4$ $1 \cdot 10^{-8}$

como se relaciona la solubilidad

$$PbI_2 \rightleftharpoons Pb^{+2} + I^-_2 \qquad BaSO_4 \rightleftharpoons SO_4^{=} + Ba^{+2}$$

$$1 \cdot 10^{-8} = [Pb^{+2}] \cdot [I^-]^2 \qquad 1 \cdot 10^{-8} = [SO_4^{=}][Ba^{+2}]$$

$$x \cdot x^2 = y^2$$

$$x^3 = y^2 \qquad y = \sqrt{x^3}$$

$$1 \cdot 10^{-8} = x^3$$

$x = 2'1 \cdot 10^{-3}$ moles de Pb y I^- por litro

$y = 1 \cdot 10^{-4}$ moles $SO_4^{=}$, Ba^+ por litro.

17.6. $2I^- \; 2Fe^{+3} \rightleftharpoons 2Fe^{+2} + I_2$

disminuye 1

aumenta 2

$$2I^- + 2Fe^{+3} \rightleftharpoons 2Fe^{+2} + I_2$$

17.7. $7H^+ + Mn^{+2} + 3HBiO_3^{2} \rightleftharpoons 3Bi^{3+} + MnO_4^{-2} + 5H_2O$

disminuye 2

aumenta 6

17.8. $Mn^{+2} + MnO_4^- \rightleftharpoons MnO_2$

$$2H_2O + Mn^{+2} \rightleftharpoons MnO_2 + 4H^+ + 2e^-$$

$$3e^- + 4H^+ + MnO_4^- \rightleftharpoons MnO_2 + 2H_2O$$

$$6H_2O + 3Mn^{+2} + 8H^+ + 2MnO_4^- \rightleftharpoons 3MnO_2 + 12H^+ + 2MnO_2 + 4H_2O$$

$$3Mn^{+2} + 2MnO_4^- + 2H_2O \rightleftharpoons 3MnO_2 + 2MnO_2 + 4H^+$$

$$3Mn^{+2} + 2MnO_4^- + 2H_2O \rightleftharpoons 5MnO_2 + 4H^+$$

17.9

$$Sb_2S_3 + NO_3^- \rightleftharpoons NO_2 + 3SO_4^{-2} + O_5Sb_2$$

$$17H_2O + Sb_2S_3 \rightleftharpoons 3SO_4^{-2} + O_5Sb_2 + 34H^+ + 28e^-$$

$$e^- + 2H^+ + NO_3^- \rightleftharpoons NO_2 + H_2O$$

$$Sb_2S_3 + 28NO_3^- + 17H_2O + 56H^+ \rightleftharpoons 3SO_4^{-2} + O_5Sb_2 + 28NO_2 + 34H^+ + 28H_2O$$

$$Sb_2S_3 + 28NO_3^- + 22H^+ \rightleftharpoons 3SO_4^{-2} + O_5Sb_2 + 28NO_2 + 11H_2O$$

17.1 $Sn^{+2} + Ce^{4+} \rightleftharpoons Ce^{3+} + Sn^{+4}$

(10-1) 17/ 9 $8H^+$

oxidación

$\bar{e} + Ce^{4+} \rightleftharpoons C^{3+}$

$Sn^{+2} \longrightarrow Sn^{+4} + 2e^-$

$2Ce^{4} \rightleftharpoons 2Ce^{3+}$

$Sn^{+2} \rightleftharpoons Sn^{+4}$

$2Ce^{+4} + Sn^{+2} \rightleftharpoons Sn^{+4} + 2Ce^{3+}$

17.2 $2H^+ + H_2S^{-2} + 2Fe^{+3} \rightleftharpoons 2Fe^{+2} + S. + 2H_2O$

disminuye 1

aumenta 2

17.3 $2H_2\overset{+4}{S}O_3 + H\overset{5}{N}O_2^- \rightleftharpoons NO + 2\overset{6}{S}O_4^{2-} + 4H^+ + H_2O$

disminuye 4

aumenta 2

17.4. $Br^- + MNO_4^- \rightleftharpoons Mn^{+2} + Br_2$

$2Br^- \longrightarrow Br_2 + 2e^-$ $5e^- + 8H^+ + MNO_4^- \rightleftharpoons Mn^{+2} + 4H_2O$

