Clase 14 15 Enero 2021

$$pH = 0$$

$$Fe^{3+}$$

$$MnO_4^-$$

$$\to \varepsilon(v)$$

$$Fe^{2+}$$

$$0.77$$

$$Mn^{+2}$$

$$1.51$$

$$Kr = 10^{\left(\frac{\varepsilon_{ox} - \varepsilon_{red}}{0.059}\right)n_1}$$

#elect.o

red (nT)

O x		
1	1	1
2	1	2
2	3	6
2	4	4
5	1	5
5	2	10
5	10	10

$$8H_3O^+ + 5\bar{e} + MnO_4^- \rightleftharpoons Mn^{+2} + 12H_2O \Big) 1$$

$$\Big(Fe^{2+} \rightleftharpoons Fe^{3+} + 1e^-\Big) 5$$

$$8H_3O^+ + \cancel{5\bar{e}} + MnO_4^- + 5Fe^{2+} \rightleftharpoons Mn^{+2} + 12H_2O + 5Fe^{3+} + \cancel{5\bar{e}}$$
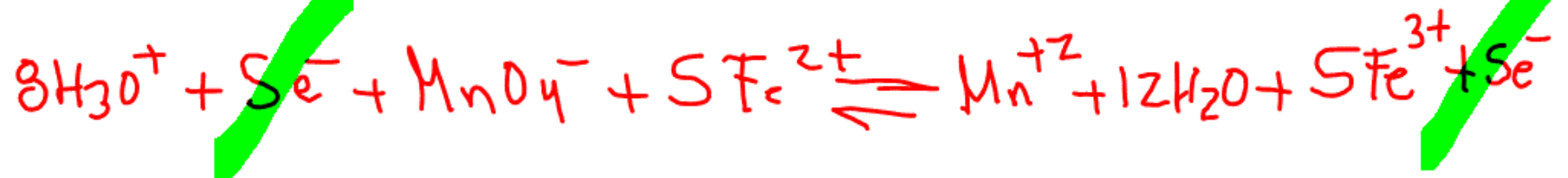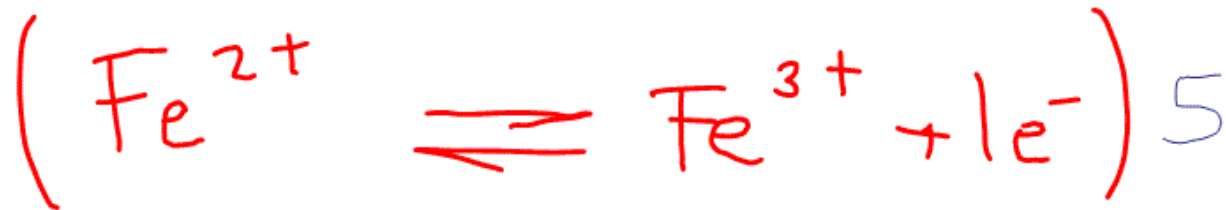
$$PH = 0 \qquad Kr = 10^{\frac{(1.51 - 0.77)5}{0.059}}$$

$$= 10^{62.7}$$

$$pH = 2$$

$$Kr = 10^{\frac{(1.3212 - 0.77)5}{0.059}}$$

$$= 10^{46.71}$$

$$OH = 4$$

$$Kr = 10^{\frac{(1.1324 - 0.77)5}{0.059}}$$

$$= 10^{30.71}$$

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

$$pK_s \; Fe(OH)_3 = 38.6$$

$$pK_s \; Fe(OH)_2 = 15.1$$

pH de inicio de precipitación

Co	=	0.01

$Fe(OH)_3$	⟵	Fe^{+3}	3 OH⁻

pH	=	1.8

Ks=	[Cr]	$[OH]^3$	=	2.51189E-39		
$[OH]^3$	=	$\dfrac{Ks}{[Cr]}$	=	$\dfrac{2.51189E\text{-}39}{0.01}$	=	2.51189E-37

