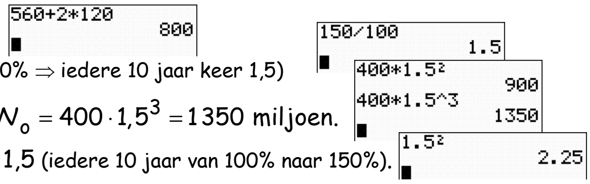
1a In 1980 is $N_i = 560 + 2 \cdot 120 = 800$ miljoen.

1b Vermenigvuldigen met 1,5. (iedere 10 jaar van 100% naar 150% $\Rightarrow$ iedere 10 jaar keer 1,5)

1c In 1980 is $N_o = 400 \cdot 1{,}5^2 = 900$ miljoen en in 1990 is $N_o = 400 \cdot 1{,}5^3 = 1350$ miljoen.

1d 50% toename per 10 jaar $\Rightarrow$ groeifactor per 10 jaar is 1,5 (iedere 10 jaar van 100% naar 150%).
Dus de groeifactor per 20 jaar is $1{,}5^2 = 2{,}25 \Rightarrow$ een toename van 125% in 20 jaar. Dus Gerben heeft geen gelijk.

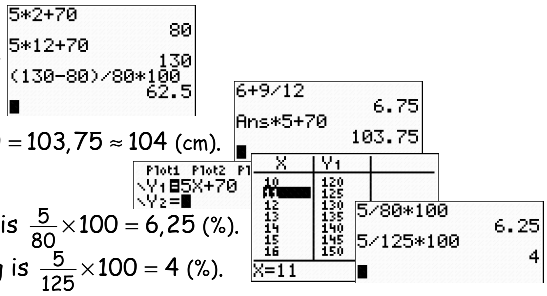


2a Per jaar groeit Michiel 5cm.

2b $t = 2 \Rightarrow L = 5 \cdot 2 + 70 = 80$ (cm) en $t = 12 \Rightarrow L = 5 \cdot 12 + 70 = 130$ (cm).
De procentuele toename is $\frac{130-80}{80} \times 100 = 62{,}5$ (%).

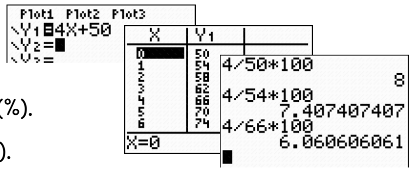
2c Bij 6 jaar en 9 maanden hoort $t = 6 + \frac{9}{12} = 6{,}75 \Rightarrow L = 5 \cdot 6{,}75 + 70 = 103{,}75 \approx 104$ (cm).

2d Elk jaar (tussen de tweede en twaalfde verjaardag) groeit Michiel 5 cm.
De procentuele toename tussen zijn tweede en derde verjaardag is $\frac{5}{80} \times 100 = 6{,}25$ (%).
De procentuele toename tussen zijn elfde en twaalfde verjaardag is $\frac{5}{125} \times 100 = 4$ (%).



3a $L = 4t + 50$ (cm met t in dagen).

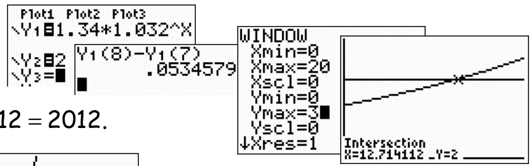
3b De procentuele toename op de eerste dag is $\frac{54-50}{50} \times 100 = \frac{4}{50} \times 100 = 8$ (%).
De procentuele toename op de tweede dag is $\frac{58-54}{54} \times 100 = \frac{4}{54} \times 100 \approx 7{,}4$ (%).
De procentuele toename op de vijfde dag is $\frac{70-66}{66} \times 100 = \frac{4}{66} \times 100 = 6{,}1$ (%).



3c $L = 4t + 50 = 130 \Rightarrow 4t = 80 \Rightarrow t = 20$. Dus na 20 dagen.

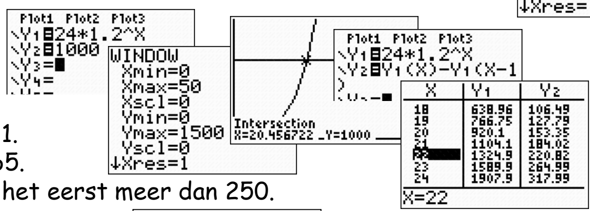
4a $N(8) - N(7) = 1{,}34 \cdot 1{,}032^8 - 1{,}34 \cdot 1{,}032^7 \approx 0{,}053$ miljoen inwoners.

4b $N = 1{,}34 \cdot 1{,}032^t = 2$ intersect $\Rightarrow t \approx 12{,}7$. Dus in (de loop van) $2000 + 12 = 2012$.

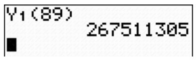


5a $N = 24 \cdot 1{,}2^t = 1000$ intersect $\Rightarrow t \approx 20{,}5$.
Dus in (de loop van) $1911 + 20 = 1931$.

5b $t = 22 \Rightarrow$ de toename is $N(22) - N(21) \approx 221$.
$t = 23 \Rightarrow$ de toename is $N(23) - N(22) \approx 265$.
Dus in $1911 + 22 = 1933$ is de toename voor het eerst meer dan 250.



5c Op 1-1-2000 is $t = 89 \Rightarrow N = 24 \cdot 1{,}2^{89} \approx 267\,500\,000$.

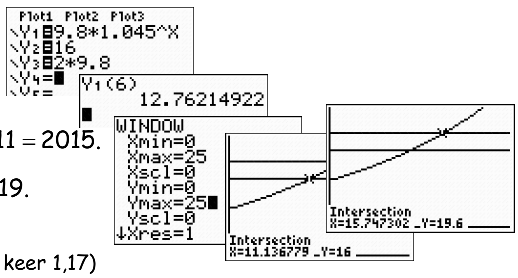


6a $N = 9{,}8 \cdot 1{,}045^t$ (miljoen inwoners met t in jaren en $t = 0$ in januari 2004).

6b $t = 6 \Rightarrow N = 9{,}8 \cdot 1{,}045^6 \approx 12{,}8$ (miljoen inwoners).

6c $N = 9{,}8 \cdot 1{,}045^t = 16$ intersect $\Rightarrow t \approx 11{,}1$. Dus in (de loop van) $2004 + 11 = 2015$.

6d $N = 9{,}8 \cdot 1{,}045^t = 2 \times 9{,}8$ intersect $\Rightarrow t \approx 15{,}7$. Dus in (de loop van) 2019.



7 De groeifactor per jaar is 1,17. (jaarlijks van 100% naar 117% $\Rightarrow$ jaarlijks keer 1,17)

8a De groeifactor per jaar is 1,127. (jaarlijks van 100% naar 112,7% $\Rightarrow$ jaarlijks keer 1,127)

8b De groeifactor per maand is 0,932. (maandelijks van 100% naar 93,2% $\Rightarrow$ maandelijks keer 0,932)

8c Het groeipercentage per maand is 73,5 (%). (maandelijks van 100% naar $100 \times 1{,}735 = 173{,}5\%$)

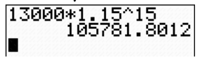
8d De procentuele afname per dag is 15,5 (%). (dagelijks van 100% naar $100 \times 0{,}845 = 84{,}5\%$)

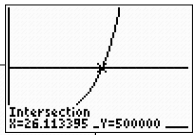
8e Het groeipercentage per jaar is 142 (%). (jaarlijks van 100% naar $100 \times 2{,}42 = 242\%$)

8f De groeifactor per dag is 0,993. (dagelijks van 100% naar 99,3% $\Rightarrow$ dagelijks keer 0,993)

9a $A = 13\,000 \cdot 1{,}15^t$ (ha met t in jaren en $t = 0$ in 1995).

9b $t = 15 \Rightarrow A = 13\,000 \cdot 1{,}15^{15} \approx 106\,000$ (ha).



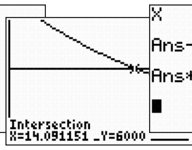


9c $A = 13\,000 \cdot 1{,}15^t = 0{,}25 \times 2\,000\,000$ intersect $\Rightarrow t \approx 26{,}1$ Dus in (de loop van) 2021.

10a $I = 12\,000 \cdot 0{,}952^t$ (cm^3 met t in uren).

10b $t = 6 \Rightarrow I = 12\,000 \cdot 0{,}952^6 \approx 8\,933 \approx 9\,000$ (cm^3).

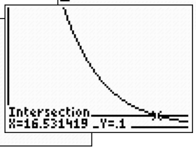
10c $I = 12\,000 \cdot 0{,}952^t = 6\,000$ intersect $\Rightarrow t \approx 14{,}09...$ (uren).
Dit is na (afgerond) 14 uur en 5 minuten.



11a $t = 3 \Rightarrow h = 4 \cdot 0{,}8^3 = 2{,}048 \approx 2{,}05$ (m).

11b $4 + 2 \cdot 4 \cdot 0{,}8^1 + 2 \cdot 4 \cdot 0{,}8^2 + 2 \cdot 4 \cdot 0{,}8^3 \approx 19{,}616$ (m). Dus de bal heeft 1962 cm afgelegd.

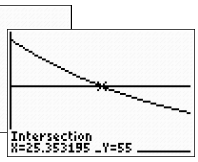
11c $h = 4 \cdot 0{,}8^n = 0{,}10$ (intersect) $\Rightarrow n \approx 16{,}53$.
$h < 0{,}10 \Rightarrow n \geq 17$. Dus voor het eerst na 17 keer.



11d $h = b \cdot 0{,}8^3 = 4$ (m) $\Rightarrow b = \frac{4}{0{,}8^3} = 7{,}8125 \approx 7{,}81$ (m).

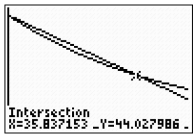
12a $P = 94{,}2 \cdot 0{,}979^t$ (miljarden kg met $t = 0$ in 1986).

12b $P = 94{,}2 \cdot 0{,}979^t = 55 \Rightarrow t \approx 25{,}4$ (jaar na 1986).
$P = 94{,}2 \cdot 0{,}979^t \leq 55 \Rightarrow t \geq 26$ (jaar na 1986).
Dus voor het eerst in 2012.



12c De procentuele verandering is $\frac{P(19) - P(14)}{P(14)} \times 100 \approx -10{,}1$ (%).
De procentuele afname is 10,1 (%).

12d $P_{\text{milieuorganisatie}} = 94{,}2 - 1{,}40t$ (miljarden kg met $t = 0$ in 1986).
$P = P_{\text{milieuorganisatie}}$ intersect $\Rightarrow t \approx 35{,}8$.
Vanaf $1986 + 36 = 2022$ leiden de plannen van de milieuorganistie tot een lagere mestproductie.



13a De vier factoren zijn $\frac{45{,}6}{39{,}7} \approx 1{,}149$; $\frac{52{,}5}{45{,}6} \approx 1{,}151$; $\frac{60{,}3}{52{,}5} \approx 1{,}149$ en $\frac{69{,}4}{60{,}3} \approx 1{,}151$.

13b Ja, de factoren zijn ongeveer gelijk (afgerond op twee decimalen zijn ze 1,15).

14a $\frac{3286}{3189} \approx 1{,}030$; $\frac{3385}{3286} \approx 1{,}030$; $\frac{3488}{3385} \approx 1{,}030$; $\frac{3593}{3488} \approx 1{,}030$; $\frac{3702}{3593} \approx 1{,}030$;
$\frac{3815}{3702} \approx 1{,}031$ en $\frac{3930}{3815} \approx 1{,}030$. De factoren (per 3 jaar) verschillen weinig $\Rightarrow$ exponentiële groei.

14b $N = 3189 \cdot 1{,}030^t$ (duizend inwoners met t in drietallen jaren en $t = 0$ in 1980).

14c $t = 10$ ($\times 3$ jaar) $\Rightarrow N = 3189 \cdot 1{,}030^{10} \approx 4\,286$ (duizend inwoners). In overeenstemming met het groeimodel.

15a $\frac{897}{1013} \approx 0{,}885$; $\frac{793}{897} \approx 0{,}884$; $\frac{702}{793} \approx 0{,}885$; $\frac{621}{702} \approx 0{,}885$ en $\frac{550}{621} \approx 0{,}886$.
De factoren (per 1000 meter) verschillen weinig $\Rightarrow$ er is exponentiële groei.

