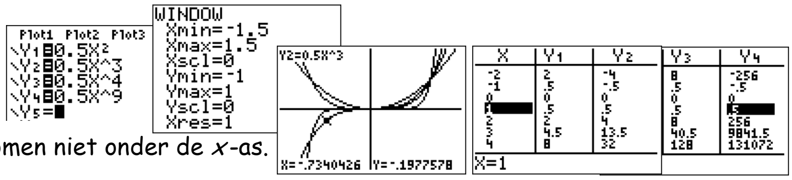
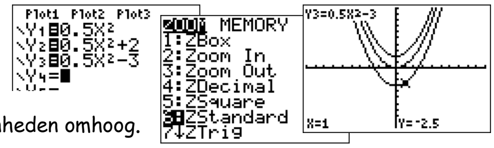


1a Zie de plot hiernaast.

1b Alle grafiek gaan door $O(0,0)$ en $(1;0{,}5)$.

1c De grafieken van $y = 0{,}5x^2$ en $y = 0{,}5x^6$ komen niet onder de x-as.

1d De grafieken van $y = 0{,}5x^2$ en $y = 0{,}5x^6$ hebben de y-as als symmetrieas.



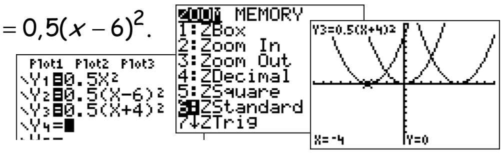
2a Zie de plot hiernaast.

2b $y_1 = 0{,}5x^2 \xrightarrow[\text{(2 omhoog)}]{\text{translatie }(0,2)} y_2 = 0{,}5x^2 + 2.$

Translatie $(0,2)$ is een verschuiving van 0 naar rechts en 2 eenheden omhoog.

2c $y_1 = 0{,}5x^2 \xrightarrow[\text{(3 omlaag)}]{\text{translatie }(0,-3)} y_3 = 0{,}5x^2 - 3.$

2d $y = 0{,}5x^2 \xrightarrow[\text{(6 omhoog)}]{\text{translatie }(0,6)} y = 0{,}5x^2 + 6.$



3a Zie de plot hiernaast; $y_1 = 0{,}5x^2 \xrightarrow[\text{(6 naar rechts)}]{\text{translatie }(6,0)} y_2 = 0{,}5(x-6)^2.$

3b $y_1 = 0{,}5x^2 \xrightarrow[\text{(4 naar links)}]{\text{translatie }(-4,0)} y_3 = 0{,}5(x+4)^2.$

3c $y = 0{,}5x^2 \xrightarrow[\text{(2 naar rechts)}]{\text{translatie }(2,0)} y = 0{,}5(x-2)^2.$

4a $y = -5(x-2)^2 + 5;$ $y = -5(x+3)^2 + 6;$ $y = -5(x-7)^2.$

4b $y = 4(x+5)^5 + 7;$ $y = 4x^5 - 10;$ $y = 4(x-320)^5 + 50.$

5a $y = 5(x-4)^2 + 1 + 6 = 5(x-4)^2 + 7.$

5b $y = (x-6-4)^3 + 6 = (x-10)^3 + 6.$

5c $y = -(x-4)^4 + 2 + 6 = -(x-4)^4 + 8.$

5d $y = 3(x-5-4)^6 + 8 + 6 = 3(x-9)^6 + 14.$

5e $y = -2(x+4-4)^5 + 6 + 6 = -2x^5 + 12.$

5f $y = -2(x-4-4)^2 - 6 + 6 = -2(x-8)^2.$

6a $y = 5(x-8)^6 - 3.$

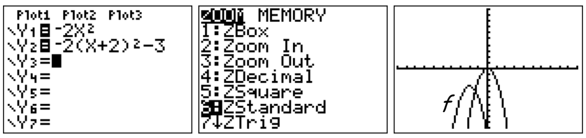
6b $y = -3(x+4)^4 + 6.$

6c $y = 2(x-3-5)^2 = 2(x-8)^2.$

6d $y = -5(x-1-2)^3 + 8 - 7 = -5(x-3)^3 + 1.$

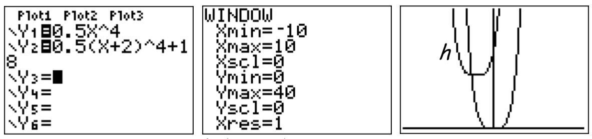
6e $y = (x+8)^5 + 6 - 3 = (x+8)^5 + 3.$

6f $y = -(x-7)^4 - 8.$

7a 

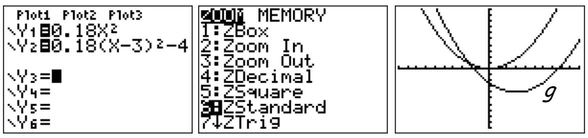
$y = -2x^2 \xrightarrow{\text{transl. }(-2,-3)} f(x) = -2(x+2)^2 - 3.$

max. $y(0) = 0$ max. $f(-2) = -3.$

7c 

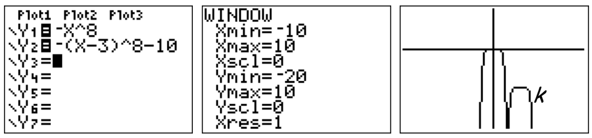
$y = 0{,}5x^4 \xrightarrow{\text{transl. }(-2,18)} h(x) = 0{,}5(x+2)^4 + 18.$

min. $y(0) = 0$ min. $h(-2) = 18.$

7b 

$y = 0{,}18x^2 \xrightarrow{\text{transl. }(3,-4)} g(x) = 0{,}18(x-3)^2 - 4.$

min. $y(0) = 0$ min. $g(3) = -4.$

7d 

$y = -x^8 \xrightarrow{\text{transl. }(3,-10)} k(x) = -(x-3)^8 - 10.$

max. $y(0) = 0$ max. $k(3) = -10.$

8a $y = -3x^2 \xrightarrow{\text{transl. }(5,8)} f(x) = -3(x-5)^2 + 8 \Rightarrow \text{max. } f(5) = 8.$

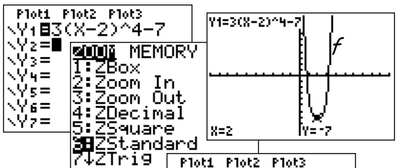
8b $y = 5x^2 \xrightarrow{\text{transl. }(0,7)} g(x) = 5x^2 + 7 \Rightarrow \text{min. } g(0) = 7.$

8c $y = 2x^2 \xrightarrow{\text{transl. }(-8,0)} h(x) = 2(x+8)^2 \Rightarrow \text{min. } h(-8) = 0.$

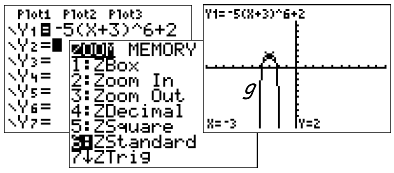
8d $y = 6x^2 \xrightarrow{\text{transl. }(8,12)} k(x) = 6(x-8)^2 + 12 \Rightarrow \text{min. } k(8) = 12.$

8e $y = -0{,}5x^2 \xrightarrow{\text{transl. }(100,0)} l(x) = -0{,}5(x-100)^2 \Rightarrow \text{max. } l(100) = 0.$

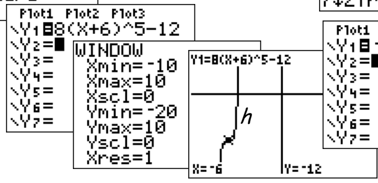
8f $y = -0{,}4x^2 \xrightarrow{\text{transl. }(-0{,}15;-0{,}3)} m(x) = -0{,}4(x+0{,}15)^2 - 0{,}3 \Rightarrow \text{max. } m(-0{,}15) = -0{,}3.$



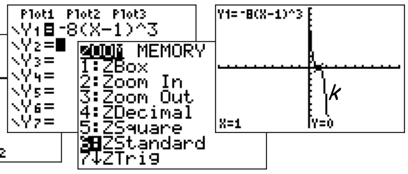
9a $f(x)=3(x-2)^4-7 \Rightarrow$ top $(2,\ -7)$.
(maak een schets van de plot)



9b $g(x)=-5(x+3)^6+2 \Rightarrow$ top $(-3, 2)$.
(maak een schets van de plot)

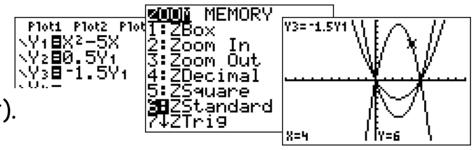


9c $h(x)=8(x+6)^5-12 \Rightarrow$ punt van symm. $(-6,\ -12)$.
(maak een schets van de plot)



9d $k(x)=-8(x-1)^3 \Rightarrow$ punt van symm. $(1, 0)$.
(maak een schets van de plot)

10a Zie de plot hiernaast.



10b $y_1=x^2-5x \xrightarrow{y\text{-waarden met 0,5 vermenigvuldigen}} y_2=0{,}5(x^2-5x)$.
$y_1=x^2-5x \xrightarrow{y\text{-waarden met }-1{,}5\text{ vermenigvuldigen}} y_3=-1{,}5(x^2-5x)$.

11a $y=0{,}3x^2 \xrightarrow{\text{transl. }(-5,6)} y=0{,}3(x+5)^2+6 \xrightarrow{\text{verm. t.o.v. de }x\text{-as met }-3} y=-0{,}9(x+5)^2-18$.
top $(0, 0)$ — top $(-5, 6)$ — top $(-5,\ -18)$

11b $y=0{,}5x^4 \xrightarrow{\text{verm. t.o.v. de }x\text{-as met }-4} y=-2x^4 \xrightarrow{\text{transl. }(-3,5)} y=-2(x+3)^4+5$.
top $(0, 0)$ — top $(0, 0)$ — top $(-3, 5)$

11c $y=-3x^5+4 \xrightarrow{\text{transl. }(2,-7)} y=-3(x-2)^5-3 \xrightarrow{\text{verm. t.o.v. de }x\text{-as met }6} y=-18(x-2)^5-18$.
punt van symm. $(0, 4)$ — punt van symm. $(2,\ -3)$ — punt van symm. $(2,\ -18)$

12a $y=-0{,}12x^2 \xrightarrow{\text{transl. }(4,5)} y=-0{,}12(x-4)^2+5 \xrightarrow{\text{verm. t.o.v. de }x\text{-as met }4} y=-0{,}48(x-4)^2+20$.
top $(0, 0)$ — top $(4, 5)$ — top $(4, 20)$

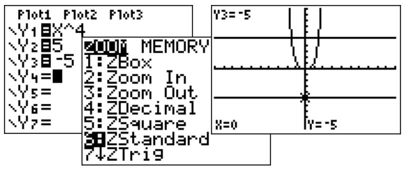
12b $y=5x^4 \xrightarrow{\text{verm. t.o.v. de }x\text{-as met }-2} y=-10x^4 \xrightarrow{\text{transl. }(6,0)} y=-10(x-6)^4$.
top $(0, 0)$ — top $(0, 0)$ — top $(6, 0)$

12c $y=3(x-4)^2-8 \xrightarrow{\text{transl. }(-5,2)} y=3(x+1)^2-6 \xrightarrow{\text{verm. t.o.v. de }x\text{-as met }-4} y=-12(x+1)^2+24$.
top $(4,\ -8)$ — top $(-1,\ -6)$ — top $(-1, 24)$

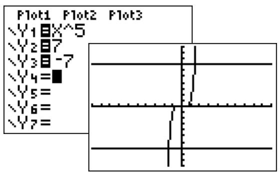
12d $y=-1{,}5(x+3)^3+8 \xrightarrow{\text{verm. t.o.v. de }x\text{-as met }-2} y=3(x+3)^3-16 \xrightarrow{\text{transl. }(8,20)} y=3(x-5)^3+4$.
punt van symm. $(-3, 8)$ — punt van symm. $(-3,\ -16)$ — punt van symm. $(5, 4)$

13a Spiegelen in de x-as komt op hetzelfde neer als verm. t.o.v. de x-as met -1. (de y-coördinaten tegengesteld nemen)

13b $y=3(x-1)^2-6 \xrightarrow[\text{(spiegel in de }x\text{-as)}]{\text{verm. t.o.v. de }x\text{-as met }-1} y=-3(x-1)^2+6$.

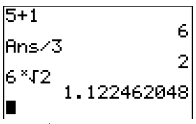


14a De vergelijking $x^4=5$ heeft twee oplossingen.
(de y-as is symmetiras van de grafiek van $y=x^4$)
De vergelijking $x^4=-5$ heeft geen oplossingen.
(de grafiek van $y=x^4$ komt niet onder de x-as)

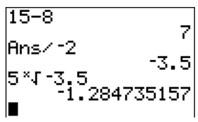


14b De vergelijking $x^5=7$ heeft één oplossing.
De vergelijking $x^5=-7$ heeft één oplossing.

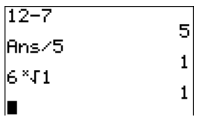
15a $3x^6-1=5$
$3x^6=6$
$x^6=2$
$x=\sqrt[6]{2} \vee x=-\sqrt[6]{2}$. (niet afronden)



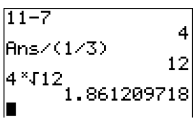
15c $-2x^5+8=15$
$-2x^5=7$
$x^5=\frac{7}{-2}=-3\frac{1}{2}$
$x=\sqrt[5]{-3\frac{1}{2}}$. (niet afronden)



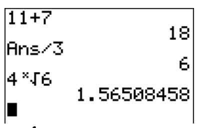
15e $5(2x-1)^6+7=12$
$5(2x-1)^6=5$
$(2x-1)^6=1$
$2x-1=1 \vee 2x-1=-1$
$2x=2 \vee 2x=0$
$x=1 \vee x=0$.



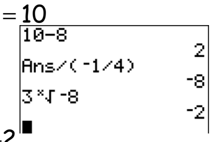
15b $\frac{1}{3}x^4+7=11$
$\frac{1}{3}x^4=4$
$x^4=12$
$x=\sqrt[4]{12} \vee x=-\sqrt[4]{12}$. (niet afronden)

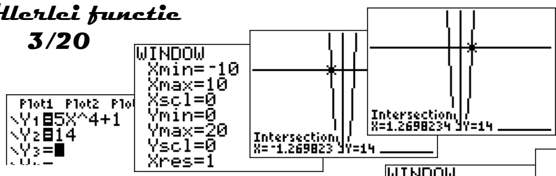


15d $3x^4-7=11$
$3x^4=18$
$x^4=6$
$x=\sqrt[4]{6} \vee x=-\sqrt[4]{6}$. (niet afronden)

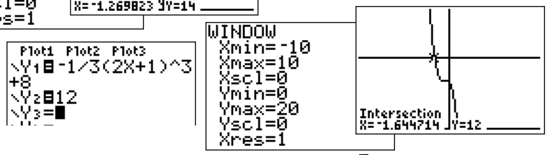


15f $-\frac{1}{4}(3x-1)^3+8=10$
$-\frac{1}{4}(3x-1)^3=2$
$(3x-1)^3=-8$
$3x-1=\sqrt[3]{-8}=-2$
$3x=-1$
$x=-\frac{1}{3}$. (niet afronden)



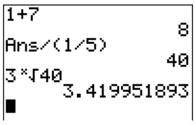


16a $5x^4+1=14$ (intersect) $\Rightarrow x \approx -1{,}27 \ \vee \ x \approx 1{,}27$.
$5x^4+1>14$ (zie een plot) $\Rightarrow x<-1{,}27 \ \vee \ x>1{,}27$.

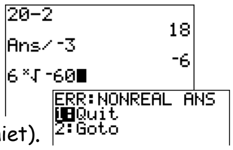


16b $-\frac{1}{3}(2x+1)^3+8=12$ (intersect) $\Rightarrow x \approx -1{,}64$.
$-\frac{1}{3}(2x+1)^3+8 \ge 12$ (zie een plot) $\Rightarrow x \le -1{,}64$.

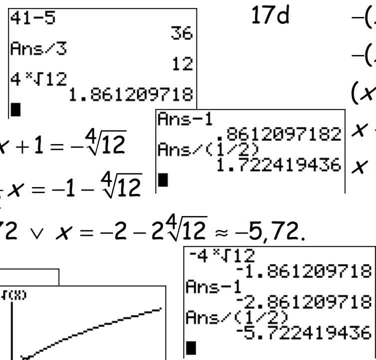
17a $\frac{1}{5}x^3-7=1$
$\frac{1}{5}x^3=8$
$x^3=40$
$x=\sqrt[3]{40}\approx 3{,}42$.



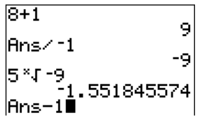
17b $-3x^6+2=20$
$-3x^6=18$
$x^6=-6$
$x=\sqrt[6]{-6}$ (kan niet).



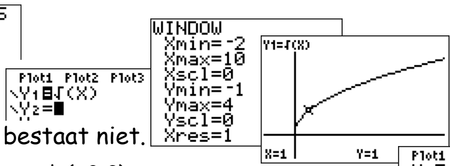
17c $3(\frac{1}{2}x+1)^4+5=41$
$3(\frac{1}{2}x+1)^4=36$
$(\frac{1}{2}x+1)^4=12$
$\frac{1}{2}x+1=\sqrt[4]{12} \ \vee \ \frac{1}{2}x+1=-\sqrt[4]{12}$
$\frac{1}{2}x=-1+\sqrt[4]{12} \ \vee \ \frac{1}{2}x=-1-\sqrt[4]{12}$
$x=-2+2\sqrt[4]{12}\approx 1{,}72 \ \vee \ x=-2-2\sqrt[4]{12}\approx -5{,}72$.



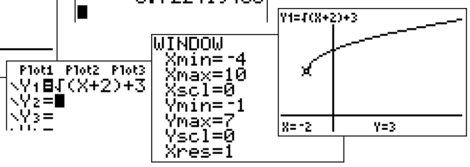
17d $-(x+1)^5-1=8$
$-(x+1)^5=9$
$(x+1)^5=-9$
$x+1=\sqrt[5]{-9}$
$x=-1+\sqrt[5]{-9}\approx -2{,}55$.



18a Zie de plot hiernaast.
De wortel uit een negatief getal bestaat niet.



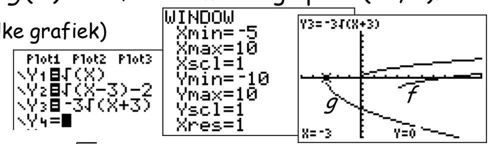
18b Zie de plot hiernaast. $y=\sqrt{x} \xrightarrow{\text{transl. }(-2,3)} y=\sqrt{x+2}+3$.