[OH]	=	6.31E-13

$Fe(OH)_2$	⟵	Fe^{+2}	2 OH⁻

pH	=	7.45

Ks=	[Cr]	$[OH]^2$	=	7.94328E-16		
$[OH]^2$	=	$\dfrac{Ks}{[Cr]}$	=	$\dfrac{7.94328E\text{-}16}{0.01}$	=	7.94328E-14

[OH]	=	2.818E-07

$$\varepsilon = \varepsilon^{\circ}{}_{Fe^{3+}/Fe^{2+}} + \frac{0.059}{1} \log \frac{[Fe^{3+}]_{L}^{5}}{[Fe^{2+}]_{L}^{5}}$$

$$5Fe^{2+} + MnO_4^{-} \rightleftharpoons 5Fe^{3+} + Mn^{+2}$$

Inicio C_0

Ag $x\,C_0$

APE $C_0(1-5x) \curvearrowright 0$ $5x\,C_0$ $x\,C_0$

PE $\varepsilon\,C_0$ $\dfrac{\varepsilon\,C_0}{5}$ C_0 $\dfrac{C_0}{5}$

DPE $\curvearrowright 0$ $C_0\left(x-\dfrac{1}{5}\right)$ C_0 $\dfrac{C_0}{5}$

$\alpha Fe^{3+}(OH)$	=	1	+	$\beta_1(OH)$	+	$\beta_2(OH)^2$	+	$\beta_3(OH)^3$
$\alpha Fe^{3+}(OH)$	=	1	+	0.1	+	0.005011872	+	1E-36
$\alpha Fe^{3+}(OH)$	=	1.10501187	LOG =	0.043366944				

$[Fe^{3+}]_L$	=	Co	=	0.01	=	0.009049677
		$\alpha Fe^{3+}(OH)$		1.105011872		

$\alpha Fe^{2+}(OH)$	=	1	+	$\beta_1(OH)$	+	$\beta_2(OH)^2$	+	$\beta_3(OH)^3$
$\alpha Fe^{2+}(OH)$	=	1	+	3.16228E-08	+	1E-24	+	1E-36
$\alpha Fe^{2+}(OH)$	=	1.00000003	LOG =	1.37336E-08				

$[Fe^{2+}]_L$	=	Co	=	0.01	=	0.01
		$\alpha Fe^{2+}(OH)$		1.000000045		

$$PH = 2$$

$\alpha Fe^{3+}(OH)$	=	1	+	$\beta_1(OH)$	+	$\beta_2(OH)^2$	+	$\beta_3(OH)^3$
$\alpha Fe^{3+}(OH)$	=	1	+	0.001	+	5.01187E-07	+	1E-42
$\alpha Fe^{3+}(OH)$	=	1.0010005	LOG =	0.000434295				

$[Fe^{3+}]_L$	=	Co	=	0.01	=	0.009990005
		$\alpha Fe^{3+}(OH)$		1.001000501		

$\alpha Fe^{2+}(OH)$	=	1	+	$\beta_1(OH)$	+	$\beta_2(OH)^2$	+	$\beta_3(OH)^3$
$\alpha Fe^{2+}(OH)$	=	1	+	3.16228E-10	+	1E-28	+	1E-42
$\alpha Fe^{2+}(OH)$	=	1	LOG =	1.37336E-10				

$[Fe^{2+}]_L$	=	Co	=	0.01	=	0.01
		$\alpha Fe^{2+}(OH)$		1		

$$pH = 0$$

$\alpha Fe^{3+}(OH)$	=	1	+	$\beta_1(OH)$	+	$\beta_2(OH)^2$	+	$\beta_3(OH)^3$
$\alpha Fe^{3+}(OH)$	=	1	+	0.01	+	5.01187E-05	+	1E-39
$\alpha Fe^{3+}(OH)$	=	1.01005012	LOG =	0.004342924				

$[Fe^{3+}]_L$	=	Co	=	0.01	=	0.009900499
		$\alpha Fe^{3+}(OH)$		1.010050119		

$\alpha Fe^{2+}(OH)$	=	1	+	$\beta_1(OH)$	+	$\beta_2(OH)^2$	+	$\beta_3(OH)^3$
$\alpha Fe^{2+}(OH)$	=	1	+	3.16228E-09	+	1E-26	+	1E-39
$\alpha Fe^{2+}(OH)$	=	1	LOG =	1.37336E-09				

$[Fe^{2+}]_L$	=	Co	=	0.01	=	0.01
		$\alpha Fe^{2+}(OH)$		1.000000005		

$$PH = 1$$

Inicio

p. e.

