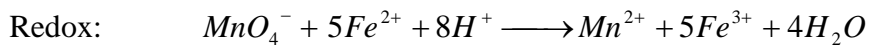
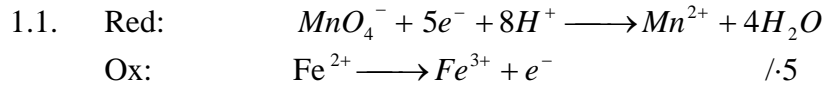


Lösungen zur Manganometrie

1980/I/1

Kursleiter Klaus Bentz



$$\Rightarrow \frac{n(\text{MnO}_4^-)}{n\text{Fe}^{2+}} = \frac{1}{5} \quad \Rightarrow n \text{Fe}^{2+} = 5n(\text{MnO}_4^-)$$

\Rightarrow

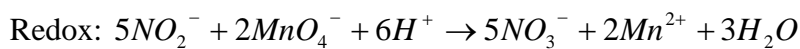
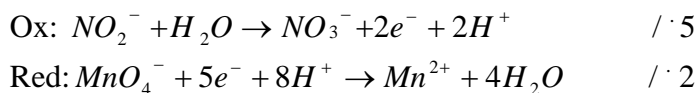
$$\begin{aligned} m(\text{Fe}^{2+}) &= 5 \cdot c(\text{MnO}_4^-) \cdot V(\text{MnO}_4^-) \cdot M \text{Fe}^{2+} \\ &= 5 \cdot 0,02 \text{ mol/l} \cdot 0,04 \text{ l} \cdot 55,8 \text{ g/mol} = 0,2232 \text{ g} \end{aligned}$$

prozentualer Eisengehalt im Erz:

$$\frac{0,2232 \text{ g}}{0,896 \text{ g}} = 0,2491 \Rightarrow 24,91 \%$$

1985/II

Kursleiter Klaus Bentz/Kollegiatin Anna Falk 2C1



$$\text{Geg.: } V(\text{KNO}_2) = 47 \cdot 10^{-3} \text{ l}; V(\text{MnO}_4^-) = 50 \cdot 10^{-3} \text{ l}; c(\text{MnO}_4^-) = 0,1 \frac{\text{mol}}{\text{l}}$$

Ges.: $m(\text{KNO}_2)$; $c(\text{KNO}_2)$

$$\frac{n(\text{NO}_2^-)}{n(\text{MnO}_4^-)} = \frac{5}{2}$$

$$n = n \quad n(\text{NO}_2^-) = n(\text{KNO}_2)$$

$$n(\text{KNO}_2) = 2,5 \cdot c(\text{MnO}_4^-) \cdot V(\text{MnO}_4^-) = 2,5 \cdot 50 \cdot 10^{-3} \text{ l} \cdot 0,1 \frac{\text{mol}}{\text{l}} = 0,0125 \text{ mol}$$

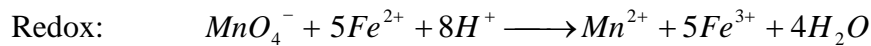
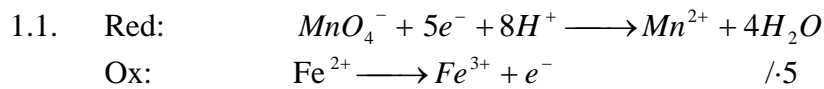
$$c(\text{KNO}_2) = \frac{0,0125 \text{ mol}}{47 \cdot 10^{-3} \text{ l}} = 0,27 \frac{\text{mol}}{\text{l}}$$

$$c(\text{KNO}_2) \cdot V(\text{KNO}_2) = \frac{m(\text{KNO}_2)}{M(\text{KNO}_2)}$$

$$m(\text{KNO}_2) = c(\text{KNO}_2) \cdot V(\text{KNO}_2) \cdot M(\text{KNO}_2) = 0,27 \frac{\text{mol}}{\text{l}} \cdot 47 \cdot 10^{-3} \text{l} \cdot 85,0 \frac{\text{g}}{\text{mol}} = 1,08 \text{g}$$