19a $y=\sqrt{x} \xrightarrow{\text{transl. }(3,-2)} f(x)=\sqrt{x-3}-2$ met beginpunt $(3,-2)$.
$y=\sqrt{x} \xrightarrow{\text{transl. }(-3,0)} y=\sqrt{x+3} \xrightarrow{\text{verm. t.o.v. de }x\text{-as met }-3} g(x)=-3\sqrt{x+3}$ met beginpunt $(-3,\,0)$.

19b Maak een schets van de plot hiernaast. (vermeld het beginpunt bij elke grafiek)

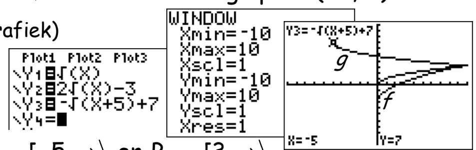
19c $D_f=[3,\rightarrow\rangle$; $B_f=[-2,\rightarrow\rangle$; $D_g=[-3,\rightarrow\rangle$ en $B_g=\langle\leftarrow,0]$.



20a $y=\sqrt{x} \xrightarrow{\text{verm. t.o.v. de }x\text{-as met }2} y=2\sqrt{x} \xrightarrow{\text{transl. }(0,-3)} f(x)=2\sqrt{x}-3$ met beginpunt $(0,-3)$.
$y=\sqrt{x} \xrightarrow{\text{verm. t.o.v. de }x\text{-as met }-1} y=-\sqrt{x} \xrightarrow{\text{transl. }(-5,7)} g(x)=-\sqrt{x+5}+7$ met beginpunt $(-5,\,7)$.

20b Maak een schets van de plot hiernaast. (vermeld het beginpunt bij elke grafiek)

20c $D_f=[0,\rightarrow\rangle$; $B_f=[-3,\rightarrow\rangle$; $D_g=[-5,\rightarrow\rangle$ en $B_g=\langle\leftarrow,7]$.



21a $y=\sqrt{x} \xrightarrow{\text{transl. }(-5,3)} f(x)=\sqrt{x+5}+3$ met beginpunt $(-5,\,3)$; $D_f=[-5,\rightarrow\rangle$ en $B_f=[3,\rightarrow\rangle$.

21b $y=\sqrt{x} \xrightarrow{\text{transl. }(-3,-7)} g(x)=\sqrt{x+3}-7$ met beginpunt $(-3,-7)$; $D_g=[-3,\rightarrow\rangle$ en $B_g=[-7,\rightarrow\rangle$.

21c $y=\sqrt{x} \xrightarrow{\text{transl. }(-1,0)} y=\sqrt{x+1} \xrightarrow{\text{verm. t.o.v. de }x\text{-as met }-2} h(x)=-2\sqrt{x+1}$.
Het beginpunt van de grafiek van h is $(-1,\,0)$; $D_h=[-1,\rightarrow\rangle$ en $B_h=\langle\leftarrow,0]$.

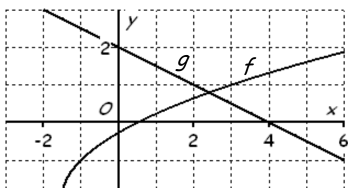
21d $y=\sqrt{x} \xrightarrow{\text{verm. t.o.v. de }x\text{-as met }3} y=3\sqrt{x}+1 \xrightarrow{\text{transl. }(0,1)} k(x)=3\sqrt{x}+1$.
Het beginpunt van de grafiek van k is $(0,\,1)$; $D_k=[0,\rightarrow\rangle$ en $B_k=[1,\rightarrow\rangle$.

21e $y=\sqrt{x} \xrightarrow{\text{transl. }(1,-1)} m(x)=\sqrt{x-1}-1$ met beginpunt $(1,-1)$; $D_m=[1,\rightarrow\rangle$ en $B_m=[-1,\rightarrow\rangle$.

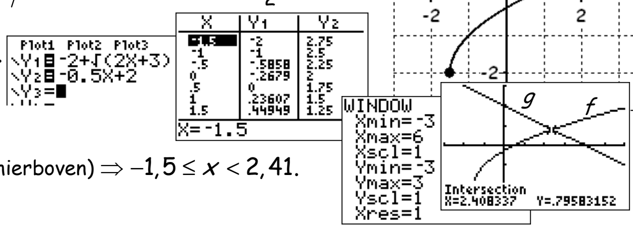
21f $y=\sqrt{x} \xrightarrow{\text{transl. }(0,-3)} p(x)=\sqrt{x}-3$ met beginpunt $(0,-3)$; $D_p=[0,\rightarrow\rangle$ en $B_p=[-3,\rightarrow\rangle$.

22a Het beginpunt is $(2,\,1)$.

22b Het beginpunt kan niet worden aangewezen.
Dat komt doordat de trace-cursor met een vaste stapgrootte over de grafiek loopt.



23a $2x+3\ge 0 \Rightarrow 2x\ge -3 \Rightarrow x\ge -1\frac{1}{2}$. Dus $D_f=[-1\frac{1}{2},\rightarrow\rangle$. Het beginpunt is $(-1\frac{1}{2},-2)$.
De grafiek van g is de lijn door $(0,2)$ en $(2,1)$.
Maak met de GR een tabel en teken de grafieken.



23b $B_f=[-2,\rightarrow\rangle$.

23c $f(x)=g(x)$ (intersect) $\Rightarrow x\approx 2{,}41$.
$f(x)<g(x)$ (zie een plot, het domein en de berekening hierboven) $\Rightarrow -1{,}5\le x<2{,}41$.

24a $8-4x \geq 0 \Rightarrow -4x \geq -8 \Rightarrow x \leq 2$. Dus $D_f = \langle \leftarrow, 2]$; $B_f = [3, \rightarrow\rangle$ (gebruik eventueel een plot) en het beginpunt is (2, 3).

24b $4x-8 \geq 0 \Rightarrow 4x \geq 8 \Rightarrow x \geq 2$. Dus $D_g = [2, \rightarrow\rangle$; $B_g = [3, \rightarrow\rangle$ en het beginpunt is (2, 3).

24c $2x+6 \geq 0 \Rightarrow 2x \geq -6 \Rightarrow x \geq -3$. Dus $D_h = [-3, \rightarrow\rangle$; $B_h = \langle \leftarrow, 5]$ en het beginpunt is (−3, 5).

24d $x \geq 0$. Dus $D_k = [0, \rightarrow\rangle$; $B_k = \langle \leftarrow, 3]$ en het beginpunt is (0, 3).

25a Omdat $\sqrt{x-3}$ niet negatief wordt.

25b $\sqrt{x-3} = 5$ (kwadrateren) $\Rightarrow x-3 = 25 \Rightarrow x = 28$ (voldoet) en $\sqrt{x} - 3 = 5 \Rightarrow \sqrt{x} = 8$ (kwadrateren) $\Rightarrow x = 64$ (voldoet).

26a $\sqrt{2x-1} = 3$
$2x-1 = 9$
$2x = 10$
$x = 5$ (voldoet).

26b $7 + \sqrt{2x-1} = 3$
$\sqrt{2x-1} = -4$
geen opl. (een wortel kan niet negatief zijn).

26c $3\sqrt{x} + 1 = 7$
$3\sqrt{x} = 6$
$\sqrt{x} = \frac{6}{3} = 2$
$x = 4$ (voldoet).

26d $2 + \sqrt{x} = 9$
$\sqrt{x} = 7$
$x = 49$ (voldoet).

26e $5 + 3\sqrt{x} = 41{,}3$
$3\sqrt{x} = 36{,}3$
$\sqrt{x} = 12{,}1$
$x = 146{,}41$ (voldoet).

26f $2 - 4\sqrt{x} = -8$
$-4\sqrt{x} = -10$
$\sqrt{x} = 2{,}5$
$x = 6{,}25$ (voldoet).

27a $5 - 3\sqrt{x} = -7$
$-3\sqrt{x} = -12$
$\sqrt{x} = 4$
$x = 16$ (voldoet).

27b $2\sqrt{5-2x} = 16$
$\sqrt{5-2x} = 8$
$5-2x = 64$
$-2x = 59$
$x = -29{,}5$ (voldoet).

27c $6 + 5\sqrt{2x-6} = 51$
$5\sqrt{2x-6} = 45$
$\sqrt{2x-6} = 9$
$2x-6 = 81$
$2x = 87$
$x = 43{,}5$ (voldoet).

27d $1 - 0{,}5\sqrt{1-x} = -7$
$-0{,}5\sqrt{1-x} = -8$
$\sqrt{1-x} = 16$
$1-x = 256$
$-x = 255$
$x = -255$ (voldoet).

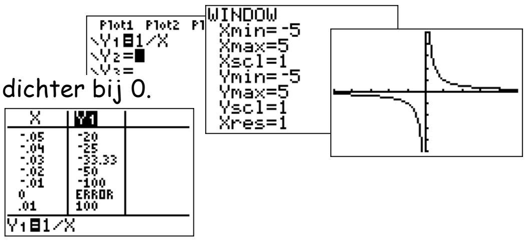
28a $q = 20 \Rightarrow K = 15 + \sqrt{2 \cdot 20 + 30} \approx 23{,}37$ (€).

28b $15 + \sqrt{2q+30} = 25$
$\sqrt{2q+30} = 10$
$2q+30 = 100$
$2q = 70$
$q = 35$

28c $R = p \cdot q = 1{,}65q$ (€).

28d $W = R - K = 1{,}65q - (15 + \sqrt{2q+30}) = 1{,}65q - 15 - \sqrt{2q+30}$ (€).

29a Zie de plot hiernaast.



29b Als je x steeds groter kiest, komt de waarde van $f(x)$ steeds dichter bij 0.

29c Voor $x < 0$ en heel dicht bij 0 wordt $f(x)$ heel groot negatief.
Voor $x > 0$ en heel dicht bij 0 wordt $f(x)$ heel groot positief.

29d $\frac{1}{0} = \ldots$ zou betekenen $\ldots \times 0 = 1$ (hieraan voldoet geen enkel getal).

30a $y = \frac{1}{x} \xrightarrow{\text{transl. }(-2,-3)} f(x) = \frac{1}{x+2} - 3$.

30b De verticale asymptoot (V.A.) is $x = -2$ en de horizontale asymptoot (H.A.) is $y = -3$.

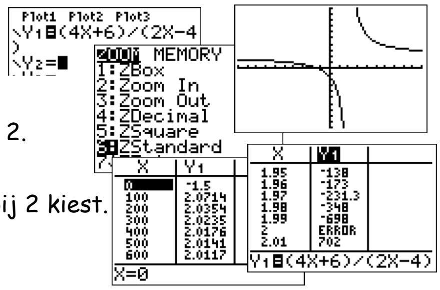
31a V.A.: $x = 5$ en H.A.: $y = 6$.

31b V.A.: $x = -1$ en H.A.: $y = -3$.

31c V.A.: $x = 3$ en H.A.: $y = 0$ (de x-as).

31d V.A.: $x = 0$ (de y-as) en H.A.: $y = -3$.

32 $y = \frac{1}{x} \xrightarrow{\text{transl. }(3,-2)} f(x) = \frac{1}{x-3} - 2$. (met V.A.: $x = 3$ en H.A.: $y = -2$)



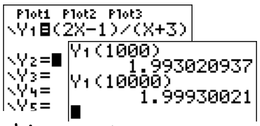
33a Zie de plot hiernaast. (denk op de GR aan de haakjes in de teller en de noemer)

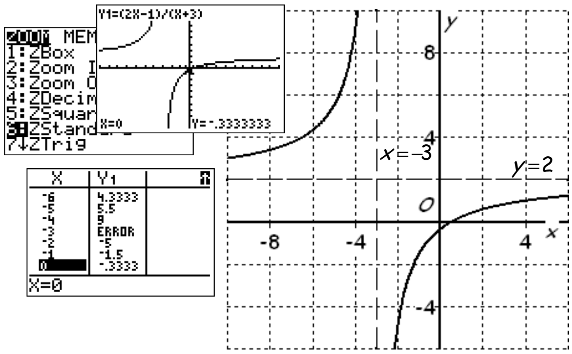
33b Als je x steeds groter kiest, komt de waarde van $f(x)$ steeds dichter bij 2.
De grafiek van f heeft als horizontale asymptoot de lijn $y = 2$.

33c $f(x)$ wordt heel groot positief of juist heel goot negatief als je x dicht bij 2 kiest.
De grafiek van f heeft als verticale asymptoot de lijn $x = 2$.

34a V.A.: $x = -3$ en H.A.: $y = 2$. 34b V.A.: $x = -2{,}5$ en H.A.: $y = 1$. 34c V.A.: $x = 1{,}5$ en H.A.: $y = 0$.

35 Noemer $= 0 \Rightarrow x + 3 = 0 \Rightarrow$ V.A.: $x = -3$.
$\left.\begin{array}{l} f(1000) \approx 1{,}993 \\ f(10\,000) \approx 1{,}999 \end{array}\right\} \Rightarrow$ H.A.: $y = 2$.
Maak met een tabel op de GR de grafiek hiernaast.





36a $\frac{3}{a} = \frac{2}{5}$
$3 \cdot 5 = 2 \cdot a$
$2a = 15$
$a = 7{,}5$.

36b $\frac{5}{x} = \frac{3}{12}$
$5 \cdot 12 = 3 \cdot x$
$3x = 60$
$x = 20$.

37a $\frac{3}{2x-1} = \frac{2}{x+3}$
$3 \cdot (x+3) = 2 \cdot (2x-1)$
$3x + 9 = 4x - 2$
$-x = -11$
$x = 11$.

37b $5 + \frac{x}{x+1} = 7$
$\frac{x}{x+1} = \frac{2}{1}$
$2 \cdot (x+1) = x$
$2x + 2 = x$
$x = -2$.

37c $\frac{x-2}{2x+6} = \frac{3}{1}$
$3 \cdot (2x+6) = x - 2$
$6x + 18 = x - 2$
$5x = -20$
$x = -4$.

37d $8 + \frac{2x-3}{x-3} = 8$
$\frac{2x-3}{x-3} = \frac{0}{1}$ (teller = 0)
$2x - 3 = 0$
$2x = 3$
$x = 1{,}5$.

37e $\frac{x-1}{x-3} = \frac{2x-1}{2x+5}$
$(x-3) \cdot (2x-1) = (x-1) \cdot (2x+5)$
$2x^2 - x - 6x + 3 = 2x^2 + 5x - 2x - 5$
$-10x = -8$
$x = 0{,}8$.

37f $\frac{x+3}{x-1} = \frac{10}{x}$
$x \cdot (x+3) = 10 \cdot (x-1)$
$x^2 + 3x = 10x - 10$
$x^2 - 7x + 10 = 0$
$(x-2) \cdot (x-5)$
$x = 2 \vee x = 5$.

38a $\frac{2x+3}{x+1} = \frac{2x+2}{x-1}$
$(x+1) \cdot (2x+2) = (x-1) \cdot (2x+3)$
$2x^2 + 2x + 2x + 2 = 2x^2 + 3x - 2x - 3$
$3x = -5$
$x = -\frac{5}{3}$.

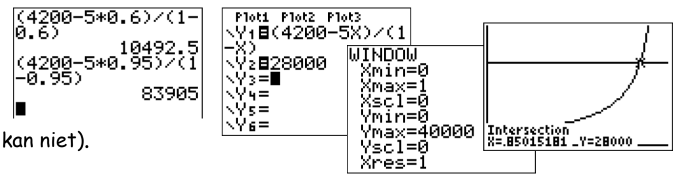
38b $4 + \frac{2x-6}{x+1} = 7$
$\frac{2x-6}{x+1} = \frac{3}{1}$
$3 \cdot (x+1) = 2x - 6$
$3x + 3 = 2x - 6$
$x = -9$.

38c $\frac{2x+4}{x-1} = \frac{x}{1}$
$x \cdot (x-1) = 2x + 4$
$x^2 - x = 2x + 4$
$x^2 - 3x - 4 = 0$
$(x+1) \cdot (x-4) = 0$
$x = -1 \vee x = 4$.

38d $\frac{x-12}{x+2} = \frac{2x}{x+3}$
$2x \cdot (x+2) = (x+3) \cdot (x-12)$
$2x^2 + 4x = x^2 - 12x + 3x - 36$
$x^2 + 13x + 36 = 0$
$(x+9) \cdot (x+4) = 0$
$x = -9 \vee x = -4$.

39a $p = 0{,}6 \Rightarrow K = \frac{4200 - 5 \cdot 0{,}6}{1 - 0{,}6} = 10\,492{,}50$ (€).

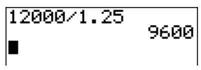
39b $p = 0{,}95 \Rightarrow K = \frac{4200 - 5 \cdot 0{,}95}{1 - 0{,}95} = 83\,905$ (€).



39c $p = 1 \Rightarrow$ de noemer wordt nul (delen door nul kan niet).

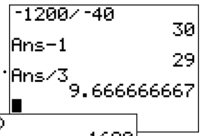
39d $K = \frac{4200 - 5p}{1-p} = \frac{28000}{1}$ (algebraïsch of intersect) $\Rightarrow p \approx 0{,}850$. Dus (ongeveer) 85% van de markt wordt bereikt.

40 $GK = \frac{12q + 12000}{q} = \frac{13{,}25}{1} \Rightarrow 13{,}25q = 12q + 12\,000 \Rightarrow 1{,}25q = 12\,000 \Rightarrow q = 9600$.

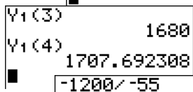


41a Maak een schets van de plot hiernaast.

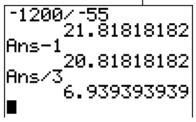
41b $\left.\begin{array}{l} N(100) \approx 1796 \\ N(1000) \approx 1799{,}6 \end{array}\right\} \Rightarrow$ H.A.: $N = 1800$.
Betekenis: N komt niet boven de 1800 uit, maar komt er wel heel dicht bij.



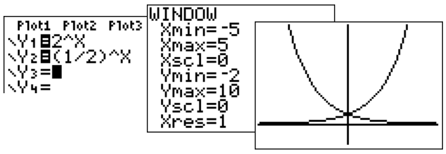
41c $N = 1800 - \frac{1200}{1+3t} = 1760$ (intersect of) $\Rightarrow -\frac{1200}{1+3t} = -40 \Rightarrow \frac{-1200}{-40} = 1 + 3t \Rightarrow 29 = 3t \Rightarrow t = \frac{29}{3} = 9\frac{2}{3}$.
1 mei loopt van $t = 0$ tot $t = 1$ (gegeven) $\Rightarrow$ van $t = 9$ tot $t = 10$ is 10 mei $\Rightarrow$ op 10 mei.



