

Exercise Sheet 3

–Sketch of Solution–

Exercise 1

$$10 \text{ Mt/a} \cdot 0.92 = 9.2 \text{ Mt/a} = \begin{cases} 4.6 \text{ Mt Diesel} + \text{heating oil p.a.} \\ 2.76 \text{ Mt gasoline p.a.} \\ 0.92 \text{ Mt gas} = 920 \text{ Mkg} \cdot \frac{1 \text{ m}^3}{0.8 \text{ kg}} = 1150 \cdot 10^6 \text{ m}^3 \text{ gas} \end{cases}$$

$$\Rightarrow 0.92 \text{ Mt waste materials}$$

Exercise 2

static

$$\text{a) } 3.9 \cdot 10^9 \text{ t} \cdot x = 149 \cdot 10^9 \text{ t} \Rightarrow x = 38.27$$

$$\text{b) } 3.9 \cdot 10^9 \text{ t} \cdot x = 283 \cdot 10^9 \text{ t} \Rightarrow x = 72.67$$

dynamic

a)

$$149 \cdot 10^9 \text{ t} = 3.9 \cdot 10^9 \text{ t} \cdot \sum_{t=0}^n 1.03^t$$

$$149 = 3.9 \frac{1.03^{n+1} - 1}{1.03 - 1}$$

$$1.146 = 1.03^{n+1} - 1$$

$$2.146 = 1.03^{n+1}$$

$$n + 1 = \log_{1.03} 2.146 = 25.8359$$

$$n \approx 25 \text{ years}$$

b)

$$283 \cdot 10^9 \text{ t} = 3.9 \cdot 10^9 \text{ t} \cdot \sum_{t=0}^n 1.03^t$$

$$72.56 = \frac{1.03^{n+1} - 1}{1.03 - 1}$$

$$3.1769 = 1.03^{n+1}$$

$$n + 1 = \log_{1.03} 3.1769 = 39.1055$$

$$n \approx 38 \text{ years}$$

Exercise 3

cf tutorial

Exercise 4

- a) overall resources = $(240 + 139) 10^9 t = 379 10^9 t$
 $\Rightarrow \text{dmp} = 1/2 \cdot 379 10^9 t = 189.5 10^9 t$
consumption up to now: $139 t \Rightarrow$ until dmp: $50.5 10^9 t$
 $\Rightarrow 50.5 10^9 t / 3.9 \frac{10^9 t}{\text{year}} = 12.9 \text{ years}$
- b) overall resources = $(379 + 315) 10^9 t = 694 10^9 t$
 $\text{dmp} = 347 10^9 t$
 $\Rightarrow 208 10^9 t$ until dmp
 $\Rightarrow 208 \text{ Mrd } t / 3.9 \frac{10^9 t}{\text{year}} = 53.3 \text{ years}$

Exercise 5

cf tutorial

Exercise 6

cf tutorial

Exercise 7

$478 \text{ Mt HCU} \approx x \text{ barrels of oil}$

$1 t \text{ crude oil} \approx 1458 \text{ kg HCU}$

$478 \cdot 10^9 \text{ kg HCU} \cdot \frac{1 t \text{ crude oil}}{1458 \text{ kg HCU}} = 327.8 \cdot 10^6 t \text{ crude oil}$

$327.8 \cdot 10^6 t \text{ crude oil} \cdot \frac{1 \text{ bbl}}{0.136 t} = 2.41 \text{ Gbbl} \approx 784 \text{ vessels}$

Exercise 8

- a) $50 L \cdot 32.4 \frac{MJ}{L} = 1620 \text{ MJ}$
 $1 \text{ GJ} \approx 278 \text{ kWh} \Rightarrow 1.62 \text{ GJ} \cdot 278 \frac{kWh}{GJ} = 450.4 \text{ kWh}$
- b) $450 \text{ kWh} / 0.03 \text{ h} = 13.5 \text{ MW}$
- c) $450 \text{ kWh} / 3.5 \text{ kW} = 128.6 \text{ hours}$
- d) (i) $225 \text{ kWh} / 3.5 \text{ kW} = 64 \text{ hours}$
(ii) $225 \text{ kWh} / 32 \text{ kW} = 7 \text{ hours}$