15b $P = 1013 \cdot 0{,}885^h$ (hPa met h in duizenden meters dus in km).

15c De procentuele afname per 1000 meter is 11,5 (%). (iedere 1000m van 100% naar $100 \times 0{,}885 = 88{,}5\%$)

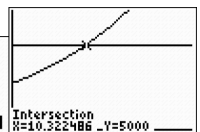
15d $h = 6 \Rightarrow P = 1013 \cdot 0{,}885^6 \approx 487$ (hPa).

15e De procentuele toename is $\frac{P(2) - P(12)}{P(12)} \times 100$ of $\frac{P(2)}{P(12)} \times 100 - 100 \approx 239$ (%).

16a $\frac{578}{462} \approx 1{,}251$; $\frac{716}{578} \approx 1{,}239$; $\frac{885}{716} \approx 1{,}236$; $\frac{1120}{885} \approx 1{,}266$;
$\frac{1402}{1120} \approx 1{,}252$; $\frac{1736}{1402} \approx 1{,}238$; $\frac{2170}{1736} = 1{,}25$ en $\frac{2740}{2170} \approx 1{,}263$.
De factoren (per jaar) verschillen weinig $\Rightarrow$ er is exponentiële groei.

16b $L = 462 \cdot 1{,}25^t$ (km met $t = 0$ op 1-1-1990).

16c $L_c = 2\,740 \cdot 1{,}06^t$ (km met $t = 0$ op 1-1-1998).
$L_c = 2\,740 \cdot 1{,}06^t = 5\,000$ intersect $\Rightarrow t \approx 10{,}3$. Dus in (de loop van) $1998 + 10 = 2008$.



17a Zie de tabel hiernaast.

tijd in jaren	0	1	2	3	4	5
hoeveelheid N	2	18	162	1458	13122	118098

```
Plot1 Plot2 P
\Y1=2*9^X
\Y2=
```

```
X  Y1
0  2
1  18
2  162
3  1458
4  13122
5  118098
6  1062882
Y1=1062882
```

17b Per twee jaar wordt vemenigvuldigd met $9 \cdot 9 = 9^2 = 81$.

17c $4{,}5 \cdot 4{,}5 = 20{,}25 > 9$. Dus N wordt per half jaar met minder dan 4,5 vermenigvuldigd.
Per half jaar wordt vemenigvuldigd met $9^{\frac{1}{2}} = \sqrt{9} = 3$.

```
4.5*4.5
            20.25
```

```
100+12
              112
1.12^4
       1.57351936
Ans*100-100
        57.351936
```

18a $g_{\text{kwartier}} = 1{,}12 \Rightarrow g_{\text{uur}} = 1{,}12^4 \approx 1{,}574$. De procentuele toename per uur is 57,4 (%).

```
1.12^(1/3)
       1.03849882
Ans*100-100
      3.849882037
```

18b $g_{\text{kwartier}} = 1{,}12 \Rightarrow g_{5\text{ min.}} = 1{,}12^{\frac{1}{3}} \approx 1{,}038$. De procentuele toename per 5 minuten is 3,8 (%).

19a $g_{\text{dag}} = 0{,}84 \Rightarrow g_{\text{week}} = 0{,}84^7 \approx 0{,}295$.

```
100-16
               84
0.84^7
     .2950903466
```

```
0.84^(1/24)
      .9927615999
Ans*100-100
     -.7238400138
```

19b $g_{\text{dag}} = 0{,}84 \Rightarrow g_{\text{uur}} = 0{,}84^{\frac{1}{24}} \approx 0{,}993$. De procentuele afname per uur is 0,7 (%).

```
1.3^7
        6.2748517
Ans*100-100
        527.48517
```

20a $g_{\text{dag}} = 1{,}3 \Rightarrow g_{\text{week}} = 1{,}3^7 \approx 6{,}275$. Het groeipercentage per week is 527,5 (%).

```
1.3^(1/6)
      1.044697508
Ans*100-100
      4.469750792
```

20b $g_{\text{dag}} = 1{,}3 \Rightarrow g_{4\text{ uur}} = 1{,}3^{\frac{1}{6}} \approx 1{,}045$. Het groeipercentage per 4 uur is 4,5 (%).

```
100-19.5
             80.5
0.805^(1/4)
      .9472158794
Ans*100-100
     -5.278412057
```

21a $g_{\text{uur}} = 0{,}805 \Rightarrow g_{\text{kwartier}} = 0{,}805^{\frac{1}{4}} \approx 0{,}947$. De procentuele afname per kwartier is 5,3 (%).

```
100+8.6
            108.6
1.086^25
      7.865849476
Ans*100-100
      686.5849476
```

21b $g_{\text{jaar}} = 1{,}086 \Rightarrow g_{25\text{ jaar}} = 1{,}086^{25} \approx 7{,}866$. Het groeipercentage per 25 jaar is 686,6 (%).

```
100+180
              280
2.8^(1/7)
      1.158456468
Ans*100-100
      15.84564682
```

21c $g_{\text{week}} = 2{,}8 \Rightarrow g_{\text{dag}} = 2{,}8^{\frac{1}{7}} \approx 1{,}158$. Het groeipercentage per dag is 15,8 (%).

```
100+5
              105
1.05^7
      1.407100423
Ans*100-100
      40.71004227
```

22a $g_{\text{dag}} = 1{,}05 \Rightarrow g_{\text{week}} = 1{,}05^7 \approx 1{,}407$. De toename per week is 40,7 %.

22b $g_{\text{dag}} = 1{,}5 \Rightarrow g_{\text{week}} = 1{,}5^7$ ($\approx 17{,}086$).

```
1.5^7
       17.0859375
```

```
100-20
               80
0.8^(1/4)
       .945741609
Ans*100-100
       -5.4258391
```

22c $g_{\text{uur}} = 0{,}8 \Rightarrow g_{\text{kwartier}} = 0{,}8^{\frac{1}{4}} \approx 0{,}946$. De afname per kwartier is 5,4 %.

22d $g_{\text{uur}} = 0{,}7 \Rightarrow g_{\text{kwartier}} = 0{,}7^{\frac{1}{4}}$ ($\approx 0{,}915$).

```
0.7^(1/4)
      .9146912192
```

23a $g_{\text{week}} = 2{,}8 \Rightarrow g_{\text{dag}} = 2{,}8^{\frac{1}{7}} \approx 1{,}158$.

```
2.8^(1/7)
      1.158456468
```

```
2.8^(1/(7*24))
      1.006147506
Ans*100-100
      .6147505835
```

23b $g_{\text{week}} = 2{,}8 \Rightarrow g_{\text{uur}} = 2{,}8^{\frac{1}{7 \cdot 24}} \approx 1{,}006$. Het groeipercentage per uur is 0,6 (%).

```
210/150
              1.4
Ans^(1/5)
      1.069610376
Ans*100-100
      6.961037573
```

24ab $g_{5\text{ jaar}} = \frac{210}{150} = \frac{7}{5} = 1{,}4 \Rightarrow g_{\text{jaar}} = 1{,}4^{\frac{1}{5}} \approx 1{,}070$. De procentuele toename per jaar is 7,0 (%).

```
0.25^(1/25)
      .9460576467
Ans*100-100
     -5.394235327
```

25a $g_{25\text{ jaar}} = \frac{20000}{80000} = \frac{1}{4} = 0{,}25 \Rightarrow g_{\text{jaar}} = 0{,}25^{\frac{1}{25}} \approx 0{,}946$. De procentuele afname per jaar is 5,4 (%).

```
8^0.1
      1.231144413
Ans*100-100
      23.11444133
```

25b $g_{10\text{ jaar}} = 8 \Rightarrow g_{\text{jaar}} = 8^{\frac{1}{10}} \approx 1{,}231$. Het groeipercentage per jaar is 23,1 (%).

```
0.5^(1/15)
      .9548416039
Ans*100-100
     -4.515839609
```

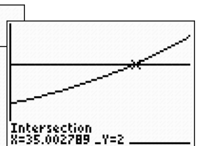
25c $g_{15\text{ jaar}} = \frac{1}{2} = 0{,}5 \Rightarrow g_{\text{jaar}} = 0{,}5^{\frac{1}{15}} \approx 0{,}955$. De procentuele afname per jaar is 4,5 (%).

26a $g_{9\text{ jaar}} = \frac{21{,}5}{18} \Rightarrow g_{\text{jaar}} = \left(\frac{21{,}5}{18}\right)^{\frac{1}{9}} \approx 1{,}02$.
$N = 18 \cdot 1{,}02^t$ (miljoen inwoners met t in jaren en $t = 0$ op 1-1-1990).

```
21.5/18
      1.194444444
Ans^(1/9)
      1.019938522
```

```
Plot1 Plot2 Plot3
\Y1=1.02^X
\Y2=2
\Y3=
```

```
WINDOW
 Xmin=0
 Xmax=50
 Xscl=0
 Ymin=0
 Ymax=3
 Yscl=0
```



26b $N = 18 \cdot 1{,}02^t = 18 \cdot 2$ (of $1{,}02^t = 2$) intersect $\Rightarrow$ 35,00.... Dus het verdubbelt in 35 jaar.

```
100+150
              250
2.5^(1/20)
      1.046880235
Ans*100-100
      4.688023498
```

27 $g_{20\text{ jaar}} = 2{,}5 \Rightarrow g_{\text{jaar}} = 2{,}5^{\frac{1}{20}} \approx 1{,}047$. Het groeipercentage per jaar is 4,7 (%).

28 $g_{20\text{ jaar}} = 9 \Rightarrow g_{\text{jaar}} = 9^{\frac{1}{20}} \approx 1{,}116$. Het groeipercentage per jaar is 11,6 (%).

```
9^(1/20)
        1.116123174
Ans*100-100
        11.6123174
```

```
100-95
                  5
0.05^0.1
        .7411344491
Ans*100-100
       -25.88655509
```

29a $g_{10\text{ jaar}} = 0{,}05 \Rightarrow g_{\text{jaar}} = 0{,}05^{\frac{1}{10}} \approx 0{,}741$. De procentuele afname per jaar is 25,9 (%).

```
12^(1/20)
        1.132293625
Ans*100-100
        13.22936253
```

29b $g_{20\text{ jaar}} = 12 \Rightarrow g_{\text{jaar}} = 12^{\frac{1}{20}} \approx 1{,}132$. Het groeipercentage per jaar is 13,2 (%).

29c In 1965: (gebruik 29b) $\frac{14000}{12} \approx 1167$ broedparen $\Rightarrow$ in 1955: (gebruik nu 29a) $\frac{1167}{0{,}05} \approx 23333$ broedparen.

```
14000/12
        1166.666667
Ans/5
        233.3333333
Ans*100
        23333.33333
```

30ab $g_{4\text{ uur}} = \frac{300000}{50000} = \frac{30}{5} = 6 \Rightarrow g_{\text{uur}} = 6^{\frac{1}{4}} \approx 1{,}565$.

```
6^0.25
        1.56508458
```

```
(41/16)^(1/7)
        1.143880228
1600/Ans^3
        1069.001519
```

31 $g_{7\text{ uur}} = \frac{4100}{1600} = \frac{41}{16} \Rightarrow g_{\text{uur}} = (\frac{41}{16})^{\frac{1}{7}} \approx 1{,}144$ met $b \cdot \left((\frac{41}{16})^{\frac{1}{7}}\right)^3 = 1600 \Rightarrow b = \frac{1600}{(\frac{41}{16})^{\frac{3}{7}}} \approx 1070$. Dus $N = 1070 \cdot 1{,}144^t$.

```
(25/3)^(1/6)
        1.423868205
150000/Ans²
        73986.36223
```

32 $g_{6\text{ uur}} = \frac{125}{15} = \frac{25}{3} \Rightarrow g_{\text{uur}} = (\frac{25}{3})^{\frac{1}{6}} \approx 1{,}42$ met $b \cdot \left((\frac{25}{3})^{\frac{1}{6}}\right)^2 = 150\,000 \Rightarrow b = \frac{150000}{(\frac{25}{3})^{\frac{2}{6}}} \approx 74\,000$. Dus $N = 74\,000 \cdot 1{,}42^t$.

```
(0.47/0.6)^(1/3)
        .9218258217
0.60/Ans^5
        .9013778972
```

33 $g_{3\text{ dagen}} = \frac{0{,}47}{0{,}60} \Rightarrow g_{\text{dag}} = (\frac{0{,}47}{0{,}60})^{\frac{1}{3}} \approx 0{,}922$ met $b \cdot \left((\frac{0{,}47}{0{,}60})^{\frac{1}{3}}\right)^5 = 0{,}60 \Rightarrow b = \frac{0{,}60}{(\frac{0{,}47}{0{,}60})^{\frac{5}{3}}} \approx 0{,}90$. Dus $H = 0{,}90 \cdot 0{,}922^t$.

