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Elektrokimia

1) Consider the electrolysis of molten Barium Chloride, $BaCl_2$. (a) Write the half-reactions (b) How many grams of Barium metal can be produced by supplying 0.5 A for 30 minutes?

(a) Half-Reactions

$Ba^{2+}_{(molten)} + 2e^- \rightarrow Ba_{(s)}$

(b) $i = 0.5$ A

$t = 30$ minutes $= 1800$ s

$Ar\ Ba = 137$

$e = \frac{137}{2} = 86.5$

$W = \frac{e\, i\, t}{96500}$

$W = \frac{(86.5)(0.5)(1800)}{96.500} \Rightarrow W = 0.6389$ gram

2) Considering only the cost of electricity, would it be cheaper to produce a ton of Sodium or a ton of Alumunium by electrolysis?

Rumus Umum :

$W = \frac{e\, i\, t}{96500} \Rightarrow i = \frac{W \cdot 96500}{e\, t}$ yang mana $i \approx \frac{1}{e\uparrow}$

$e_{sodium} = \frac{23}{1} = 23$

$e_{Alu} = \frac{27}{3} = 9$

Semakin besar nilai e maka semakin kecil nilai i
Jadi, untuk memproduksi Sodium lebih murah jika dibandingkan dengan memproduksi Alumunium

3) Calculate the amounts of Cu dan Br_2 produced in 1.0 h at inert electrodes in a Solusion of $CuBr_2$ by a Current of 4.50 A.

60 menit = 3600 s

$W_{Cu} = \frac{e\, i\, t}{96.500}$

$W_{Cu} = \frac{(63.5/2)(4,5)(3600)}{96500}$

$W_{Cu} = 5,33$ gram

$W_{Br} = \frac{e\, i\, t}{96500}$

$= \frac{(80/1)(4.5)(3600)}{96500}$

$W_{Br} = 13,43$ gram

4) The passage of a Current of 0,750 A for 25 minutes deposited 0,369 gram of copper from a $CuSO_4$ Solusion. From this information, Calculate the value of molar mass of copper.

$W = \frac{i\, e\, t}{96500}$ 25 menit = 1500 s

$e = \frac{W \cdot 96500}{i t} \Rightarrow e = \frac{(0,369)\, 96500}{(0,750)(1500)}$

$e = 31,625$

$e \approx 32$

$e = \frac{Ar}{e^-}$

$32 = \frac{Ar}{2} \Rightarrow Ar = 64$

5) A constant electric current flows for 3,75 hour through two electrolytic cells connected in series. One contains a solusion of $AgNO_3$ and the second a solusion of $CuCl_2$. During this time 2.00 gram of silver are deposited in the first cell. (a) How many grams of copper are deposited in second cell? (b) What is the current flowing, in Amperes?

(a) $\frac{W_{Cu}}{W_{Ag}} = \frac{e_{Cu}}{e_{Ag}}$

$\frac{W_{Cu}}{2.00} = \frac{(63{,}5/2)}{(108/1)}$

$W_{Cu} = \frac{(63{,}5)(2.00)}{2 \cdot 108}$

$W_{Cu} = 0{,}58796$ gram

(b) $W_{Ag} = \frac{e_{Ag}\ i\ t}{96500}$

$i = \frac{W_{Ag} \cdot 96500}{e_{Ag}\ t}$

$i = \frac{(2)(96500)}{(108)(13500)} \Rightarrow i = 0{,}13237$ Ampere

6) The equilibrium constant for the reaction

$Sr_{(s)} + Mg^{2+}_{(aq)} \rightleftharpoons Sr^{2+}_{(aq)} + Mg_{(s)}$

Is $2{,}69 \times 10^{12}$ at 25°C. Calculate E° for a cell made up of Sr/Sr^{2+} and Mg/Mg^{2+} half cells

$Sr + Mg^{2+} \rightleftharpoons Sr^{2+} + Mg$

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Reduksi : $Mg^{2+} + 2e^- \rightarrow Mg$

Oksidasi : $Sr \rightarrow Sr^{2+} + 2e^-$

mol elektron (n) = 2

$E^\circ_{cell} = \frac{RT}{nF} \ln(K)$

$E^\circ_{cell} = \frac{(8{,}314)(298)}{(2)(96500)} \ln(2{,}69 \times 10^{12})$

$E^\circ_{cell} = 0{,}0128\ (28{,}62)$

$E^\circ_{cell} = 0{,}366$ Volt.