1987/III/1

Kursleiter Klaus Bentz



$$\Rightarrow \frac{n(\text{MnO}_4^-)}{n\text{Fe}^{2+}} = \frac{1}{5} \Rightarrow n \text{Fe}^{2+} = 5n(\text{MnO}_4^-)$$

⇒

$$m(\text{Fe}^{2+}) = 5 \cdot c(\text{MnO}_4^-) \cdot V(\text{MnO}_4^-) \cdot M \text{Fe}^{2+}$$

$$= 5 \cdot 0,01 \text{ mol/l} \cdot 0,0181 \cdot 55,8 \text{ g/mol} = 0,05 \text{g}$$

117,5 g Eisen befinden sich in 159,7g Fe₂O₃ (1 mol)

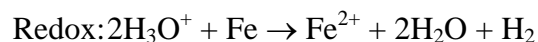
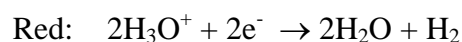
0,05 g Eisen befinden sich in 0,072 g Fe₂O₃

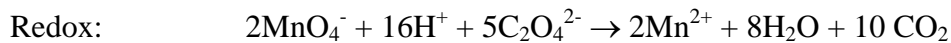
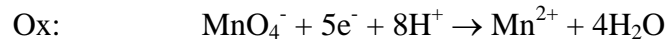
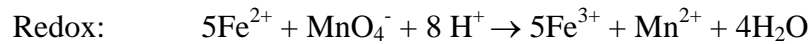
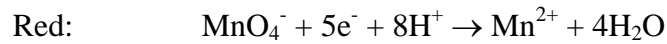
⇒ 0,092 g – 0,072 g = 0,02 g; Es befinden sich 0,02 Gramm ZnO im Gemisch

1990 / IV

Kursleiter Klaus Bentz / Kollegiat Winfried Weigl

1. Geg: $m(\text{Legierung}) = 0,178 \text{g}$; $V(\text{MnO}_4^-) = 0,00613 \text{l}$; $V_1(\text{MnO}_4^-) = 0,00975 \text{l}$ $V(\text{C}_2\text{O}_4^{2-}) = 0,010 \text{l}$; $c(\text{C}_2\text{O}_4^{2-}) = 5 \cdot 10^{-2} \frac{\text{mol}}{\text{l}}$





$$\text{Ges: } \frac{m(\text{Fe})}{m(\text{Legierung})}$$

$$\frac{n_1(\text{MnO}_4^-)}{n(\text{C}_2\text{O}_4^{2-})} = \frac{2}{5}$$

$$n_1(\text{MnO}_4^-) = \frac{2}{5} \cdot V(\text{C}_2\text{O}_4^{2-}) \cdot c(\text{C}_2\text{O}_4^{2-}) = \frac{2}{5} \cdot 0,011 \cdot 5 \cdot 10^{-2} \frac{\text{mol}}{\text{l}} = 0,2 \cdot 10^{-3} \text{ mol}$$

$$c(\text{MnO}_4^-) = \frac{n_1(\text{MnO}_4^-)}{V_1(\text{MnO}_4^-)} = \frac{0,2 \cdot 10^{-3} \text{ mol}}{0,00975 \text{ l}} = 0,0205 \frac{\text{mol}}{\text{l}}$$

$$n(\text{Fe}^{2+}) = n(\text{Fe})$$

$$\frac{n(\text{Fe})}{n(\text{MnO}_4^-)} = \frac{5}{1}$$

$$m(\text{Fe}) = \frac{5 \cdot V(\text{MnO}_4^-) \cdot c(\text{MnO}_4^-) \cdot M(\text{Fe})}{1} = \frac{5 \cdot 0,00613 \text{ l} \cdot 0,0205 \frac{\text{mol}}{\text{l}} \cdot 56 \frac{\text{g}}{\text{mol}}}{1} = 0,035 \text{ g}$$

$$\frac{m(\text{Fe})}{m(\text{Legierung})} = \frac{0,035 \text{ g}}{0,178 \text{ g}} = 0,1966 \Rightarrow 19,7\%$$