34a $g_{32\text{ jaar}} = \frac{56}{100} = 0{,}56 \Rightarrow g_{\text{jaar}} = 0{,}56^{\frac{1}{32}} \approx 0{,}982$ met $b \cdot \left(0{,}56^{\frac{1}{32}}\right)^{10} = 10\,000 \Rightarrow b = \frac{10000}{0{,}56^{\frac{10}{32}}} \approx 12\,000$.

```
0.56^(1/32)
        .9820438401
10000/Ans^10
        11986.46831
```

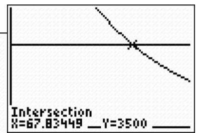
Dus $A = 12\,000 \cdot 0{,}982^t$.

34b $t = 60 \Rightarrow A = 12\,000 \cdot 0{,}982^{60} \approx 4\,000$.

```
12000*0.982^60
        4035.250623
```

```
Plot1 Plot2 Plot3
\Y1=12000*0.982^
X
\Y2=3500
\Y3=
```

```
WINDOW
 Xmin=0
 Xmax=100
 Xscl=0
 Ymin=0
 Ymax=5000
 Yscl=0
↓Xres=1
```



34c $A = 12\,000 \cdot 0{,}982^t = 3500$ intersect $\Rightarrow t \approx 68$. Dus in het jaar $1950 + 68 = 2018$.

```
(19/12)^(1/4)
        1.121742278
120/Ans^6
        60.23136613
```

35 $g_{4\text{ dagen}} = \frac{190}{120} = \frac{19}{12} \Rightarrow g_{\text{dag}} = (\frac{19}{12})^{\frac{1}{4}} \approx 1{,}12$ met $b \cdot \left((\frac{19}{12})^{\frac{1}{4}}\right)^6 = 120 \Rightarrow b = \frac{120}{(\frac{19}{12})^{\frac{6}{4}}} \approx 60$. Dus $H = 60 \cdot 1{,}12^t$.

```
2.5^(1/6)
        1.164993051
1000/Ans^4
        542.8835233
```

36 $g_{6\text{ dagen}} = \frac{2500}{1000} = 2{,}5 \Rightarrow g_{\text{dag}} = 2{,}5^{\frac{1}{6}} \approx 1{,}165$ met $b \cdot \left(2{,}5^{\frac{1}{6}}\right)^4 = 1000 \Rightarrow b = \frac{1000}{2{,}5^{\frac{4}{6}}} \approx 543$. Dus $H = 543 \cdot 1{,}165^t$.

```
315.82/292
        1.081575342
292/Ans^(5/2)
        240.0163942
```

37 $g_{2\text{ jaar}} = \frac{315{,}82}{292} \Rightarrow g_{\text{jaar}} = (\frac{315{,}82}{292})^{\frac{1}{2}}$ met $b \cdot \left((\frac{315{,}82}{292})^{\frac{1}{2}}\right)^5 = 292 \Rightarrow b = \frac{292}{(\frac{315{,}82}{292})^{\frac{5}{2}}} \approx 240$ (€).

```
(11/31)^0.25
        .7718052845
31/Ans^3
        67.42771622
```

38a $g_{4\text{ dagen}} = \frac{11}{31} \Rightarrow g_{\text{dag}} = (\frac{11}{31})^{\frac{1}{4}} \approx 0{,}772$ met $b \cdot \left((\frac{11}{31})^{\frac{1}{4}}\right)^3 = 31 \Rightarrow b = \frac{31}{(\frac{11}{31})^{\frac{3}{4}}} \approx 67$. Dus $H = 67 \cdot 0{,}772^t$.

38b De oorspronkelijke wond had een oppervlakte van 67 mm^2.

38c Na 60 uur is $t = \frac{60}{24} = 2{,}5$ (dagen) $\Rightarrow H = 67 \cdot 0{,}772^{2{,}5} \approx 35$ (mm^2).

```
60/24
                2.5
67*0.772^2.5
        35.08472312
```

```
180/4
                 45
Ans^0.1
        1.46325916
```

39a $g_{10\text{ jaar}} = \frac{180000}{4000} = \frac{180}{4} = 45 \Rightarrow g_{\text{jaar}} = 45^{\frac{1}{10}} \approx 1{,}463$. Dus $H = 4\,000 \cdot 1{,}463^t$.

```
180000-125000
              55000
180000-6/10*5500
0
             147000
```

39b Vanaf 1991 ($\Rightarrow$ vanaf eind 1990) dan nog 10 jaar voor een afname van $180\,000 - 125\,000 = 55\,000$ ton.
In 1996 zou de productie dan $180\,000 - \frac{6}{10} \cdot 55\,000 = 147\,000$ ton zijn.

```
(25/36)^0.1
        .964192504
Ans^6*180000
        144628.8756
```

39c $g_{10\text{ jaar}} = \frac{125000}{180000} = \frac{125}{180} = \frac{25}{36} \Rightarrow g_{\text{jaar}} = (\frac{25}{36})^{\frac{1}{10}}$. In 1996 dan $180\,000 \cdot (\frac{25}{36})^{\frac{6}{10}} \approx 145\,000$ ton.

40 Omdat ${}^{2}\log(8) = 3$ is $2^{{}^{2}\log(8)} = 2^3 = 8$. (onthoud: $\boxed{2^{\cdots}}$ en $\boxed{{}^{2}\log\ldots}$ heffen elkaar op)

$${}^{g}\log(a) + {}^{g}\log(b) = {}^{g}\log(a \cdot b)$$
$${}^{g}\log(a) - {}^{g}\log(b) = {}^{g}\log\left(\tfrac{a}{b}\right)$$
$$n \cdot {}^{g}\log(a) = {}^{g}\log\left(a^n\right)$$
$${}^{g}\log(a) = \frac{\log(a)}{\log(g)}$$

41a ${}^{2}\log(10) + {}^{2}\log(12) = {}^{2}\log(10 \cdot 12) = {}^{2}\log(120)$.

41b ${}^{\frac{1}{2}}\log(60) - {}^{\frac{1}{2}}\log(12) = {}^{\frac{1}{2}}\log\left(\frac{60}{12}\right) = {}^{\frac{1}{2}}\log(5)$.

41c $2 \cdot {}^{3}\log(6) + {}^{3}\log(2) = {}^{3}\log\left(6^2\right) + {}^{3}\log(2) = {}^{3}\log\left(6^2 \cdot 2\right) = {}^{3}\log(36 \cdot 2) = {}^{3}\log(72)$.

41d ${}^{5}\log(50) - 2 \cdot {}^{5}\log(10) = {}^{5}\log(50) - {}^{5}\log\left(10^2\right) = {}^{5}\log\left(\frac{50}{10^2}\right) = {}^{5}\log\left(\frac{50}{100}\right) = {}^{5}\log\left(\frac{1}{2}\right)$.

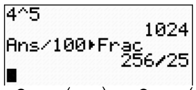
41e $5 \cdot \log(2) - 3 \cdot \log(4) = \log\left(2^5\right) - \log\left(4^3\right) = \log(32) - \log(64) = \log\left(\frac{32}{64}\right) = \log\left(\frac{1}{2}\right)$.

41f ${}^{2}\log(1\,000) - 4 \cdot {}^{2}\log(10) = {}^{2}\log(1\,000) - {}^{2}\log\left(10^4\right) = {}^{2}\log(1\,000) - {}^{2}\log(10\,000) = {}^{2}\log\left(\frac{1000}{10000}\right) = {}^{2}\log\left(\frac{1}{10}\right)$.

42a $3 + {}^{2}\log(5) = {}^{2}\log\left(2^3\right) + {}^{2}\log(5) = {}^{2}\log\left(2^3 \cdot 5\right) = {}^{2}\log(8 \cdot 5) = {}^{2}\log(40)$.

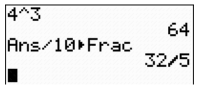
42b $4 + {}^{\frac{1}{2}}\log(50) = {}^{\frac{1}{2}}\log\left((\tfrac{1}{2})^4\right) + {}^{\frac{1}{2}}\log(50) = {}^{\frac{1}{2}}\log\left((\tfrac{1}{2})^4 \cdot 50\right) = {}^{\frac{1}{2}}\log\left(\frac{1}{16} \cdot 50\right) = {}^{\frac{1}{2}}\log\left(\frac{50}{16}\right) = {}^{\frac{1}{2}}\log\left(\frac{25}{8}\right)$.

42c $5 - {}^{4}\log(100) = {}^{4}\log\left(4^5\right) - {}^{4}\log(100) = {}^{4}\log\left(\frac{4^5}{100}\right) = {}^{4}\log\left(\frac{1024}{100}\right) = {}^{4}\log\left(\frac{256}{25}\right)$.



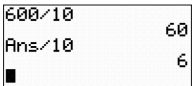
42d ${}^{2}\log(20) - {}^{3}\log(27) = {}^{2}\log(20) - {}^{3}\log\left(3^3\right) = {}^{2}\log(20) - {}^{2}\log\left(2^3\right) = {}^{2}\log\left(\frac{20}{2^3}\right) = {}^{2}\log\left(\frac{20}{8}\right) = {}^{2}\log\left(\frac{5}{2}\right)$.

42e ${}^{5}\log(125) - {}^{4}\log(10) = {}^{5}\log\left(5^3\right) - {}^{4}\log(10) = {}^{4}\log\left(4^3\right) - {}^{4}\log(10) = {}^{4}\log\left(\frac{4^3}{10}\right) = {}^{4}\log\left(\frac{64}{10}\right) = {}^{4}\log\left(\frac{32}{5}\right)$.

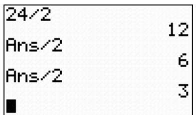


42f $\log(120) - {}^{6}\log(36) = \log(120) - {}^{6}\log\left(6^2\right) = \log(120) - \log\left(10^2\right) = \log\left(\frac{120}{10^2}\right) = \log\left(\frac{120}{100}\right) = \log\left(\frac{6}{5}\right)$.

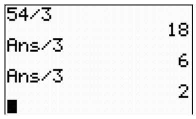
43a $\log(600) = \log\left(10^2 \cdot 6\right) = \log\left(10^2\right) + \log(6) = 2 + \log(6)$.



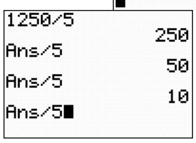
43b ${}^{2}\log(24) = {}^{2}\log\left(2^3 \cdot 3\right) = {}^{2}\log\left(2^3\right) + {}^{2}\log(3) = 3 + {}^{2}\log(3)$.



43c ${}^{3}\log(54) = {}^{3}\log\left(3^3 \cdot 2\right) = {}^{3}\log\left(3^3\right) + {}^{3}\log(2) = 3 + {}^{3}\log(2)$.



43d ${}^{5}\log(1250) = {}^{5}\log\left(5^4 \cdot 2\right) = {}^{5}\log\left(5^4\right) + {}^{5}\log(2) = 4 + {}^{5}\log(2)$.



44 $\log(x) + \log(5) = 2$ (BV = beginvoorwaarde: $x > 0$)
$\log(x \cdot 5) = 2$ (links en rechts $10^{\cdots}$ nemen) $\Rightarrow 5x = 10^2 = 100 \Rightarrow x = \frac{100}{5} = 20$ (> 0 voldoet).

45a ${}^{2}\log(x) + {}^{2}\log(10) = 4$ (BV: $x > 0$)
${}^{2}\log(x \cdot 10) = 4$ (links en rechts $2^{\cdots}$ nemen)
$10x = 2^4 = 16$
$x = \frac{16}{10} = \frac{8}{5}$ (> 0 voldoet).

45b ${}^{3}\log(4x) + {}^{3}\log(5) = 2$ (BV: $4x > 0 \Rightarrow x > 0$)
${}^{3}\log(4x \cdot 5) = 2$ (links en rechts $3^{\cdots}$ nemen)
$20x = 3^2 = 9 \Rightarrow x = \frac{9}{20}$ (> 0 voldoet).

