1a 0,5 \$/ton (zie de verticale as bij punt A) $\Rightarrow 20\,000 \cdot 0{,}5 = 10\,000$ (\$).

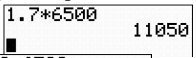
1b 2,1 \$/ton (ga vanuit A verticaal omhoog naar de rood gestippelde grafiek) $\Rightarrow 20\,000 \cdot 2{,}1 = 42\,000$ (\$). Dus 4,2 keer zoveel.

1c 4 000 mijl (op groen gestippelde grafiek) en 0,5 \$/ton (op verticale as) $\Rightarrow$ 60 000 ton (aflezen op de horizontale as).

1d De kosten zijn $\frac{54000}{40000 \text{ (op horizontale as)}} = 1{,}35$ \$/ton (op verticale as) $\Rightarrow$ 8 000 mijl (je zit op de rood gestippelde grafiek).

1e Bij een tonnage van 20 000 ton (over 10000 mijl) kost het 3 \$/ton $\Rightarrow$ totale kosten $40\,000 \cdot 3 = 120\,000$ (\$).
Bij een tonnage van 100 000 ton (over 10000 mijl) kost het 0,75 \$/ton $\Rightarrow$ totale kosten $100\,000 \cdot 0{,}75 = 75\,000$ (\$).
Eén tanker van 100 000 ton is dus goedkoper dan twee tankers van 20 000 ton.

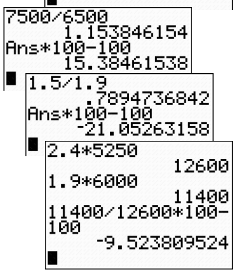
2a In 1995 waren er 1,7 miljoen koeien (aflezen op de verticale as aan de linkerkant die bij de rode grafiek hoort).
In 1995 was de melkproductie 6 500 kg/koe (aflezen op de verticale as aan de rechterkant die bij de groene grafiek hoort).
In 1995 was de totale melkproductie 1,7 miljoen $\times$ 6 500 kg $= 11\,050$ miljoen kg ≈ 11 miljard kg.



2b De melkproductie is van 6 500 kg/koe in 1995 toegenomen tot 7 500 kg/koe in 2000.
De toename is $\frac{7500-6500}{6500} \times 100\% \approx 15{,}4\%$.

2c Het aantal koeien is van 1,9 (miljoen) in 1990 afgenomen tot 1,5 (miljoen) in 2000.
De toename is $\frac{1{,}5-1{,}9}{1{,}9} \times 100\% \approx -21{,}1\%$. Dus een afname van 21,1%.

2d In 1985 was de totale melkproductie 2,4 miljoen $\times$ 5 250 kg $= 12\,600$ miljoen kg.
In 1990 was de totale melkproductie 1,9 miljoen $\times$ 6 000 kg $= 11\,400$ miljoen kg.
In 1990 was de totale melkproductie $\frac{1200}{12600} \times 100\% \approx 9{,}5\%$ minder dan in 1985.

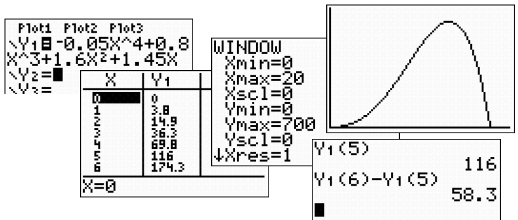


2e Nee, het snijpunt bij 1990 ontstaat door de keuze van de eenheden op de verticale assen.

3a Bij een te groot aantal werknemers loopt men elkaar in de weg.

3b Zie een plot hiernaast. $x = 5 \Rightarrow P = 116$.