41d 4 mei loopt van $t = 3$ tot $t = 4$. $N(3) = 1800 - \frac{1200}{10} = 1680$ en $N(4) = 1800 - \frac{1200}{13} \approx 1708$.
Dus er zijn op 4 mei $1708 - 1680 = 28$ insecten bij gekomen.



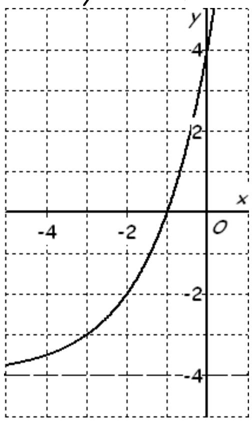
41e $N = 1800 - \frac{1200}{1+3t} = 1745$ (intersect of) $\Rightarrow -\frac{1200}{1+3t} = -55 \Rightarrow \frac{-1200}{-55} = 1 + 3t \Rightarrow 3t = \frac{1200}{55} - 1 \Rightarrow t \approx 7$.
$N = 1680 \Rightarrow t = 3$ (hierboven berekend). Het duurt dus (ongeveer) $7 - 3 = 4$ dagen.

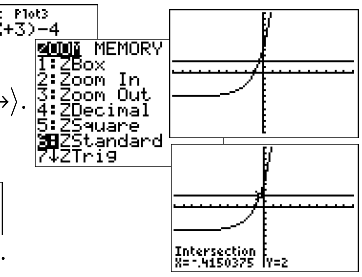


42a Zie de plot hiernaast. Ze zijn elkaars spiegelbeeld t.o.v. de y-as.
42b De lijn $y = 0$ (de x-as) is asymptoot van beide grafieken.
42c $B_f = B_g = \langle 0, \rightarrow \rangle$.

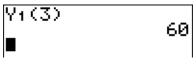
43a $y = 2^x \xrightarrow{\text{transl. }(0,3)} y = 2^x + 3$.
43c $y = 2^x \xrightarrow{\text{verm. t.o.v. } x\text{-as met } 3} y = 3 \cdot 2^x$.

43b $y = 2^x \xrightarrow{\text{transl. }(5,0)} y = 2^{x-5}$.



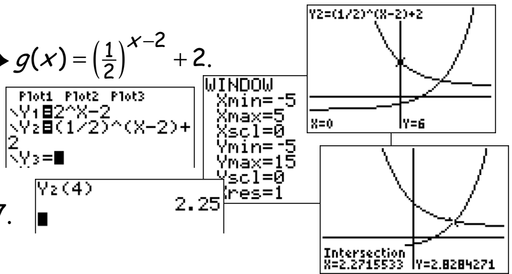


44a $y = 2^x \xrightarrow{\text{transl. }(-3,-4)} f(x) = 2^{x+3} - 4$.
44b Zie de grafiek hiernaast (gebruik TABLE). $B_f = \langle -4, \rightarrow \rangle$.
44c $f(x) = 2^{x+3} - 4 = 2$ (intersect) $\Rightarrow x \approx -0{,}42$.
$f(x) \le 2$ (zie plot) $\Rightarrow x \le -0{,}42$.



44d $f(3) = 2^6 - 4 = 60$.
$x \le 3$ (zie grafiek; let op het bereik!!!) $\Rightarrow -4 < f(x) \le 60$.

45a $y = 3^x \xrightarrow{\text{transl. }(1,5)} f(x) = 3^{x-1} + 5$ met als H.A.: $y = 5$.
45b $y = 3^x \xrightarrow{\text{verm. t.o.v. de } x\text{-as met } 5} y = 5 \cdot 3^x \xrightarrow{\text{transl. }(-1,0)} g(x) = 5 \cdot 3^{x+1}$ met als H.A.: $y = 0$ (de x-as).
45c $y = 3^x \xrightarrow{\text{verm. t.o.v. de } x\text{-as met } 4} y = 4 \cdot 3^x \xrightarrow{\text{transl. }(0,-7)} h(x) = 4 \cdot 3^x - 7$ met als H.A.: $y = -7$.
45d $y = \left(\frac{1}{2}\right)^x \xrightarrow{\text{verm. t.o.v. de } x\text{-as met } -2} y = -2 \cdot \left(\frac{1}{2}\right)^x \xrightarrow{\text{transl. }(0,3)} k(x) = -2 \cdot \left(\frac{1}{2}\right)^x + 3$ met als H.A.: $y = 3$.



46a $y = 2^x \xrightarrow{\text{transl. }(0,-2)} f(x) = 2^x - 2$ en $y = \left(\frac{1}{2}\right)^x \xrightarrow{\text{transl. }(2,2)} g(x) = \left(\frac{1}{2}\right)^{x-2} + 2$.
46b $B_f = \langle -2, \rightarrow \rangle$; $B_g = \langle 2, \rightarrow \rangle$.
46c $g(4) = \left(\frac{1}{2}\right)^2 + 2 = 2{,}25$; $x \ge 4$ (zie plot en bereik) $\Rightarrow 2 < g(x) \le 2{,}25$.
46d $f(x) = g(x)$ (intersect) $\Rightarrow x \approx 2{,}27$; $f(x) \le g(x)$ (zie plot) $\Rightarrow x \le 2{,}27$.

47 $y_1 = x^{-3}$ en $y_6 = \frac{1}{x^3}$ komen op hetzelfde neer, zo ook $y_2 = 3x^{-1}$ en $y_4 = \frac{3}{x}$ als $y_3 = x^{\frac{1}{3}}$ en $y_5 = \sqrt[3]{x}$.
(je kunt dit bijvoorbeeld met behulp van tabellen op de GR nagaan)

48a $x^5 \cdot \sqrt{x} = x^5 \cdot x^{\frac{1}{2}} = x^{5+\frac{1}{2}} = x^{5\frac{1}{2}}$.
48d $x^3 \cdot x^{2,4} = x^{3+2,4} = x^{5,4}$.

48b $\frac{\sqrt{x}}{x^3} = \frac{x^{\frac{1}{2}}}{x^3} = x^{\frac{1}{2}-3} = x^{-2\frac{1}{2}}$.
48e $\frac{x^4 \cdot \sqrt[3]{x}}{\sqrt[5]{x^2}} = \frac{x^4 \cdot x^{\frac{1}{3}}}{x^{\frac{2}{5}}} = x^{4+\frac{1}{3}-\frac{2}{5}} = x^{3\frac{14}{15}}$.

48c $\frac{1}{x \cdot \sqrt{x}} = \frac{1}{x^1 \cdot x^{\frac{1}{2}}} = \frac{1}{x^{1+\frac{1}{2}}} = \frac{1}{x^{1\frac{1}{2}}} = x^{-1\frac{1}{2}}$.
48f $x^5 \cdot x^{-\frac{1}{5}} \cdot x = x^{5-\frac{1}{5}+1} = x^{5\frac{4}{5}}$.

49a $y = \frac{5}{x^4} = 5 \cdot \frac{1}{x^4} = 5x^{-4}$.
49d $y = 5x \cdot \sqrt[4]{x} = 5x \cdot x^{\frac{1}{4}} = 5x^{1+\frac{1}{4}} = 5x^{1\frac{1}{4}}$.

49b $y = 3x^2 \cdot \sqrt{x} = 3x^2 \cdot x^{\frac{1}{2}} = 3x^{2+\frac{1}{2}} = 3x^{2\frac{1}{2}}$.
49e $y = \frac{3 \cdot \sqrt{x}}{x^2} = 3 \cdot \frac{\sqrt{x}}{x^2} = 3 \cdot \frac{x^{\frac{1}{2}}}{x^2} = 3 \cdot x^{\frac{1}{2}-2} = 3x^{-1\frac{1}{2}}$.

49c $y = \frac{1}{5x} = \frac{1}{5} \cdot \frac{1}{x} = \frac{1}{5}x^{-1}$.
49f $y = 8\sqrt{x} \cdot \sqrt[4]{x^3} = 8x^{\frac{1}{2}} \cdot x^{\frac{3}{4}} = 8x^{\frac{1}{2}+\frac{3}{4}} = 8x^{1\frac{1}{4}}$.

49g $y=\left(3x^2\right)^3\cdot x^5=27x^6\cdot x^5=27x^{6+5}=27x^{11}$.

49h $y=28\cdot(4x)^{-1}\cdot\frac{1}{x}=28\cdot 4^{-1}\cdot x^{-1}\cdot x^{-1}=28\cdot\frac{1}{4}\cdot x^{-1+-1}=7x^{-2}$.

49i $y=\sqrt[3]{x}\cdot\sqrt[4]{x}=x^{\frac{1}{3}}\cdot x^{\frac{1}{4}}=x^{\frac{1}{3}+\frac{1}{4}}=x^{\frac{7}{12}}$.

50a $N=80\cdot 2^{2t-4}=80\cdot 2^{2t}\cdot 2^{-4}=80\cdot\left(2^2\right)^t\cdot\frac{1}{2^4}=80\cdot\left(2^2\right)^t\cdot\frac{1}{16}=5\cdot 4^t$.

50b $N=2500\cdot 5^{-t-2}=2500\cdot 5^{-t}\cdot 5^{-2}=2500\cdot\left(5^{-1}\right)^t\cdot\frac{1}{5^2}=2500\cdot\left(\frac{1}{5}\right)^t\cdot\frac{1}{25}=100\cdot\left(\frac{1}{5}\right)^t$.

50c $N=\frac{100}{2^{2t}}=100\cdot\frac{1}{2^{2t}}=100\cdot 2^{-2t}=100\cdot\left(2^{-2}\right)^t=100\cdot\left(\frac{1}{4}\right)^t$.

51a $32=2^5$.

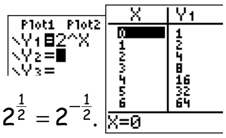
51b $\frac{1}{2}=\frac{1}{2^1}=2^{-1}$.

51c $\sqrt[4]{2}=2^{\frac{1}{4}}$.

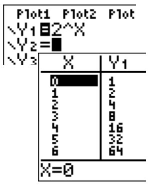
51d $16\cdot\sqrt{2}=2^4\cdot 2^{\frac{1}{2}}=2^{4\frac{1}{2}}$.

51e $1=2^0$.

51f $\frac{1}{2}\cdot\sqrt{2}=\frac{1}{2^1}\cdot 2^{\frac{1}{2}}=2^{-1}\cdot 2^{\frac{1}{2}}=2^{-\frac{1}{2}}$.

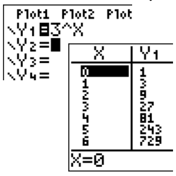


52a $2^{x+1}=64$
$2^{x+1}=2^6$
$x+1=6$
$x=5$.

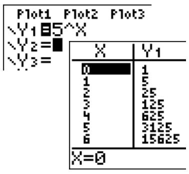


52b $2^{x-2}=\frac{1}{8}$
$2^{x-2}=\frac{1}{2^3}$
$2^{x-2}=2^{-3}$
$x-2=-3$
$x=-1$.

52c $3^{2x+1}=27\cdot\sqrt{3}$
$3^{2x+1}=3^3\cdot 3^{\frac{1}{2}}$
$3^{2x+1}=3^{3\frac{1}{2}}$
$2x+1=3\frac{1}{2}$
$2x=2\frac{1}{2}$
$x=1\frac{1}{4}$.



52d $5^{-x+6}=625$
$5^{-x+6}=5^4$
$-x+6=4$
$-x=-2$
$x=2$.



52e $3^x-2=25$
$3^x=27$
$3^x=3^3$
$x=3$.

52f $5\cdot 2^x+11=91$
$5\cdot 2^x=80$
$2^x=16$
$2^x=2^4$
$x=4$.

52g $2^x=1$
$2^x=2^0$
$x=0$.

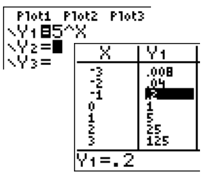
52h $2^{x-3}=\left(\frac{1}{2}\right)^{x-5}$
$2^{x-3}=\left(2^{-1}\right)^{x-5}$
$2^{x-3}=2^{-x+5}$
$x-3=-x+5$
$2x=8$
$x=4$.

52i $2^{x+3}=8^{x+2}$
$2^{x+3}=\left(2^3\right)^{x+2}$
$2^{x+3}=2^{3x+6}$
$x+3=3x+6$
$-2x=3$
$x=-1\frac{1}{2}$.

53a $2^{3x+5}=16\cdot\sqrt{2}$
$2^{3x+5}=2^4\cdot 2^{\frac{1}{2}}$
$2^{3x+5}=2^{4\frac{1}{2}}$
$3x+5=4\frac{1}{2}$
$3x=-\frac{1}{2}$
$x=-\frac{1}{6}$.

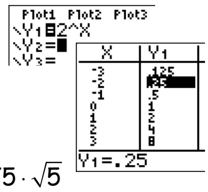
53b $3^{4x}=\frac{1}{81}\cdot\sqrt[4]{9}$
$3^{4x}=\frac{1}{3^4}\cdot\sqrt[4]{3^2}$
$3^{4x}=3^{-4}\cdot 3^{\frac{2}{4}}$
$3^{4x}=3^{-3\frac{1}{2}}$
$4x=-3\frac{1}{2}=-\frac{7}{2}$
$x=-\frac{7}{8}$.

53c $3\cdot 5^{2x-1}=0{,}6$
$5^{2x-1}=0{,}2$
$5^{2x-1}=\frac{1}{5}$
$5^{2x-1}=5^{-1}$
$2x-1=-1$
$2x=0$
$x=0$.



53d $9^{3x-3}=3^{x+4}$
$\left(3^2\right)^{3x-3}=3^{x+4}$
$3^{6x-6}=3^{x+4}$
$6x-6=x+4$
$5x=10$
$x=2$.

53e $3\cdot 2^{x-1}-1=-0{,}25$
$3\cdot 2^{x-1}=0{,}75$
$2^{x-1}=0{,}25$
$2^{x-1}=2^{-2}$
$x-1=-2$
$x=-1$.

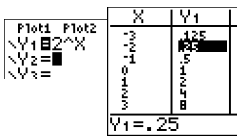


53f $3\cdot 5^{2x+1}=75\cdot\sqrt{5}$
$5^{2x+1}=25\cdot\sqrt{5}$
$5^{2x+1}=5^2\cdot 5^{\frac{1}{2}}$
$5^{2x+1}=5^{2\frac{1}{2}}$
$2x+1=2\frac{1}{2}$
$2x=1\frac{1}{2}$
$x=\frac{3}{4}$.

54 $f(3)=2^3=8$, $16=2^4=f(4)$, $\frac{1}{2}=2^{-1}=f(-1)$, $\sqrt{2}=2^{\frac{1}{2}}=f(\frac{1}{2})$.

55a $f^{\text{inv}}(16)=4$, want $2^4=16$.

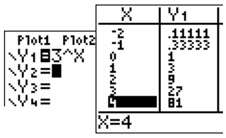
55b $f^{\text{inv}}(4)=2$, want $2^2=4$.



55c $f^{\text{inv}}(1)=0$, want $2^0=1$.

55d $f^{\text{inv}}(\frac{1}{2})=-1$, want $2^{-1}=\frac{1}{2}$.

56a $g^{\text{inv}}(9)=2$, want $3^2=9$.
56b $g^{\text{inv}}(81)=4$, want $3^4=81$.



56c $g^{\text{inv}}(1)=0$, want $3^0=1$.
56d $g^{\text{inv}}(\frac{1}{3})=-1$, want $3^{-1}=\frac{1}{3}$.

57a $^{2}\log(32)=5$, want $2^5=32$.
57b $^{3}\log(\frac{1}{3})=-1$, want $3^{-1}=\frac{1}{3}$.
57c $^{5}\log(25)=2$, want $5^2=25$.
57d $^{6}\log(\sqrt{6})=\frac{1}{2}$, want $6^{\frac{1}{2}}=\sqrt{6}$.

$^{g}\log(x)=y$ betekent $g^y=x$
dus $^{g}\log(g^y)=y$

58a $^{5}\log(125)={}^{5}\log(5^3)=3$.
58b $^{10}\log(\frac{1}{10})={}^{10}\log(10^{-1})=-1$.
58c $^{2}\log(4)={}^{2}\log(2^2)=2$.
58d $^{7}\log(49)={}^{7}\log(7^2)=2$.
58e $^{2}\log(\sqrt{2})={}^{2}\log(2^{\frac{1}{2}})=\frac{1}{2}$.
58f $^{3}\log(27)={}^{3}\log(3^3)=3$.
58g $^{2}\log(\frac{1}{16})={}^{2}\log(\frac{1}{2^4})={}^{2}\log(2^{-4})=-4$.
58h $^{4}\log(\frac{1}{4})={}^{4}\log(4^{-1})=-1$.
58i $^{5}\log(5)={}^{5}\log(5^1)=1$.
58j $^{6}\log(1)={}^{6}\log(6^0)=0$.
58k $^{7}\log(\sqrt{7})={}^{7}\log(7^{\frac{1}{2}})=\frac{1}{2}$.
58l $^{2}\log(\frac{1}{4})={}^{2}\log(\frac{1}{2^2})={}^{2}\log(2^{-2})=-2$.

59a Omdat $2^{-2}=\frac{1}{2^2}=\frac{1}{4}\neq-4$.
59b Omdat $1^8=1\neq 8$.
59c $1^8=1$, maar ook $1^7=1$; dan zou ook $^{1}\log(1)=7$. Dit kan natuurlijk niet.
59d $(-2)^{-3}=\frac{1}{(-2)^3}=\frac{1}{-8}=-\frac{1}{8}\neq 8$.

60a $^{2}\log(64\cdot\sqrt{2})={}^{2}\log(2^6\cdot 2^{\frac{1}{2}})={}^{2}\log(2^{6\frac{1}{2}})=6\frac{1}{2}$.
60b $^{3}\log(\frac{1}{9}\cdot\sqrt{3})={}^{3}\log(3^{-2}\cdot 3^{\frac{1}{2}})={}^{3}\log(3^{-1\frac{1}{2}})=-1\frac{1}{2}$.
60c $^{3}\log(3^{2{,}76})=2{,}76$.
60d $^{5}\log(\frac{1}{125})={}^{5}\log(5^{-3})=-3$.
60e $^{\frac{1}{2}}\log(\frac{1}{4})={}^{\frac{1}{2}}\log((\frac{1}{2})^2)=2$.
60f $^{\sqrt{5}}\log(5)={}^{\sqrt{5}}\log((\sqrt{5})^2)=2$.
60g $^{2}\log(\frac{1}{32}\cdot\sqrt[3]{2})={}^{2}\log(2^{-5}\cdot 2^{\frac{1}{3}})={}^{2}\log(2^{-4\frac{2}{3}})=-4\frac{2}{3}$.
60h $^{4}\log(1)={}^{4}\log(4^0)=0$.
60i $^{3}\log(\sqrt[5]{3^2})={}^{3}\log(3^{\frac{2}{5}})=\frac{2}{5}$.
60j $^{5}\log(5^{-6\frac{1}{2}})=-6\frac{1}{2}$.
60k $^{\frac{1}{3}}\log(\frac{1}{27})={}^{\frac{1}{3}}\log((\frac{1}{3})^3)=3$.
60l $^{10}\log(10\,000)={}^{10}\log(10^4)=4$.