X	E(v)
0	Incalkulable
$\frac{1}{10}$	
$\frac{2}{10}$	
$\frac{3}{10}$	
$\frac{4}{10}$	

$$X = \frac{1}{10}$$

$$\varepsilon = \varepsilon^{0}\, Fe^{3+}/Fe^{2+} + \frac{0.059}{1} \log \frac{[Fe^{3+}]^5}{[Fe^{2+}]^5}$$

$$\varepsilon = 0.77V + 0.059 \log \left[\frac{(5xCo)^5}{[Co(1-5x)]^5}\right]$$

$$\varepsilon = 0.77V + 0.059 \log \frac{\left[5\left(\frac{1}{10}\right)(10^{-2})\right]^5}{\left[(10^{-2})\left(1-5\frac{1}{10}\right)\right]^5}$$

$$\varepsilon = 0.77V + 0.059 \log 1$$

$$\varepsilon = 0.77\,v$$

$$x = \frac{2}{10} \quad \acute{o} \quad \frac{1}{5} \qquad\qquad pH = 0$$

$$\varepsilon = \frac{n_{ox}\,\varepsilon'_{ox} + n_{red}\,\varepsilon'_{red}}{n_{ox}\,n_{red}}$$

$$= \frac{5\,(1.51\,v) + (1)\,(0.77\,v)}{5 + 1}$$

$$= 1.3867\,v$$

$$X = \frac{3}{10}$$

$$\varepsilon = \varepsilon'_{MnO_4^-/Mn^{+2}} + \frac{0.059}{5} \log \frac{[MnO_4^-]}{[Mn^{+2}]}$$

$$= 1.51 \, V + \frac{0.059}{5} \log \frac{[C_0(x - \frac{1}{5})]}{(C_0/5)}$$

$$= 1.51 V + \frac{0.059}{5} \log \left\{ \frac{\left[(10^{-2})(\frac{3}{10} - \frac{2}{10}) \right]}{\left(\frac{10^{-2}}{5} \right)} \right\}$$

$$= 1.504 \, V$$

X	Ɛ° (V)
0	INC
0.01	0.3862
0.02	0.4836
0.03	0.5439
0.04	0.5893
0.05	0.6267
0.06	0.6595
0.07	0.6892
0.08	0.7170
0.09	0.7437
0.10	0.7699
0.11	0.7960
0.12	0.8227
0.13	0.8505
0.14	0.8803
0.15	0.9130
0.16	0.9505
0.17	0.9959
0.18	1.0561
0.19	1.1535
0.20	1.3867
0.21	1.4944
0.22	1.4980
0.23	1.5001
0.24	1.5016
0.25	1.5028
0.26	1.5037
0.27	1.5045
0.28	1.5052
0.29	1.5058
0.30	1.5064
0.31	1.5069
0.32	1.5073
0.33	1.5078