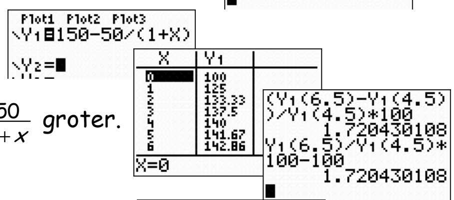
3c $x = 6 \Rightarrow P = 174{,}3$.
De productieomvang per dag neemt toe met $174{,}3 - 116 = 58{,}3$.



4a $x = 0 \Rightarrow P = 150 - \frac{50}{1+0} = 150 - 50 = 100$ (kg/perenboom).

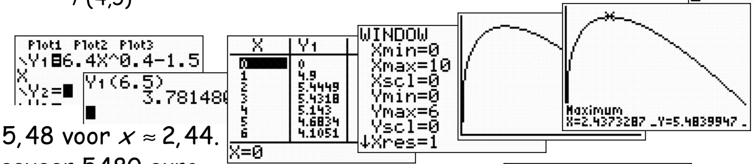
4b Bij toename van x zal ook P toenemen.
Als x toeneemt, wordt $1+x$ groter en $\frac{50}{1+x}$ kleiner, dus wordt $150 - \frac{50}{1+x}$ groter.

4c De toename is $\frac{P(6{,}5)-P(4{,}5)}{P(4{,}5)} \times 100\%$ of $\frac{P(6{,}5)}{P(4{,}5)} \times 100\% - 100\% \approx 1{,}7\%$.

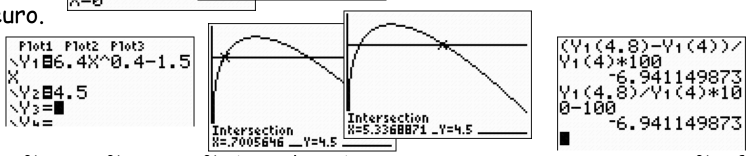


5a $q = 6{,}5 \Rightarrow R \approx 3{,}78$ (duizend euro).

5b Plot de grafiek van R.
De optie maximum geeft $R_{max} \approx 5{,}48$ voor $x \approx 2{,}44$.
Dus de maximale opbrengst is ongeveer 5480 euro.



5c $R = 4{,}5$ (intersect) $\Rightarrow q \approx 0{,}70 \vee q \approx 5{,}34$.
$R > 4{,}5$ (zie een plot) $\Rightarrow 0{,}70 < q < 5{,}34$.
De productie ligt tussen 700 en 5 340 stuks.



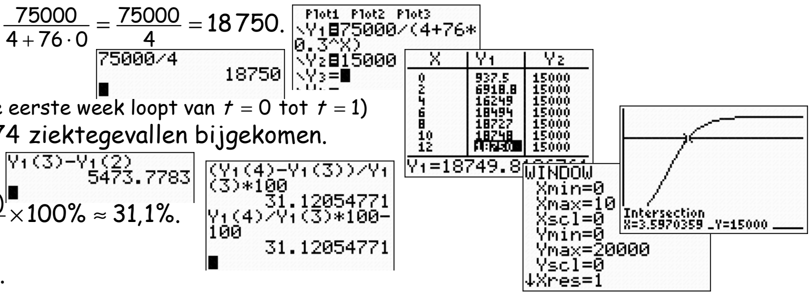
5d De toename is $\frac{R(4{,}8)-R(4)}{R(4)} \times 100\%$ of $\frac{R(4{,}8)}{R(4)} \times 100\% - 100\% \approx -6{,}9\%$. Dus de opbrengst neem met (ongeveer) 6,9% af.

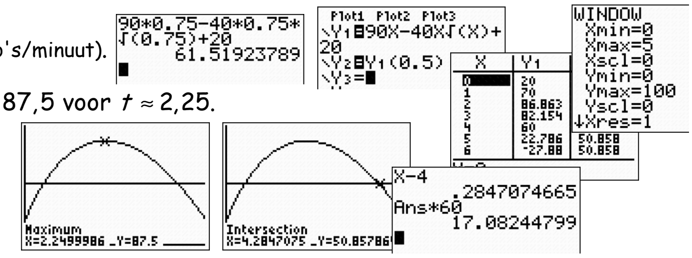
6a $N = \frac{75000}{4+76\cdot 0{,}3^t}$ gaat voor grote t naar $N \approx \frac{75000}{4+76\cdot 0} = \frac{75000}{4} = 18\,750$.
Dus $G = 18\,750$ (of gebruik TABLE).

