Hoofdstuk 11: Groei

11.1 Exponentiële groei

<u>Opgave 1:</u>
a. $560 + 2 \cdot 120 = 800$ miljoen
b.   1,5
c.   1980: $N_o = 400 \cdot 1,5^2 = 900$ miljoen

   1990: $N_o = 400 \cdot 1,5^3 = 1350$ miljoen

d.   klopt niet, per 20 jaar is de toename: $\dfrac{900 - 400}{400} \cdot 100\% = 125\%$

<u>Opgave 2:</u>
a.   5 cm per jaar
b. $L(12) = 130$

   $L(2) = 80$

   $\dfrac{130 - 80}{80} \cdot 100\% = 62,5\%$

c. $L(6,75) = 103,75$ cm
d. $L(3) = 85$

   $L(2) = 80$

   $\dfrac{85 - 80}{80} \cdot 100\% = 6,25\%$

   $L(12) = 130$

   $L(11) = 125$

   $\dfrac{130 - 125}{125} \cdot 100\% = 4\%$

<u>Opgave 3:</u>
a. $L = 50 + 4t$
b. $L(1) = 54$

   $L(0) = 50$

   $\dfrac{54 - 50}{50} \cdot 100\% = 8\%$

   $L(2) = 58$

   $L(1) = 54$

   $\dfrac{58 - 54}{54} \cdot 100\% = 7,4\%$

   $L(5) = 70$

   $L(4) = 66$

   $\dfrac{70 - 66}{66} \cdot 100\% = 6,1\%$

c. $50 + 4t = 130$

   $4t = 80$

   $t = 20$ dus na 20 dagen

Opgave 4:

a. $N(8) = 1,724$ miljoen

   $N(7) = 1,671$ miljoen

   $N(8) - N(7) = 0,053$ dus 53000

b. $1,34 \cdot 1,032^t = 2$

   $y_1 = 1,34 \cdot 1,032^x$ en $y_2 = 2$ intersect geeft $x = 12,7$

   dus in 2012

Opgave 5:

a. $24 \cdot 1,2^t = 1000$

   $y_1 = 24 \cdot 1,2^x$ en $y_2 = 1000$ intersect geeft $x = 20,5$

   dus in 1931

b.   maak een tabel

   $t = 21 \quad N = 1104$

   $t = 22 \quad N = 1324$

   $t = 23 \quad N = 1590$

   dus van $t = 22$ naar $t = 23$, dus in 1933

c. $t = 89$ dus $N = 24 \cdot 1,2^{89} = 267511305$

Opgave 6:

a. $N = 9,8 \cdot 1,045^t$

b. $9,8 \cdot 1,045^6 = 12,8$ dus 12,8 miljoen

c. $9,8 \cdot 1,045^t = 16$

   $y_1 = 9,8 \cdot 1,045^x$ en $y_2 = 16$ intersect geeft $x = 11,1$

   dus in 2015

d. $9,8 \cdot 1,045^t = 19,6$

   $y_1 = 9,8 \cdot 1,045^x$ en $y_2 = 19,6$ intersect geeft $x = 15,7$

   dus in 2019

Opgave 7:

$g = 1,17$

Opgave 8:

a. $1 + \dfrac{12,7}{100} = 1,127$

b. $1 - \dfrac{6,8}{100} = 0,932$

c. $g = 1,735 = 173,5\%$ dus een toename van 73,5% per maand

d. $g = 0,845 = 84,5\%$ dus een afname van $100 - 84,5 = 15,5\%$

e. $g = 2,42 = 242\%$ dus een toename van $242 - 100 = 142\%$

f. $g = 1 - \dfrac{0,7}{100} = 0,993$

Opgave 9:

a. $g = 1 + \dfrac{15}{100} = 1,15$

   $A = 13000 \cdot 1,15^t$

b. $13000 \cdot 1,15^{15} = 105782$ ha

c. 25% van 2 miljoen ha is 500000 ha

   $13000 \cdot 1,15^t = 500000$

   $y_1 = 13000 \cdot 1,15^x$ en $y_2 = 500000$ intersect geeft $x = 26,1$

   dus in 2021

Opgave 10:

a. $I = 12000 \cdot 0,952^t$

b. $I = 12000 \cdot 0,952^6 = 8933$ cm³

c. $12000 \cdot 0,952^t = 6000$

   $y_1 = 12000 \cdot 0,952^x$ en $y_2 = 6000$ intersect geeft $x = 14,09$

   dus na 14 uur en 6 minuten

Opgave 11:

a. $4 \cdot 0,8^3 = 2,048 = 2,05$ m

b. $4 + 2 \cdot 4 \cdot 0,8 + 2 \cdot 4 \cdot 0,8^2 + 2 \cdot 4 \cdot 0,8^3 = 19,62$ m

c. $4 \cdot 0,8^n = 0,1$

   $y_1 = 4 \cdot 0,8^x$ en $y_2 = 0,1$ intersect geeft $x = 16,5$

   dus na 17 keer

d. $h \cdot 0,8^3 = 4$

   $h = \dfrac{4}{0,8^3} = 7,8125$ m

Opgave 12:

a. $P = 94,2 \cdot 0,979^t$

b. $94,2 \cdot 0,979^t = 55$

   $y_1 = 94,2 \cdot 0,979^x$ en $y_2 = 55$ intersect geeft $x = 25,4$

   dus in 2011

c. $P(19) = 62,9$

   $P(14) = 70,0$

   $\dfrac{62,9 - 70,0}{70,0} \cdot 100\% = -10,1\%$ dus een afname van 10,1%

d. $P_m = 94,2 - 1,4t$

   $y_1 = 94,2 \cdot 0,979^x$ en $y_2 = 94,2 - 1,4x$ intersect geeft: $x = 0 \quad \vee \quad x = 35,8$

   dus vanaf 1986 t/m 2011

Opgave 13:

a. $\dfrac{45,6}{39,7} = 1,149 \quad \dfrac{52,5}{45,6} = 1,151 \quad \dfrac{60,3}{52,5} = 1,149 \quad \dfrac{69,4}{60,3} = 1,151$

b. ja , $g = 1,15$

Opgave 14:

a. $\dfrac{3286}{3189} = 1,030$ $\dfrac{3385}{3286} = 1,030$ $\dfrac{3488}{3385} = 1,030$ $\dfrac{3593}{3488} = 1,030$ $\dfrac{3702}{3593} = 1,030$

$\dfrac{3815}{3702} = 1,031$ $\dfrac{3930}{3815} = 1,030$

b. $N = 3189 \cdot 1,03^t$

c. 30 jaar dus $t = 10$

$N = 3189 \cdot 1,03^{10} = 4286$ dus 4286000

Opgave 15:

a. $\dfrac{897}{1013} = 0,885$ $\dfrac{793}{897} = 0,884$ $\dfrac{702}{793} = 0,885$ $\dfrac{621}{702} = 0,885$ $\dfrac{550}{621} = 0,886$

b. $P = 1013 \cdot 0,885^h$

c. 11,5%

d. $P = 1013 \cdot 0,885^6 = 487\,\text{hPa}$

e. $P(12) = 233,8$

$P(2) = 793,4$

$\dfrac{793,4 - 233,8}{233,8} \cdot 100\% = 239\%$

Opgave 16:

a. $\dfrac{578}{462} = 1,251$ $\dfrac{716}{578} = 1,239$ $\dfrac{885}{716} = 1,236$ $\dfrac{1120}{885} = 1,266$ $\dfrac{1402}{1120} = 1,252$

$\dfrac{1736}{1402} = 1,238$ $\dfrac{2170}{1736} = 1,250$ $\dfrac{2740}{2170} = 1,263$

dus $g = 1,25$

b. $L = 462 \cdot 1,25^t$

c. $L = 2740 \cdot 1,06^t$

$2740 \cdot 1,06^t = 5000$

$y_1 = 2740 \cdot 1,06^x$ en $y_2 = 5000$ intersect geeft $x = 10,3$

dus in 2008

11.2 Exponentiële groeiformules

Opgave 17:
a.