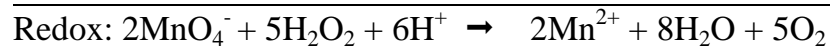
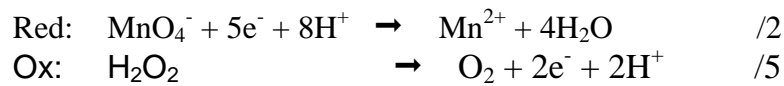
91/IV

Kursleiter Klaus Bentz / Kollegiat Ralf Deutzmann

1.1

Das Abwasser wird mit schwefelsaurer Kaliumpermanganatlösung bekannter Konzentration titriert. Am Äquivalenzpunkt erfolgt eine Entfärbung der violetten Kaliumpermanganatlösung.

1.2



1.3

$$\frac{n(\text{H}_2\text{O}_2)}{n(\text{MnO}_4^-)} = \frac{5}{2}$$

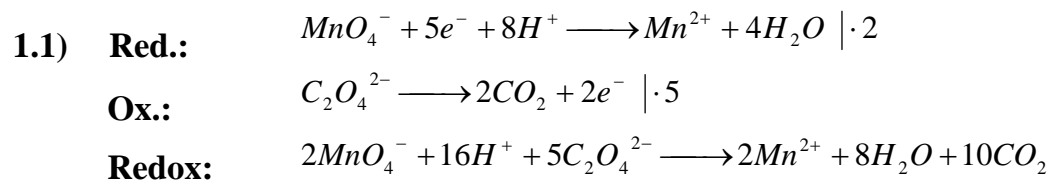
$$m(\text{H}_2\text{O}_2) = \frac{5}{2} \cdot c(\text{MnO}_4^-) \cdot V(\text{MnO}_4^-) \cdot M(\text{H}_2\text{O}_2)$$

$$m(\text{H}_2\text{O}_2) = \frac{5}{2} \cdot 0,1 \cdot 37,5 \cdot 10^{-3} \cdot 34 = 0,319 \text{ (g)} \quad (\text{Masse an Wasserstoffperoxid in 200ml Abwasser})$$

$$\Rightarrow \text{Masse an Wasserstoffperoxid in 1l Abwasser} = 0,319\text{g} \cdot 5 = 1,59\text{g}$$

1993/II

Kursleitung: Klaus Bentz; Kollegiat: Bastian Pflüger 2C1



1.2)

$$n_1(\text{KMnO}_4) = c_1(\text{KMnO}_4) \cdot V_1(\text{KMnO}_4) = 0,002 \frac{\text{mol}}{\text{l}} \cdot 5 \cdot 10^{-3} \text{l} = 0,00001 \text{mol}$$

$$n_2(\text{KMnO}_4) = c_2(\text{KMnO}_4) \cdot V_2(\text{KMnO}_4) = 0,002 \frac{\text{mol}}{\text{l}} \cdot 15 \cdot 10^{-3} \text{l} = 0,00003 \text{mol}$$

$$n'(\text{KMnO}_4) = n_1(\text{KMnO}_4) + n_2(\text{KMnO}_4) = \underline{0,00004 \text{mol}}$$

$$\frac{n_0(\text{KMnO}_4)}{n(\text{H}_2\text{C}_2\text{O}_4)} = \frac{2}{5} \Rightarrow n_0(\text{KMnO}_4) = \frac{2}{5} \cdot n(\text{H}_2\text{C}_2\text{O}_4) = \frac{2 \cdot c(\text{H}_2\text{C}_2\text{O}_4) \cdot V(\text{H}_2\text{C}_2\text{O}_4)}{5} =$$

$$= \frac{2 \cdot 0,005 \frac{\text{mol}}{\text{l}} \cdot 15 \cdot 10^{-3} \text{l}}{5} = \underline{0,00003 \text{mol}}$$

$$\Rightarrow n(\text{KMnO}_4) = n'(\text{KMnO}_4) - n_0(\text{KMnO}_4) = \underline{0,00001 \text{mol}}$$