6b De derde week loopt van $t = 2$ tot $t = 3$. (de eerste week loopt van $t = 0$ tot $t = 1$)
Er zijn in de derde week $N(3) - N(2) \approx 5\,474$ ziektegevallen bijgekomen.

6c De derde week loopt van $t = 3$ tot $t = 4$.
De toename in de vierde week is $\frac{N(4)-N(3)}{N(3)} \times 100\% \approx 31{,}1\%$.

6d $N = \frac{75000}{4+76\cdot 0{,}3^t} = 15\,000$ (intersect) $\Rightarrow t \approx 3{,}6$.

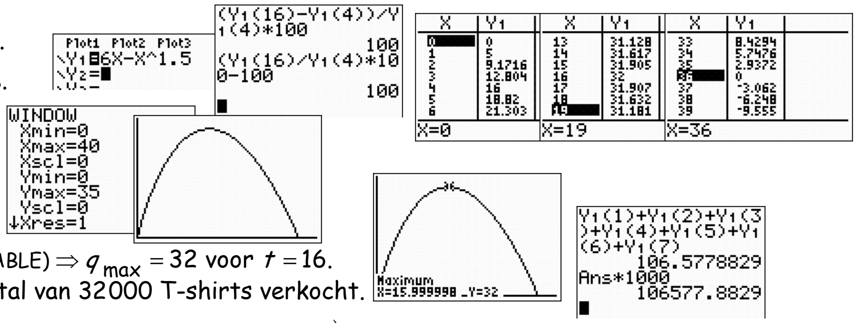




7a Om 7:45 is $t = \frac{45}{60} = \frac{3}{4} = 0{,}75 \Rightarrow N \approx 62$ (of 61 auto's/minuut).

7b $N = 90t - 40t \cdot \sqrt{t} + 20$ (optie maximum) $\Rightarrow N_{max} \approx 87{,}5$ voor $t \approx 2{,}25$.
Bij $t \approx 2{,}25$ hoort 9:15 en
er passeren 88 (of 87) auto's per minuut.

7c $N = N(0{,}5)$ (intersect) $\Rightarrow t \approx 4{,}28$.
Hierbij hoort 11:17 uur.

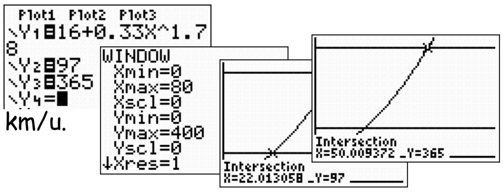


8a Op 16 mei is $t = 4$ en op 28 mei is $t = 16$.
De toename is $\frac{q(28) - q(4)}{q(4)} \times 100\% = 100\%$.

8b $q(0) = 0$ en $q(36) = 0$.
Tussen $t = 0$ en $t = 36$ is $q > 0$.
Zie een plot van de grafiek hiernaast.
Dus de T-shirts zijn 36 dagen verkocht.

8c De optie maximum geeft (of bladeren in TABLE) $\Rightarrow q_{max} = 32$ voor $t = 16$.
Dus op 28 mei werden het maximale aantal van 32000 T-shirts verkocht.

8d In de eerste week werden $\left(q(1) + q(2) + q(3) + q(4) + q(5) + q(6) + q(7)\right) \times 1000 \approx 106\,580$ T-shirts verkocht.