45c ${}^{2}\log(x) = 4 - {}^{2}\log(3)$ (BV: $x > 0$)
${}^{2}\log(x) + {}^{2}\log(3) = 4$
${}^{2}\log(x \cdot 3) = 4$ (links en rechts $2^{\cdots}$ nemen)
$3x = 2^4 = 16 \Rightarrow x = \frac{16}{3}$ (> 0 voldoet).

45d ${}^{4}\log(x) + {}^{4}\log(3) = {}^{4}\log(x+1)$
(BV: $x > 0$ én $x + 1 > 0 \Rightarrow x > 0$ én $x > -1 \Rightarrow x > 0$)
${}^{4}\log(x \cdot 3) = {}^{4}\log(x+1)$
$3x = x + 1 \Rightarrow 2x = 1 \Rightarrow x = \frac{1}{2}$ (> 0 voldoet).

46a ${}^{2}\log(x+6) = 4 - {}^{2}\log(x)$
(BV: $x + 6 > 0$ én $x > 0 \Rightarrow x > -6$ én $x > 0 \Rightarrow x > 0$)
${}^{2}\log(x+6) + {}^{2}\log(x) = 4$
${}^{2}\log((x+6) \cdot x) = 4$ (links en rechts $2^{\cdots}$ nemen)
$x(x+6) = 2^4 = 16 \Rightarrow x^2 + 6x - 16 = 0$
$(x+8)(x-2) = 0$
$x = -8$ (≤ 0 voldoet niet) $\vee$ $x = 2$ (> 0 voldoet).

46b ${}^{\frac{1}{2}}\log(x-2) = -3 - {}^{\frac{1}{2}}\log(x)$
(BV: $x - 2 > 0$ én $x > 0 \Rightarrow x > 2$ én $x > 0 \Rightarrow x > 2$)
${}^{\frac{1}{2}}\log(x-2) + {}^{\frac{1}{2}}\log(x) = -3$
${}^{\frac{1}{2}}\log((x-2) \cdot x) = -3$ (links en rechts $\left(\frac{1}{2}\right)^{\cdots}$ nemen)
$x(x-2) = \left(\frac{1}{2}\right)^{-3} = \left(2^{-1}\right)^{-3} = 2^3 = 8 \Rightarrow x^2 - 2x - 8 = 0$
$(x-4)(x+2) = 0 \Rightarrow x = 4$ (> 2 vold.) $\vee$ $x = -2$ (≤ 2 vold. niet).

46c ${}^3\log(2x+1)-2={}^3\log(x-3)$
(BV: $2x+1>0$ én $x-3>0 \Rightarrow 2x>-1$ én $x>3 \Rightarrow x>3$)
${}^3\log(2x+1)-{}^3\log(x-3)=2$
${}^3\log\left(\frac{2x+1}{x-3}\right)=2$ (links en rechts $3^{\cdots}$ nemen)
$\frac{2x+1}{x-3}=3^2=\frac{9}{1}$
$9(x-3)=2x+1$
$9x-27=2x+1$
$7x=28 \Rightarrow x=\frac{28}{7}=4$ (>3 voldoet).

46d ${}^3\log(2x)=1+{}^3\log(x+1)$
(BV: $2x>0$ én $x+1>0 \Rightarrow x>0$ én $x>-1 \Rightarrow x>0$)
${}^3\log(2x)-{}^3\log(x+1)=1$
${}^3\log\left(\frac{2x}{x+1}\right)=1$ (links en rechts $3^{\cdots}$ nemen)
$\frac{2x}{x+1}=3^1=\frac{3}{1}$
$3(x+1)=2x\cdot 1$
$3x+3=2x$
$x=-3$ (≤ 0 voldoet niet).

47a ${}^{\frac{1}{2}}\log(x+3)=1+{}^{\frac{1}{2}}\log(x+7)$
(BV: $x+3>0$ én $x+7>0 \Rightarrow x>-3$ én $x>-7 \Rightarrow x>-3$)
${}^{\frac{1}{2}}\log(x+3)-{}^{\frac{1}{2}}\log(x+7)=1$
${}^{\frac{1}{2}}\log\left(\frac{x+3}{x+7}\right)=1$ (links en rechts $\left(\frac{1}{2}\right)^{\cdots}$ nemen)
$\frac{x+3}{x+7}=\left(\frac{1}{2}\right)^1=\frac{1}{2}$
$2(x+3)=x+7$
$2x+6=x+7$
$x=1$ (>-3 voldoet).

47b ${}^4\log(3x+4)=3-{}^4\log(x)$
(BV: $3x+4>0$ én $x>0 \Rightarrow 3x>-4$ én $x>0 \Rightarrow x>0$)
${}^4\log(3x+4)+{}^4\log(x)=3$
${}^4\log((3x+4)\cdot x)=3$ (links en rechts $4^{\cdots}$ nemen)
$x(3x+4)=4^3=64$
$3x^2+4x-64=0$ met $D=4^2-4\cdot 3\cdot -64=784$

```
4²-4*3*-64
                 784
```

$x=\frac{-4\pm\sqrt{784}}{2\cdot 3}=\frac{-4\pm 28}{6}$

```
√(784)
                  28
```

$x=\frac{-4-28}{6}$ (≤ 0 vold. niet) $\vee$ $x=\frac{-4+28}{6}=4$ (>0 voldoet).

48a De regel ${}^g\log(a)=\frac{\log(a)}{\log(g)}$.

48b ${}^2\log(25)\approx 4{,}644$; ${}^3\log(100)\approx 4{,}192$;

```
log(25)/log(2)
          4.64385619
log(100)/log(3)
         4.191806549
```

$\frac{1}{{}^5\log(1000)}\approx 0{,}233$ en $\frac{1}{5-{}^2\log(20)}\approx 1{,}475$.

```
1/(log(1000)/log
(5))
        .2329900014
```

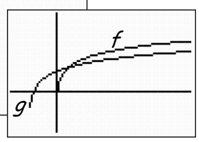
```
1/(5-log(20)/log
(2))
        1.474769847
```

Bestudeer **Theorie C** de standaardgrafiek van $f(x)={}^g\log(x)$. (standaardgrafieken moet je snel kunnen schetsen)

49a $f(x)=g(x) \Rightarrow {}^2\log(6x)=1+{}^2\log(x+3)$
(BV: $6x>0$ én $x+3>0 \Rightarrow x>0$ én $x>-3 \Rightarrow x>0$)
${}^2\log(6x)-{}^2\log(x+3)=1$
${}^2\log\left(\frac{6x}{x+3}\right)=1$ (links en rechts $2^{\cdots}$ nemen)
$\frac{6x}{x+3}=2^1=\frac{2}{1}$
$6x=2(x+3)$
$6x=2x+6$
$4x=6$
$x=\frac{6}{4}=\frac{3}{2}$ (>0 voldoet).
Snijpunt: $\left(\frac{3}{2},\ {}^2\log(9)\right)$.

```
Plot1 Plot2 Plot3
\Y1=log(6X)/log(
2)
\Y2=1+log(X+3)/l
og(2)
\Y3=
```

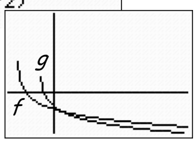
```
WINDOW
 Xmin=-5
 Xmax=15
 Xscl=0
 Ymin=-5
 Ymax=10
 Yscl=0
↓Xres=1
```



49b $f(x)\leq g(x) \Rightarrow 0<x\leq\frac{3}{2}$.
(gebruik de berekening, de BV en de plot)

50a $f(x)=g(x) \Rightarrow {}^{\frac{1}{2}}\log(x+4)=1+{}^{\frac{1}{2}}\log(4x+6)$
(BV: $x+4>0$ én $4x+6>0 \Rightarrow x>-4$ én $4x>-6 \Rightarrow x>-1\frac{1}{2}$)
${}^{\frac{1}{2}}\log(x+4)-{}^{\frac{1}{2}}\log(4x+6)=1$
${}^{\frac{1}{2}}\log\left(\frac{x+4}{4x+6}\right)=1$ (links en rechts $\left(\frac{1}{2}\right)^{\cdots}$ nemen)
$\frac{x+4}{4x+6}=\left(\frac{1}{2}\right)^1=\frac{1}{2}$
$4x+6=2(x+4)$
$4x+6=2x+8$
$2x=2$
$x=\frac{2}{2}=1$ ($>-1\frac{1}{2}$ voldoet).
Snijpunt: $\left(1,\ {}^{\frac{1}{2}}\log(5)\right)$.

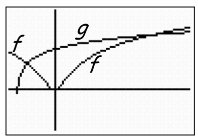
```
Plot1 Plot2 Plot3
\Y1=log(X+4)/log
(1/2)
\Y2=1+log(4X+6)/
log(1/2)
\Y3=
```



50b $f(x)\leq g(x) \Rightarrow -1\frac{1}{2}<x\leq 1$.

51a $f(x)=g(x) \Rightarrow {}^2\log\left(x^2+1\right)=3+{}^2\log\left(x+4\frac{1}{4}\right)$
(BV: $x^2+1>0$ én $x+4\frac{1}{4}>0 \Rightarrow x^2>-1$ én $x>-4\frac{1}{4} \Rightarrow x>-4\frac{1}{4}$)
${}^2\log\left(x^2+1\right)-{}^2\log\left(x+4\frac{1}{4}\right)=3$
${}^2\log\left(\frac{x^2+1}{x+4\frac{1}{4}}\right)=3$ (links en rechts $2^{\cdots}$ nemen)
$\frac{x^2+1}{x+4\frac{1}{4}}=2^3=\frac{8}{1}$
$x^2+1=8(x+4\frac{1}{4})$
$x^2+1=8x+34$
$x^2-8x-33=0$
$(x-11)(x+3)=0$
$x=11$ ($>-4\frac{1}{4}$ voldoet) $\vee$ $x=-3$ ($>-4\frac{1}{4}$ voldoet)
Snijpunten: $\left(11,\ {}^2\log(122)\right)$ en $\left(-3,\ {}^2\log(10)\right)$.

```
Plot1 Plot2 Plot3
\Y1=log(X²+1)/lo
g(2)
\Y2=3+log(X+17/4
)/log(2)
\Y3=
```




```
11²+1
                 122
(-3)²+1
                  10
```

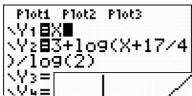
51b $g(x)\leq f(x) \Rightarrow -4\frac{1}{4}<x\leq -3 \vee x\geq 11$.

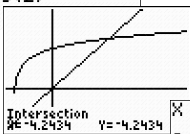
51c $AB=y_B-y_A=g(2)-f(2)=3+{}^2\log\left(2+4\frac{1}{4}\right)-{}^2\log\left(2^2+1\right)$
$={}^2\log\left(2^3\right)+{}^2\log\left(6\frac{1}{4}\right)-{}^2\log(5)={}^2\log\left(\frac{8\cdot 6\frac{1}{4}}{5}\right)={}^2\log(10)$.