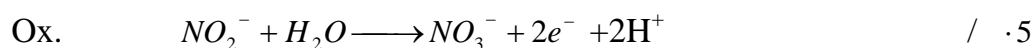
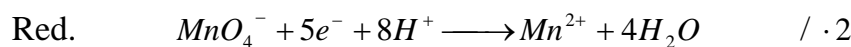
$$\Rightarrow m(\text{KMnO}_4) = n(\text{KMnO}_4) \cdot M(\text{KMnO}_4) = 0,00001 \text{mol} \cdot 158 \frac{\text{g}}{\text{mol}} = \underline{1,58 \text{mg}}$$

$$\frac{1,58 \text{mg}}{0,1 \text{l}} \Rightarrow \underline{\underline{\frac{15,8 \text{mg}}{1 \text{l}}}}$$

Abi 95/ III

Kursleiter Klaus Bentz / Kollegiatin: Louise Podlich

1.1



1.2. geg: $V(\text{NO}_2^-) = 0,047 \text{l}$

ges: $m(\text{NO}_2^-)$; $c(\text{NO}_2^-)$

$$V(\text{MnO}_4^-) = 0,05 \text{l}$$

$$c(\text{MnO}_4^-) = 0,1 \text{mol/l}$$

$$\frac{n(\text{MnO}_4^-)}{n(\text{NO}_2^-)} = \frac{2}{5}$$

$$n(\text{NO}_2^-) = \frac{5}{2} \cdot n(\text{MnO}_4^-)$$

$$n(\text{NO}_2^-) = \frac{5}{2} \cdot c(\text{MnO}_4^-) \cdot V(\text{MnO}_4^-)$$

$$n(\text{NO}_2^-) = \frac{5}{2} \cdot 0,1 \text{mol/l} \cdot 0,05 \text{l} = 0,0125 \text{mol}$$

$$n = n$$

$$n(\text{NO}_2^-) = \frac{m(\text{NO}_2^-)}{M(\text{NO}_2^-)}$$

$$m(\text{NO}_2^-) = n(\text{NO}_2^-) \cdot M(\text{NO}_2^-)$$

$$m(\text{NO}_2^-) = 0,0125 \text{ mol} \cdot (14 + 2 \cdot 16 + 39 \text{ g/mol})$$

$$m(\text{NO}_2^-) = 0,0125 \text{ mol} \cdot 85 \text{ g/mol} = 1,0625 \text{ g}$$

$$n = n$$

$$n(\text{NO}_2^-) = c(\text{NO}_2^-) \cdot V(\text{NO}_2^-)$$

$$c(\text{NO}_2^-) = \frac{n(\text{NO}_2^-)}{V(\text{NO}_2^-)}$$

$$c(\text{NO}_2^-) = \frac{0,0125 \text{ mol}}{0,047 \text{ l}} = 0,2659 \text{ mol/l}$$

1996 III/1

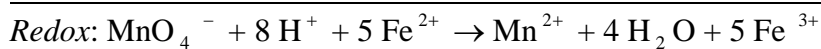
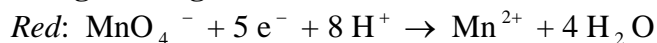
Kursleiter Klaus Bentz/ Kollegiat Thorben Kutz 2C1

Geg: Fe^{2+} ; $V(\text{Fe}^{2+}) = 25 \cdot 10^{-3} \text{ l}$; $c(\text{KMnO}_4) = 0,02 \frac{\text{mol}}{\text{l}}$; $m(\text{FeSO}_4 \cdot 7\text{H}_2\text{O}) = 0,203 \text{ g}$;