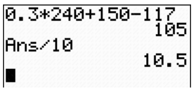


9a $B = 16 + 0{,}33v^{1{,}78} = 97$ (intersect) $\Rightarrow$ de snelheidsovertreding $v \approx 22$.
Mevrouw Krisman reed $100 + 22 = 122$ km/u.

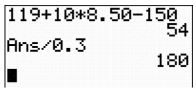
9b $B = 16 + 0{,}33v^{1{,}78} = 365$ (intersect) $\Rightarrow$ de snelheidsovertreding $v \approx 50$ km/u.

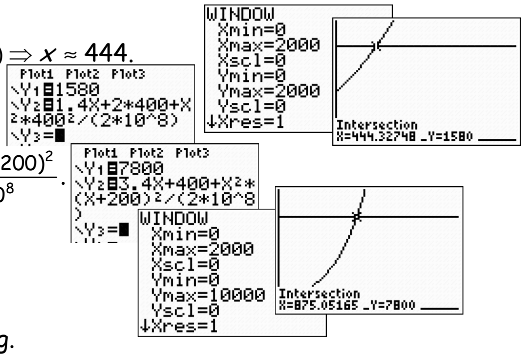
9c Jeroen heeft geen gelijk (zie bijvoorbeeld $v = 10$ en $v = 20$ in TABLE).

10a $A = 240$ en $q = 117$ geeft
$117 = -10p + 0{,}3 \cdot 240 + 150$
$10p = 0{,}3 \cdot 240 + 150 - 117 = 105$
$p = 10{,}5$.



10b $q = 119$ en $p = 8{,}50$ geeft
$119 = -10 \cdot 8{,}50 + 0{,}3A + 150$
$119 + 10 \cdot 8{,}50 - 150 = 0{,}3A$
$A = 180$. (het die week uitgegeven bedrag aan reclame in €)

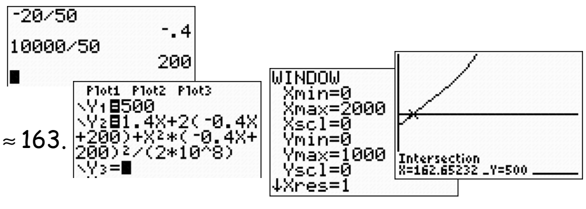




11a $N = 1580$ en $y = 400$ geeft $1580 = 1{,}4x + 2 \cdot 400 + \frac{x^2 \cdot 400^2}{2 \cdot 10^8}$ (intersect) $\Rightarrow x \approx 444$.
Er zijn dus 444 zakken rijst nodig.

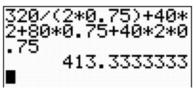
11b $N = 7\,800$ en $y = x + 200$ geeft
$7\,800 = 1{,}4x + 2 \cdot (x + 200) + \frac{x^2 \cdot (x+200)^2}{2 \cdot 10^8} = 1{,}4x + 2x + 400 + \frac{x^2 \cdot (x+200)^2}{2 \cdot 10^8}$.
Dus $3{,}4x + 400 + \frac{x^2 \cdot (x+200)^2}{2 \cdot 10^8} = 7\,800$.

11c $7\,800 = 3{,}4x + 400 + \frac{x^2 \cdot (x+200)^2}{2 \cdot 10^8}$ (intersect) $\Rightarrow x \approx 875$.
Dus er zijn 875 zakken rijst en $875 + 200 = 1075$ zakken bonen nodig.



12a $20x + 50y = 10\,000 \Rightarrow 50y = -20x + 10\,000 \Rightarrow y = -0{,}4x + 200$.

12b $N = 500$ en $y = -0{,}4x + 200$ geeft
$500 = 1{,}4x + 2 \cdot (-0{,}4x + 200) + \frac{x^2 \cdot (-0{,}4x + 200)^2}{2 \cdot 10^8}$ (intersect) $\Rightarrow x \approx 163$.
Dus er zijn 163 zakken rijst geleverd.