$10Br^- \longrightarrow 5Br_2$ $16H^+ + 2MNO_4^- \rightleftharpoons 2Mn^{+2} + 8H_2O$

$10Br^- + 16H^+ + 2MNO_4^- \rightleftharpoons 5Br_2 + 2Mn^{+2} + 8H_2O$

17.5. $2H^+ + Sn^{+2} + H_2O_2^{-2} \rightleftharpoons Sn^{+4} + 2H_2O$ (oxígeno)

aumenta 2 disminuye 2

$2H^+ + Sn^{+2} + H_2O_2 \rightleftharpoons Sn^{+4} + 2H_2O$

17.34. Cual cant g/l. $KMnO_4$ 0'1 N cuando se usa 0'1 equiv.

$$MnO_4^- + Cl^- \rightleftharpoons Mn^{+2} + Cl_2$$

$$5e^- + 8H^+ + MnO_4^- \rightleftharpoons Mn^{+2} + 4H_2O \qquad 2Cl^- \rightarrow Cl_2 + 2e^-$$

$$2\overset{+7}{Mn}O_4^- + 10Cl^- + 16H^+ \rightleftharpoons 2Mn^{+2} + 8H_2O + 5Cl_2$$

+5

$$P_{eq}\ redox = \frac{\text{peso formula}}{\text{variacion del n° de oxidacion}}$$

$PM = KMnO_4 = 39'1 + 54'9 + 64 = 158\,gr$

$$P_{eq}\ redox = \frac{158}{5} = 31'6$$

~~0'1 N = peso equivalente~~

1 eq → 31'6
0'1 eq → ~~x~~ } 3'16 gr/l.

17.35. gr? $KClO_3$ se necesita para prep 400cc. de $KClO_3$ 0'2 N a fin de utilizarlo en la reacion siguiente.

$$ClO_3^- + H_2SO_3 \rightleftharpoons Cl^- + SO_4^=$$

$$4e^- + 6H^+ + ClO_3^- \rightleftharpoons Cl^- + 3H_2O \qquad H_2O + H_2SO_3 \rightleftharpoons SO_4^= + 4H^+ + 2e^-$$

$$2ClO_3^- + 4H_2SO_3 + \cancel{12H^+} + \cancel{4H_2O} \rightleftharpoons 2Cl^- + 4SO_4^= + \cancel{16H^+} + \cancel{6H_2O}$$

(4H⁺ 2H₂O)

$$2ClO_3^- + 4H_2SO_3 \rightleftharpoons 2Cl^- + 4SO_4^= + 4H^+ + 2H_2O.$$

$39'1 + 35'4 + 48 = 122'5$

$$P_{eq}\ redox = \frac{PM.\ KClO_3}{n°\ oxi} = \frac{122'5}{6} = 20'4\ gr.$$

$$0'2N = \frac{\text{peso equiva}}{0'4}$$

1 eq → 20'4 gr
0'08 → x } 1'632 gr/l.

17.33. Cuant. equ. $KMnO_4$ se necesitaran para reaccionar con 30gr $FeSO_4$?

disolucion acida.

$$Fe^{+2} + MnO_4^- \rightleftharpoons Fe^{+3} + Mn^{+2}$$

$$n^o \text{ eq. } KMnO_4 = n^o \text{ eq. } FeSO_4$$

$$\frac{PM}{\text{mol.} \times n^o \text{ oxid. puesto en juego}} = \frac{PM}{n^o \text{ oxid. puesto en juego} \times \text{mol.}}$$

$$Fe^{+2} \rightleftharpoons Fe^{+3} + e^- \qquad 5e^- + 8H^+ + MnO_4^- \rightleftharpoons Mn^{+2} + 4H_2O$$