tijd	0	1	2	3	4	5	6
N	2	18	162	1458	13122	118098	1062882

b. $9 \cdot 9 = 81$

c. minder want $g_{jaar} = 1,09$ en $1,045 \cdot 1,045 = 1,092025$

Opgave 18:
a. $g_{kwartier} = 1,12$

$g_{uur} = 1,12^4 = 1,574$ dus 57,4%

b. $g_{5\,min} = 1,12^{\frac{1}{3}} = 1,038$ dus 3,8%

Opgave 19:
a. $g_{dag} = 0,84$

$g_{week} = 0,84^7 = 0,295$ dus 70,5%

b. $g_{uur} = 0,84^{\frac{1}{24}} = 0,993$ dus 0,7%

Opgave 20:
a. $g_{week} = 1,3^7 = 6,27$ dus 527%

b. $g_{4\,uur} = 1,3^{\frac{1}{6}} = 1,045$ dus 4,5%

Opgave 21:
a. $g_{uur} = 0,805$

$g_{kwartier} = 0,805^{\frac{1}{4}} = 0,947$ dus 5,3% afname

b. $g_{jaar} = 1,086$

$g_{25\,jaar} = 1,086^{25} = 7,866$ dus 686,6% toename

C. $g_{week} = 2,8$

$g_{dag} = 2,8^{\frac{1}{7}} = 1,158$ dus 15,8% toename

Opgave 22:
a. $g_{dag} = 1,05$

$g_{week} = 1,05^7 = 1,407$ dus 40,7% toename

b. $g_{dag} = 1,5$

$g_{week} = 1,5^7 = 17,1$

c. $g_{uur} = 0,8$

$g_{kwartier} = 0,8^{\frac{1}{4}} = 0,946$ dus 5,4% afname

d. $g_{uur} = 0,7$

$$g_{kwartier} = 0,7^{\frac{1}{4}} = 0,915$$

Opgave 23:

a. $g_{week} = 2,8$

  $g_{dag} = 2,8^{\frac{1}{7}} = 1,158$

b. $g_{uur} = 2,8^{\frac{1}{168}} = 1,006$ dus een toename van 0,6%

Opgave 24:

a. $g^5 = \frac{210}{150} = 1,4$

  $g = \sqrt[5]{1,4} = 1,070$

b.   7,0% toename

Opgave 25:

a. $g^{25} = \frac{20000}{80000} = 0,25$

  $g = \sqrt[25]{0,25} = 0,946$ dus 5,4% afname

b. $g^{10} = 8$

  $g = \sqrt[10]{8} = 1,231$ dus 23,1% toename

c. $g^{15} = \frac{1}{2}$

  $g = \sqrt[15]{\frac{1}{2}} = 0,955$ dus 4,5% afname

Opgave 26:

a. $g^9 = \frac{21,5}{18} = 1,194$

  $g = \sqrt[9]{1,194} = 1,02$

  $N = 18 \cdot 1,02^t$

b. $1,02^t = 2$

  $t = \frac{\log 2}{\log 1,02} = 35$

Opgave 27:

$g^{20} = 2,5$

$g = \sqrt[20]{2,5} = 1,047$ dus 4,7% toename

Opgave 28:

$g^{20} = 9$

$g = \sqrt[20]{9} = 1,116$ dus 11,6% toename

Opgave 29:

a. $g^{10} = 0,05$

  $g = \sqrt[10]{0,05} = 0,741$ dus 25,9% afname

b. $g^{20} = 12$

  $g = \sqrt[20]{12} = 1,132$ dus 13,2% toename

c. $14000 : 12 = 1167$ in 1965
$1167 \cdot 20 = 23340$ in 1955

Opgave 30:
a. $g^4 = \frac{300000}{50000} = 6$
b. $g = \sqrt[4]{6} = 1{,}565$

Opgave 31:
$g^7 = \frac{4100}{1600} = 2{,}5625$

$g = \sqrt[7]{2{,}5625} = 1{,}144$

$b = \frac{1600}{1{,}144^3} = 1069$

$N = 1069 \cdot 1{,}144^t$

Opgave 32:
$g^6 = \frac{1250000}{150000} = 8{,}33$

$g = \sqrt[6]{8{,}33} = 1{,}42$

$b = \frac{150000}{1{,}42^2} = 73986$

$N = 73986 \cdot 1{,}42^t$

Opgave 33:
$g^3 = \frac{0{,}47}{0{,}60} = 0{,}783$

$g = \sqrt[3]{0{,}783} = 0{,}922$

$b = \frac{0{,}6}{0{,}922^5} = 0{,}9$

$H = 0{,}9 \cdot 0{,}922^t$

Opgave 34:
a. $g^{32} = \frac{5600}{10000} = 0{,}56$

   $g = \sqrt[32]{0{,}56} = 0{,}982$

   $b = \frac{10000}{0{,}982^{10}} = 11986$

   $A = 11986 \cdot 0{,}982^t$
b. $A(60) = 11986 \cdot 0{,}982^{60} = 4031\,\text{ha}$
c. $11986 \cdot 0{,}982^t = 3500$

   $0{,}982^t = 0{,}292$

   $t = \frac{\log 0{,}292}{\log 0{,}982} = 68$ dus in 2018

Opgave 35:
$g^4 = \frac{190}{120} = 1{,}583$

$$g = \sqrt[4]{1{,}583} = 1{,}12$$

$$b = \frac{120}{1{,}12^4} = 60$$

$$A = 60 \cdot 1{,}12^t$$

Opgave 36:

$$g^6 = \tfrac{2500}{1000} = 2{,}5$$

$$g = \sqrt[6]{2{,}5} = 1{,}165$$

$$b = \frac{1000}{1{,}165^4} = 543$$

$$N = 543 \cdot 1{,}165^t$$

Opgave 37:

$$g^2 = \tfrac{315{,}82}{292} = 1{,}082$$

$$g = \sqrt{1{,}082} = 1{,}04$$

$$b = \frac{292}{1{,}04^5} = 240 \quad \text{dus } € 240{,}-$$

Opgave 38:

a. $\quad g^4 = \tfrac{11}{31} = 0{,}355$

$\quad\quad g = \sqrt[4]{0{,}355} = 0{,}772$

$$b = \frac{31}{0{,}772^3} = 67$$

$\quad\quad A = 67 \cdot 0{,}772^t$

b. $\quad$ 67 mm²

c. $\quad$ 60 uur = 2,5 dag

$\quad\quad A = 67 \cdot 0{,}772^{2{,}5} = 35 \ $ mm²

Opgave 39:

a. $\quad g^{10} = \tfrac{180000}{4000} = 45$

$\quad\quad g = \sqrt[10]{45} = 1{,}463$

$\quad\quad P = 4000 \cdot 1{,}463^t$

b. $\quad \dfrac{180000 - 125000}{10} = 5500 \ $ is de afname per jaar

$\quad\quad N = 180000 - 6 \cdot 5500 = 147000$

c. $\quad g^{10} = \tfrac{125000}{180000} = 0{,}694$

$\quad\quad g = \sqrt[10]{0{,}694} = 0{,}964$

$\quad\quad N = 180000 \cdot 0{,}964^6 = 144629$

11.3 Machten en logaritmen

Opgave 40:

$^2\log 8 = 3$

$2^3 = 2^{^2\log 8}$ en $2^3 = 8$ dus $2^{^2\log 8} = 8$

Opgave 41:

a. $^2\log 10 + {}^2\log 12 = {}^2\log(10 \cdot 12) = {}^2\log 120$

b. $^{\frac{1}{2}}\log 60 - {}^{\frac{1}{2}}\log 12 = {}^{\frac{1}{2}}\log(\frac{60}{12}) = {}^{\frac{1}{2}}\log 5$

c. $2 \cdot {}^3\log 6 + {}^3\log 2 = {}^3\log 6^2 + {}^3\log 2 = {}^3\log 36 + {}^3\log 2 = {}^3\log(36 \cdot 2) = {}^3\log 72$

d. $^5\log 50 - 2 \cdot {}^5\log 10 = {}^5\log 50 - {}^5\log 10^2 = {}^5\log 50 - {}^5\log 100 = {}^5\log(\frac{50}{100}) = {}^5\log \frac{1}{2}$

e. $5 \cdot \log 2 - 3 \cdot \log 4 = \log 2^5 - \log 4^3 = \log 32 - \log 64 = \log(\frac{32}{64}) = \log \frac{1}{2}$

f. $^2\log 1000 - 4 \cdot {}^2\log 10 = {}^2\log 1000 - {}^2\log 10^4 = {}^2\log 1000 - {}^2\log 10000 = {}^2\log \frac{1000}{10000} = {}^2\log \frac{1}{10}$