61
1) $f(\frac{1}{8})={}^{2}\log(\frac{1}{8})={}^{2}\log(\frac{1}{2^3})={}^{2}\log(2^{-3})=-3$;
2) $f(4\sqrt{2})={}^{2}\log(4\cdot\sqrt{2})={}^{2}\log(2^2\cdot 2^{\frac{1}{2}})={}^{2}\log(2^{2\frac{1}{2}})=2\frac{1}{2}$;
3) $f(\sqrt[5]{4})={}^{2}\log(\sqrt[5]{4})={}^{2}\log(\sqrt[5]{2^2})={}^{2}\log(2^{\frac{2}{5}})=\frac{2}{5}$;
4) $f(1)={}^{2}\log(1)={}^{2}\log(2^0)=0$.

62a
$^{3}\log(x+2)=2$
$x+2=3^2$
$x+2=9$
$x=7$.

62b
$1+{}^{\frac{1}{2}}\log(x)=4$
$^{\frac{1}{2}}\log(x)=3$
$x=(\frac{1}{2})^3$
$x=\frac{1}{8}$.

62c
$^{3}\log(2x+1)=4$
$2x+1=3^4$
$2x+1=81$
$2x=80$
$x=40$.

62d
$5+{}^{4}\log(x)=3$
$^{4}\log(x)=-2$
$x=4^{-2}$
$x=\frac{1}{4^2}=\frac{1}{16}$.

62e
$^{\frac{1}{2}}\log(x-1)=3$
$x-1=(\frac{1}{2})^3$
$x-1=\frac{1}{8}$
$x=1\frac{1}{8}$.

62f
$^{2}\log(x^2-4)=5$
$x^2-4=2^5$
$x^2-4=32$
$x^2=36$
$x=6 \vee x=-6$.

63a
$4\cdot{}^{3}\log(x)=2$
$^{3}\log(x)=\frac{1}{2}$
$x=3^{\frac{1}{2}}$
$x=\sqrt{3}$.

63b
$^{3}\log(4x-1)=-2$
$4x-1=3^{-2}$
$4x-1=\frac{1}{9}$
$4x=1\frac{1}{9}$
$x=\frac{5}{18}$.

```
(10/9)/4▸Frac
                5/18
```

63c
$3+{}^{2}\log(x)=-1$
$^{2}\log(x)=-4$
$x=2^{-4}$
$x=\frac{1}{2^4}=\frac{1}{16}$.

63d
$^{5}\log(3x+2)=1$
$3x+2=5^1$
$3x=3$
$x=1$.

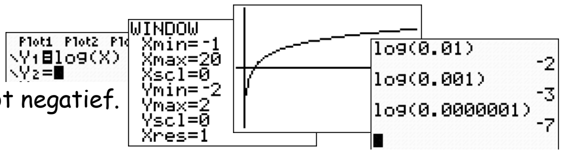
63e
$^{3}\log(0{,}4x-5)=2$
$0{,}4x-5=3^2$
$0{,}4x=14$
$x=35$.

```
14/0.4
                35
```

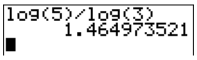
63f
$4+2\cdot{}^{2}\log(x)=7$
$2\cdot{}^{2}\log(x)=3$
$^{2}\log(x)=1\frac{1}{2}$
$x=2^{1\frac{1}{2}}$
$x=2^1\cdot 2^{\frac{1}{2}}$
$x=2\cdot\sqrt{2}$.

64a Zie de plot hiernaast.

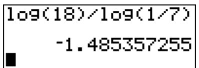
64bc $f(0{,}01)=-2;\ f(0{,}001)=-3;\ f(0{,}0000001)=-7.$
Als je x steeds dichter bij nul kiest, dan wordt $f(x)$ heel groot negatief.
De y-as is de verticale asymptoot van de grafiek van f.



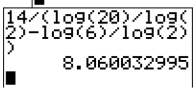
65a $^3\log(5)=\frac{\log(5)}{\log(3)}\approx 1{,}46.$



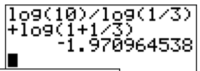
65b $^{\frac{1}{7}}\log(18)=\frac{\log(18)}{\log(\frac{1}{7})}\approx -1{,}49.$



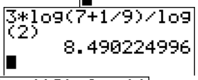
65c $\frac{14}{^2\log(20)-{}^2\log(6)}\approx 8{,}06.$



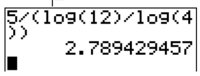
65d $^{\frac{1}{3}}\log(10)+\log(1\frac{1}{3})\approx -1{,}97.$



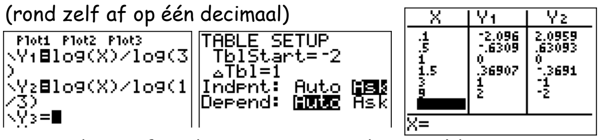
65e $3\cdot{}^2\log(7\frac{1}{9})\approx 8{,}49.$

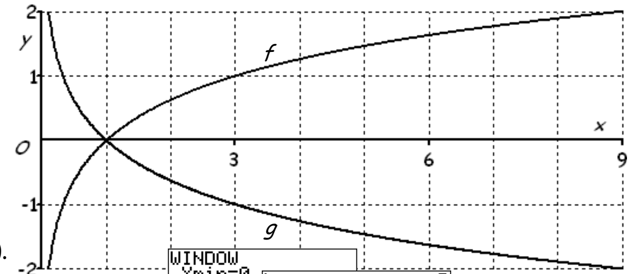


65f $\frac{5}{^4\log(12)}\approx 2{,}79.$



66a Neem de tabel op de GR hieronder over.
(rond zelf af op één decimaal)

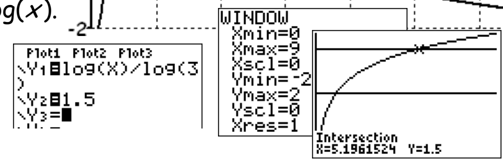




66b Maak de grafiek hiernaast met de tabel hierboven.

66c $f(x)={}^3\log(x)\xrightarrow[\text{(spiegelen in de }x\text{-as)}]{\text{verm. t.o.v. de }x\text{-as met }-1} g(x)={}^{\frac{1}{3}}\log(x).$

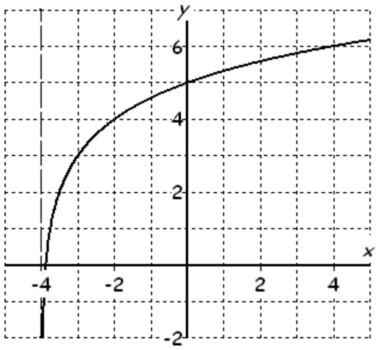
66d $f(x)={}^3\log(x)=1\frac{1}{2}$ (intersect) $\Rightarrow x\approx 5{,}20.$
$f(x)\le 1\frac{1}{2}$ (zie een plot en gebruik domein) $\Rightarrow 0<x\le 5{,}20.$



67a $y={}^2\log(x)\xrightarrow{\text{transl. }(0,3)} y={}^2\log(x)+3.$

67b $y={}^2\log(x)\xrightarrow{\text{transl. }(-3,0)} y={}^2\log(x+3).$

67c $y={}^2\log(x)\xrightarrow{\text{verm. t.o.v. de }x\text{-as met }3} y=3\cdot{}^2\log(x).$



68a $y={}^2\log(x)\xrightarrow{\text{transl. }(-4,3)} f(x)={}^2\log(x+4)+3.$

68b Maak de grafiek hiernaast (gebruik TABLE). $D_f=\langle -4,\rightarrow\rangle.$

69a $3x-12=0\Rightarrow 3x=12\Rightarrow$ V.A.: $x=4.$

69b $8-4x=0\Rightarrow -4x=-8\Rightarrow$ V.A.: $x=2.$

69c $8x-10=0\Rightarrow 8x=10\Rightarrow$ V.A.: $x=1\frac{1}{4}.$

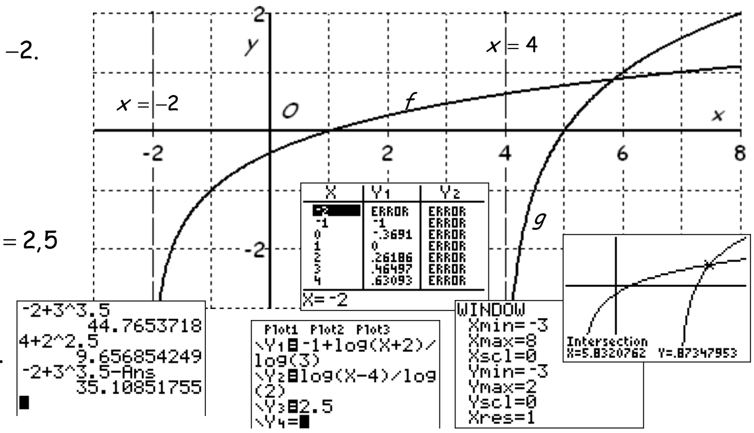
69d $8-5x=0\Rightarrow -5x=-8\Rightarrow$ V.A.: $x=1\frac{3}{5}.$

70a $f(x)=-1+{}^3\log(x+2)\Rightarrow$ V.A.: $x+2=0\Rightarrow x=-2.$
$g(x)={}^2\log(x-4)\Rightarrow$ V.A.: $x-4=0\Rightarrow x=4.$
Teken de grafieken hiernaast (gebruik TABLE).

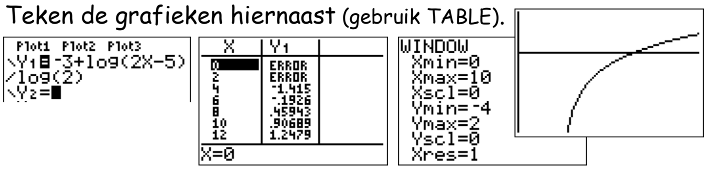
70b $f(x)=g(x)\Rightarrow -1+{}^3\log(x+2)={}^2\log(x-4)$
Intersect geeft het snijpunt (5,83; 0,87).

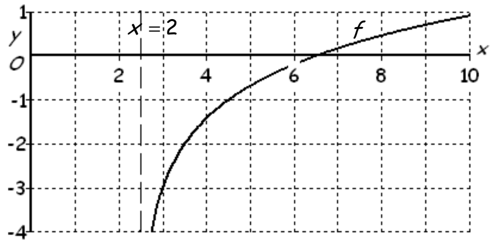
70c $-1+{}^3\log(x+2)=2{,}5$
(intersect of) $^3\log(x+2)=3{,}5$
$x+2=3^{3{,}5}$
$x=-2+3^{3{,}5}$
$x_A\approx 44{,}765.$
Dus $AB=x_A-x_B\approx 35{,}11.$

$^2\log(x-4)=2{,}5$
$x-4=2^{2{,}5}$
$x=4+2^{2{,}5}$
$x_B\approx 9{,}657.$



71a $f(x)=-3+{}^2\log(2x-5)\Rightarrow$ V.A.: $2x-5=0\Rightarrow 2x=5\Rightarrow x=2\frac{1}{2}.$
Teken de grafieken hiernaast (gebruik TABLE).





71b $x = 10\frac{1}{2} \Rightarrow f(10\frac{1}{2}) = -3 + {}^{2}\log(21-5) = -3 + {}^{2}\log(16) = -3 + {}^{2}\log(2^4) = -3 + 4 = 1.$

$x \le 10\frac{1}{2}$ (zie de grafiek en de berekening hierboven) $\Rightarrow f(x) \le 1.$

```
Y1(10.5)
                1
```

71c $f(x) = 4 \Rightarrow -3 + {}^{2}\log(2x-5) = 4 \Rightarrow {}^{2}\log(2x-5) = 7 \Rightarrow 2x - 5 = 2^7 = 128 \Rightarrow 2x = 133 \Rightarrow x = 66\frac{1}{2}.$

```
4+3
                7
2^7
              128
Ans+5
              133
Ans/2
```

72a $L = 85$ (dB)

$10 \cdot \log(I) + 120 = 85$ (intersect of)

$10 \cdot \log(I) = -35$

$\log(I) = -3{,}5$

$I = 10^{-3{,}5} \approx 0{,}0003$ (watt/m²).

```
85-120
              -35
Ans/10
             -3.5
10^Ans
   3.16227766E-4
```

72c $L = 125$ (dB)

$10 \cdot \log(I) + 120 = 125$ (intersect of)

$10 \cdot \log(I) = 5$

$\log(I) = 0{,}5$

$I = 10^{0{,}5}$ (watt/m²).

```
10^0.5
       3.16227766
Ans/10^-7
        31622776.6
```

Dus het geluid van een drilboor is ruim 30 miljoen keer zo hard als het geluid van een normaal gesprek.

72b $I = 10^{-7}$ (watt/m²) $\Rightarrow L = 10 \cdot \log(10^{-7}) + 120 = 10 \cdot -7 + 120 = 50$ (dB).

$I = 2 \cdot 10^{-7}$ (watt/m²) $\Rightarrow L = 10 \cdot \log(2 \cdot 10^{-7}) + 120 \approx 53$ (dB).

Het geluidsniveau neemt toe van 50 dB naar 53 dB.
Dit is geen verdubbeling.

```
10*log(10^-7)+12
0
               50
10*log(2*10^-7)+
120
      53.01029996
```

72d $I = 10^{-7} \Rightarrow L = 50$ (dB).

$I = 10 \times 10^{-7} = 10^{-6} \Rightarrow$

$L = 10 \cdot \log(10^{-6}) + 120$

$= 10 \cdot -6 + 120 = 60$ (dB).

Geluidsniveau neemt 10 dB toe.

73a $y_2 = \log(x) + \log(5)$ en $y_3 = \log(5x)$ zijn hetzelfde (zie hiernaast).

```
Plot1 Plot2 Plot3
\Y1=log(X+5)
\Y2=log(X)+log(5
)
\Y3=log(5X)
\Y4=
```

X	Y1	Y2	Y3
0	.69897	ERROR	ERROR
1	.77815	.69897	.69897
2	.8451	1	1
3	.90309	1.1761	1.1761
4	.95424	1.301	1.301
5	1	1.3979	1.3979
6	1.0414	1.4771	1.4771

X=0

73b $y_2 = \log(x) - \log(5)$ en $y_3 = \log(\frac{x}{5})$ zijn hetzelfde (zie hieronder).

```
Plot1 Plot2 Plot3
\Y1=log(X-5)
\Y2=log(X)-log(5
)
\Y3=log(X/5)
\Y4=
\Y5=
\Y6=
```

X	Y1	Y2	Y3
0	ERROR	ERROR	ERROR
1	ERROR	-.699	-.699
2	ERROR	-.3979	-.3979
3	ERROR	-.2218	-.2218
4	ERROR	-.0969	-.0969
5	ERROR	0	0
6	0	.07918	.07918

X=0

```
Plot1 Plot2 Plot3
\Y1=log(X^3)
\Y2=3*log(X)
\Y3=(log(X))^3
\Y4=
\Y5=
\Y6=
\Y7=
```

X	Y1	Y2	Y3
0	ERROR	ERROR	ERROR
1	0	0	0
2	.90309	.90309	.02728
3	1.4314	1.4314	.10861
4	1.8062	1.8062	.21823
5	2.0969	2.0969	.34149
6	2.3345	2.3345	.47119

X=0

73c $y_1 = \log(x^3)$ en $y_2 = 3 \cdot \log(x)$ zijn hetzelfde (zie hierboven).

74a ${}^{2}\log(7) + {}^{2}\log(6) = {}^{2}\log(7 \cdot 6) = {}^{2}\log(42).$

74b ${}^{2}\log(15) - {}^{2}\log(3) = {}^{2}\log(\frac{15}{3}) = {}^{2}\log(5).$

74c $2 \cdot {}^{2}\log(3) - 3 \cdot {}^{2}\log(5) = {}^{2}\log(3^2) - {}^{2}\log(5^3) = {}^{2}\log(\frac{9}{125}).$

74d $3 + {}^{2}\log(5) = {}^{2}\log(2^3) + {}^{2}\log(5) = {}^{2}\log(8 \cdot 5) = {}^{2}\log(40).$

74e $-2 \cdot {}^{2}\log(5) + 3 \cdot {}^{2}\log(3) = {}^{2}\log(3^3) - {}^{2}\log(5^2) = {}^{2}\log(\frac{27}{25}).$

74f $... = {}^{3}\log(50) - {}^{3}\log(5^2) = {}^{3}\log(\frac{50}{25}) = {}^{3}\log(2).$

75a $... = {}^{2}\log(a) + {}^{2}\log(b^3) = {}^{2}\log(ab^3).$

75b $... = {}^{3}\log(a^5) - {}^{3}\log(b^2) = {}^{3}\log(\frac{a^5}{b^2}).$

75c $... = {}^{5}\log(5^2) + {}^{5}\log(a) = {}^{5}\log(25a).$

75d $... = {}^{3}\log(3^2) - {}^{3}\log(a) = {}^{3}\log(\frac{9}{a}).$

75e $... = {}^{6}\log(a) - {}^{6}\log(6^1) = {}^{6}\log(\frac{a}{6}).$

75f $... = {}^{5}\log(b^2) + {}^{5}\log(\sqrt{a}) = {}^{5}\log(b^2 \cdot \sqrt{a}).$

76a ${}^{5}\log(x) = 3 \cdot {}^{5}\log(2) - 2 \cdot {}^{5}\log(3)$

${}^{5}\log(x) = {}^{5}\log(2^3) - {}^{5}\log(3^2)$

${}^{5}\log(x) = {}^{5}\log(\frac{8}{9})$

$x = \frac{8}{9}.$

76b ${}^{5}\log(x) = 3 + 4 \cdot {}^{5}\log(3)$

${}^{5}\log(x) = {}^{5}\log(5^3) + {}^{5}\log(3^4)$

${}^{5}\log(x) = {}^{5}\log(125 \cdot 81)$

$x = 10125.$

```
125*81
            10125
```

76c ${}^{2}\log(x) = 9 - {}^{2}\log(3)$

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

${}^{2}\log(x) = {}^{2}\log(\frac{512}{3})$

$x = \frac{512}{3}.$

```
2^9
              512
Ans/3
      170.6666667
```

${}^{g}\log(...)$ en $g^{...}$ heffen elkaar op

76d ${}^{3}\log(x) = 0{,}5 \cdot {}^{3}\log(5) + 1$

${}^{3}\log(x) = {}^{3}\log(\sqrt{5}) + {}^{3}\log(3)$

${}^{3}\log(x) = {}^{3}\log(3 \cdot \sqrt{5})$

$x = 3 \cdot \sqrt{5}.$

77a ${}^{5}\log(x) = {}^{5}\log(6) - 2 \cdot {}^{5}\log(4)$

${}^{5}\log(x) = {}^{5}\log(6) - {}^{5}\log(4^2)$

${}^{5}\log(x) = {}^{5}\log(\frac{6}{16})$

$x = \frac{3}{8}.$

77b ${}^{4}\log(x) = \frac{1}{2} - {}^{4}\log(3)$

${}^{4}\log(x) = {}^{4}\log(\sqrt{4}) - {}^{4}\log(3)$

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

$x = \frac{2}{3}.$

77c ${}^{2}\log(x) = 5 - 3 \cdot {}^{2}\log(6)$

${}^{2}\log(x) = {}^{2}\log(2^5) - {}^{2}\log(6^3)$

${}^{2}\log(x) = {}^{2}\log(\frac{32}{216})$

$x = \frac{32}{216} = \frac{4}{27}.$

```
2^5
               32
6^3
              216
```