Curva de titulación potenciométrica

Curva de titulación potenciométrica
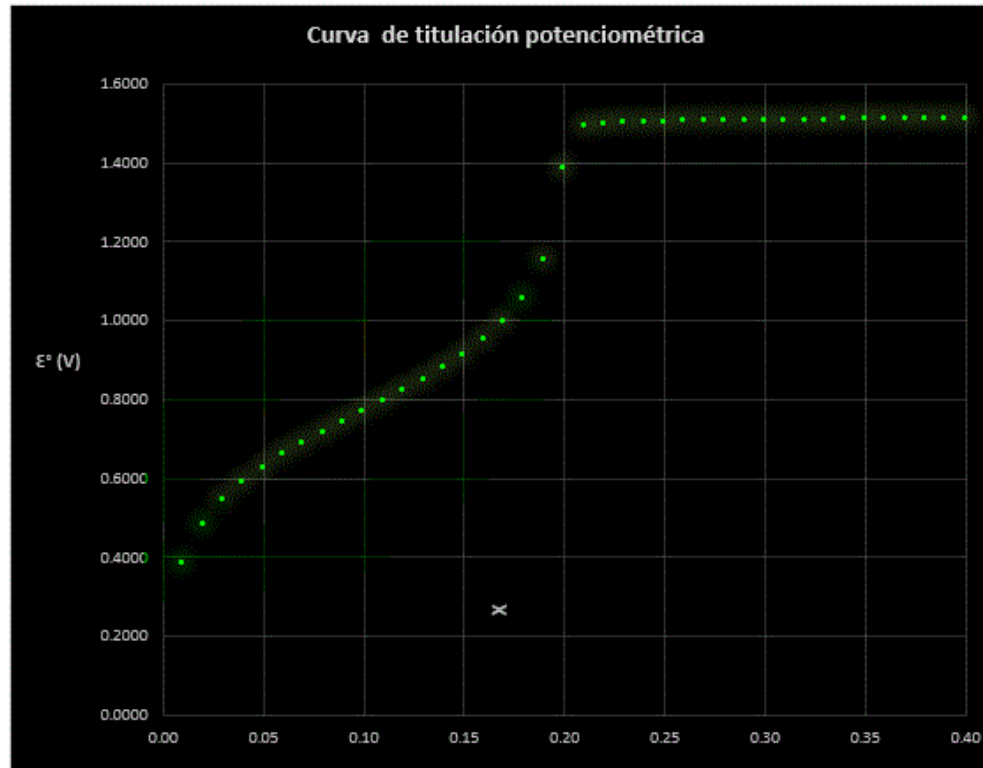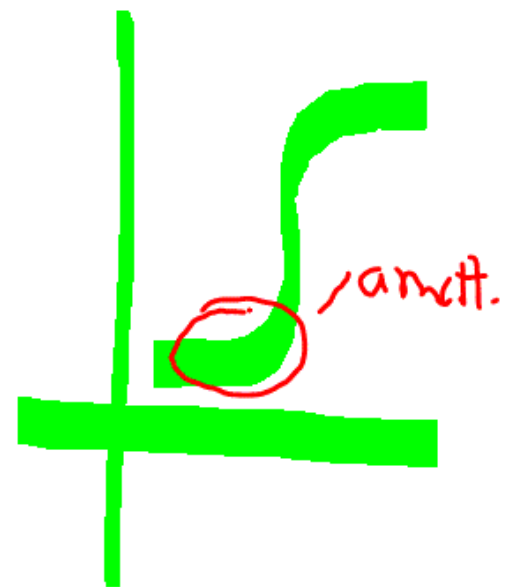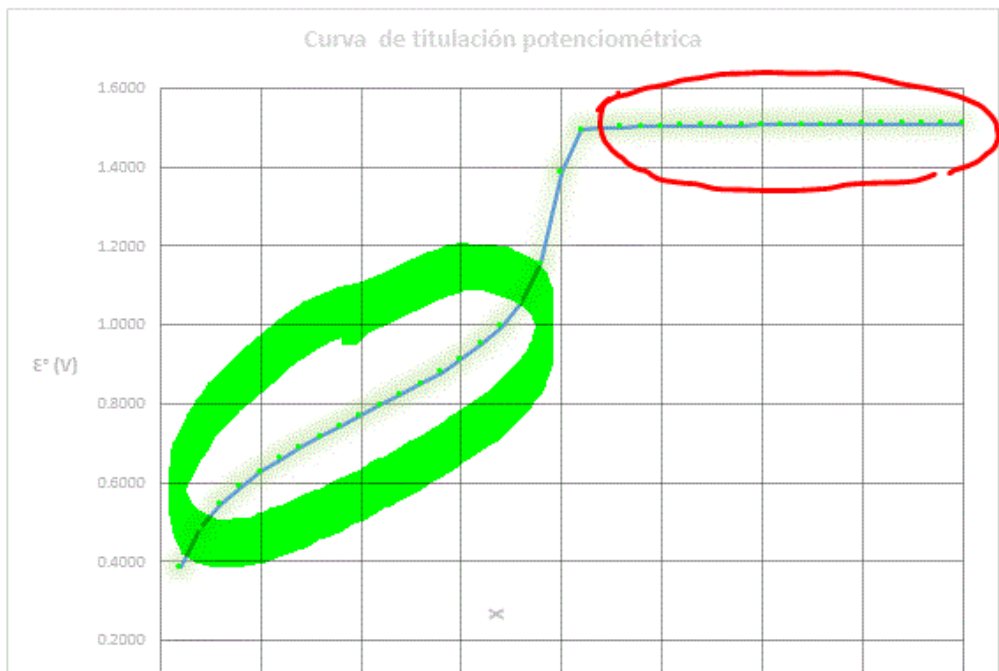
$$PH = 0$$