$$5Fe^{+2} + MnO_4^- + 8H^+ \rightleftharpoons 5Fe^{+3} + Mn^{+2} + 4H_2O$$

1 mol → 55'84 + 32 + 64 = 151'84 gr $FeSO_4$

30 gr

0'039 moles $FeSO_4$: 5 = 0'039 moles

$$n^o \text{ eq } FeSO_4 = \frac{151'84}{0'039} = 3893.$$

151'84 → poseen en juego 1

30 gr → x

} 0'99 equivalentes $KMnO_4$

$MnO_4^- + AsO_2^- \longrightarrow AsO_3^- + Mn^{+2}$

$5e^- + 8H^+ + \overset{+7}{MnO_4^-} \longrightarrow Mn^{+2} + 4H_2O$

$H_2O + AsO_2^- \longrightarrow AsO_3^- + 2H^+ + 2e^-$

~~$16H^+$~~ $6H^+$ $+ 2MnO_4^- +$ ~~$5H_2O$~~ $+ 5AsO_2^- \longrightarrow 2Mn^{+2} +$ ~~$8H_2O$~~ $3H_2O + 5AsO_2^-$ ~~$+10H^+$~~

$2MnO_4^- + 5AsO_2^- + 6H^+ \longrightarrow 2Mn^{+2} + 5AsO_3^- + 3H_2O$

~~$KMnO_4 + NaAsO_2 \longrightarrow NaAsO_3 + K_2MnO_2$~~

~~$2KMnO_4^-$~~ ~~$\longrightarrow K_2MnO_2$~~

$6H^+ + 2\overset{+7}{Mn}O_4^- + 5\overset{+3}{As}O_2^- \longrightarrow 5\overset{+5}{As}O_3^- + 2Mn^{+2} + 3H_2O$

aumenta 2

disminuye en 5

Molar

$M = eq\ N$

$KAsO_2 = 39 + 74'9 + 32 = 145'9$

$$N = \frac{\frac{g}{PM}}{V} = \frac{}{0'028\ l.}$$

b) $N \cdot V = N' \cdot V'$

$0'1 \cdot 0'056 = N' \cdot 0'028$

$N' = 0'2$

$$0'2 = \frac{\frac{g}{145'9}}{0'028} =$$

$$0'2 = \frac{g}{4'0852}$$

$g = 0'81\ gr.$

[signature]

$a\,KMnO_4 + b\,NaAsO_2 \longrightarrow c\,KAsO_3 + d\,Na_2MnO_2$

1 2 1 1

$a = c \qquad a = 1 \quad c = 1 \quad d = 1 \quad b = 2$

$a = d$

$4a + 2b = 3c + 2d$

$b = 2d$

$b = c$

$KMnO_4 + H_2O + NaAsO_2 \longrightarrow KAsO_3 + Na_2MnO_2$

$6e^- + 6H^+ + KMnO_4 + H_2O \longrightarrow Na_2MnO_2 + 3H_2O$

$NaAsO_2 + H_2O \longrightarrow KAsO_3 + 2H_2^+ + 2e^-$

$6H^+ + KMnO_4 + H_2O + 3NaAsO_2 + 3H_2O \longrightarrow Na_2MnO_2 + 3H_2O + 3KAsO_3 + 6H^+$

$KMnO_4 + H_2O + 3NaAsO_2 \longrightarrow Na_2MnO_2 + 3KAsO_3$

$K\overset{+7}{Mn}O_4^{2}$ $NaAsO_2 \rightarrow$

$KMnO_4 + NaAsO_2 \longrightarrow KAsO_3 + Na_2\overset{+2}{Mn}O_2$

$4e^- + 4H^+ + KMnO_4 \longrightarrow Na_2MnO_2 + 2H_2O$

$H_2O + NaAsO_2 \longrightarrow KAsO_3 + 2H^+ + 2e^-$

$8H^+ + 2KMnO_4 + 4H_2O + 4NaAsO_2 \rightarrow 2Na_2MnO_2 + 4H_2O + 4KAsO_3 + 8H^+$

$2KMnO_4 + 4NaAsO_2 \rightarrow 2Na_2Mn$

$4H^+ + KMnO_4 + 2H_2O + 2NaAsO_2 \rightarrow Na_2MnO_2 + 2H_2O + 2KAsO_3 + 4H^+$

~~$K_2MnO_4 + 2NaAsO_2 \rightarrow Na_2MnO_2 + 2KAsO_3$~~

$K\overset{+5}{Mn}O_3 + NaAsO_2 \longrightarrow KAsO_3 + Na_2\overset{+2}{Mn}O_2$