77d ${}^{3}\log(x) = 5 \cdot {}^{3}\log(2) - 3 \cdot {}^{3}\log(4)$

${}^{3}\log(x) = {}^{3}\log(2^5) - {}^{3}\log(4^3)$

${}^{3}\log(x) = {}^{3}\log(\frac{32}{64})$

$x = \frac{32}{64} = \frac{1}{2}.$

```
2^5
               32
4^3
               64
```

77e $\;{}^{3}\log(x+7) - {}^{3}\log(x-1) = 2$
$\;{}^{3}\log(\frac{x+7}{x-1}) = {}^{3}\log(3^2)$
$\;\frac{x+7}{x-1} = \frac{9}{1}$
$\;9x - 9 = x + 7$
$\;8x = 16$
$\;x = 2.$

$g^{\dots}$ en ${}^{g}\log(\dots)$ heffen elkaar op

77f $\;\log(x+98) = \log(x-1) + 2$
$\;\log(x+98) = \log(x-1) + \log(10^2)$
$\;\log(x+98) = \log(100\cdot(x-1))$
$\;x + 98 = 100x - 100$
$\;-99x = -198$
$\;x = 2.$

78a $\;{}^{3}\log(y) = p \Rightarrow y = 3^p.$

78b $\;{}^{2}\log(y) = t + 5 \Rightarrow y = 2^{t+5}.$

78c $\;\log(y) = q \Rightarrow y = 10^q.$

79a $\;\log(y) = 1{,}3 - 0{,}6x \Rightarrow y = 10^{1{,}3-0{,}6x} \Rightarrow y = 10^{1{,}3}\cdot 10^{-0{,}6x} = 10^{1{,}3}\cdot(10^{-0{,}6})^x \approx 20\cdot 0{,}25^x.$

```
10^1.3
         19.95262315
10^-0.6
         .2511886432
```

79b $\;3\cdot\log(P) = 8 - 4t \Rightarrow \log(P) = \frac{8}{3} - \frac{4}{3}t \Rightarrow P = 10^{\frac{8}{3}-\frac{4}{3}t} = 10^{\frac{8}{3}}\cdot 10^{-\frac{4}{3}t} = 10^{\frac{8}{3}}\cdot(10^{-\frac{4}{3}})^t \approx 460\cdot 0{,}046^t.$

```
10^(8/3)
         464.1588834
10^(-4/3)
         .0464158883
```

79c $\;{}^{2}\log(A) = 1{,}7 - 0{,}3t \Rightarrow A = 2^{1{,}7-0{,}3t} = 2^{1{,}7}\cdot 2^{-0{,}3t} = 2^{1{,}7}\cdot(2^{-0{,}3})^t \approx 3\cdot 0{,}81^t.$

```
2^1.7
         3.249009585
2^-0.3
         .8122523964
```

80a $\;N = 280\cdot 1{,}7^t \Rightarrow \log(N) = \log(280\cdot 1{,}7^t) = \log(280) + \log(1{,}7^t) \approx 2{,}45 + t\cdot\log(1{,}7) \approx 0{,}23t + 2{,}45.$

```
log(280)
         2.447158031
log(1.7)
         .2304489214
```

80b $\;N = 20\cdot 0{,}4^{3t-2} \Rightarrow \log(N) = \log(20\cdot 0{,}4^{3t-2}) = \log(20) + \log(0{,}4^{3t-2}) = \log(20) + (3t-2)\cdot\log(0{,}4) \approx -1{,}19t + 2{,}10.$

```
log(20)-2log(0.4
)
         2.096910013
3*log(0.4)
         -1.193820026
```

81a $\;20\cdot\log(A) = 5 - 100x \Rightarrow \log(A) = \frac{1}{4} - 5x \Rightarrow A = 10^{\frac{1}{4}-5x} = 10^{\frac{1}{4}}\cdot 10^{-5x} = 10^{\frac{1}{4}}\cdot(10^{-5})^x \approx 1{,}8\cdot 0{,}00001^x.$

```
10^(1/4)
         1.77827941
10^-5
         1E-5
```

81b $\;-5\cdot\log(y) = 20 - 10x^2 \Rightarrow \log(y) = -4 + 2x^2 \Rightarrow y = 10^{-4+2x^2} = 10^{2x^2-4}.$

81c $\;0{,}5\cdot\log(N) + 3 = 5 - 2x \Rightarrow 0{,}5\cdot\log(N) = 2 - 2x \Rightarrow \log(N) = 4 - 4x \Rightarrow$
$\;N = 10^{4-4x} = 10^4\cdot 10^{-4x} = 10^4\cdot(10^{-4})^x = 10^4\cdot(\frac{1}{10^4})^x = 10\,000\cdot(\frac{1}{10000})^x.$

```
10^4
         10000
10^-4
         1E-4
```

82a $\;\log(W) = \log(2{,}4) + 0{,}008\cdot 130 \Rightarrow W = 10^{\log(2{,}4)+0{,}008\cdot 130} \approx 26$ (kg).

```
log(2.4)+0.008*1
30
         1.420211242
10^Ans
         26.31547671
```

82b $\;\log(23{,}5) = \log(2{,}4) + 0{,}008\cdot h$ (intersect of) $\Rightarrow h = \frac{\log(23{,}5)-\log(2{,}4)}{0{,}008} \approx 124$ (cm).

```
log(23.5)-log(2.
4)
         .9908566206
Ans/0.008
         123.8570776
```

82c $\;\log(W) = \log(2{,}4) + 0{,}008h \Rightarrow W = 10^{\log(2{,}4)+0{,}008h} = 10^{\log(2{,}4)}\cdot(10^{0{,}008})^h = 2{,}4\cdot 1{,}0186^h$ (kg).

```
10^log(2.4)
         2.4
10^0.008
         1.018591388
```

83a De bruine walvis is $\frac{100\,000}{10} = 10\,000$ keer zo zwaar als de wasbeer.
De bruine walvis is $\frac{100\,000}{0{,}002} = 50\,000\,000$ keer zo zwaar als de kolibrie.

```
100000/10
         10000
100000/0.002
         50000000
```

83b De getallenlijn zou $\frac{100\,000\,000}{1} = 100\,000\,000$ mm $= 100\,000$ m $= 100$ km lang moeten worden.

83c De getallenlijn zou $\frac{100\,000}{1\,000} = 100$ mm $= 10$ cm lang moeten worden.
Bezwaar: de eerste 8 gewichten komen binnen de eerste 0,6 mm (praktisch niet uitvoerbaar).

84a A: 1,3; B: 7,5; C: 23; D: 55; E: 150 en F: 2400.

84b Op de verticale as staan lijntjes bij: 550; 210; 9,5 en 2,4; geen lijntjes bij: 310; 49; 1,25 en 0.

84c A: 1300; B: 7500; C: 23000; D: 55000; E: 150000 en F: 2400000. (1000 keer zo groot als bij 84a)

85a De minimale aanvoer tong is 11000 ($\times$1000 kg in 1997); de maximale aanvoer is 24000 ($\times$1000 kg in 1994).

```
53000/5500
         9.636363636
```

85b Schol (in 2001): 53000 ($\times$1000 kg) en kabeljauw: 5500 ($\times$1000 kg) $\Rightarrow \frac{53000}{5500} \approx 9{,}6$ keer zoveel schol als kabeljauw.

85c Tong van (in 1994): 24000 ($\times$1000 kg) naar (in 2004): 15000 ($\times$1000 kg).
In 2004 nog $\frac{15000}{24000}\times 100\% = 62{,}5\%$ van de hoeveelheid in 1994 $\Rightarrow$ 37,5% minder dan in 1994.

```
15000/24000*100
         62.5
100-62.5
         37.5
```

85d Makreel van (in 1998): 1000 ($\times$1000 kg) naar (in 1999): 3000 ($\times$1000 kg) $\Rightarrow$ een toename van 2000 ($\times$1000 kg).
Makreel van (in 2001): 5000 ($\times$1000 kg) naar (in 2002): 14000 ($\times$1000 kg) $\Rightarrow$ een toename van 9000 ($\times$1000 kg).
De toename in de periode 2001-2002 was meer.

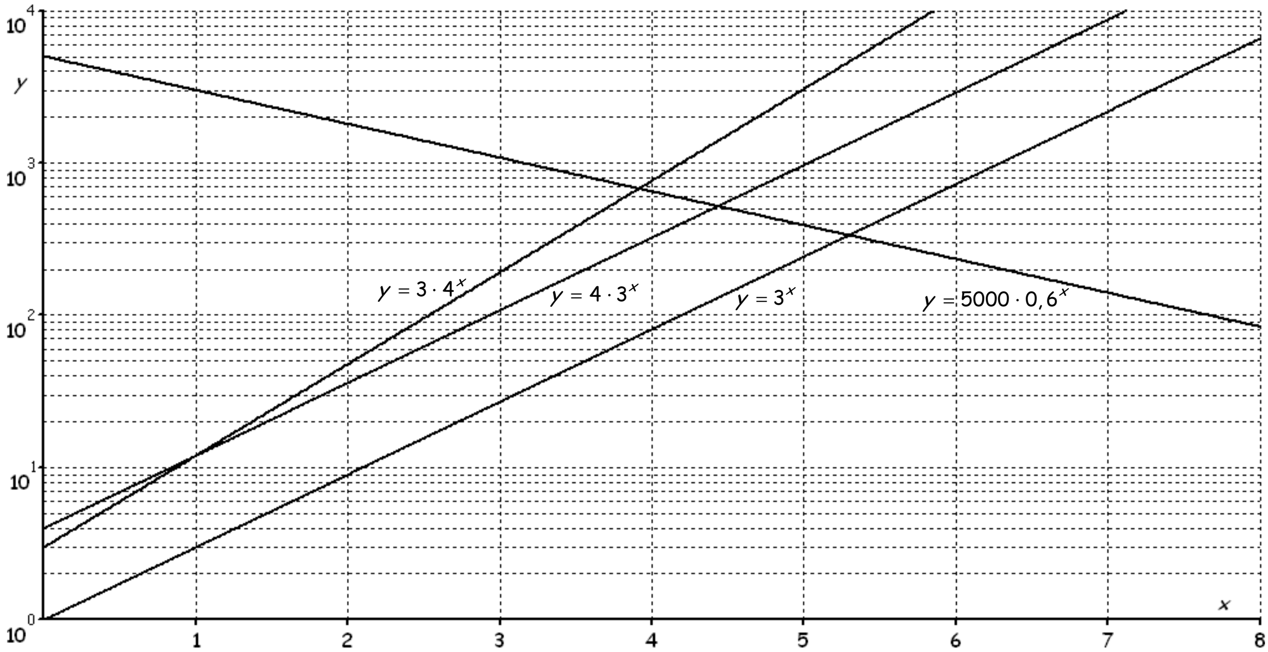
85e De hoogste waarde (makreel) is 74000 ($\times$1000 kg) in 2004 $\Rightarrow$ de grafiek zou 74 cm hoog worden.

86a Zie de tabel hiernaast. (maak zelf eerst een tabel met de GR)

86b Zie de grafiek onder opgave 86. (de grafiek wordt een rechte lijn)
(gebruik het werkboek of vraag logaritmisch papier aan je docent)

86c Zie de tabel hiernaast en de grafiek onder opgave 86.

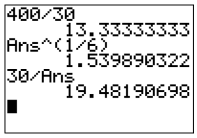
x	0	2	4	6	8
$y = 3^x$	1	9	81	729	6561
$y = 4\cdot 3^x$	4	36	243	2916	26244
$y = 3\cdot 4^x$	3	48	768	12288	196608
$y = 5000\cdot 0{,}6^x$	5000	1800	648	233	84



87a Rechte lijn op logaritmisch papier $\Rightarrow N = b \cdot g^t$.

$\left.\begin{array}{l} t = 1 \text{ en } N = 30 \\ t = 7 \text{ en } N = 400 \end{array}\right\} \Rightarrow g_{6 \text{ dagen}} = g^6 = \frac{400}{30} \Rightarrow g_{\text{dag}} = g = \left(\frac{400}{30}\right)^{\frac{1}{6}} \approx 1{,}540.$

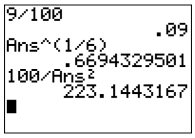
$\left.\begin{array}{l} N = b \cdot \text{Ans}^t \\ t = 1 \text{ en } N = 30 \end{array}\right\} \Rightarrow b \cdot \text{Ans}^1 = 30 \Rightarrow b = \frac{30}{\text{Ans}} \approx 19{,}5.$ Dus $N \approx 19{,}5 \cdot 1{,}540^t$.



87b Rechte lijn op logaritmisch papier $\Rightarrow N = b \cdot g^t$.

$\left.\begin{array}{l} t = 2 \text{ en } N = 100 \\ t = 8 \text{ en } N = 9 \end{array}\right\} \Rightarrow g_{6 \text{ dagen}} = g^6 = \frac{9}{100} = 0{,}09 \Rightarrow g_{\text{dag}} = g = 0{,}09^{\frac{1}{6}} \approx 0{,}669.$

$\left.\begin{array}{l} N = b \cdot \text{Ans}^t \\ t = 2 \text{ en } N = 100 \end{array}\right\} \Rightarrow b \cdot \text{Ans}^2 = 100 \Rightarrow b = \frac{100}{\text{Ans}^2} \approx 233.$ Dus $N \approx 233 \cdot 0{,}669^t$.



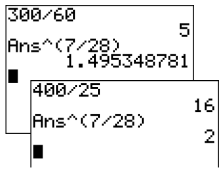
88a De grafieken van B en C zijn rechte lijnen $\Rightarrow$ bij de planten B en C is sprake van exponentiële groei.

88bc Plant B: $L = b \cdot g^t$.

$\left.\begin{array}{l} t = 0 \text{ en } L = 60 \Rightarrow b = 60 \\ t = 28 \text{ en } L = 300 \end{array}\right\} \Rightarrow g_{28 \text{ dagen}} = \frac{300}{60} = 5 \Rightarrow g_{\text{week}} = g = 5^{\frac{7}{28}} \approx 1{,}50.$ Dus $L \approx 60 \cdot 1{,}50^t$.

Plant C: $L = b \cdot g^t$.

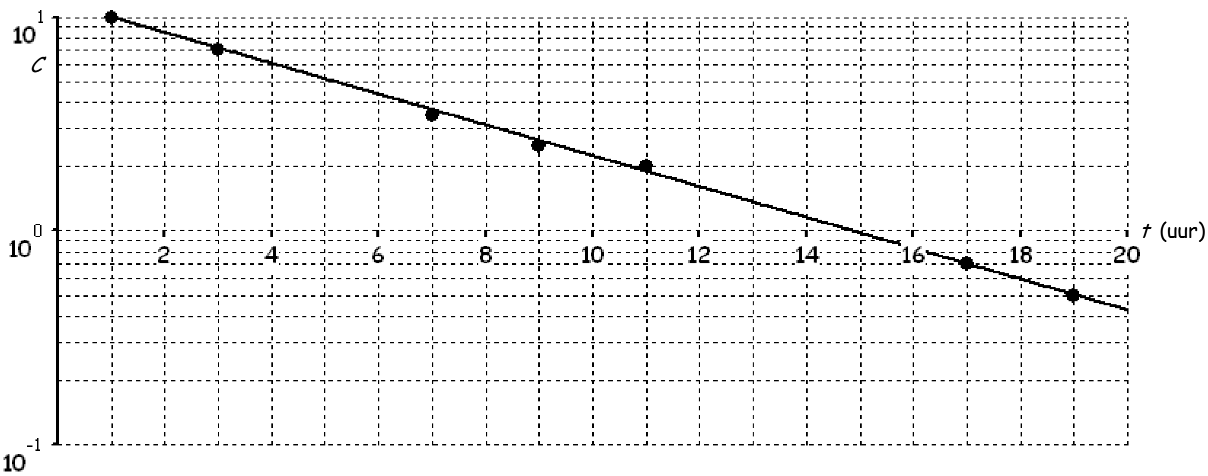
$\left.\begin{array}{l} t = 0 \text{ en } L = 25 \Rightarrow b = 25 \\ t = 28 \text{ en } L = 400 \end{array}\right\} \Rightarrow g_{28 \text{ dagen}} = \frac{400}{25} = 16 \Rightarrow g_{\text{week}} = g = 16^{\frac{7}{28}} = 2.$ Dus $L = 25 \cdot 2^t$.



88d Plant E groeit exponentiëel $\Rightarrow$ een rechte lijn door (5,30) en (25,400). (doe dit zelf in het **werkboek**)

88e Plant F groeit exponentiëel $\Rightarrow$ rechte lijn door (10,50) evenwijdig met de grafiek van B. (zelf doen in het **werkboek**)

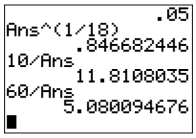
89a



89b Rechte lijn op enkelvoudig logaritmisch papier $\Rightarrow$ exponentiële functie $C = b \cdot g^t$.

$\left.\begin{array}{l} t = 1 \text{ en } C = 10 \\ t = 19 \text{ en } C = 0{,}5 \end{array}\right\} \Rightarrow g_{18\text{ uur}} = g^{18} = \frac{0{,}5}{10} = 0{,}05 \Rightarrow g_{\text{uur}} = g = 0{,}05^{\frac{1}{18}} \approx 0{,}847.$

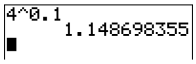
$\left.\begin{array}{l} C = b \cdot \text{Ans}^t \\ t = 1 \text{ en } C = 10 \end{array}\right\} \Rightarrow b \cdot \text{Ans} = 10 \Rightarrow b = \frac{10}{\text{Ans}} \approx 11{,}81.$ Dus $C \approx 11{,}81 \cdot 0{,}847^t$.