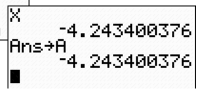
```
8*(6+1/4)
                  50
Ans/5
```

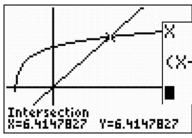
51d $f(x)=5 \Rightarrow {}^2\log\left(x^2+1\right)=5$ (links en rechts $2^{\cdots}$ nemen)
(BV: $x^2+1>0 \Rightarrow x^2>-1$ klopt altijd)
$x^2+1=2^5=32$
$x^2=31$
$x=-\sqrt{31} \vee x=\sqrt{31}.$
$CD=\sqrt{31}--\sqrt{31}=2\sqrt{31}.$

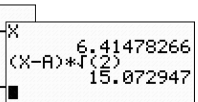
51e $y=x \Rightarrow g(x)=x \Rightarrow 3+{}^2\log\left(x+4\frac{1}{4}\right)=x$ intersect
(BV: $4x+6>0 \Rightarrow 4x>-6 \Rightarrow x>-1\frac{1}{2}$)
geeft $x=y\approx-4{,}2324...$ en $x=y\approx 6{,}4148...$
$EF=\sqrt{(x_F-x_E)^2+(y_F-y_E)^2}$
$=\sqrt{(6{,}4148...--4{,}2324...)^2\cdot 2}$
$=(6{,}4148...--4{,}2324...)\cdot\sqrt{2}\approx 15{,}073.$







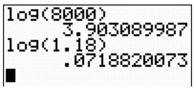




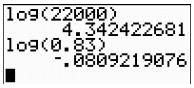
52 $N=200\cdot 1{,}08^t$ (links en rechts log... nemen)
$\log(N)=\log(200\cdot 1{,}08^t)$
$\log(N)=\log(200)+\log(1{,}08^t)$
$\log(N)=\log(200)+t\cdot\log(1{,}08).$

$${}^g\log(a)+{}^g\log(b)={}^g\log(a\cdot b)$$
$$n\cdot{}^g\log(a)={}^g\log\left(a^n\right)$$

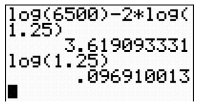
53a $N=8\,000\cdot 1{,}18^t$ (links en rechts log... nemen)
$\log(N)=\log(8\,000\cdot 1{,}18^t)$
$\log(N)=\log(8\,000)+\log(1{,}18^t)$
$\log(N)=\log(8\,000)+t\cdot\log(1{,}18)$
$\log(N)\approx 3{,}90+t\cdot 0{,}0719.$
Dus $\log(N)=0{,}0719\cdot t+3{,}90.$



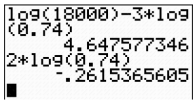
53b $N=22\,000\cdot 0{,}83^t$ (links en rechts log... nemen)
$\log(N)=\log(22\,000\cdot 0{,}83^t)$
$\log(N)=\log(22\,000)+\log(0{,}83^t)$
$\log(N)=\log(22\,000)+t\cdot\log(0{,}83)$
$\log(N)\approx 4{,}34+t\cdot -0{,}0809.$
Dus $\log(N)=-0{,}0809\cdot t+4{,}34.$



53c $N=6\,500\cdot 1{,}25^{t-2}$ (links en rechts log... nemen)
$\log(N)=\log(6\,500\cdot 1{,}25^{t-2})$
$\log(N)=\log(6\,500)+\log(1{,}25^{t-2})$
$\log(N)=\log(6\,500)+(t-2)\cdot\log(1{,}25)$
$\log(N)\approx 3{,}62+t\cdot 0{,}0969.$
Dus $\log(N)=0{,}0969\cdot t+3{,}62.$

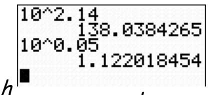


53d $N=18\,000\cdot 0{,}74^{2t-3}$ (links en rechts log... nemen)
$\log(N)=\log(18\,000\cdot 0{,}74^{2t-3})$
$\log(N)=\log(18\,000)+\log(0{,}74^{2t-3})$
$\log(N)=\log(18\,000)+(2t-3)\cdot\log(0{,}74)$
$\log(N)\approx 4{,}65+t\cdot -0{,}2615.$
Dus $\log(N)=-0{,}2615\cdot t+4{,}65.$

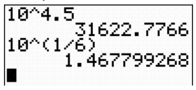


54 $N=b\cdot g^t$ (links en rechts log... nemen)
$\log(N)=\log(b\cdot g^t)$
$\log(N)=\log(b)+\log(g^t)$
$\log(N)=\log(b)+t\cdot\log(g)$
Dus $\log(N)=\log(g)\cdot t+\log(b).$

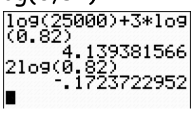
55a $\log(P)=0{,}05h+2{,}14$ (links en rechts $10^{\cdots}$ nemen)
$P=10^{0{,}05h+2{,}14}=10^{0{,}05h}\cdot 10^{2{,}14}=10^{2{,}14}\cdot\left(10^{0{,}05}\right)^h\approx 138\cdot 1{,}12^h.$



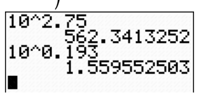
55b $L=6\log(K)-27 \Rightarrow 6\log(K)=L+27 \Rightarrow \log(K)=\frac{1}{6}L+4{,}5$ ($10^{\cdots}$ nemen)
$K=10^{\frac{1}{6}L+4{,}5}=10^{\frac{1}{6}L}\cdot 10^{4{,}5}=10^{4{,}5}\cdot\left(10^{\frac{1}{6}}\right)^L\approx 31\,600\cdot 1{,}47^L.$



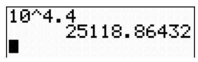
56a $N=25\,000\cdot 0{,}82^{2t+3}$ (links en rechts log... nemen)
$\log(N)=\log(25\,000\cdot 0{,}82^{2t+3})$
$\log(N)=\log(25\,000)+\log(0{,}82^{2t+3})$
$\log(N)=\log(25\,000)+(2t+3)\cdot\log(0{,}82)$
$\log(N)\approx 4{,}14+t\cdot -0{,}1724.$
Dus $\log(N)=-0{,}1724\cdot t+4{,}14.$



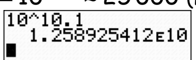
56b
$\log(N)=0{,}193t+2{,}75$ (links en rechts $10^{\cdots}$ nemen)
$N=10^{0{,}193t+2{,}75}=10^{0{,}193t}\cdot 10^{2{,}75}=10^{2{,}75}\cdot\left(10^{0{,}193}\right)^t\approx 562\cdot 1{,}56^t.$



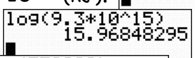
57a $M=2$ geeft (op de horizontale as 1,1 cm $\Rightarrow$) $\log(E)=4{,}4$. Dus $E=10^{4{,}4}\approx 25\,000$ (kJ).



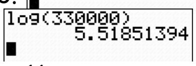
57b $M=5{,}8$ geeft $\log(E)=10{,}1$. Dus $E=10^{10{,}1}\approx 1{,}26\cdot 10^{10}$ (kJ).



57c $E=9{,}3\cdot 10^{15}$ (kJ) $\Rightarrow \log(E)=\log(9{,}3\cdot 10^{15})\approx 16{,}0.$ Dit geeft $M\approx 9{,}8$ op de schaal van Richter.



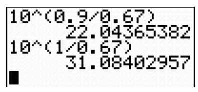
57d $E=330\,000$ (kJ) $\Rightarrow \log(E)=\log(330\,000)\approx 5{,}5.$ Dit geeft $M\approx 2{,}8$ op de schaal van Richter.



57e Neem bijvoorbeeld $E=10^{10}$ en $E=10^6\cdot 10^{10}=10^{16}$.
$E=10^{10}$ (kJ) $\Rightarrow \log(E)=\log(10^{10})=10$ geeft $M\approx 5{,}8$ en
$E=10^{16}$ (kJ) $\Rightarrow \log(E)=\log(10^{16})=16$ geeft $M\approx 9{,}8$.
Dus het klopt voor $E=10^{10}$ en $E=10^{16}$.
Zie de grafiek: als $\log(E)$ met 6 toeneemt, dan neemt M met 4 toe.
Dus de bewering is ook algemeen waar.

57f Uit 57e volgt: als M met 2 toeneemt, dan neemt $\log(E)$ met 3 toe.
Dus de hoeveelheid energie die bij de tweede beving vrijkwam
was $10^3=1000$ keer zoveel als bij de eerste beving.

57g $M=0{,}67\log(E)-0{,}9$
$0{,}67\log(E)=M+0{,}9$
$\log(E)=\frac{1}{0{,}67}M+\frac{0{,}9}{0{,}67}$ ($10^{\cdots}$ nemen)
$E=10^{\frac{1}{0{,}67}M+\frac{0{,}9}{0{,}67}}$
$E=10^{\frac{1}{0{,}67}M}\cdot 10^{\frac{0{,}9}{0{,}67}}$
$E=10^{\frac{0{,}9}{0{,}67}}\cdot\left(10^{\frac{1}{0{,}67}}\right)^M$
$E\approx 22\cdot 31^M.$



58a $t = 1 = 10^0$ geeft $\log(t) = 0$ en $G = 1 = 10^0$ geeft $\log(G) = 0$.
Dus bij $t = 1$ en $G = 1$ hoort $\log(t) = 0$ en $\log(G) = 0$, of in figuur 11.6
het punt $(\log(t), \log(G)) = (0, 0)$ dat inderdaad op de grafiek ligt.

```
log(80)
         1.903089987
log(200000)
         5.301029996
```

58b Na $t = 80$ dagen $G = 200\,000$ ha bos verloren gegaan.
$t = 80 \Rightarrow \log(t) = \log(80) \approx 1{,}9$ en $G = 200\,000 \Rightarrow \log(G) = \log(200\,000) \approx 5{,}3$. Klopt met punt P in de grafiek.

58c De grafiek is een rechte lijn door de oorsprong $\Rightarrow$ een verhoudingstabel.

log(t)	log(80)	log(10) = 1	log(50)
log(G)	log(200000)	...	...

$t = 10 \Rightarrow \log(t) = \log(10) = 1$ en $\log(G) = \frac{1 \cdot \log(200\,000)}{\log(80)} \Rightarrow G \approx 600$ (ha bos).
$t = 50 \Rightarrow \log(t) = \log(50)$ en $\log(G) = \frac{\log(50) \cdot \log(200\,000)}{\log(80)} \Rightarrow G \approx 54\,000$ (ha bos).
Tussen $t = 10$ en $t = 50$ is er $54\,000 - 600 = 53\,400$ ha in vlammen opgegaan.

```
log(200000)/log(
80)
         2.785485727
10^Ans
         610.2190014
```

```
log(50)*log(2000
00)/log(80)
         4.732456697
10^Ans
         54007.8262
```

58d $G = 100 \Rightarrow \log(G) = 2$ en $\log(t) = \frac{2 \cdot \log(80)}{\log(200\,000)} \Rightarrow t \approx 5{,}2$ (dagen na de brand).

log(t)	log(80)	...	...
log(G)	log(200000)	2	5

$G = 100\,000 \Rightarrow \log(G) = 5$ en $\log(t) = \frac{5 \cdot \log(80)}{\log(200\,000)} \Rightarrow t \approx 62{,}4$ (dagen na de brand).
Dus het duurde $62{,}4 - 5{,}2 \approx 57{,}2 \approx 57$ of 58 dagen.

```
2*log(80)/log(20
0000)
         .7180076282
10^Ans
         5.224053647
```

```
5*log(80)/log(20
0000)
         1.79501907
10^Ans
         62.3762225
```

58e $\log(G) = \frac{\log(200000) \cdot \log(t)}{\log(80)} = \frac{\log(200000)}{\log(80)} \cdot \log(t) \approx 2{,}8 \cdot \log(t)$. (met de verhoudingstabel)

58f $\log(G) = 2{,}8 \cdot \log(t)$
$\log(G) = \log(t^{2,8})$ (links en rechts 10^... nemen)
$G = t^{2,8}$.

```
log(200000)/log(
80)
         2.785485727
```

58g $t = 10 \Rightarrow G = 10^{2,8} \approx 630$ (ha bos) en $t = 50 \Rightarrow G = 50^{2,8} \approx 57\,160$ (ha bos).
Vooral de tweede G-waarde wijkt af van de tweede G-waarde in 58c.
Dit komt door de afronding tot 2,8 in de formule van 58f.

```
10^2.8
         630.9573445
50^2.8
         57163.13149
```

```
2.785485727→X
         2.785485727
10^X
         610.2190016
50^X
         54007.82623
```

59a Bij $l = 10$ hoort (lees af op de verticale as) $\log(s) = 1{,}8 \Rightarrow s = 10^{1,8} \approx 63$ (sterfgevallen per 100000 inwoners).

```
10^1.8
         63.09573445
```

59b Bij $l = 20$ hoort (lees af op de verticale as) $\log(s) = 2{,}4 \Rightarrow s = 10^{2,4} \approx 251$ (per 100000 inwoners).

```
10^2.4
         251.1886432
```

59c Bij $l = 0$ hoort (lees af op de verticale as) $\log(s) = 3{,}4 \Rightarrow s = 10^{3,4} \approx 2\,510$ (per 100000 inwoners).
Dus $\frac{2\,510}{100\,000} \times 100\% \approx 2{,}5\%$ van de (nuljarige) baby's sterft binnen een jaar.

```
10^3.4
         2511.886432
Ans/100000*100
         2.511886432
```

59d $s = 126$ geeft $\log(s) \approx 2{,}1$. Teken nu het punt $Q(5;\, 2{,}1)$.