$V(\text{KMnO}_4) = 25,5 \cdot 10^{-3} \text{ l}$

Ges: $m(\text{Fe}^{2+})$

Redoxgleichung



$$n_1(\text{FeSO}_4 \cdot 7\text{H}_2\text{O}) = n_1(\text{Fe}^{2+}) = \frac{m}{M} = \frac{0,203 \text{ g}}{277,8 \frac{\text{g}}{\text{mol}}} = 7,3 \cdot 10^{-4} \text{ mol}$$

$$\frac{n_2(\text{Fe}^{2+})}{n(\text{MnO}_4^-)} = \frac{5}{1}$$

$$n_2(\text{Fe}^{2+}) = 5 \cdot c(\text{MnO}_4^-) \cdot V(\text{MnO}_4^-)$$

$$n_2(\text{Fe}^{2+}) = 5 \cdot 0,02 \frac{\text{mol}}{\text{l}} \cdot 25,5 \cdot 10^{-3} \text{ l} = 2,55 \cdot 10^{-3} \text{ mol}$$

$$n(\text{Fe}^{2+}) = n_2(\text{Fe}^{2+}) - n_1(\text{Fe}^{2+}) = 1,82 \cdot 10^{-3} \text{ mol}$$

$$n(\text{Fe}^{2+}) = n(\text{Fe}^{2+}) \Rightarrow m(\text{Fe}^{2+}) = M(\text{Fe}^{2+}) \cdot n(\text{Fe}^{2+}) = 55,8 \frac{\text{g}}{\text{mol}} \cdot 1,82 \cdot 10^{-3} \text{ mol} =$$

$$= 0,102\text{g}$$

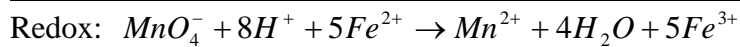
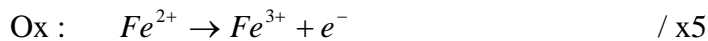
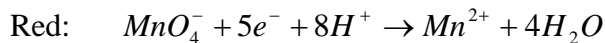
1996/ III

Kursleiter Klaus Bentz/ Kollegiat Martin Raithel

Geg: $V(\text{Fe}^{2+}) = 25 \cdot 10^{-3} \text{ l}$, $m(\text{FeSO}_4 \cdot 7 \text{H}_2\text{O}) = 0,203\text{g}$

$$c(\text{KMnO}_4) = 0,02 \frac{\text{mol}}{\text{l}}, V(\text{KMnO}_4) = 2505 \text{ ml}$$

1.1)



Eine Kaliumpermanganatlösung hat die Farbe Lila. Der Endpunkt der Titration ist dann erreicht, wenn keine Lilafärbung nicht mehr erkennbar ist.

1.2)

$$\frac{n(\text{Fe}^{2+})}{n(\text{MnO}_4^-)} = \frac{5}{1} \Rightarrow n_0(\text{Fe}^{2+}) = 5 \cdot n(\text{MnO}_4^-) = 5 \cdot c(\text{MnO}_4^-) \cdot V(\text{MnO}_4^-) =$$

$$= 5 \cdot 0,02 \frac{\text{mol}}{\text{l}} \cdot 25,5 \cdot 10^{-3} \text{ l} = 2,55 \cdot 10^{-3} \text{ mol}$$

$$- n(\text{Fe}^{2+}) = n(\text{FeSO}_4 \cdot 7\text{H}_2\text{O})$$

$$- n(\text{FeSO}_4 \cdot 7\text{H}_2\text{O}) = n(\text{KMnO}_4)$$

$$n(\text{FeSO}_4 \cdot 7\text{H}_2\text{O}) = \frac{m}{M} = \frac{0,203}{56 + 32 + 4 \cdot 16 + 7 \cdot 18} \frac{\text{g}}{\text{mol}} = \frac{0,203\text{g}}{278 \frac{\text{g}}{\text{mol}}} = 7,3 \cdot 10^{-4} \text{ mol}$$