89c Stel dat de patiënt x liter bloed heeft $\Rightarrow$ concentratie C op $t = 0$ is dan $C = \frac{60}{x}$.
Verder geldt volgens de formule: concentratie C op $t = 0$ is $C \approx 11{,}81$.
Dus $\frac{60}{x} \approx 11{,}81 \Rightarrow$ de patiënt heeft ongeveer $x \approx \frac{60}{11{,}81} \approx 5{,}1$ liter bloed.

90a De grafiek van plant A is een rechte lijn op enkelvoudig logaritmisch papier $\Rightarrow$ exponentiële functie $N_A = b \cdot g^t$.

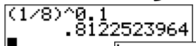
$\left.\begin{array}{l} t = 0 \text{ en } N_A = 5\,000 \Rightarrow b = 5\,000 \\ t = 10 \text{ en } N_A = 20\,000 \end{array}\right\} \Rightarrow g_{10\text{ jaar}} = \frac{20000}{5000} = 4 \Rightarrow g_{\text{jaar}} = g = 4^{\frac{1}{10}} \approx 1{,}149.$



Dus $N_A \approx 5\,000 \cdot 1{,}149^t$.

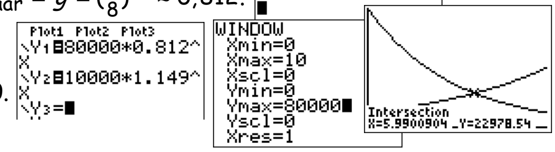
De grafiek van plant B is een rechte lijn op enkelvoudig logaritmisch papier $\Rightarrow$ exponentiële functie $N_B = b \cdot g^t$.

$\left.\begin{array}{l} t = 0 \text{ en } N_B = 80\,000 \Rightarrow b = 80\,000 \\ t = 10 \text{ en } N_B = 10\,000 \end{array}\right\} \Rightarrow g_{10\text{ jaar}} = \frac{10000}{80000} = \frac{1}{8} \Rightarrow g_{\text{jaar}} = g = (\frac{1}{8})^{\frac{1}{10}} \approx 0{,}812.$



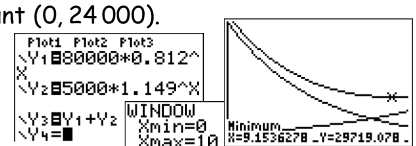
Dus $N_B \approx 80\,000 \cdot 0{,}812^t$.

90b $N_B = 2 \cdot N_A \Rightarrow 80\,000 \cdot 0{,}812^t = 10\,000 \cdot 1{,}149^t$ (intersect) $\Rightarrow t \approx 6{,}0$.



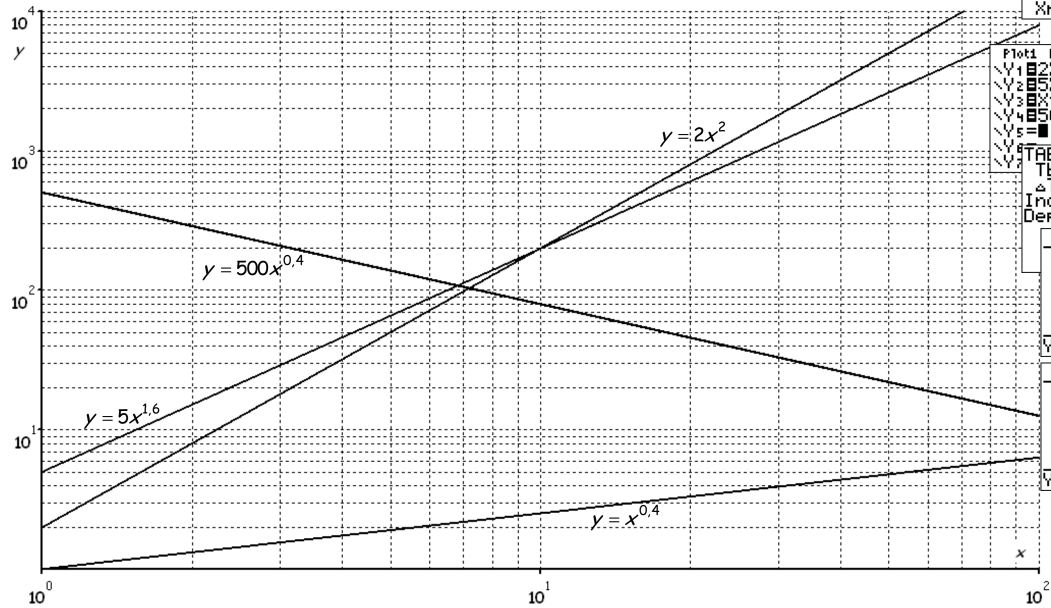
90c $N_C = 0{,}3 \cdot N_B = 0{,}3 \cdot 80\,000 \cdot 0{,}812^t = 24\,000 \cdot 0{,}812^t$.
De grafiek van N_C is dus evenwijdig met de grafiek van N_B en gaat door het punt (0, 24 000).

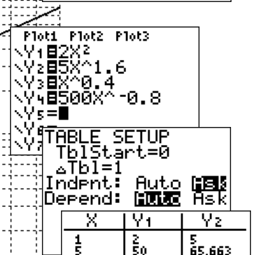
90d $N_A + N_B$ (minimum) heeft voor $t \approx 9{,}15$ het minimale aantal van ongeveer 29 700.
Het snijpunt van N_A en N_B ligt bij $t \approx 8 \Rightarrow$ Wesley heeft geen gelijk.



91a Vul de tabel zelf in (gebruik TABLE). 91bc Zie de grafieken onder deze opgave.

91d De grafieken van machtsfuncties (op dubbellogaritmisch papier) zijn rechte lijnen.





X	Y1	Y2
1	2	5
5	50	65.663
10	200	199.05
20	800	603.42
30	1800	1154.4
50	5000	2614.1
100	20000	7924.5

Y1=20000

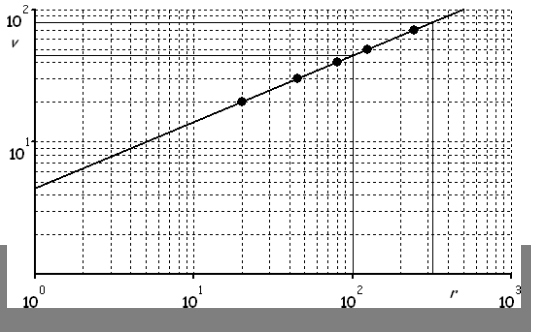
X	Y3	Y4
1	1	500
5	1.9037	137.97
10	2.5119	79.245
20	3.3145	45.514
30	3.8981	32.906
50	4.7818	21.867
100	6.3096	12.559

Y4=12.5594321575

92ab Zie de grafiek hiernaast.

92b v is een machtsfunctie van $r \Rightarrow v = a \cdot r^p$.

92c $r = 100 \Rightarrow v \approx 44$ en $v = 80 \Rightarrow r = 320$. (zo nauwkeurig niet af te lezen)



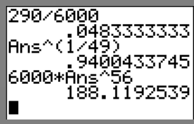
Bij het uitwerken van opgave 93 en 94 lees je op bladzijde 14 en 15 van het WERKBOEK-I hoe je Excel een logaritmische schaalverdeling kunt laten tekenen.

93a Zie de puntengrafiek onder deze opgave.

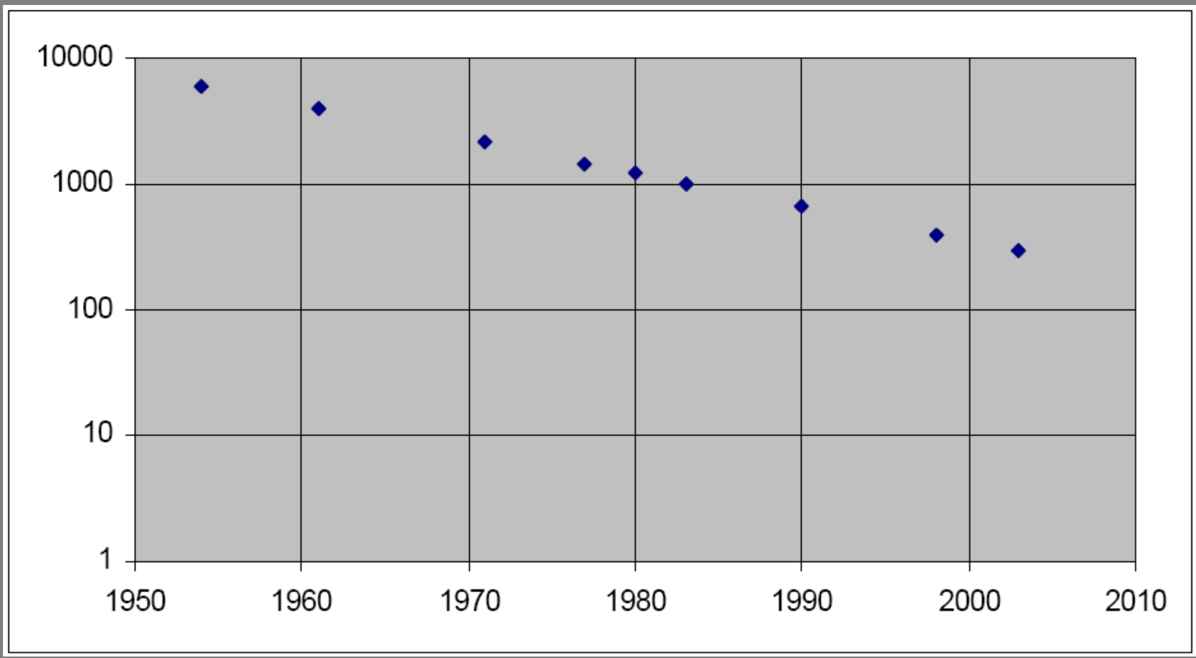
93b De punten liggen vrijwel op een rechte lijn $\Rightarrow$ exponentiële afname.

De groeifactor in 49 jaar is $\frac{290}{6000} \Rightarrow g_{\text{jaar}} = (\frac{290}{6000})^{\frac{1}{49}} \approx 0{,}94$.

De beginhoeveelheid is 6000 $\Rightarrow N = 6\,000 \cdot 0{,}94^t$.



93c $N(56) \approx 6\,000 \cdot 0{,}94^{56} \approx 188$. Dus ongeveer 190 broedparen.



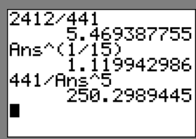
94a Zie de puntengrafiek onder deze opgave.

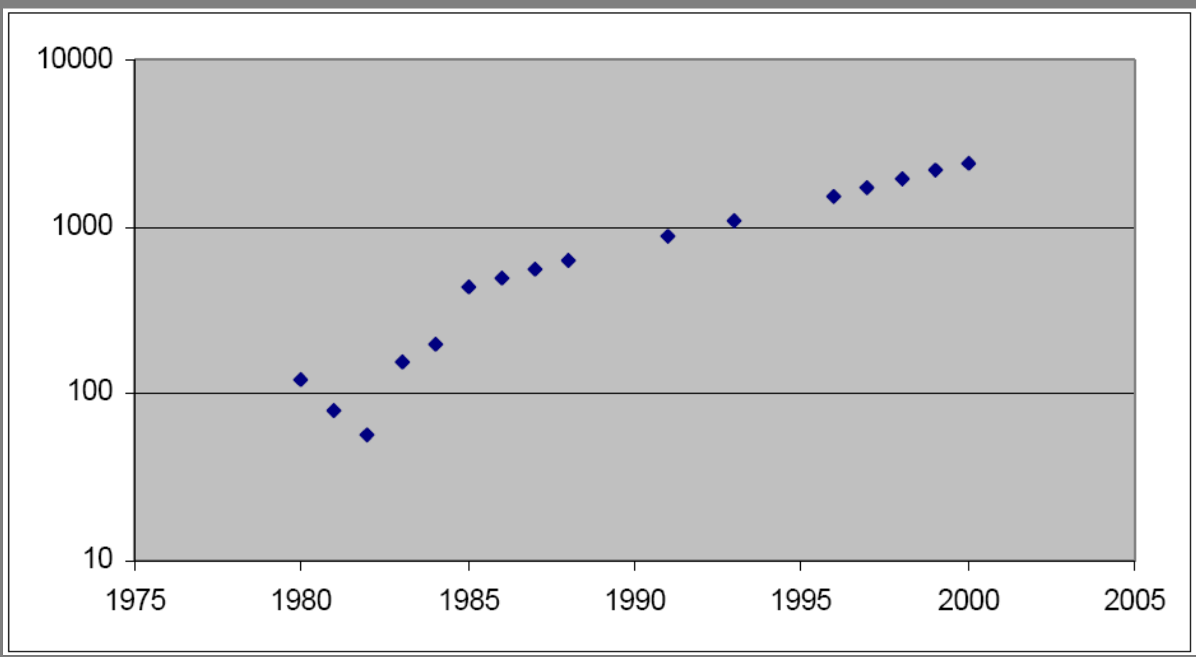
94b Vanaf 1990 liggen de punten vrijwel op een rechte lijn $\Rightarrow$ exponentiële groei.

94c Neem $t = 5$ voor 1985 $\Rightarrow$ punt (5, 441) en (20, 2 412).

De groeifactor in 15 jaar is $\frac{2412}{441} \Rightarrow g_{\text{jaar}} = (\frac{2412}{441})^{\frac{1}{15}} \approx 1{,}12$.

$\left.\begin{array}{l} N \approx b \cdot 1{,}12^t \\ \text{door } (5,\,441) \end{array}\right\} \Rightarrow 441 \approx b \cdot 1{,}12^5 \Rightarrow b \approx \frac{441}{1{,}12^5} \approx 250.$ Dus $N \approx 250 \cdot 1{,}12^t$.



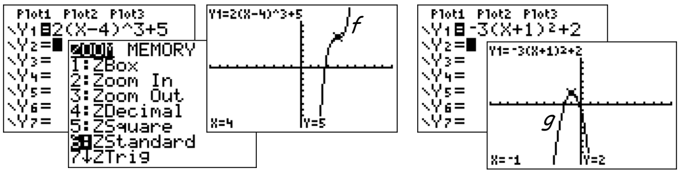


Diagnostische toets

D1 $y = 4(x-2+1)^3 + 1 - 5 = 4(x-1)^3 - 4.$

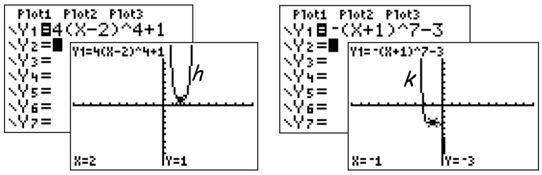
D2a $f(x) = 2(x-4)^3 + 5 \Rightarrow$ punt van symm. $(4, 5)$.
(maak een schets van de plot)

D2b $g(x) = -3(x+1)^2 + 2 \Rightarrow$ top $(-1, 2)$.
(maak een schets van de plot)



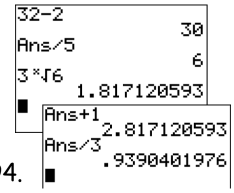
D2c $h(x) = 4(x-2)^4 + 1 \Rightarrow$ top $(2, 1)$.
(maak een schets van de plot)

D2d $k(x) = -(x+1)^7 - 3 \Rightarrow$ punt van symm. $(-1, -3)$.
(maak een schets van de plot)

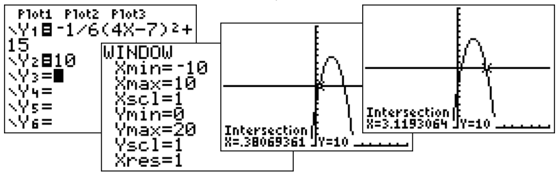


D3 $y = 1{,}5(x-2)^4 - 5 \xrightarrow{\text{verm. t.o.v. de } x\text{-as met } 4} y = 6(x-2)^4 - 20 \xrightarrow{\text{transl. } (-3,-16)} y = 6(x+1)^4 - 36.$
min. $f(-2) = -5$ — min. $f(2) = -20$ — min. $f(-1) = -36$

D4a
$5(3x-1)^3 + 2 = 32$
$5(3x-1)^3 = 30$
$(3x-1)^3 = 6$
$3x - 1 = \sqrt[3]{6}$
$3x = 1 + \sqrt[3]{6}$
$x = \frac{1+\sqrt[3]{6}}{3} \approx 0{,}94.$



D4b $-\frac{1}{6}(4x-7)^2 + 15 = 10$ (intersect) $\Rightarrow x \approx 0{,}38 \vee x \approx 3{,}12.$
$-\frac{1}{6}(4x-7)^2 + 15 \geq 10$ (zie een plot) $\Rightarrow 0{,}38 \leq x \leq 3{,}12.$

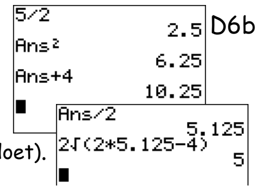


D5a $x \geq 0$. Dus $D_f = [0, \rightarrow\rangle$; $B_f = [-1, \rightarrow\rangle$ en het beginpunt is $(0, -1)$.

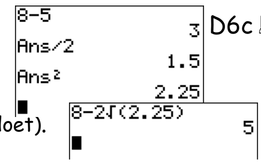
D5b $2x - 5 \geq 0 \Rightarrow 2x \geq 5 \Rightarrow x \geq 2\frac{1}{2}$. Dus $D_g = [2\frac{1}{2}, \rightarrow\rangle$; $B_g = [6, \rightarrow\rangle$ en het beginpunt is $(2\frac{1}{2}, 6)$.

D5c $3 - 2x \geq 0 \Rightarrow -2x \geq -3 \Rightarrow x \leq 1\frac{1}{2}$. Dus $D_f = \langle \leftarrow, 1\frac{1}{2}]$; $B_f = [4, \rightarrow\rangle$ en het beginpunt is $(1\frac{1}{2}, 4)$.

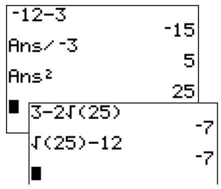
D6a
$2\sqrt{2x-4} = 5$
$\sqrt{2x-4} = 2{,}5$
$2x - 4 = 6{,}25$
$2x = 10{,}25$
$x = 5{,}125$ (voldoet).



D6b
$5 = 8 - 2\sqrt{x}$
$2\sqrt{x} = 3$
$\sqrt{x} = 1{,}5$
$x = 2{,}25$ (voldoet).

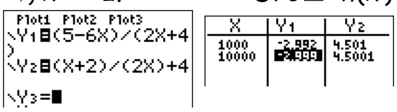


D6c
$3 - 2\sqrt{x} = \sqrt{x} - 12$
$-3\sqrt{x} = -15$
$\sqrt{x} = 5$
$x = 25$ (voldoet).