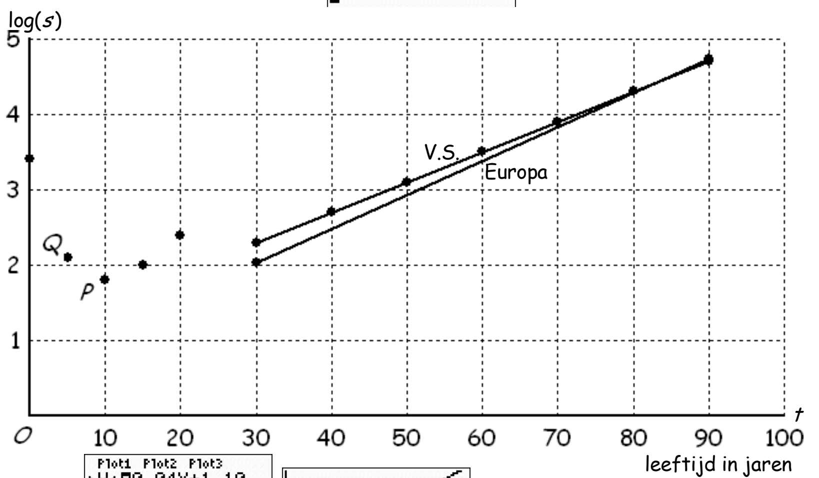
```
log(126)
         2.100370545
```

59e $l = 50$ geeft $\log(s) = 0{,}04 \cdot 50 + 1{,}10 = 3{,}1 \Rightarrow s = 10^{3,1} \approx 1260$.

```
0.04*50+1.10
         3.1
10^3.1
         1258.925412
```

59f $s = 12\,600$ geeft $\log(s) = \log(12\,600) \approx 4{,}10$.
Dus $0{,}04l + 1{,}10 \approx 4{,}10$
$0{,}04l \approx 3{,}00$
$l \approx 75$.
Dus bij 75 jaar.

```
log(12600)
         4.100370545
Ans-1.10
         3.000370545
Ans/0.04
         75.00926363
```



59g $\log(s) = 0{,}04l + 1{,}10$ (links en rechts 10^... nemen)
$s = 10^{0,04l + 1,10}$
$s = 10^{0,04l} \cdot 10^{1,10}$
$s = 10^{1,10} \cdot \left(10^{0,04}\right)^l$
$s \approx 12{,}6 \cdot 1{,}096^l$.

```
10^1.10
         12.58925412
10^0.04
         1.096478196
```

59h Zie de onderste lijn
in de figuur hiernaast.

```
0.045*30+0.68
         2.03
0.045*90+0.68
         4.73
```

59i $0{,}045l + 0{,}68 = 0{,}04l + 1{,}10$ (intersect of)
$0{,}005l = 0{,}42$
$l = \frac{0{,}42}{0{,}005} = 84$.
Dus bij een leeftijd van 84 jaar.

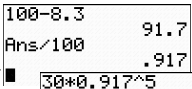
```
1.10-0.68
         .42
Ans/0.005
         84
```

```
Plot1 Plot2 Plot3
\Y1=0.04X+1.10
\Y2=0.045X+0.68
\Y3=
```

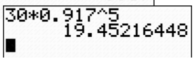
```
WINDOW
 Xmin=0
 Xmax=100
 Xscl=0
 Ymin=0
 Ymax=5
 Yscl=0
↓Xres=1
```

Diagnostische toets

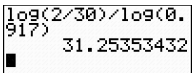
D1a $H = 30 \cdot 0{,}917^t$ (mg met t in dagen).

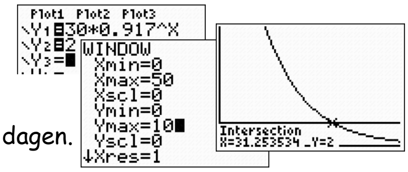


D1b $t = 5 \Rightarrow H = 30 \cdot 0{,}917^t \approx 19{,}45$ (mg).

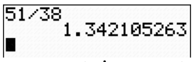


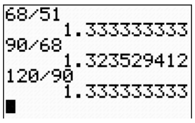
D1c $H = 30 \cdot 0{,}917^t = 2$ (intersect of) $\Rightarrow t = {}^{0{,}917}\log\left(\frac{2}{30}\right) \approx 31{,}3$ (dagen). Dus na 32 dagen.





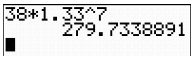
D2a $\frac{51}{38} \approx 1{,}342$; $\frac{68}{51} \approx 1{,}333$; $\frac{90}{68} \approx 1{,}324$ en $\frac{120}{90} \approx 1{,}333$.
De factoren (per 3 jaar) verschillen weinig $\Rightarrow$ er is exponentiële groei.



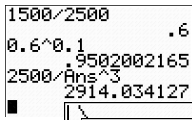


D2b $N = 38 \cdot 1{,}33^t$ (werknemers met t in drietallen jaar en $t = 0$ op 1-1-1990).

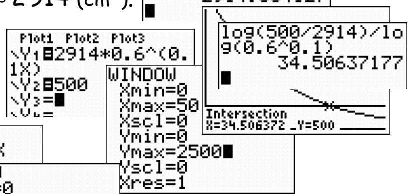
D2c $t = 7$ ($\times 3$ jaar) $\Rightarrow N = 38 \cdot 1{,}33^7 \approx 280$ (werknemers).



D3a $g_{10\text{ uur}} = \frac{1500}{2500} = \frac{15}{25} = 0{,}6 \Rightarrow g_{\text{uur}} = 0{,}6^{\frac{1}{10}}$ met $b \cdot \left(0{,}6^{\frac{1}{10}}\right)^3 = 2500 \Rightarrow b = \frac{2500}{0{,}6^{0{,}3}} \approx 2914$ (cm^3).

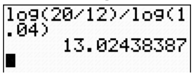


D3b $H = 2914 \cdot \left(0{,}6^{0{,}1}\right)^t = 500$ (intersect of) $\Rightarrow t = {}^{(0{,}6^{0{,}1})}\log\left(\frac{500}{2914}\right) \approx 34{,}5$ (dagen).

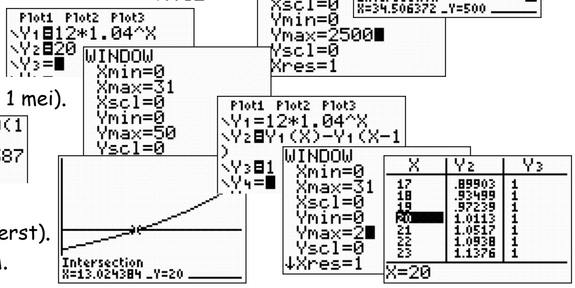


D4a $H = 12 \cdot 1{,}04^t$ (cm met t in dagen na 1 mei).

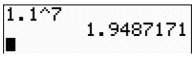
D4b $H = 12 \cdot 1{,}04^t = 20$ (intersect of) $\Rightarrow t = {}^{1{,}04}\log\left(\frac{20}{12}\right) \approx 13{,}02$ (dagen na 1 mei).
Dus op $1 + 13 = 14$ mei is de orchidee 20 cm hoog.



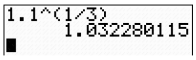
D4c $H(t) - H(t-1)$ (met t geheel) is de groei per dag.
($t = 1$ geeft $H(1) - H(0) \Rightarrow$ de groei op 1 mei).
$H(t) - H(t-1) > 1$ (met t geheel $\Rightarrow$) TABLE geeft $t = 20$ (voor het eerst).
Dus op 20 mei groeide de orchidee voor het eerst meer dan 1 cm.



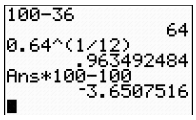
D5a $g_{\text{dag}} = 1{,}10 \Rightarrow g_{\text{week}} = 1{,}10^7$ ($\approx 1{,}949$).



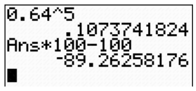
D5b $g_{\text{dag}} = 1{,}10 \Rightarrow g_{8\text{ uur}} = 1{,}10^{\frac{1}{3}}$ ($\approx 1{,}032$).



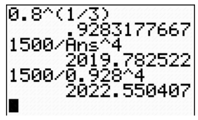
D6a $g_{\text{jaar}} = 0{,}64 \Rightarrow g_{\text{maand}} = 0{,}64^{\frac{1}{12}} \approx 0{,}963$. De afname per maand is 3,7%.



D6b $g_{\text{jaar}} = 0{,}64 \Rightarrow g_{5\text{ jaar}} = 0{,}64^5 \approx 0{,}107$. De afname per 5 jaar is 89,3%.

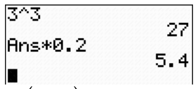


D7 $g_{3\text{ uur}} = \frac{1200}{1500} = \frac{12}{15} = \frac{4}{5} = 0{,}8 \Rightarrow g_{\text{uur}} = 0{,}8^{\frac{1}{3}}$ ($\approx 0{,}928$) met $b \cdot \left(0{,}8^{\frac{1}{3}}\right)^4 = 1500 \Rightarrow b = \frac{1500}{0{,}8^{\frac{4}{3}}} \approx 2020$.
Dus $N = 2020 \cdot 0{,}928^t$ (als men werkt met de afgeronde $g \approx 0{,}928$ krijgt men $N = 2023 \cdot 0{,}928^t$).

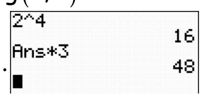


D8a ${}^3\log(5) + 2 \cdot {}^3\log(2) - {}^3\log(7) = {}^3\log(5) + {}^3\log(2^2) - {}^3\log(7) = {}^3\log\left(\frac{5 \cdot 2^2}{7}\right) = {}^3\log\left(\frac{20}{7}\right)$.

D8b $3 + {}^2\log(5) = {}^2\log(2^3) + {}^2\log(5) = {}^2\log(2^3 \cdot 5) = {}^2\log(40)$.



D8c ${}^2\log(8) + {}^3\log(0{,}2) = {}^2\log(2^3) + {}^3\log(0{,}2) = 3 + {}^3\log(0{,}2) = {}^3\log(3^3) + {}^3\log(0{,}2) = {}^2\log(3^3 \cdot 0{,}2) = {}^2\log(5{,}4)$.

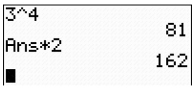


D8d ${}^2\log(3) + {}^{\frac{1}{2}}\log\left(\frac{1}{16}\right) = {}^2\log(3) + {}^{\frac{1}{2}}\log\left(\left(\frac{1}{2}\right)^4\right) = {}^2\log(3) + 4 = {}^2\log(3) + {}^2\log(2^4) = {}^2\log(3 \cdot 2^4) = {}^2\log(48)$.

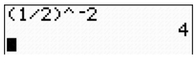
D9a $2 \cdot {}^2\log(x-1) = 1 + {}^2\log(18)$
(BV = beginvoorwaarde: $x - 1 > 0 \Rightarrow x > 1$)
${}^2\log\left((x-1)^2\right) = {}^2\log(2) + {}^2\log(18)$
${}^2\log\left((x-1)^2\right) = {}^2\log(2 \cdot 18)$ (links en rechts $2^{\cdots}$ nemen)
$(x-1)^2 = 36$
$x - 1 = -6 \vee x - 1 = 6$
$x = -5$ (≤ 1 voldoet niet) $\vee$ $x = 7$ (> 1 voldoet).

D9b ${}^2\log(x) = 3 - {}^2\log(x+2)$
(BV: $x > 0$ én $x + 2 > 0 \Rightarrow x > 0$ én $x > -2 \Rightarrow x > -2$)
${}^2\log(x) - {}^2\log(x+2) = {}^2\log(2^3)$
${}^2\log(x \cdot (x+2)) = 3$ (links en rechts $2^{\cdots}$ nemen)
$x(x+2) = 2^3 = 8$
$x^2 + 2x - 8 = 0$
$(x+4)(x-2) = 0$
$x = -4$ (≤ -2 voldoet niet) $\vee$ $x = 2$ (> -2 voldoet).

D9c $^{3}\log(2x)+{}^{2}\log(16)={}^{3}\log(2x+1)$
(BV: $2x>0$ én $2x+1>0 \Rightarrow 2x>0 \Rightarrow x>0$)
$^{3}\log(2x)+{}^{2}\log(2^4)={}^{3}\log(2x+1)$
$^{3}\log(2x)+{}^{3}\log(3^4)={}^{3}\log(2x+1)$
$^{2}\log(2x\cdot 3^4)={}^{3}\log(2x+1)$ (links en rechts $2^{\cdots}$ nemen)
$162x=2x+1$
$160x=1$
$x=\frac{1}{160}$ (>0 voldoet).