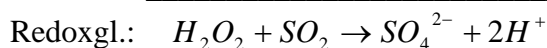
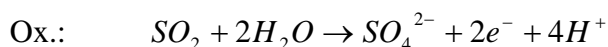
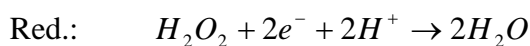
$$n = n_0 - n_1 = 2,55 \cdot 10^{-3} \text{ mol} - 7,3 \cdot 10^{-4} \text{ mol} = 1,82 \cdot 10^{-3} \text{ mol}$$

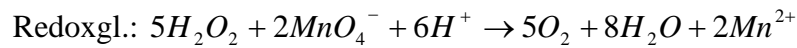
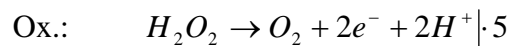
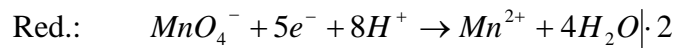
$$n(\text{Fe}^{2+}) = \frac{m}{M} \Rightarrow m(\text{Fe}^{2+}) = n \cdot M = 1,82 \cdot 10^{-3} \text{ mol} \cdot 56 \frac{\text{g}}{\text{mol}} = 0,102\text{g}$$

1998/ IV

Kursleiter Klaus Bentz / Kollegiat Simon Baisl 2C1

1.1





$$\frac{n(\text{H}_2\text{O}_2)}{n(\text{MnO}_4^-)} = \frac{5}{2}$$

$$n_1(\text{H}_2\text{O}_2) = \frac{5 \cdot c \cdot V}{2} = \frac{5 \cdot 0,05 \frac{\text{mol}}{\text{l}} \cdot 0,0176 \text{l}}{2} = 0,0022 \text{ mol}$$

$$n_0(\text{H}_2\text{O}_2) - n_1(\text{H}_2\text{O}_2) = n(\text{H}_2\text{O}_2) = 0,0058 \text{ mol} = \text{Schwefelverbrauch}$$

$$\frac{n(\text{H}_2\text{O}_2)}{n(\text{SO}_2)} = \frac{1}{1}$$

$$\frac{n(\text{S})}{n(\text{SO}_2)} = \frac{1}{1}$$

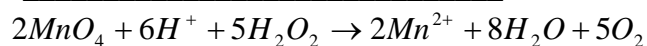
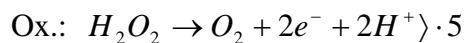
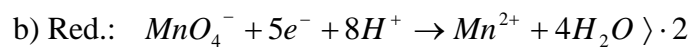
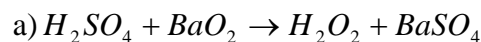
$$m(\text{S}) = n \cdot M = 0,1856 \text{ g}$$

$$\text{prozentualer Massenanteil: } \frac{0,1856 \text{ g}}{0,580 \text{ g}} = 0,32 \Rightarrow 32\%$$

Abitur 1999/ IV

Kursleiter Klaus Bentz / Kollegiat Simon Baisl 2C1

3.2.1



3.2.2.

$$\frac{n(\text{H}_2\text{O}_2)}{n(\text{MnO}_4^-)} = \frac{5}{2}$$

$$n(\text{H}_2\text{O}_2) = \frac{5}{2} n(\text{MnO}_4^-) = \frac{5}{2} \cdot c(\text{MnO}_4^-) \cdot V(\text{MnO}_4^-) = \frac{5}{2} \cdot 2,4 \cdot 10^{-2} \text{ mol} \cdot 0,0345 \text{ l} = 2,07 \cdot 10^{-3} \text{ mol}$$

$$n(\text{H}_2\text{O}_2) = n(\text{BaO}_2)$$

$$m(\text{BaO}_2) = n(\text{BaO}_2) \cdot M(\text{BaO}_2) = 2,7 \cdot 10^{-3} \text{ mol} \cdot 169,3 \frac{\text{g}}{\text{mol}} = 0,35 \text{ g}$$