7) The half - Reaction at an electrode is

$Mg^{2+}_{(molten)} + 2e^- \rightarrow Mg_{(s)}$

Calculate the number of grams of magnesium that can be produces by supplying 1.00F to the electrode

$\frac{Mol\ e^-}{mol\ Mg} = \frac{2}{1}$

$Mol\ Mg = \frac{1}{2}\ mol\ e^-$

$\frac{gr\ Mg}{Ar\ Mg} = \frac{1}{2}\ mol\ e^-$

$gr\ Mg = \frac{mol\ e^- \times Ar\ Mg}{2}$

$= \frac{1}{2} \times 24{,}312$

$gr\ Mg = 12{,}156$ gram

8) One of the half-reactions for the electrolysis of water is

$2H_2O_{(l)} \rightarrow O_{2(g)} + 4H^+_{(aq)} + 4e^-$

If 0,076 L of O_2 is collected at 25°C and 755 mmHg, how many moles of electrons had to pass through the solusion?

$P = 755\ mmHg \times \frac{1\ atm}{760\ mmHg}$

$P = 0{,}993\ atm$

$PV = n_{O_2} RT$

$n_{O_2} = \frac{(0{,}993)(0{,}076)}{(0{,}0821)(298)}$

$n_{O_2} = 3{,}082 \times 10^{-3}\ mol$

$\frac{mol\ e^-}{mol\ O_2} = \frac{4}{1} \Rightarrow mol\ e^- = 4 \times mol\ O_2$

$mol\ e^- = 4\ (3{,}082 \times 10^{-3})$

$mol\ e^- = 12{,}344\ mmol$

9) Calculate the emf of the following concentration cell:

$Mg_{(s)}\ |\ Mg^{2+}(0{,}24M)\ ||\ Mg^{2+}(0{,}53M)\ |\ Mg_{(s)}$

Reduksi : $Mg^{2+}(0{,}53\ M) + 2e^- \rightarrow Mg_{(s)}$

Oksidasi : $Mg_{(s)} \rightarrow Mg^{2+}(0{,}24M) + 2e^-$

$Mg^{2+}(0{,}53M) \rightarrow Mg^{2+}(0{,}24M)$

$k = \frac{0{,}24}{0{,}53}$

$E° = -2{,}37 + 2{,}37$

$E° = 0\ V$

$E = E° - \frac{0{,}0257}{2} \ln(k)$

$E = 0 - \frac{0{,}0257}{2} \ln\left(\frac{0{,}24}{0{,}53}\right)$

$E = 0 - (-0{,}0102)$

$E = 0{,}0102\ V$

10) What is the emf of a cell consisting of a Pb^{2+}/Pb half-cell and a $Pt/H^+/H_2$ half-cell if $[Pb^{2+}] = 0{,}10\ M$, $[H^+] = 0{,}050\ M$, and $P_{H_2} = 1{,}0\ atm$?

Reduksi : $2H^+_{(aq)} + 2e^- \rightarrow H_{2(g)}$ | $E° = 0V$

Oksidasi : $Pb_{(s)} \rightarrow Pb^{2+}_{(aq)} + 2e^-$ | $E° = -0{,}13V$

$2H^+_{(aq)} + Pb_{(s)} \rightarrow H_{2(g)} + Pb^{2+}_{(aq)}$ $E° = 0{,}13V$

$K = \frac{[Pb^{2+}]P_{H_2}}{[H^+]^2}$

$K = \frac{(0{,}1)(1)}{(0{,}05)^2}$

$k = 40$

$E = E° - \frac{RT}{nF} \ln(k)$

$E = 0{,}13 - \frac{0{,}0257}{2} \ln(40)$

$E = 0{,}13 - 0{,}0474$

$E = 0{,}0826\ V$