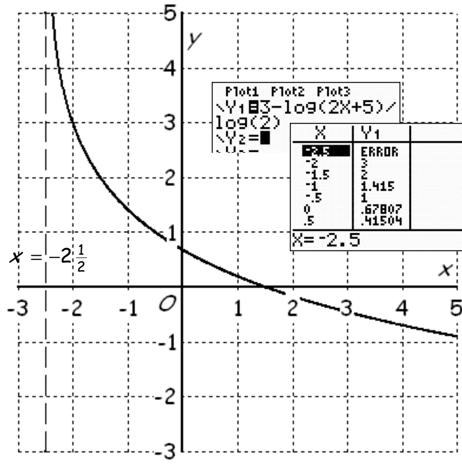


D9d $^{\frac12}\log(2x)+{}^{\frac12}\log(x+1)=-2$
(BV: $2x>0$ én $x+1>0 \Rightarrow x>0$ én $x>-1 \Rightarrow x>-1$)
$^{\frac12}\log(2x(x+1))=-2$ (links en rechts $(\frac12)^{\cdots}$ nemen)
$2x(x+1)=\left(\frac12\right)^{-2}=\left(2^{-1}\right)^{-2}=2^2=4$
$2x^2+2x=4$
$x^2+x-2=0$
$(x+2)(x-1)=0$
$x=-2$ (≤ -1 voldoet niet) $\vee$ $x=1$ (>-1 voldoet).

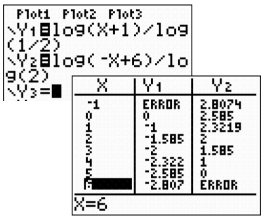


D10a $f(x)=3-{}^{2}\log(2x+5)$ (BV: $2x+5>0 \Rightarrow 2x>-5 \Rightarrow x>-2\frac12$).
Zie de grafiek hiernaast. (gebruik TABLE)

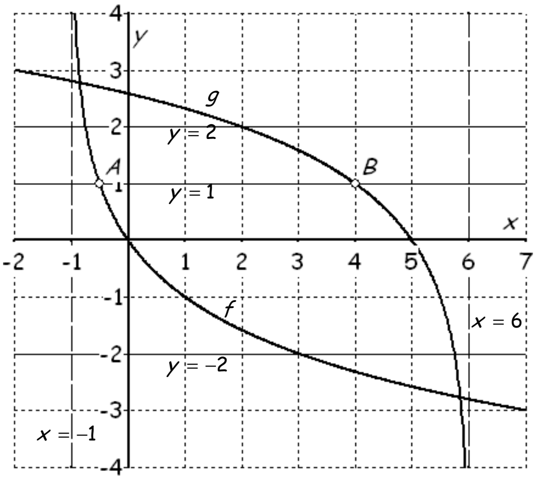
D10b $f(x)=-2$ (BV: $x>-2\frac12$)
$3-{}^{2}\log(2x+5)=-2$
$-{}^{2}\log(2x+5)=-5$
$^{2}\log(2x+5)=5$ (links en rechts $2^{\cdots}$ nemen)
$2x+5=2^5=32$
$2x=27$
$x=\frac{27}{2}=13\frac12$ ($>-2\frac12$ voldoet).
$f(x)\ge -2$ (zie grafiek) $\Rightarrow -2\frac12<x\le 13\frac12$.



D11a $f(x)={}^{\frac12}\log(x+1)$ (BV: $x+1>0 \Rightarrow x>-1$).
$g(x)={}^{2}\log(-x+6)$ (BV: $-x+6>0 \Rightarrow -x>-6 \Rightarrow x<6$).
Zie de grafiek hiernaast. (gebruik TABLE)



D11b $f(x)=4$ (BV (zie 11a): $x>-1$)
$^{\frac12}\log(x+1)=4$ (links en rechts $(\frac12)^{\cdots}$ nemen)
$x+1=\left(\frac12\right)^4=\frac{1}{16}$
$x=-\frac{15}{16}$ (>-1 voldoet).

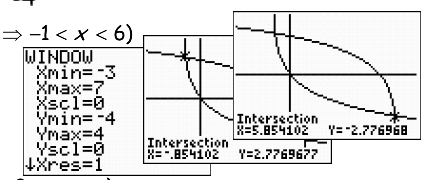


D11c $f(x)=-2$ (BV: $x>-1$)
$^{\frac12}\log(x+1)=-2$
$x+1=\left(\frac12\right)^{-2}=\left(2^{-1}\right)^{-2}=2^2=4$
$x=3$ (>-1 voldoet).
$-2\le f(x)\le 2$ (zie grafiek) $\Rightarrow -\frac34\le x\le 3$.

en

$f(x)=2$ (BV: $x>-1$)
$^{\frac12}\log(x+1)=2$
$x+1=\left(\frac12\right)^2=\frac14$
$x=-\frac34$ (>-1 voldoet).

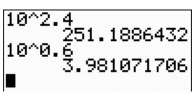
D11d $f(x)=g(x)$ (BV : $x+1>0$ én $-x+6>0 \Rightarrow x>-1$ én $-x>-6 \Rightarrow x>-1$ én $x<6 \Rightarrow -1<x<6$)
$^{\frac12}\log(x+1)={}^{2}\log(-x+6)$ intersect geeft $x\approx -0{,}85$ en $x\approx 5{,}85$.
$f(x)\le g(x)$ (gebruik de grafiek/plot) $\Rightarrow -0{,}85\le x\le 5{,}85$.



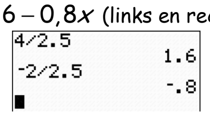
D11e $f(x)=1$ (BV: $x>-1$)
$^{\frac12}\log(x+1)=1$ (links en rechts $(\frac12)^{\cdots}$ nemen)
$x+1=\left(\frac12\right)^1=\frac12$
$x_A=-\frac12$ (>-1 voldoet).

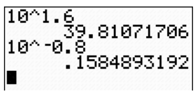
$g(x)=1$ (BV: $x<6$)
$^{2}\log(-x+6)=1$ (links en rechts $2^{\cdots}$ nemen)
$-x+6=2^1=2$
$-x=-4$
$x_B=4$ (>-1 voldoet). Nu is $AB=x_B-x_A=4--\frac12=4\frac12$.

D12a $\log(W)=0{,}6t+2{,}4$ (links en rechts $10^{\cdots}$ nemen)
$W=10^{0{,}6t+2{,}4}$
$W=10^{0{,}6t}\cdot 10^{2{,}4}$
$W=10^{2{,}4}\cdot\left(10^{0{,}6}\right)^t$
$W\approx 251\cdot 4{,}0^t$.

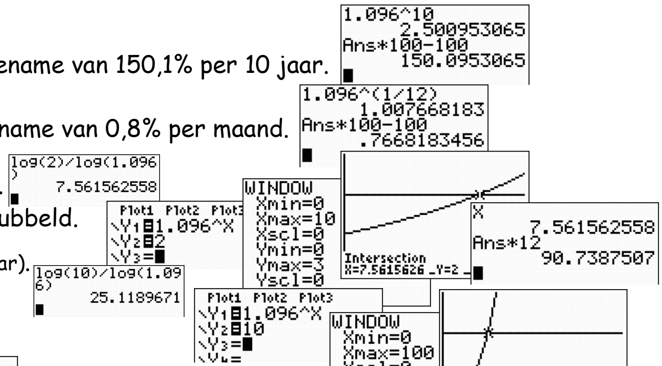


D12b $2x+2{,}5\log(y)=4$
$2{,}5\log(y)=4-2x$
$\log(y)=\frac{4}{2{,}5}-\frac{2x}{2{,}5}=1{,}6-0{,}8x$ (links en rechts $10^{\cdots}$ nemen)
$y=10^{1{,}6-0{,}8x}$
$y=10^{1{,}6}\cdot 10^{-0{,}8x}$
$y=10^{1{,}6}\cdot\left(10^{-0{,}8}\right)^x$
$y\approx 39{,}8\cdot 0{,}2^x$.





Gemengde opgaven 11. Groei

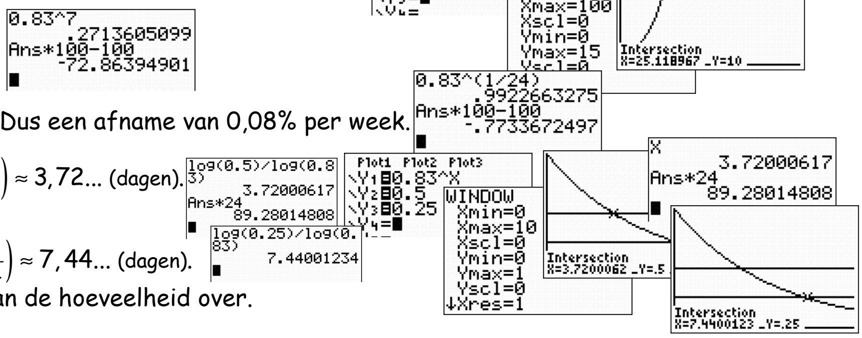


G21a $g_{\text{jaar}} = 1{,}096 \Rightarrow g_{10\text{ jaar}} = 1{,}096^{10} \approx 2{,}501$. Dus een toename van 150,1% per 10 jaar.

G21b $g_{\text{jaar}} = 1{,}096 \Rightarrow g_{\text{maand}} = 1{,}096^{\frac{1}{12}} \approx 1{,}008$. Dus een toename van 0,8% per maand.

G21c $1{,}096^t = 2$ (intersect of) $\Rightarrow t = {}^{1{,}096}\log(2) \approx 7{,}56...$ (jaar).
Dus na $7{,}56... \cdot 12 \approx 91$ maanden is de hoeveelheid verdubbeld.

G21d $1{,}096^t = 10$ (intersect of) $\Rightarrow t = {}^{1{,}096}\log(10) \approx 25{,}11...$ (jaar).
Na ruim 25 jaar is de hoeveelheid verdubbeld.

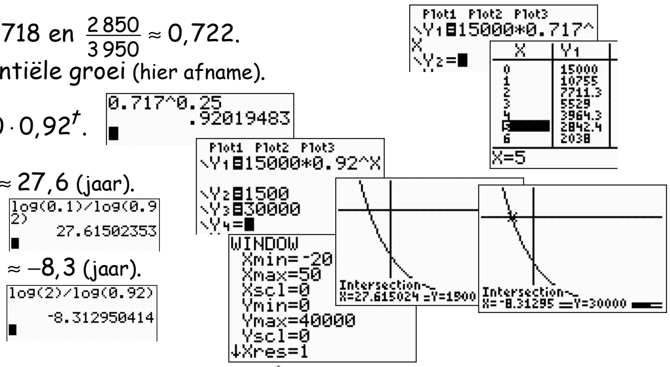


G22a $g_{\text{dag}} = 0{,}83 \Rightarrow g_{\text{week}} = 0{,}83^7 \approx 0{,}271$.
Dus een afname van 72,9% per week.

G22b $g_{\text{dag}} = 0{,}83 \Rightarrow g_{\text{uur}} = 0{,}83^{\frac{1}{24}} \approx 0{,}992$. Dus een afname van 0,08% per week.

G22c $0{,}83^t = \frac{1}{2}$ (intersect of) $\Rightarrow t = {}^{0{,}83}\log\left(\frac{1}{2}\right) \approx 3{,}72...$ (dagen).
Dit is na $(3{,}72... \cdot 24 \approx 89{,}3)$ ruim 89 uur.

G22d $0{,}83^t = \frac{1}{4}$ (intersect of) $\Rightarrow t = {}^{0{,}83}\log\left(\frac{1}{4}\right) \approx 7{,}44...$ (dagen).
Dus na ruim 7 dagen is er een kwart van de hoeveelheid over.

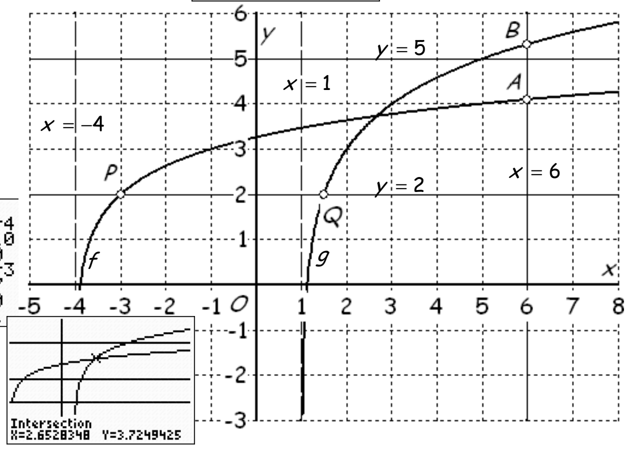


G23a $\frac{10\,750}{15\,000} \approx 0{,}717$; $\frac{7\,700}{10\,750} \approx 0{,}716$; $\frac{5\,500}{7\,700} \approx 0{,}714$; $\frac{3\,950}{5\,500} \approx 0{,}718$ en $\frac{2\,850}{3\,950} \approx 0{,}722$.
De factoren (per 4 jaar) verschillen weinig $\Rightarrow$ er is exponentiële groei (hier afname).