Opgave 42:

a. $3 + {}^2\log 5 = {}^2\log 2^3 + {}^2\log 5 = {}^2\log 8 + {}^2\log 5 = {}^2\log(8 \cdot 5) = {}^2\log 40$

b. $4 + {}^{\frac{1}{2}}\log 50 = {}^{\frac{1}{2}}\log(\frac{1}{2})^4 + {}^{\frac{1}{2}}\log 50 = {}^{\frac{1}{2}}\log \frac{1}{16} + {}^{\frac{1}{2}}\log 50 = {}^{\frac{1}{2}}\log(\frac{1}{16} \cdot 50) = {}^{\frac{1}{2}}\log 3\frac{1}{8}$

c. $5 - {}^4\log 100 = {}^4\log 4^5 - {}^4\log 100 = {}^4\log 1012 - {}^4\log 100 = {}^4\log \frac{1024}{100} = {}^4\log 10{,}24$

d. $^2\log 20 - {}^3\log 27 = {}^2\log 20 - {}^3\log 3^3 = {}^2\log 20 - 3 = {}^2\log 20 - {}^2\log 2^3 = {}^2\log 20 - {}^2\log 8 = {}^2\log 2\frac{1}{2}$

e. $^5\log 125 - {}^4\log 10 = {}^5\log 5^3 - {}^4\log 10 = 3 - {}^4\log 10 = {}^4\log 4^3 - {}^4\log 10 = {}^4\log 64 - {}^4\log 10 =$
$${}^4\log 6{,}4$$

f. $\log 120 - {}^6\log 36 = \log 120 - {}^6\log 6^2 = \log 120 - 2 = \log 120 - \log 10^2 = \log 120 - \log 100 =$
$$\log 1{,}2$$

Opgave 43:

a. $\log 600 = \log(100 \cdot 6) = \log 100 + \log 6 = 2 + \log 6$

b. $^2\log 24 = {}^2\log(8 \cdot 3) = {}^2\log 8 + {}^2\log 3 = 3 + {}^2\log 3$

c. $^3\log 54 = {}^3\log(27 \cdot 2) = {}^3\log 27 + {}^3\log 2 = 3 + {}^3\log 2$

d. $^5\log 1250 = {}^5\log(625 \cdot 2) = {}^5\log 625 + {}^5\log 2 = 4 + {}^5\log 2$

Opgave 44:

$\log x + \log 5 = 2$

$\log 5x = 2$

$5x = 10^2$

$5x = 100$

$x = 20$

Opgave 45:

a. $^2\log x + {}^2\log 10 = 4$

$^2\log 10x = {}^2\log 16$

$10x = 16$

$x = 1{,}6$

b. $^3\log 4x + {}^3\log 5 = 2$

$^3\log 20x = {}^3\log 9$

$20x = 9$

$x = \frac{9}{20}$

c. $^2\log x = 4 - {}^2\log 3$

$^2\log x = {}^2\log 16 - {}^2\log 3$

$^2\log x = {}^2\log \frac{16}{3}$

$x = \frac{16}{3}$

d. $^4\log x + {}^4\log 3 = {}^4\log(x+1)$

$^4\log 3x = {}^4\log(x+1)$

$3x = x + 1$

$2x = 1$

$x = \frac{1}{2}$

Opgave 46:

