

Exercise Sheet 4

–Sketch of Solution–

Exercise 1

$$\text{Global: } \frac{184\,246 \text{ Mt} + 991\,241 \text{ Mt}}{911.5 \text{ Mt/a}} = 1\,289.6 \text{ years}$$

$$\text{D: } \frac{41\,300 \text{ Mt} + 77\,600 \text{ Mt}}{179.1 \text{ Mt/a}} = 663.87 \text{ years}$$

Exercise 2

$$1.67 \cdot 10^{12} \text{ kg HCU} \cdot \frac{1}{1022 \frac{\text{kg HCU}}{\text{t hard coal}}} = 1630 \cdot 10^6 \text{ t of hard coal}$$

$$728\,436 \cdot 10^6 \text{ t of hard coal} = 1630 \cdot 10^6 \text{ t of hard coal} \cdot \sum_{t=0}^m 1.03^t$$

$$446 = \frac{1.03^{n+1} - 1}{1.03 - 1}$$

$$13.4 = 1.03^{n+1} - 1$$

$$14.4 = 1.03^{n+1}$$

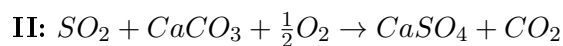
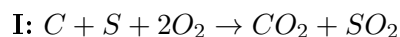
$$n + 1 = \log_{1.03} 14.4 = 90 \Rightarrow n = 89 \text{ years}$$

Exercise 3

cf. tutorial

Exercise 4

a) (strongly simplified)



[$CaCO_3$ – calcium carbonate; $CaSO_4$ – calcium sulfate/cement]

b) 25 t sulfur $\rightarrow$ Change units to mol!

$$\text{III: amount of substance } n = \frac{\text{mass } m}{\text{molar mass } M}$$

$$\frac{25 \cdot 10^6 \cdot g \text{ S}}{32 \text{ g/mol}} = 781\,250 \text{ mol} = n(S)$$

With I and II the following equation olds:

$$n(S) = n(SO_2) \text{ and } n(SO_2) = n(CaCO_3)$$

$$\text{From III follows } m(CaCO_3) = n(CaCO_3) \cdot M(CaCO_3) = 78 \cdot 10^6 \text{ g}$$

$$\approx 78 \text{ t } CaCO_3$$

c) $m(CO_2) = n(CO_2) \cdot M(CO_2) = 34 \text{ t}$
 (with $n(CO_2) = n(S)$ and $M(CO_2) = 44 \text{ g/mol}$)

Exercise 5

- a) Depletion in D = $63 \text{ Mt} \cdot 0.37 = 23.31 \text{ Mt}$
 prices on the world market = $65 \text{ USD/t} \cdot \frac{1 \text{ Euro}}{1.2 \text{ USD}} = 54.17 \text{ Euro/t}$
 Difference to the german prices = 85.83 Euro/t
 Subsidies = $85.83 \text{ Euro/t} \cdot 23.31 \text{ Mt} = 2 \cdot 10^9 \text{ Euro p.a.}$
- b) approx. 80 000 Euro per employee and year.