$$Kr = 10^{6.2 \cdot 71} = p.e.$$

$$10^{62.71} = \frac{[Mn^{+2}][Fe^{3+}]^5}{[MnO_4^-][Fe^{2+}]^5}$$

$$10^{62.71} = \frac{\left(\frac{C_0}{5}\right)(C_0)^5}{\left(\frac{\varepsilon C_0}{5}\right)(\varepsilon C_0)^5}$$

$$10^{62.71} = \dfrac{C_0^6 / 5}{\dfrac{\varepsilon^6 C_0^6}{5}}$$
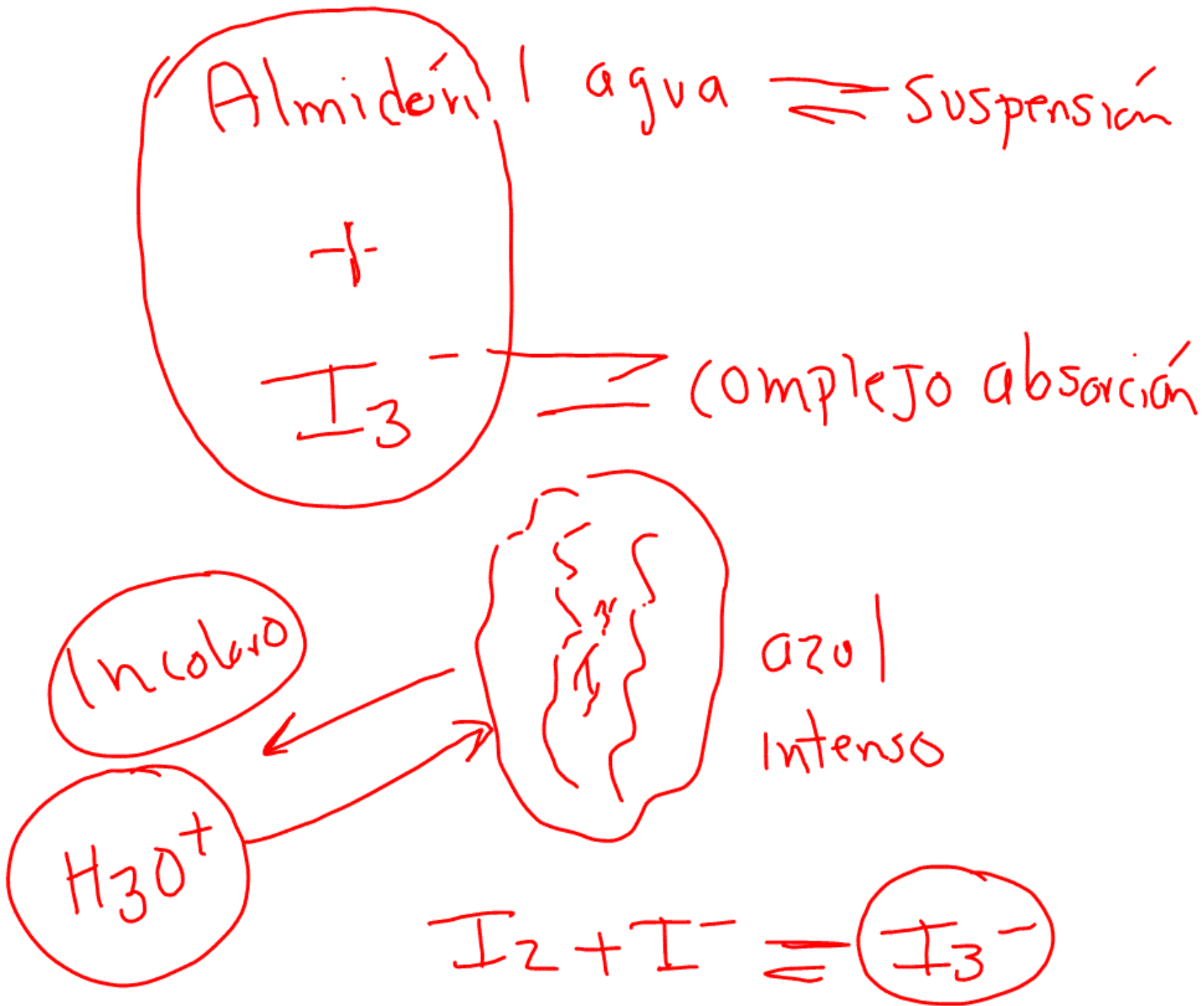
$$= \dfrac{1}{\varepsilon^6}$$