a. $^2\log(x+6) = 4 - {}^2\log x$

$^2\log(x+6) + {}^2\log x = 4$

$^2\log(x^2 + 6x) = {}^2\log 16$

$x^2 + 6x - 16 = 0$

$(x-2)(x+8) = 0$

$x = 2 \quad \vee \quad x = -8 \text{ (vervalt)}$

b. $^{\frac{1}{2}}\log(x-2) = -3 - {}^{\frac{1}{2}}\log x$

$^{\frac{1}{2}}\log(x-2) + {}^{\frac{1}{2}}\log x = -3$

$^{\frac{1}{2}}\log(x^2 - 2x) = {}^{\frac{1}{2}}\log 8$

$x^2 - 2x = 8$

$x^2 - 2x - 8 = 0$

$(x-4)(x+2) = 0$

$x = 4 \quad \vee \quad x = -2 \text{ (vervalt)}$

c. $^3\log(2x+1) - 2 = {}^3\log(x-3)$

$^3\log(2x+1) = 2 + {}^3\log(x-3)$

$^3\log(2x+1) = {}^3\log 9 + {}^3\log(x-3)$

$^3\log(2x+1) = {}^3\log(9x - 27)$

$2x + 1 = 9x - 27$

$-7x = -28$

$x = 4$

d. $^3\log 2x = 1 + {}^3\log(x+1)$

$^3\log 2x = {}^3\log 3 + {}^3\log(x+1)$

$^3\log 2x = {}^3\log(3x+3)$

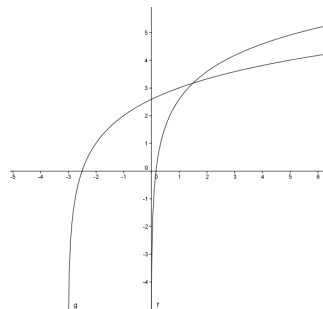$2x = 3x + 3$

$-x = 3$

$x = -3 \text{ vervalt}$

Opgave 47:

a. $\frac{1}{2}\log(x+3) = 1 + \frac{1}{2}\log(x+7)$

$\frac{1}{2}\log(x+3) = \frac{1}{2}\log\frac{1}{2} + \frac{1}{2}\log(x+7)$

$\frac{1}{2}\log(x+3) = \frac{1}{2}\log(\frac{1}{2}x + 3\frac{1}{2})$

$x + 3 = \frac{1}{2}x + 3\frac{1}{2}$

$\frac{1}{2}x = \frac{1}{2}$

$x = 1$

b. $^4\log(3x+4) = 3 - {}^4\log x$

$^4\log(3x+4) + {}^4\log x = {}^4\log 64$

$^4\log(3x^2 + 4x) = {}^4\log 64$

$3x^2 + 4x = 64$

$3x^2 + 4x - 64 = 0$

$x = \dfrac{-4 \pm \sqrt{784}}{6} = \dfrac{-4 \pm 28}{6}$

$x = 4 \quad \vee \quad x = -5\frac{1}{3} \text{ (vervalt)}$

Opgave 48:

a. $^a\log b = \dfrac{\log b}{\log a}$

b. $^2\log 25 = \dfrac{\log 25}{\log 2} = 4{,}644$

$^3\log 100 = \dfrac{\log 100}{\log 3} = 4{,}192$

$\dfrac{1}{^5\log 1000} = \dfrac{1}{\frac{\log 1000}{\log 5}} = 0{,}233$

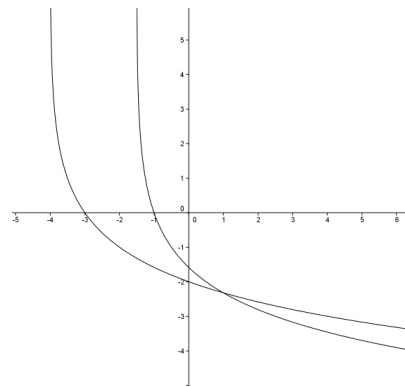$\dfrac{1}{5 - {}^2\log 20} = \dfrac{1}{5 - \frac{\log 20}{\log 2}} = 1{,}475$

Opgave 49:

a. $^2\log 6x = 1 + {}^2\log(x+3)$

$^2\log 6x = {}^2\log 2 + {}^2\log(x+3)$

$^2\log 6x = {}^2\log(2x+6)$

$6x = 2x + 6$

$4x = 6$

$x = 1\frac{1}{2}$

$y = {}^2\log 9$

$S = (1\frac{1}{2}, {}^2\log 9)$
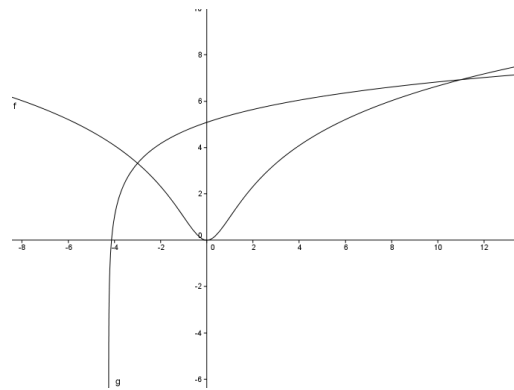
b. $f(x) \le g(x)$ als $0 < x \le 1\frac{1}{2}$