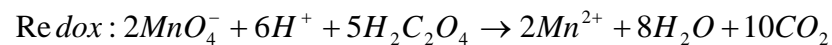
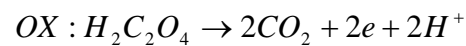
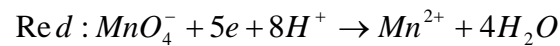
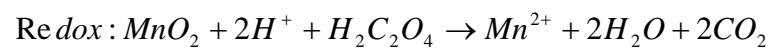
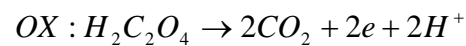
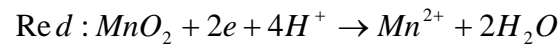
$$\text{Anteil des BaO}_2 : \frac{0,35\text{g}}{0,523\text{g}} = 0,67 \Rightarrow 67\%$$

2000/III/1

Kursleiter Klaus Bentz / Kollegiat Clemens Krug

1.1

$$\text{Geg : } V(\text{H}_2\text{C}_2\text{O}_4) = 0,1\text{l}; c(\text{H}_2\text{C}_2\text{O}_4) = 0,05 \frac{\text{mol}}{\text{l}}; n_0(\text{H}_2\text{C}_2\text{O}_4) = c \cdot V(\text{H}_2\text{C}_2\text{O}_4)$$



$$\frac{n(\text{MnO}_4^-)}{n_2(\text{C}_2\text{O}_4^{2-})} = \frac{2}{5}$$

$$\frac{5 \cdot V(\text{MnO}_4^-) \cdot c(\text{MnO}_4^-)}{2} = n_2(\text{C}_2\text{O}_4^{2-}) = 1,25 \cdot 10^{-3} \text{ mol}$$

$$n_0(\text{C}_2\text{O}_4^{2-}) = V(\text{C}_2\text{O}_4^{2-}) \cdot c(\text{C}_2\text{O}_4^{2-}) = 0,1\text{l} \cdot 0,05 \frac{\text{mol}}{\text{l}} = 5 \cdot 10^{-3} \text{ mol}$$

$$n_0 - n_2 = 5 \cdot 10^{-3} \text{ mol} - 1,25 \cdot 10^{-3} \text{ mol} = 3,75 \cdot 10^{-3} \text{ mol}$$

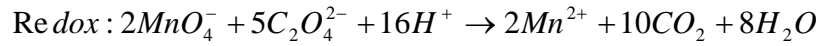
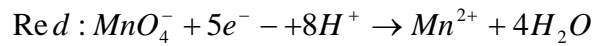
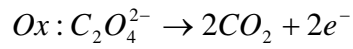
$$\frac{n(\text{MnO}_2)}{n(\text{C}_2\text{O}_4^{2-})} = 1$$

$$\begin{aligned} m(\text{MnO}_2) &= n(\text{C}_2\text{O}_4^{2-}) \cdot M(\text{MnO}_2) = \\ &= 3,75 \cdot 10^{-3} \text{ mol} \cdot (55 + 2 \cdot 26) \frac{\text{g}}{\text{mol}} = 0,32625 \text{ g} \end{aligned}$$

$$\frac{0,32625\text{g}}{0,4\text{g}} = 0,8156 = 81,56\%$$

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$$\frac{n(C_2O_4^{2-})}{n(MnO_4^-)} = \frac{5}{2}$$

$$n_0(C_2O_4^{2-}) = \frac{5 \cdot c \cdot V(MnO_4^-)}{2} = 0,001425$$

$$n_1((NH_4)_2C_2O_4^{2-}) = \frac{m}{M}((NH_4)_2C_2O_4^{2-}) = \frac{0,1g}{124 \frac{g}{mol}} = 0,000806452mol$$

$$n_{ges} = n_0 - n_1 = 0,001425mol - 0,000806452mol = 0,000619mol$$

$$\frac{n(C_2O_4^{2-})}{n(Ca^{2+})} = 1$$

$$m(Ca^{2+}) = n_{ges} \cdot M(Ca^{2+}) = 0,000619mol \cdot 40 \frac{g}{mol} = 0,0247g = 24,7mg$$