D7a $y = \frac{1}{x} \xrightarrow{\text{transl. } (-2,-3)} f(x) = \frac{1}{x+2} - 3 \Rightarrow$ V.A.: (noemer $= 0 \Rightarrow$) $x = -2$ en H.A.: $y = -3$.

D7b $g(x) = \frac{5-6x}{2x+4}$ heeft V.A.: (noemer $= 0 \Rightarrow$) $x = -2$.
$\left.\begin{array}{l} g(1000) \approx -2{,}992 \\ g(10\,000) \approx -2{,}999 \end{array}\right\} \Rightarrow$ H.A.: $y = -3$



D7c $h(x) = \frac{x+2}{2x} + 4$ heeft V.A.: (noemer $= 0 \Rightarrow$) $x = 0$.
$\left.\begin{array}{l} h(1000) \approx 4{,}501 \\ h(10\,000) \approx 4{,}5001 \end{array}\right\} \Rightarrow$ H.A.: $y = 4{,}5$.

D8a
$3 - \frac{2x}{x+1} = 5$
$\frac{-2x}{x+1} = \frac{2}{1}$
$2 \cdot (x+1) = -2x$
$2x + 2 = -2x$
$4x = -2$
$x = -\frac{2}{4} = -\frac{1}{2}.$

D8b
$\frac{x+13}{2x+2} = \frac{x+10}{x}$
$(2x+2) \cdot (x+10) = x \cdot (x+13)$
$2x^2 + 20x + 2x + 20 = x^2 + 13x$
$x^2 + 9x + 20 = 0$
$(x+5) \cdot (x+4) = 0$
$x = -5 \vee x = -4.$

D8c
$6 + \frac{3x}{x-1} = 15$
$\frac{3x}{x-1} = \frac{9}{1}$
$9 \cdot (x-1) = 3x$
$9x - 9 = 3x$
$6x = 9$
$x = \frac{9}{6} = 1\frac{1}{2}.$

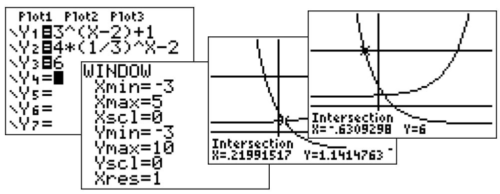
D9a $y = 3^x \xrightarrow{\text{transl. } (2,1)} f(x) = 3^{x-2} + 1$ met H.A.: $y = 1$.
$y = \left(\frac{1}{3}\right)^x \xrightarrow{\text{verm. t.o.v. de } x\text{-as met } 4} y(x) = 4 \cdot \left(\frac{1}{3}\right)^x \xrightarrow{\text{transl. } (0,-2)} g(x) = 4 \cdot \left(\frac{1}{3}\right)^x - 2$ met H.A.: $y = -2$.

D9b $B_f = \langle 1, \rightarrow\rangle$ en $B_g = \langle -2, \rightarrow\rangle$.

D9c $f(x) = g(x)$ (intersect) $\Rightarrow x \approx 0{,}22$; $f(x) \geq g(x)$ (zie plot) $\Rightarrow x \geq 0{,}22$.

D9d $g(x) = 6$ (intersect) $\Rightarrow x \approx -0{,}63$; $g(x) \leq 6$ (zie plot) $\Rightarrow x \geq -0{,}63$.

D9e $f(5) = 3^3 + 1 = 27 + 1 = 28$; $x \leq 5$ (zie plot en bereik) $\Rightarrow 1 < f(x) \leq 28$.

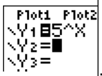


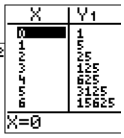
D10a $y=\frac{6}{x^3}=6\cdot\frac{1}{x^3}=6\cdot x^{-3}$.

D10b $y=5x^2\cdot\sqrt[3]{x}=5x^2\cdot x^{\frac{1}{3}}=5\cdot x^{2+\frac{1}{3}}=5x^{2\frac{1}{3}}$.

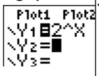
D10c $y=\left(3x^2\right)^3\cdot\frac{2}{9x}=27x^6\cdot\frac{2}{9}\cdot\frac{1}{x}=27x^6\cdot\frac{2}{9}\cdot x^{-1}=6\cdot x^{6+-1}=6x^5$.

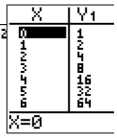
D11a $5^{x-1}=125\cdot\sqrt[3]{5}$
$5^{x-1}=5^3\cdot 5^{\frac{1}{3}}$
$5^{x-1}=5^{3\frac{1}{3}}$
$x-1=3\frac{1}{3}$
$x=4\frac{1}{3}$.





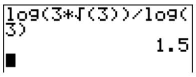
D11b $2\cdot 4^{2x-1}-3=61$
$2\cdot\left(2^2\right)^{2x-1}=64$
$2^{4x-2}=32$
$2^{4x-2}=2^5$
$4x-2=5$
$4x=7$
$x=\frac{7}{4}$.

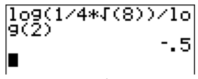




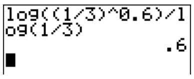
D11c $2^{3x+1}+6=6\frac{1}{8}$
$2^{3x+1}=\frac{1}{8}$
$2^{3x+1}=\frac{1}{2^3}$
$2^{3x+1}=2^{-3}$
$3x+1=-3$
$3x=-4$
$x=-\frac{4}{3}$.

D12a ${}^3\log(3\cdot\sqrt{3})={}^3\log(3^1\cdot 3^{\frac{1}{2}})={}^3\log(3^{1\frac{1}{2}})=1\frac{1}{2}$.



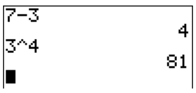


D12b ${}^{\frac{1}{3}}\log(\left(\frac{1}{3}\right)^{0,6})=0,6$.

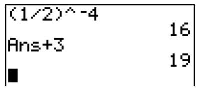


D12c ${}^2\log(\frac{1}{4}\cdot\sqrt{8})={}^2\log(2^{-2}\cdot\sqrt{2^3})={}^2\log(2^{-2}\cdot 2^{\frac{3}{2}})={}^2\log(2^{-\frac{1}{2}})=-\frac{1}{2}$.

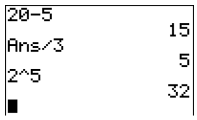
D13a $3+{}^3\log(x)=7$
${}^3\log(x)=4$
$x=3^4$
$x=81$.



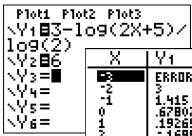
D13b ${}^{\frac{1}{2}}\log(x-3)=-4$
$x-3=\left(\frac{1}{2}\right)^{-4}$
$x-3=(2^{-1})^{-4}=2^4$
$x=19$.

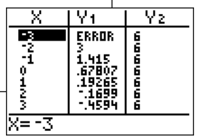


D13c $5+3\cdot{}^2\log(x)=20$
$3\cdot{}^2\log(x)=15$
${}^2\log(x)=5$
$x=2^5=32$.

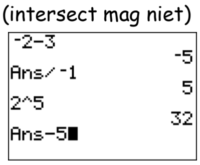


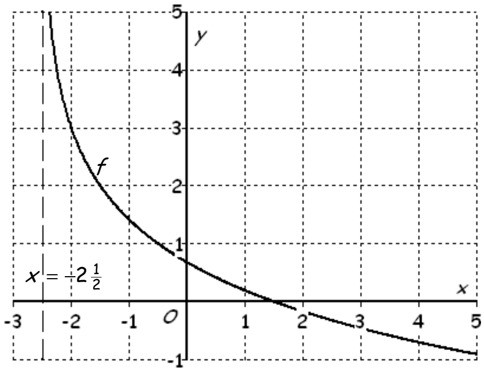
D14a V.A.: $2x+5=0\Rightarrow 2x=-5\Rightarrow x=-2\frac{1}{2}$.
Zie de grafiek hiernaast (gebruik TABLE).



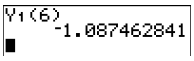


D14b $3-{}^2\log(2x+5)=-2$ (intersect mag niet)
$-{}^2\log(2x=5)=-5$
${}^2\log(2x+5)=5$
$2x+5=2^5=32$
$2x=27\Rightarrow x=13\frac{1}{2}$.



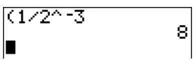


D14c $x=6\Rightarrow f(6)=3-{}^2\log(2\cdot 6+5)\approx -1,087$.
$x\le 6$ (zie grafiek) $\Rightarrow f(x)\ge -1,087$.



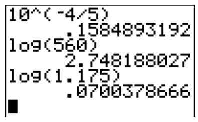
D15a $5\cdot{}^3\log(4)-\frac{1}{2}\cdot{}^3\log(16)={}^3\log(4^5)-{}^3\log(16^{\frac{1}{2}})={}^3\log(1024)-{}^3\log(\sqrt{16})={}^3\log(1024)-{}^3\log(4)={}^3\log(\frac{1024}{4})={}^3\log(256)$.

D15b ${}^{\frac{1}{2}}\log(2x+5)-{}^{\frac{1}{2}}\log(x+1)=-3$
${}^{\frac{1}{2}}\log(\frac{2x+5}{x+1})=-3$
$\frac{2x+5}{x+1}=\left(\frac{1}{2}\right)^{-3}=(2^{-1})^{-3}=2^3=\frac{8}{1}$
$8(x+1)=2x+5$
$8x+8=2x+5$
$6x=-3$
$x=-\frac{1}{2}$.



D15c $\log(x+145)=1+\log(x+10)$
$\log(x+145)=\log(10^1)+\log(x+10)$
$\log(x+145)=\log(10\cdot(x+10))$
$x+145=10\cdot(x+10)$
$x+145=10x+100$
$-9x=-45$
$x=5$.

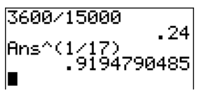
D15d $5\cdot\log(N)=10-4P\Rightarrow\log(N)=2-\frac{4}{5}P\Rightarrow N=10^{2-\frac{4}{5}P}=10^2\cdot 10^{-\frac{4}{5}P}=100\cdot(10^{-\frac{4}{5}})^P\approx 100\cdot 0,158^P$.



D15e $F=560\cdot 1,175^t\Rightarrow\log(F)=\log(560\cdot 1,175^t)=\log(560)+\log(1,175^t)=\log(560)+t\cdot\log(1,175)\approx 0,07t+2,75$.

D16a Doe dit nu een keer zelf zonder voorbeeld.

D16b De grafiek is een rechte lijn op enkelvoudig logaritmisch papier $\Rightarrow$ exponentiële functie $N=b\cdot g^t$.

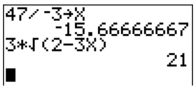


$$\left.\begin{array}{l} t=0 \text{ en } N=15\,000\Rightarrow b=15\,000 \\ t=17 \text{ en } N=3\,600 \end{array}\right\}\Rightarrow g_{17\text{ jaar}}=\frac{3600}{15000}=0,24\Rightarrow g_{\text{jaar}}=g=0,24^{\frac{1}{17}}\approx 0,92\Rightarrow N\approx 15\,000\cdot 0,92^t.$$

Gemengde opgaven 10. Allerlei functies

G10a $5x^6-1=9$
$5x^6=10$
$x^6=2$
$x=-\sqrt[6]{2} \vee x=\sqrt[6]{2}$.

G10b $3\cdot\sqrt{2-3x}=21$
$\sqrt{2-3x}=7$ (kwadrateren)
$2-3x=49$
$-3x=47$
$x=\frac{47}{-3}=-15\frac{2}{3}$ (voldoet).

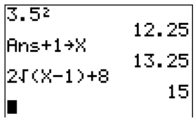


G10c $\frac{x+2}{x-1}=\frac{x}{x+5}$
$(x+2)(x+5)=x(x-1)$
$x^2+5x+2x+10=x^2-x$
$7x+10=-x$
$8x=-10$
$x=\frac{-10}{8}=-1\frac{1}{4}$.

G10d $2x^3+15=69$
$2x^3=54$
$x^3=27=3^3$
$x=3$.

G10e $\frac{2x-1}{x+2}=\frac{x+4}{x-2}$
$(2x-1)(x-2)=(x+2)(x+4)$
$2x^2-4x-x+2=x^2+4x+2x+8$
$x^2-11x-6=0$
$D=(-11)^2-4\cdot1\cdot-6=121+24=145$
$x=\frac{11+\sqrt{145}}{2} \vee x=\frac{11-\sqrt{145}}{2}$.

G10f $2\cdot\sqrt{x-1}+8=15$
$2\cdot\sqrt{x-1}=7$
$\sqrt{x-1}=3{,}5$ (kwadrateren)
$x-1=12{,}25$
$x=13{,}25$ (voldoet).



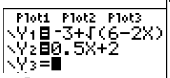
G10g $8x^3+34=-6$
$8x^3=-40$
$x^3=-5$
$x=\sqrt[3]{-5}=-\sqrt[3]{5}$.

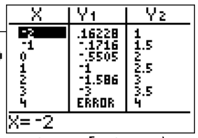
G10h $\frac{4+2x}{x}=\frac{12}{x+1}$
$(4+2x)(x+1)=12x$
$4x+4+2x^2+2x=12x$
$2x^2-6x+4=0$
$x^2-3x+2=0$
$(x-2)(x-1)=0$
$x=2 \vee x=1$.

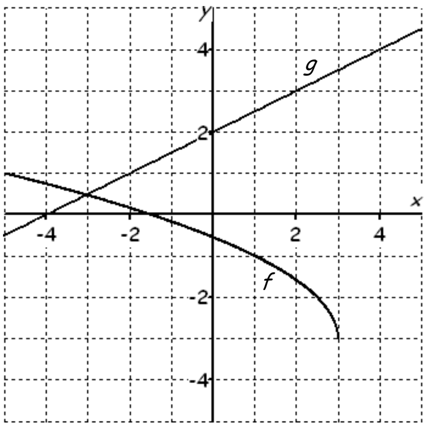
G10i $0{,}1x^4+5=13$
$0{,}1x^4=8$ (keer 10)
$x^4=80$
$x=-\sqrt[4]{80} \vee x=\sqrt[4]{80}$.

G10j $\frac{2x}{x-1}-2=4$
$\frac{2x}{x-1}=\frac{6}{1}$
$6(x-1)=2x$
$6x-6=2x$
$4x=6$
$x=\frac{6}{4}=1\frac{1}{2}$.

G11a Zie de grafieken hiernaast. (gebruik TABLE)

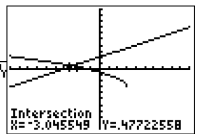


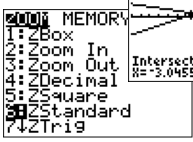




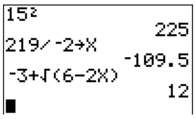
G11b $6-2x\geq0 \Rightarrow -2x\geq-6 \Rightarrow x\leq3 \Rightarrow D_f=\langle\leftarrow,3]$.
Het beginpunt van de grafiek $(3,-3)$ is het laagste punt $\Rightarrow B_f=[-3,\rightarrow\rangle$.

G11c $f(x)=g(x)$ (intersect) $\Rightarrow x\approx-3{,}0$.
$f(x)<g(x)$ (zie grafiek en gebruik domein) $\Rightarrow -3{,}0<x\leq3$.

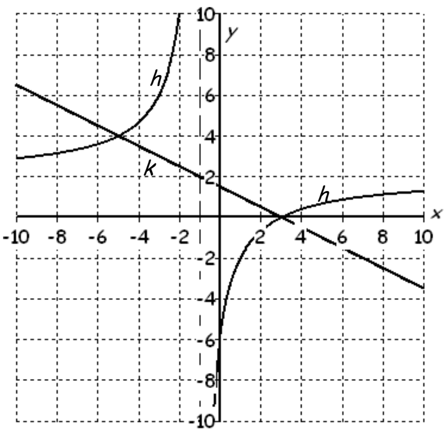




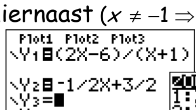
G11d $f(x)=12$
$-3+\sqrt{6-2x}=12$
$\sqrt{6-2x}=15$ (kwadrateren)
$6-2x=225$
$-2x=219$
$x=\frac{219}{-2}=-109\frac{1}{2}$ (voldoet).

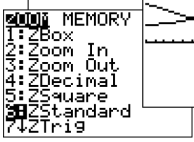


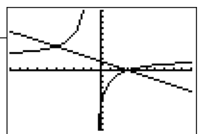
G12a Zie de grafieken hiernaast ($x\neq-1 \Rightarrow$ V.A.: $x=-1$). (gebruik TABLE)

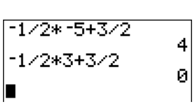


G12b $h(x)=k(x)$
$\frac{2x-6}{x+1}=-\frac{1}{2}x+1\frac{1}{2}$
$2x-6=(x+1)(-\frac{1}{2}x+1\frac{1}{2})$
$2x-6=-\frac{1}{2}x^2+1\frac{1}{2}x-\frac{1}{2}x+1\frac{1}{2}$
$\frac{1}{2}x^2+x-7\frac{1}{2}=0$ (keer 2)
$x^2+2x-15=0$
$(x+5)(x-3)=0$
$x=-5 \vee x=3$.
Snijpunten $(-5,4)$ en $(3,0)$.









G12c $h(x)\leq k(x)$ (zie G12b, grafiek en domein) $\Rightarrow x\leq-5 \vee -1<x\leq3$.

G13a $f(x)=0{,}25(x+2)^2-4 \xrightarrow{\text{translatie }(0,\,q)} g(x)=0{,}25(x+2)^2-4+q.$

$g(0)=0 \Rightarrow 0{,}25(0+2)^2-4+q=0 \Rightarrow q=-0{,}25\cdot 2^2+4=-1+4=3.$

G13b $f(x)=0{,}25(x+2)^2-4 \xrightarrow{\text{translatie }(p,\,0)} h(x)=0{,}25((x-p)+2)^2-4.$

$h(0)=0 \Rightarrow 0{,}25((0-p)+2)^2-4=0 \Rightarrow 0{,}25(-p+2)^2=4 \Rightarrow (-p+2)^2=16 \Rightarrow -p+2=-4 \vee -p+2=4 \Rightarrow$
$-p=-2-4=-6 \vee -p=-2+4=2 \Rightarrow p=6 \vee p=-2.$

G13c $f(x)=0{,}25(x+2)^2-4 \xrightarrow[\text{de } x\text{-as met factor } a]{\text{vermenigvuldiging t.o.v.}} k(x)=a\cdot(0{,}25(x+2)^2-4).$

De grafiek van $k(x)=a\cdot(0{,}25(x+2)^2-4)=0{,}25a(x+2)^2-4a$ is een parabool met top $(-2,\,-4a)$.