<u>Opgave 50:</u>

a. $\frac{1}{2}\log(x+4) = 1 + \frac{1}{2}\log(4x+6)$

     $\frac{1}{2}\log(x+4) = \frac{1}{2}\log\frac{1}{2} + \frac{1}{2}\log(4x+6)$

     $\frac{1}{2}\log(x+4) = \frac{1}{2}\log(2x+3)$

     $x+4 = 2x+3$

     $-x = -1$

     $x = 1$

     $y = \frac{1}{2}\log 5$

     $S = (1, \frac{1}{2}\log 5)$

b. $f(x) \le g(x)$ als $-1\frac{1}{2} < x \le 1$

<u>Opgave 51:</u>

a. ${}^2\log(x^2+1) = 3 + {}^2\log(x+4\frac{1}{4})$

     ${}^2\log(x^2+1) = {}^2\log 8 + {}^2\log(x+4\frac{1}{4})$

     ${}^2\log(x^2+1) = {}^2\log(8x+34)$

     $x^2+1 = 8x+34$

     $x^2 - 8x - 33 = 0$

     $(x-11)(x+3) = 0$

     $x = 11 \quad \vee \quad x = -3$

     $(11, {}^2\log 122)$ en $(-3, {}^2\log 10)$

b. $-4\frac{1}{4} < x \le -3 \quad \vee \quad x \ge 11$

c. $f(2) = {}^2\log 5$

     $g(2) = 3 + {}^2\log 6\frac{1}{4} = {}^2\log 8 + {}^2\log 6\frac{1}{4} = {}^2\log 50$

     $AB = g(2) - f(2) = {}^2\log 50 - {}^2\log 5 = {}^2\log 10$

d. ${}^2\log(x^2+1) = 5$

     ${}^2\log(x^2+1) = {}^2\log 32$

     $x^2+1 = 32$

     $x^2 = 31$

     $x = \sqrt{31} \quad \vee \quad x = -\sqrt{31}$

     $CD = 2\sqrt{31}$

e. $y_1 = 3 + \log(x+4.25)/\log(2)$ en $y_2 = x$ inetrsect geeft $x = 6{,}4148 \quad \vee \quad x = -4{,}2434$

     $\Delta x = 6{,}4148 - -4{,}2434 = 10{,}6582 = \Delta y$

     $EF = \sqrt{10{,}6582^2 + 10{,}6582^2} = 15{,}073$

<u>Opgave 52:</u>

$N = 200 \cdot 1{,}08^t$

$\log N = \log(200 \cdot 1{,}08^t)$

       $= \log 200 + \log 1{,}08^t$

       $= \log 200 + t \cdot \log 1{,}08$

Opgave 53:

a. $N = 8000 \cdot 1{,}18^{t}$

$\log N = \log(8000 \cdot 1{,}18^{t})$
$\quad = \log 8000 + \log 1{,}18^{t}$
$\quad = \log 8000 + t \cdot \log 1{,}18$
$\quad = 3{,}90 + 0{,}0719\,t$

b. $N = 22000 \cdot 0{,}83^{t}$

$\log N = \log(22000 \cdot 0{,}83^{t})$
$\quad = \log 22000 + \log 0{,}83^{t}$
$\quad = \log 22000 + t \cdot \log 0{,}83$
$\quad = 4{,}34 - 0{,}0809\,t$

c. $N = 6500 \cdot 1{,}25^{t-2}$

$\log N = \log(6500 \cdot 1{,}25^{t-2})$
$\quad = \log(6500 \cdot 1{,}25^{t} \cdot 1{,}25^{-2})$
$\quad = \log(4160 \cdot 1{,}25^{t})$
$\quad = \log 4160 + \log 1{,}25^{t}$
$\quad = \log 4160 + t \cdot \log 1{,}25$
$\quad = 3{,}62 + 0{,}0969\,t$