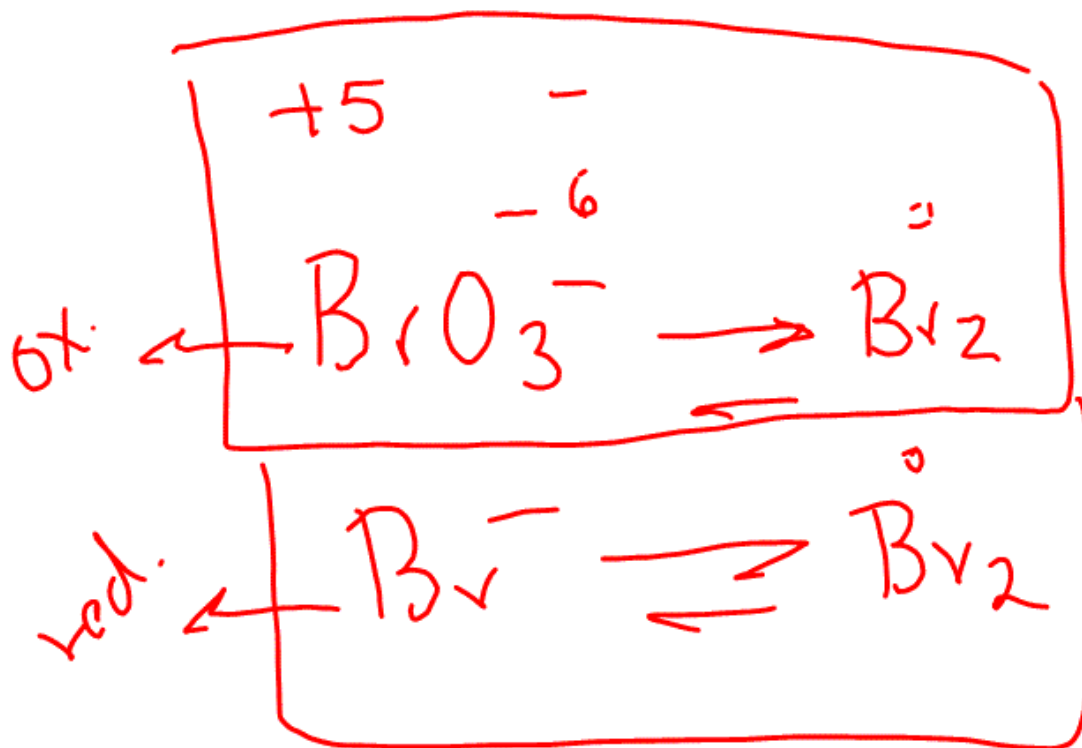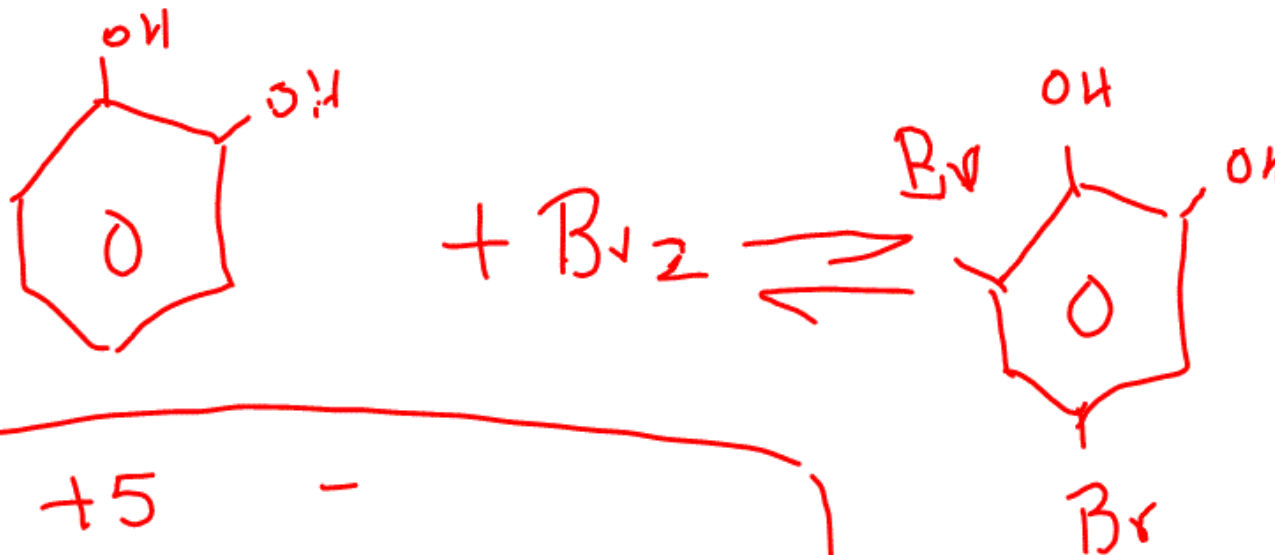$$\varepsilon = \sqrt[6]{\dfrac{1}{10^{62.71}}}$$