$2e^- + 2H^+ + KMnO_3 \longrightarrow Na_2\overset{+2}{Mn}O_2 + H_2O$

$H_2O + NaAsO_2 \longrightarrow KAsO_3 + 2H^+ + 2e^-$

$2H^+ + KMnO_3 + H_2O + NaAsO_2 \longrightarrow Na_2MnO_2 + H_2O + KAsO_3 + 2H^+$

$KMnO_3 + NaAsO_2 \longrightarrow Na_2MnO_2 + KAsO_3$

$H_2SO_4 + 2K \rightarrow K_2SO_4 + H_2$

$2H_2SO_4 + 2KOH \rightarrow 2K_2SO_4 + 2H_2O$

$2a + b = 2d \quad a = 1 \quad c = 1$

$a = c$

$4a + b = 4c + d$

$2 + b = 2d \quad d = \frac{2+b}{2}$

$4 + b = 4 + d$

$d = 3/2$

$4 + b = 4 + \frac{2+b}{2}$

$8 + 2b = 8 + 2 + b$

$8 + 2b = 10 + b$

$2b = 2 \quad b = 1$

0856 moles $2K_2SO_4$

$CH_3 - CH = CH - CH_3$

H_2SO_4 40gr de sulfúrico en 100gr $d = 2gr/ml$.

1)

a) $H_2SO_4 = 2+32+64 = 98$

1 mol H_2SO_4 ⟶ 98gr H_2SO_4 } 196gr H_2SO_4
2 mol H_2SO_4 ⟶ x

100gr dsol. ⟶ 40gr } 78'4gr.
196gr H_2SO_4 ⟶ x

2gr ⟶ 1ml. } 39'2ml.
78'4gr ⟶ x

b)

nº equival H_2SO_4 = nº equival $K(OH)$

nº equivalente = $N \cdot V = 2 \cdot 0'028 = 0'056$ moles.

$N_{KOH} = \frac{nº\ equiv}{V} = \frac{0'056}{0'020} = 2'8(N)$

$M = \frac{nº\ moles}{l}$: nº moles = $2 \cdot 0'028 = 0'056$ moles H_2SO_4

1 mol KOH ⟶ 56gr } 3'136
0'056 ⟶ x } 0.056 KOH

$N = \frac{\frac{gr}{PM}}{l} = \frac{\frac{3'136}{56}}{0'2} = 2'8\ N$

C_4 CaC_2 C_2H_2.

$$CaC_2 + C_2H_2 \longrightarrow C_4 + CaH_2$$

1 mol ⟶ 64 gr CaC_2 } 1 mol.
64 gr C.

1 mol C_2H_2 ⟶ 22'4 l } 22'4 l.

~~$CO_2 + CH_4 \longrightarrow CH$~~

$CH_4 + 2O_2 \longrightarrow (CO_2) + 2H_2O$.
448 l.

~~1 mol~~ ⟶ 16 gr CH_4 ⟶ 22'4 l. } 32 gr.
x ⟶ 448 l

1 mol ⟶ 16 gr CH_4 } 2 moles.
x ⟶ 32 gr

1 mol CH_4 ⟶ 1 CO_2 } 2 mol CO_2.
2 mol CH_4 ⟶

1 mol ⟶ 44 gr } 88 gr CO_2
2 mol ⟶

C_2H_6 etano
C_2H_4 etileno.

$$C_2H_6 \longrightarrow C_2H_4 + H_2.$$
1 mol.

273+30

1 mol ⟶ 30 gr C_2H_2

$\frac{1'25 \cdot V_0}{303} = \frac{22'4 \cdot \text{factor}}{273}$ 22'4 l. ⟶ 30 g C_2H_2 } 22'41.
30

$34'125 \cdot V_0 = 6767'2$

V_2
12.42 HCl 0'250 M se ve n. 120cc KOH 0'8 M

~~0'120 dl — 0'8 / 1 litros = x litros~~

Moles de soluto = ~~0'8 · 0'120~~ = 0'096 moles

V diso = ~~0'250~~ 0'096 / 0'250 = ~~0'024~~ = ~~24cc~~ 384cc

12.43 12gr NaOH 82cc H_2SO_4 ~~calcular la~~ molaridad de dicho acido.