d. $N = 18000 \cdot 0{,}74^{2t-3}$

$\log N = \log(18000 \cdot 0{,}74^{2t-3})$
$\quad = \log(18000 \cdot 0{,}74^{2t} \cdot 0{,}74^{-3})$
$\quad = \log(44420 \cdot (0{,}74^{2})^{t})$
$\quad = \log(44420 \cdot 0{,}5476^{t})$
$\quad = \log 44420 + \log 0{,}5476^{t}$
$\quad = \log 44420 + t \cdot \log 0{,}5476$
$\quad = 4{,}65 - 0{,}2615\,t$

Opgave 54:

$N = b \cdot g^{t}$
$\log N = \log(b \cdot g^{t})$
$\log N = \log b + \log g^{t}$
$\log N = \log b + t \cdot \log g$

Opgave 55:

a. $\log P = 0{,}05h + 2{,}14$

$P = 10^{0{,}05h + 2{,}14}$
$P = 10^{0{,}05h} \cdot 10^{2{,}14}$
$P = 138 \cdot (10^{0{,}05})^{h}$
$P = 138 \cdot 1{,}12^{h}$

b. $L = 6\log K - 27$

$6\log K = L + 27$

$\log K = \frac{1}{6}L + 4\frac{1}{2}$

$K = 10^{\frac{1}{6}L + 4\frac{1}{2}}$

$\quad = 10^{\frac{1}{6}L} \cdot 10^{4\frac{1}{2}}$

$\quad = 31600 \cdot (10^{\frac{1}{6}})^L$

$\quad = 31600 \cdot 1{,}47^L$

Opgave 56:

a. $N = 25000 \cdot 0{,}82^{2t+3}$

$\log N = \log(25000 \cdot 0{,}82^{2t+3})$

$\quad = \log(25000 \cdot 0{,}82^{2t} \cdot 0{,}82^3)$

$\quad = \log(13784{,}2 \cdot (0{,}82^2)^t)$

$\quad = \log(13784{,}2 \cdot 0{,}6724^t)$

$\quad = \log 13784{,}2 + \log 0{,}6724^t$

$\quad = \log 13784{,}2 + t \cdot \log 0{,}6724$

$\quad = 4{,}14 - 0{,}1724t$

b. $\log N = 0{,}193t + 2{,}75$

$N = 10^{0{,}193t + 2{,}75}$

$\quad = 10^{0{,}193t} \cdot 10^{2{,}75}$

$\quad = 562 \cdot (10^{0{,}193})^t$

$\quad = 562 \cdot 1{,}56^t$

Opgave 57:

a. $\log E = 4{,}4$

$E = 10^{4{,}4} = 25000 \, \text{kJ}$

b. $M = 5{,}8$

$\log E = 10{,}1$

$E = 10^{10{,}1} = 1{,}26 \cdot 10^{10} \, \text{kJ}$

c. $\log E = \log 9{,}3 \cdot 10^{15} = 16{,}0$

$M = 9{,}8$

d. $\log E = \log 330000 = 5{,}5$

$M = 2{,}8$

e. als $E = 10^{10}$ dan $\log E = \log 10^{10} = 10$ en $M = 5{,}8$

als $E = 10^6 \cdot 10^{10} = 10^{16}$ dan $\log E = \log 10^{16} = 16$ en $M = 9{,}8$

dus de bewering klopt

f. als M met 2 toeneemt neemt $\log E$ met 3 toe

dus de hoeveelheid wordt $10^3 = 1000$ keer zo groot

g. $M = 0{,}67 \log E - 0{,}9$

$0{,}67 \log E = M + 0{,}9$

$\log E = 1{,}49M + 1{,}34$

$E = 10^{1{,}49M + 1{,}34}$

$\quad = 10^{1{,}49M} \cdot 10^{1{,}34}$

$$= (10^{1,49})^M \cdot 10^{1,34}$$
$$= 22 \cdot 31^M$$