$$\varepsilon = 10^{-62.71/6} = 10^{-10.45}$$

$$\%Q = (1-\varepsilon)100$$

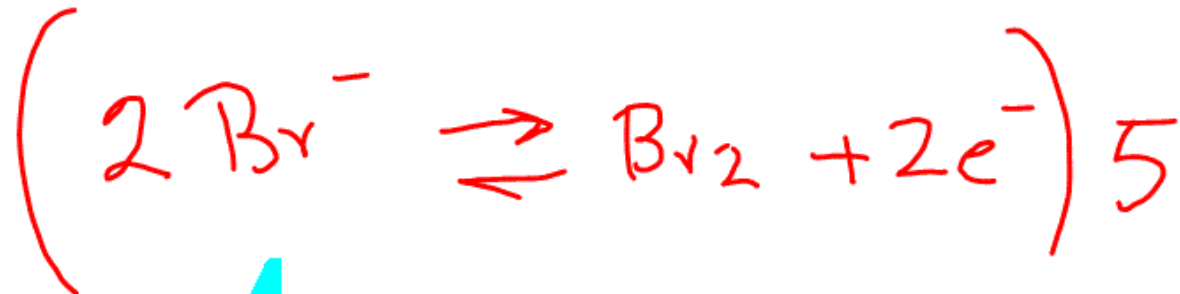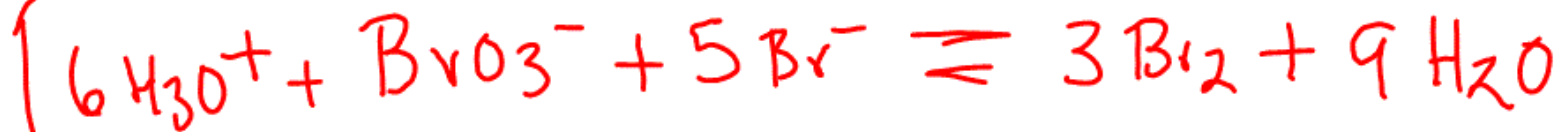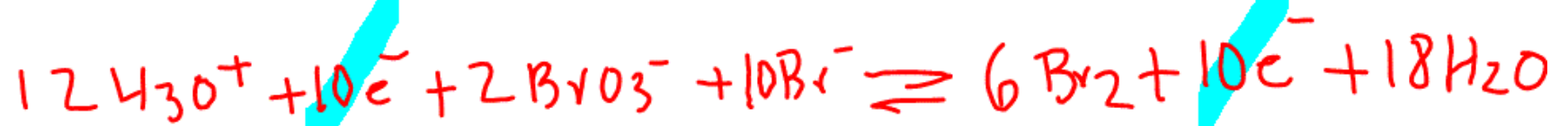$$= 99.99999999\%$$