23+16+1

1mol → 40 gr

x ← 12gr

0'3 moles

$M = \frac{0'15}{0'082} = 3'66$

2NaOH → 1mo

0'3

$HCl + KOH \rightarrow ClK + H_2O$

$aNaOH + bH_2SO_4 \rightarrow cNa_2SO_4 + dH_2O$

$a = 2c$

$a + 4b = 4c + d$

$a + 2b = 2d$

$b = c$

c = 1

a = 2

b = 1

$2 + 4 = 4 + d$

$d = 2$

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

1

12.44 25cc NaOH se neutraliza exa 40cc. H_2SO_4 0'1M.
calcular la molaridad del NaOH.

$2\,NaOH + 1\,H_2SO_4 \longrightarrow 1\,Na_2SO_4 + 2\,H_2O$.

moles de soluto del $H_2SO_4 = 0'1 \cdot 0'040 = 0'004$ mol

$M = \frac{0'008}{0'025} = 0'32$ | 1 mol H_2SO_4 → 2 NaOH
0'004 → x

12.45. $AgNO_3$ 0'250 M. se necesita para precipitar el Cl correspondiente aportar de 80cc de NaCl 0'4M. ¿ cuantos gramos de cloruro de plata se precipitarán?

$AgNO_3 + NaCl \longrightarrow AgCl + NaNO_3$.

107'8+35'4

moles de soluto NaCl = 0'08·0'4 = 0'032 moles

27'9 + 35'4
107'8+35'4

1 mol → 143'4 gr AgCl
0'032 → x

l. disolución = $\frac{0'032}{0'250} = 0'128$ l. de $AgNO_3$ (128 cc).

128
80

145.

1 mol → 22'4 l.
0'128 l → 0'128 l

5'7·10⁻³ moles
0'0057 moles

1 mol $AgNO_3$ → 1 mol AgCl

143'2
143'3

1 mol NaCl → 1 mol AgCl
0'0057 → 0'0057

1 mol → 22,4 l
x → 0,08

x = 0,0035

gr: 0,0035 · 143'2 =

12.39. 447cc Na_2CO_3 1 5l. gas CO_2 en c.n. Calcular la Molaridad d la disolución Na_2CO_3

$a Na_2CO_3 + b H_2SO_4 \rightarrow Na_2SO_4 + d CO_2 + e H_2O$

1

1 mol ⟶ 22'4
x ⟵ 5l

} 0'223 mols CO_2.

1 mol Na_2CO_3 ⟶ 1 mol CO_2
x ⟵ 0'223 mol CO_2

} 0'223 moles

$M = \frac{0'223}{0'447} = 0'49 = 0'5 M$

leer equilibrio químico.

12.45.

$(1+i)^{\frac{9\pi}{4}+i\log 2}$

$e^{\frac{9\pi}{4}+i\log 2 \cdot \log\{\sqrt{2}(\cos\frac{\pi}{4}+i\,\text{sen}\frac{\pi}{4})\}}$

$e^{(\frac{9\pi}{4}+i\log 2)\cdot \log\sqrt{2}+(\frac{\pi}{4}+2k\pi)i}$

$e^{\frac{9\pi}{4}\log\sqrt{2}-\log 2(\frac{\pi}{4}+2k\pi)} \cdot e^{\{\log 2\log\sqrt{2}+\frac{9\pi}{4}(\frac{\pi}{4}+2k\pi)\}i}$

$\frac{2+i}{e^2}$ $(1-i) \longrightarrow \sqrt{2}\left(\cos\left(\frac{-\pi}{4}\right)+i\,\text{sen}\,\frac{-\pi}{4}\right)$

$\frac{e^{zi}+e^{-zi}}{2}=2 \qquad e^{zi}+e^{-zi}-4=0.$

$\frac{-4\pm\sqrt{16-4}}{2}= \quad 12$

$e^{2zi}+4e^{zi}+1=0$

$-4\pm \qquad 2\pm$

$2\pm\sqrt{4-}$

$\frac{1\pm\sqrt{1-8}}{4} \qquad -4\pm\sqrt{16}$

$(\cos z+i\,\text{sen} z)=e^{zi}$

$\frac{8\pm\sqrt{64-4}}{2} \qquad 4\pm\frac{\sqrt{60}}{2}$

Criterio de Stolz Si es $b_n>0$