G23b $g_{4\text{ jaar}} \approx 0{,}717 \Rightarrow g_{\text{jaar}} = 0{,}717^{\frac{1}{4}} \approx 0{,}92$. Dus $N = 15\,000 \cdot 0{,}92^t$.

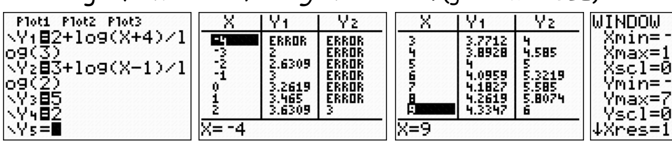
G23c $N = 15\,000 \cdot 0{,}92^t = 1500$ (intersect of) $\Rightarrow t = {}^{0{,}92}\log\left(\frac{1}{10}\right) \approx 27{,}6$ (jaar).
Dus voor het eerst op 1 september $1980 + 28 = 2008$.

G23d $N = 15\,000 \cdot 0{,}92^t = 30\,000$ (intersect of) $\Rightarrow t = {}^{0{,}92}\log(2) \approx -8{,}3$ (jaar).
Dus voor het laatst op 1 september $1980 - 9 = 1971$.



G24a $f(x) = 2 + {}^3\log(x+4)$ (BV: $x + 4 > 0 \Rightarrow x > -4$).
$B_f = \langle -4, \rightarrow \rangle$ en de verticale asymptoot van f is $x = -4$.
$g(x) = 3 + {}^2\log(x-1)$ (BV: $x - 1 > 0 \Rightarrow x > 1$).
$B_g = \langle 1, \rightarrow \rangle$ en de verticale asymptoot van g is $x = 1$.

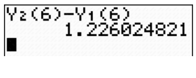
G24b Zie de grafieken van f en g hiernaast. (gebruik TABLE)



G24c $f(x) = g(x)$ (BV : $x + 4 > 0$ én $x - 1 > 0 \Rightarrow x > -4$ én $x > 1 \Rightarrow x > 1$)
$2 + {}^3\log(x+4) = 3 + {}^2\log(x-1)$ intersect geeft $x \approx 2{,}65$.
$f(x) \ge g(x)$ (gebruik de grafiek/plot) $\Rightarrow 1 < x \le 2{,}65$.

G24d $f(x) = 5$ (BV: $x > -4$)
$2 + {}^3\log(x+4) = 5$
${}^3\log(x+4) = 3$ (links en rechts 3$^{...}$ nemen)
$x + 4 = 3^3 = 27$
$x = 23$.
$f(x) \le 5$ (zie de grafiek/plot) $\Rightarrow -4 < x \le 25$

G24e $AB = y_B - y_A = g(6) - f(6) \approx 1{,}23$.



G24f $f(x) = 2$ (BV: $x > -4$)
$2 + {}^3\log(x+4) = 2$ (intersect of)
${}^3\log(x+4) = 0$ (3$^{...}$ nemen)
$x + 4 = 3^0 = 1$
$x_P = -3$.

$g(x) = 2$ (BV: $x > 1$)
$3 + {}^2\log(x-1) = 2$ (intersect of)
${}^2\log(x-1) = -1$ (2$^{...}$ nemen)
$x - 1 = 2^{-1} = \frac{1}{2}$
$x_Q = 1\frac{1}{2}$.

$PQ = x_Q - x_P = 1\frac{1}{2} - -3 = 1\frac{1}{2} + 3 = 4\frac{1}{2}$.

G25a $y = {}^2\log(x) \xrightarrow{\text{translatie }(1,0)} f(x) = {}^2\log(x-1)$.
$y = {}^2\log(x) \xrightarrow{\text{spiegelen in de } x\text{-as}} y = -{}^2\log(x) \xrightarrow{\text{translatie }(-1,2)} g(x) = 2 - {}^2\log(x+1)$.

G25b $f(x) = {}^2\log(x-1) = \frac{1}{2}$ (2^... nemen) en $g(x) = 2 - {}^2\log(x+1) = \frac{1}{2}$

$x - 1 = 2^{\frac{1}{2}} = \sqrt{2}$

$x_A = 1 + \sqrt{2}$.

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

${}^2\log(x+1) = 1\frac{1}{2}$ (links en rechts 2^... nemen)

$x + 1 = 2^{1\frac{1}{2}} = 2^1 \cdot 2^{\frac{1}{2}} = 2 \cdot \sqrt{2}$

$x_B = -1 + 2\sqrt{2}$. Dus $AB = -1 + 2\sqrt{2} - (1 + \sqrt{2}) = -1 + 2\sqrt{2} - 1 - \sqrt{2} = \sqrt{2} - 2$.

G26a De tweede coördinaat van punt P is ongeveer 0,2. Dus $\log(D) = 0,2 \Rightarrow D = 10^{0,2} \approx 1,6$ (m).

```
10^0.2
        1.584893192
```

G26b $\log(2,5) = -2 + 1,5\log(H)$

$1,5\log(H) = 2 + \log(2,5)$

$\log(H) = \frac{2 + \log(2,5)}{1,5}$ (links en rechts 10^... nemen)

$H = 10^{...} \approx 40$ (m).

```
2+log(2.5)
        2.397940009
Ans/1.5
        1.598626672
10^Ans
        39.6850263
```

G26c $\log(D) = -2 + 1,5\log(H)$

$\log(D) = \log(10^{-2}) + \log(H^{1,5})$

$\log(D) = \log(10^{-2} \cdot H^{1,5})$ (links en rechts 10^... nemen)

$D = \frac{1}{100} \cdot H^{1,5}$. Dus $p = \frac{1}{100}$ en $q = 1,5$

G27a $g_{week} = 0,30 \Rightarrow g_{dag} = 0,30^{\frac{1}{7}} \approx 0,842$.

```
0.30^(1/7)
        .8419824443
```

G27b 40% is afgebroken $\Rightarrow$ 60% is nog over.

$0,842^t = 0,60$ (intersect of links en rechts ${}^{0,842}\log...$ nemen)

$t = {}^{0,842}\log(0,6) \approx 2,97$ (dagen). Dit is na (ongeveer) 71 uur.

```
log(0.6)/log(0.8
42)
        2.970343581
Ans*24
        71.28824595
```

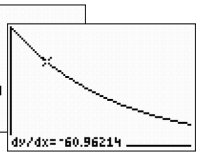
G27c $M(t) = 500 \cdot 0,842^t$ (optie $\frac{dy}{dx}$) $\Rightarrow M'(2) = \left[\frac{dM}{dt}\right]_{t=2} \approx -60,96$ (mg/dag).

De afbraaksnelheid is $\frac{60,96}{24} \approx 2,5$ mg/uur.

```
Plot1 Plot2 Plot3
\Y1=500*0.842^X
\Y2=
```

```
nDeriv(Y1,X,2)
        -60.9621361
Ans/24
        -2.540089004
```

```
WINDOW
 Xmin=0
 Xmax=10
 Xscl=0
 Ymin=0
 Ymax=500
 Yscl=0
↓Xres=1
```



G27d Na 1 week is er $0,3 \cdot 500 = 150$ mg over.

Op $t = 7$ (na 1 week) direct na de nieuwe inname is $M(t) = 150 + 500 = 650$ (mg).

Op $t = 10$ is $M(10) = 650 \cdot 0,842^3 \approx 388$ (mg).

```
0.3*500
              150
Ans+500
              650
Ans*0.842^3
      388.0159972
```

G27e Op $t = 14$ (na 2 weken) direct na de inname is $M(t) = 0,3 \cdot 650 + 500 = 695$ (mg).

Dus voor $14 < t < 21$ is de formule $M(10) = 695 \cdot 0,842^{t-14}$.

```
0.3*650
              195
Ans+500
              695
```

G28a Het aantal is $4500 \cdot 2^{\frac{1}{2}} \approx 6400$.

```
4500*2^0.5
        6363.961031
```

t	8	4	2	1	$\frac{1}{2}$	$\frac{1}{4}$
L	80	83	86	89	92	95

G28b Voor Europa gelden de waarden in de tabel hierboven. Dus teken in het werkboek de lijn door $(\frac{1}{4}, 95)$ en $(8, 80)$.

G28c $L_{Amerika} = -16,6 \cdot \log(6) + 105 \approx 92$ (dB).

Voor Europa is de overschrijding dan $92 - 80 = 12 = 4 \cdot 3$ (dB).

In Europa mag (maximaal) $8 : 2 : 2 : 2 : 2 = \frac{1}{2}$ uur gewerkt worden.

```
-16.6log(6)+105
        92.08268924
Ans-80
        12.08268924
8/2/2/2/2
                 .5
```

G28d $L = -16,6 \cdot \log(t) + 105 \Rightarrow 16,6 \cdot \log(t) = 105 - L \Rightarrow \log(t) = \frac{105}{16,6} - \frac{L}{16,6}$ (links en rechts 10^... nemen)

$t = 10^{\frac{105}{16,6} - \frac{L}{16,6}} = 10^{\frac{105}{16,6}} \cdot 10^{-\frac{L}{16,6}} = 10^{\frac{105}{16,6}} \cdot \left(10^{-\frac{1}{16,6}}\right)^L \approx 2115000 \cdot 0,87^L$.

```
10^(105/16.6)
        2114955.358
10^(-1/16.6)
        .8704804787
```

G29a In figuur G.25 aflezen: bij $t = 10$ (1-1-1995) hoort $\log(N) \approx 7,23 \Rightarrow N = 10^{7,23} \approx 17,0 \cdot 10^6$.

De procentuele toename is $\frac{17,0 \cdot 10^6 - 12,9 \cdot 10^6}{12,9 \cdot 10^6} \cdot 100\% \approx 32\%$.

```
10^7.11
        12882495.52
10^7.23
        16982436.52
(17-12.9)/12.9*1
00
        31.78294574
```

G29b Verdubbeling $\Rightarrow N = 2 \cdot 12,9 \cdot 10^6 \Rightarrow \log(N) \approx 7,41$.

```
log(2*12.9*10^6
        7.411619706
```

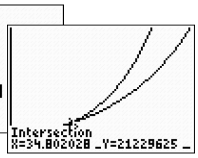
Trek in de grafiek de denkbeeldige lijn door tot $\log(N) \approx 7,41$. Je vindt dan $t \approx 25$. Dus in $1985 + 25 = 2010$.

G29c $9300000 \cdot 1,024^t = 6200000 \cdot 1,036^t$ (intersect) $\Rightarrow t \approx 35$.

Dus vanaf $1985 + 35 = 2020$.

```
Plot1 Plot2 Plot3
\Y1=9300000*1.02
4^X
\Y2=6200000*1.03
6^X
\Y3=
```

```
WINDOW
 Xmin=0
 Xmax=100
 Xscl=0
 Ymin=0
 Ymax=10^8
 Yscl=0
↓Xres=1
```



G30a De paaistand is in 1978 lager dan in 1972 maar de vangstpercentages zijn even groot.

Dus is in 1978 minder kabeljauw gevangen dan in 1972.

G30b $g_{10\ jaar} = \frac{65000}{150000} \Rightarrow$ de paaistand in 1990 is $150000 \cdot \left(\frac{65000}{150000}\right)^{\frac{7}{10}} \approx 83535$ ton kabeljauw.

```
150000*(65000/15
0000)^0.7
        83534.66348
```

G30c $\log(150000) = 4,82 + 0,11t \Rightarrow \log(150000) - 4,82 = 0,11t \Rightarrow t = \frac{\log(150000) - 4,82}{0,11} \approx 3,24$.

Dus na 3 jaar zou de paaistand voor het eerst weer boven de 150000 ton komen te liggen.

```
log(150000)-4.82
        .3560912591
Ans/0.11
        3.237193264
```