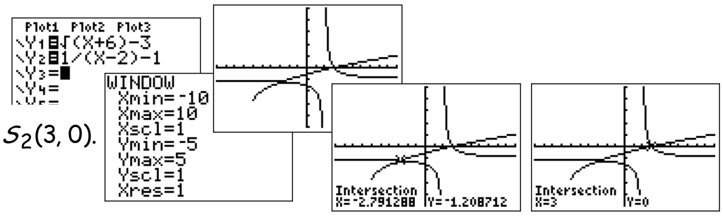
Nu moet gelden $-4a=6 \Rightarrow a=\frac{6}{-4}=-\frac{3}{2}=-1\frac{1}{2}$. (6 moet een maximum zijn $\Rightarrow 0{,}25a<0 \Rightarrow a<0$)

G13d De grafiek van $f(x)=0{,}25(x+2)^2-4$ is een parabool met top $(-2,\,-4)$.

$f(0)=0{,}25(0+2)^2-4=0{,}25\cdot 2^2-4=1-4=-3 \Rightarrow$ snijpunt met de y-as in $(0,\,-3)$.

$$\left.\begin{array}{l} m(-2)=f(-2) \Rightarrow a\cdot(-2)^4+b=-4 \Rightarrow 16a+b=-4 \\ m(0)=f(0) \Rightarrow a\cdot 0^4+b=-3 \Rightarrow \boxed{b=-3} \end{array}\right\} \Rightarrow 16a-3=-4 \Rightarrow 16a=-1 \Rightarrow \boxed{a=-\frac{1}{16}}.$$

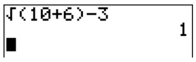
G14a Maak een schets van de plot hiernaast.
(beginvoorwaarde bij f: $x+6\ge 0 \Rightarrow x\ge -6$
en beginvoorwaarde bij g: $x\ne 2 \Rightarrow$ V.A.: $x=2$)



G14b $f(x)=g(x)$ (intersect) $\Rightarrow S_1(-2{,}791;\,-1{,}209)$ en $S_2(3,\,0)$.

G14c $f(x)\le g(x) \Rightarrow -6\le x\le -2{,}791$ en $2<x\le 3$.
(zie G14b, een plot en de beginvoorwaarden)

G14d $f(x)=1 \Rightarrow \sqrt{x+6}-3=1 \Rightarrow \sqrt{x+6}=4$ (kwadrateren) $\Rightarrow x+6=16 \Rightarrow x=10$ (voldoet).



G14e $g(x)=5 \Rightarrow \frac{1}{x-2}-1=5 \Rightarrow \frac{1}{x-2}=\frac{6}{1} \Rightarrow 6(x-2)=1 \Rightarrow x-2=\frac{1}{6} \Rightarrow x=2\frac{1}{6}.$

G15a
$30-3^{3x+1}=3$
$-3^{3x+1}=-27$
$3^{3x+1}=27=3^3$
$3x+1=3$
$3x=2$
$x=\frac{2}{3}=\frac{2}{3}.$

G15b
$5\cdot 3^{2x}=15\cdot\sqrt[4]{3}$
$3^{2x}=3\cdot\sqrt[4]{3}=3^1\cdot 3^{\frac{1}{4}}=3^{1\frac{1}{4}}$
$2x=1\frac{1}{4}=\frac{5}{4}$
$x=\frac{5}{8}.$

G15c
$4\cdot {}^{3}\log(3x-5)=20$
${}^{3}\log(3x-5)=5$
$3x-5=3^5=243$
$3x=248$
$x=\frac{248}{3}=82\frac{2}{3}.$

$g^{\cdots}$ en ${}^{g}\log(\ldots)$ heffen elkaar op

G15d
$6-{}^{0{,}5}\log(3x)=8$
$-{}^{0{,}5}\log(3x)=2$
${}^{0{,}5}\log(3x)=-2$
$3x=0{,}5^{-2}=(\frac{1}{2})^{-2}=(2^{-1})^{-2}=2^2=4$
$x=\frac{4}{3}=1\frac{1}{3}.$

G15e
$2^{x^2-2}=32=2^5$
$x^2-2=5$
$x^2=7$
$x=\sqrt{7} \vee x=-\sqrt{7}.$

G15f
$2+3\cdot {}^{\frac{1}{2}}\log(6x+1)=-4$
$3\cdot {}^{\frac{1}{2}}\log(6x+1)=-6$
${}^{\frac{1}{2}}\log(6x+1)=-2$
$6x+1=(\frac{1}{2})^{-2}=4$
$6x=3$
$x=\frac{3}{6}=\frac{1}{2}.$

G15g
$2\cdot 3^{x-1}+5=59$
$2\cdot 3^{x-1}=54$
$3^{x-1}=27=3^3$
$x-1=3$
$x=4.$

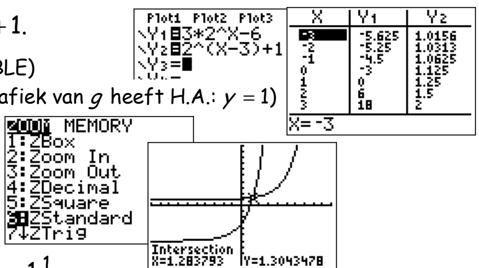
G15h
$4^{3x+1}=\frac{1}{8}\sqrt{2}$
$(2^2)^{3x+1}=2^{-3}\cdot 2^{\frac{1}{2}}=2^{-2\frac{1}{2}}$
$2^{6x+2}=2^{-2\frac{1}{2}}$
$6x+2=-2\frac{1}{2}$
$6x=-4\frac{1}{2}=-\frac{9}{2}$
$x=-\frac{9}{12}=-\frac{3}{4}.$

G15i
${}^{3}\log(4-x)=-2$
$4-x=3^{-2}=\frac{1}{9}$
$-x=-3\frac{8}{9}$
$x=3\frac{8}{9}.$

G16a $y=2^x \xrightarrow[\text{de } x\text{-as met factor 3}]{\text{vermenigvuldiging t.o.v.}} y=3\cdot 2^x \xrightarrow{\text{translatie }(0,\,-6)} f(x)=3\cdot 2^x-6.$

$y=2^x \xrightarrow{\text{translatie }(3,1)} g(x)=2^{x-3}+1.$

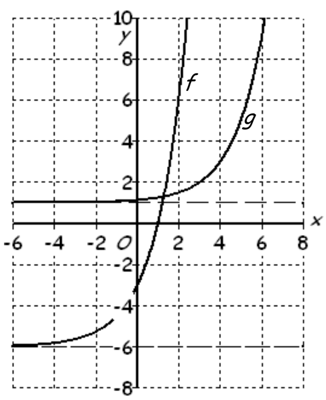
G16b Zie de grafieken hiernaast. (gebruik TABLE)
(de grafiek van f heeft H.A.: $y=-6$ en de grafiek van g heeft H.A.: $y=1$)



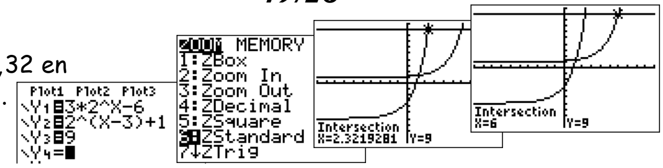
G16c $f(x)=g(x)$ (intersect) $\Rightarrow S(1{,}28;\,1{,}30)$.

G16d $f(x)=-4\frac{1}{2} \Rightarrow 3\cdot 2^x-6=-4\frac{1}{2} \Rightarrow$
$3\cdot 2^x=1\frac{1}{2} \Rightarrow 2^x=\frac{1}{2}=2^{-1} \Rightarrow x=-1.$

G16e $x=0 \Rightarrow g(0)=2^{0-3}+1=2^{-3}+1=\frac{1}{8}+1=1\frac{1}{8}.$
$x\ge 0$ (zie grafiek) $\Rightarrow g(x)\ge 1\frac{1}{8}.$

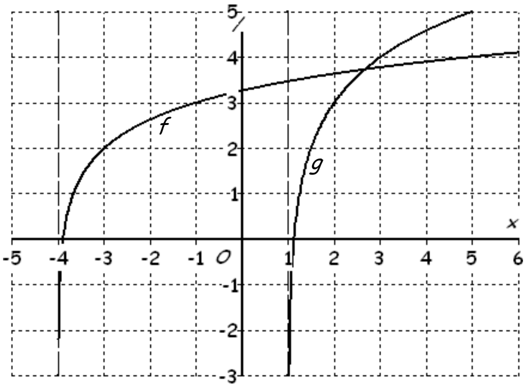


G16f $f(x) = 9$ (intersect) $\Rightarrow x \approx 2{,}32$ en
$g(x) = 9$ (intersect) $\Rightarrow x = 6$.
Dus $AB \approx 6 - 2{,}32 = 3{,}68$.

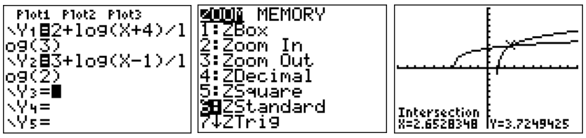


G17a Beginvoorwaarde bij f: $x + 4 > 0 \Rightarrow x > -4 \Rightarrow D_f = \langle -4, \rightarrow \rangle$.
Beginvoorwaarde bij g: $x - 1 > 0 \Rightarrow x > 1 \Rightarrow D_g = \langle 1, \rightarrow \rangle$.
Bij f is de V.A.: $x = -4$ en bij g is de V.A.: $x = 1$.

G17b Zie de grafieken hiernaast. (gebruik TABLE)

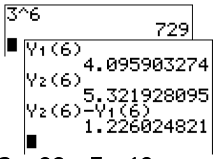


G17c



$f(x) = g(x)$ (intersect) $\Rightarrow x \approx 2{,}65$.
$f(x) \geq g(x)$ (zie grafieken en domeinen van f en g) $\Rightarrow 1 < x \leq 2{,}65$.

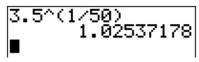
G17d $f(x) = 8 \Rightarrow 2 + {}^3\log(x+4) = 8 \Rightarrow {}^3\log(x+4) = 6 \Rightarrow x + 4 = 3^6 = 729 \Rightarrow x = 725$.
$f(x) \leq 8$ (zie domein en grafiek van f) $\Rightarrow -4 < x \leq 725$.



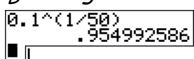
G17e $x = 6 \Rightarrow f(6) \approx 4{,}096$ en $g(6) \approx 5{,}322$. Dus $AB = g(6) - f(6) \approx 1{,}23$.

G17f $f(x) = 5 \Rightarrow 2 + {}^3\log(x+4) = 5 \Rightarrow {}^3\log(x+4) = 3 \Rightarrow x + 4 = 3^3 = 27 \Rightarrow x = 23$.
$g(x) = 5 \Rightarrow 3 + {}^2\log(x-1) = 5 \Rightarrow {}^2\log(x-1) = 2 \Rightarrow x - 1 = 2^2 = 4 \Rightarrow x = 5$. Dus $PQ = 23 - 5 = 18$.

G18a De grafiek van A is een rechte lijn op enkelvoudig logaritmisch papier $\Rightarrow$ exponentiële functie $N_A = b \cdot g^t$.
$$\left.\begin{array}{l} t = 0 \text{ en } N_A = 20\,000 \Rightarrow b = 20\,000 \\ t = 50 \text{ en } N_A = 70\,000 \end{array}\right\} \Rightarrow g_{50\text{ jaar}} = \frac{70000}{20000} = 3{,}5 \Rightarrow g_{\text{jaar}} = g = 3{,}5^{\frac{1}{50}} \approx 1{,}025.$$

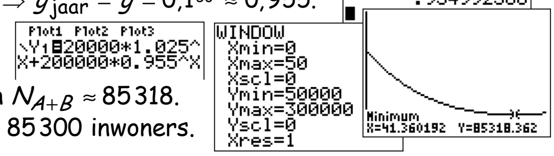


Dus $N_A \approx 20\,000 \cdot 1{,}025^t$.
De grafiek van B is een rechte lijn op enkelvoudig logaritmisch papier $\Rightarrow$ exponentiële functie $N_B = b \cdot g^t$.
$$\left.\begin{array}{l} t = 0 \text{ en } N_B = 200\,000 \Rightarrow b = 200\,000 \\ t = 50 \text{ en } N_B = 20\,000 \end{array}\right\} \Rightarrow g_{50\text{ jaar}} = \frac{20000}{200000} = 0{,}1 \Rightarrow g_{\text{jaar}} = g = 0{,}1^{\frac{1}{50}} \approx 0{,}955.$$

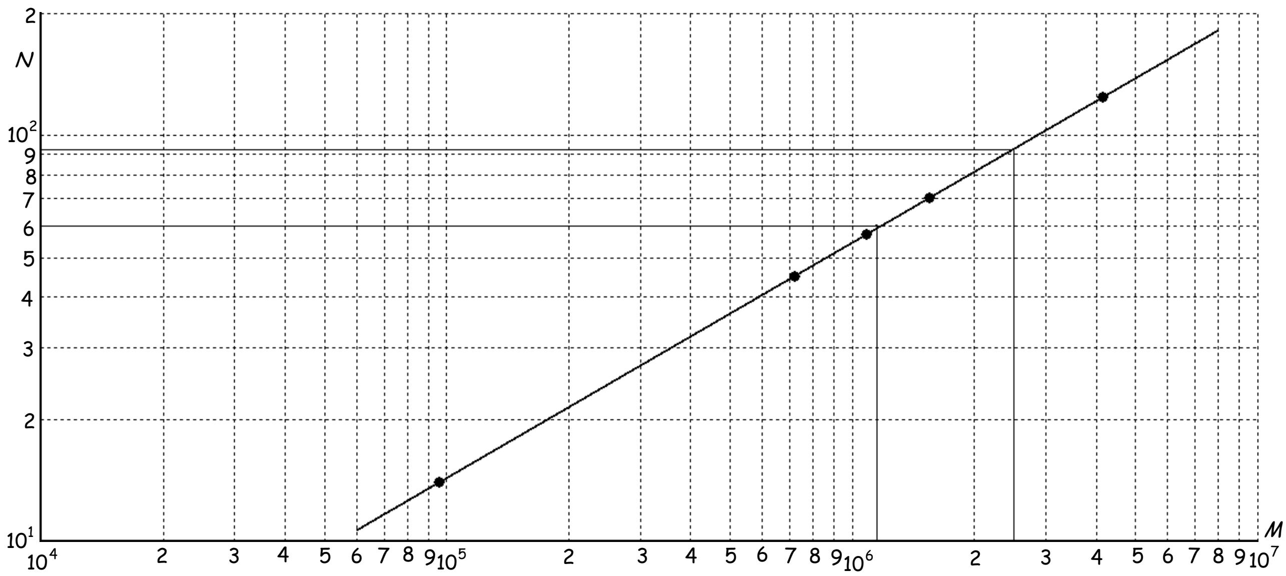


Dus $N_B \approx 200\,000 \cdot 0{,}955^t$.

G18b $N_{A+B} \approx 20\,000 \cdot 1{,}025^t + 200\,000 \cdot 0{,}955^t$ (minimum) $\Rightarrow t \approx 41{,}4$ en $N_{A+B} \approx 85\,318$.
Dus in 1991 is het aantal inwoners minimaal. Er zijn dan ongeveer 85 300 inwoners.



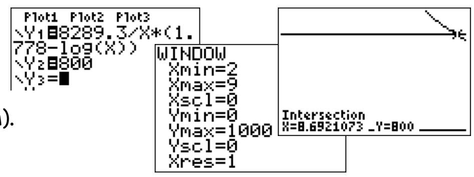
G19a Zie de punten en de lijn in de figuur hieronder.



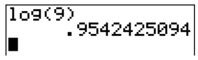
G19b Zie de figuur hierboven. Je verwacht ongeveer 92 ziektegevallen.

G19c Lees in de figuur hierboven af: ongeveer $1{,}15 \cdot 10^6$ muskieten.

G20a $N_{\max} = 800 \Rightarrow \frac{8289{,}3}{B} \cdot (1{,}778 - \log(B)) = 800$ (intersect) $\Rightarrow B \approx 8{,}7$ (m).

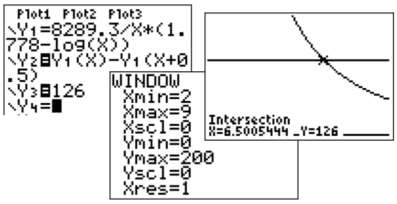


G20b Als B toeneemt van 2 naar 9, dan neemt $\frac{8289{,}3}{B}$ af, maar blijft positief.



Als B toeneemt van 2 naar 9, dan neemt $\log(B)$ toe $\Rightarrow 1{,}778 - \log(B)$ neemt af, maar blijft positief.
Dus als B toeneemt van 2 naar 9, dan neemt N_{max} af $\Rightarrow N_{max}$ is dalend.

G20c $N_{max}(B) - N_{max}(B + 0{,}5) = 126$ (intersect) $\Rightarrow B \approx 6{,}5$ (m).



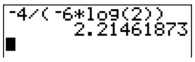
G21a Bij $t = 6$ hoort $N = 10^2 \Rightarrow 10^6 \cdot 2^{-r \cdot 6} = 10^2$ (intersect of)

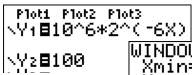
$2^{-6r} = 10^{-4}$

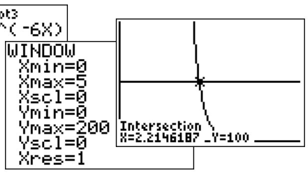
$\log(2^{-6r}) = \log(10^{-4})$

$-6r \cdot \log(2) = -4$

$r = \frac{-4}{-6 \cdot \log(2)} \approx 2{,}2.$







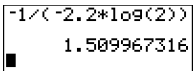
G21b $10^6 \cdot 2^{-2{,}2t} = 0{,}1 \cdot 10^6 = 10^5$ (intersect of)

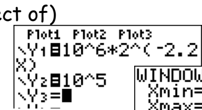
$2^{-2{,}2t} = 10^{-1}$

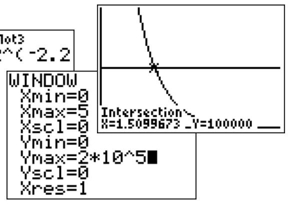
$\log(2^{-2{,}2t}) = \log(10^{-1})$

$-2{,}2t \cdot \log(2) = -1$

$t = \frac{-1}{-2{,}2 \cdot \log(2)} \approx 1{,}5$ (minuut).







G21c Teken de lijn door $(0{,}10^6)$ en $(2{,}55;10^5)$ (zie de figuur hiernaast).
Dus ook door $(5{,}1;10^4)$, $(7{,}65;10^3)$ en $(10{,}2;10^2)$.