$$asc. + I_3^- \rightleftharpoons deshasc + I^-$$

$$2e^- + I_3^- \rightleftharpoons 3I^-$$

$$\left(asc \rightleftharpoons dehidasc. + 2e^- + 2H_{30}^+\right)$$

Almidón | agua ⇌ Suspensión

+

I_3^- ⇌ complejo absorción

Incoloro

azul
intenso

H_3O^+

$I_2 + I^- \rightleftharpoons I_3^-$

$$+ Br_2 \rightleftharpoons$$

$$+5 \qquad -$$

$$-6$$

$$ox. \leftarrow BrO_3^- \rightarrow Br_2$$

$$red. \leftarrow Br^- \rightleftharpoons Br_2$$

$$12H_3O^+ + 2BrO_3^- \rightleftharpoons Br_2 + 18H_2O$$

$$10\bar{e} +$$

$$\left(12H_3O^+ + 10\bar{e} + 2BrO_3^- \rightleftharpoons Br_2 + 18H_2O\right)1$$

$$\left(2Br^- \rightleftharpoons Br_2 + 2e^-\right)5$$

$$12H_3O^+ + 10\bar{e} + 2BrO_3^- + 10Br^- \rightleftharpoons 6Br_2 + 10\bar{e} + 18H_2O$$

$$12 H_3O^+ + 10e^- + 2 BrO_3^- + 10 Br^- \rightleftharpoons 6 Br_2 + 10e^- + 18 H_2O$$

$$12 H_3O^+ + 2 BrO_3^- + 10 Br^- \rightleftharpoons 6 Br_2 + 18 H_2O$$

$$\boxed{6 H_3O^+ + BrO_3^- + 5 Br^- \rightleftharpoons 3 Br_2 + 9 H_2O}$$

$$\frac{Br_2 \; exceso}{}$$

$$\overset{0}{Br_2} + \overset{-1}{I^-} \rightleftharpoons \overset{-1}{Br^-} + \overset{0}{I_2}$$

$$I_3^- + S_2O_3^{-2} \rightleftharpoons I^- + S_4O_6^{-2}$$

Almidón

azul $\longrightarrow$ <u>Incoloro</u>

$$2\bar{e} + I_3^- \rightleftharpoons 3I^-$$

$$+4 \quad -6 = -2 \qquad\qquad 10 -12 = -2$$
$$-2 \qquad\qquad\qquad -2$$

$$2 S_2 O_3^{-2} \;\rightleftharpoons\; S_4 O_6^- + 2e^-$$

$$\left(\frac{4}{2}\right) = 2 \qquad\qquad \left(\frac{10}{4}\right) = 2.5$$

$$4 S^{2+} \longrightarrow 4 S^{2.5} + 2e^-$$

$$\text{Peso eq. } S_2O_3^{-2} = \frac{2 \cdot (M S_2O_3^{-2})}{2e^-}$$

$$\boxed{Peq = M}$$