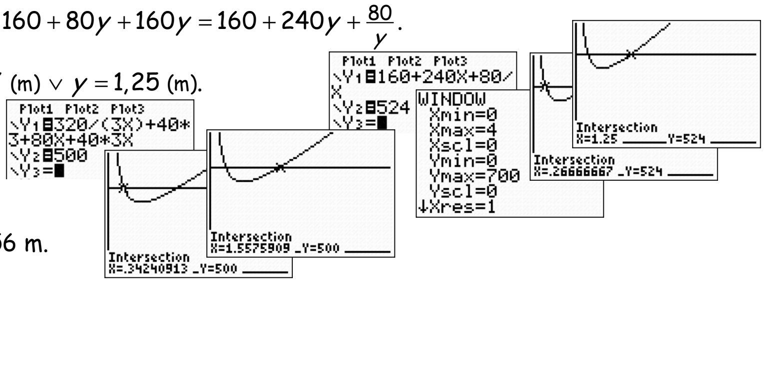


13a $x = 2$ en $y = 0{,}75 \Rightarrow K = \frac{320}{2 \cdot 0{,}75} + 40 \cdot 2 + 80 \cdot 0{,}75 + 40 \cdot 2 \cdot 0{,}75 \approx 413$ (€).

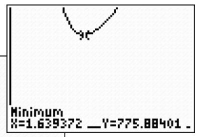
13b $x = 4 \Rightarrow K = \frac{320}{4y} + 40 \cdot 4 + 80y + 40 \cdot 4 \cdot y = \frac{80}{y} + 160 + 80y + 160y = 160 + 240y + \frac{80}{y}$.

13c $K = 160 + 240y + \frac{80}{y} = 524$ (intersect) $\Rightarrow y \approx 0{,}27$ (m) $\vee$ $y = 1{,}25$ (m).

13d $x = 3 \Rightarrow K = \frac{320}{3y} + 40 \cdot 3 + 80y + 40 \cdot 3 \cdot y$.
$K = 500$ (intersect) $\Rightarrow y \approx 0{,}34$ (m) $\vee$ $y = 1{,}56$ (m).
$K < 500$ (zie een plot) $\Rightarrow 0{,}34$ (m) $< y < 1{,}56$ (m).
De breedte van de bak ligt tussen 0,34 m en 1,56 m.



14a $x = y + 0{,}5 \Rightarrow y = x - 0{,}5 \Rightarrow K = \frac{600}{x(x-0{,}5)} + 80x + 120(x - 0{,}5) + 100x(x - 0{,}5)$
$= \frac{600}{x(x-0{,}5)} + 80x + 120x - 60 + 100x^2 - 50x$
$= \frac{600}{x(x-0{,}5)} + 150x + 100x^2 - 60.$



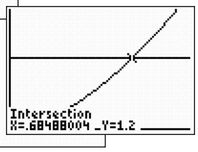
14b $K = \frac{600}{x(x-0{,}5)} + 150x + 100x^2 - 60$ (optie minimum) $\Rightarrow K_{min} \approx 776$ (€) voor $x \approx 1{,}64$ (m).
De minimale kosten zijn 776 euro bij de afmetingen van de bak van 1,64 bij 1,14 bij 0,5 m.

14c Er zijn $\frac{50}{I_{bak}} \approx 53{,}53$ ritten $\Rightarrow$ 54 ritten nodig.

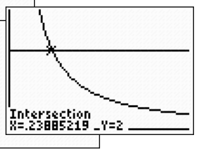
15a $s = 1{,}2$ (m) en $h = 0{,}8$ (m) $\Rightarrow v = 0{,}78 \cdot 0{,}8^{-1{,}16} \cdot 1{,}2^{1{,}67} \approx 1{,}37$ (m/s).

15b $h = 0{,}4$ (m) $\Rightarrow v = 0{,}78 \cdot 0{,}4^{-1{,}16} \cdot s^{1{,}67} \approx 2{,}258s^{1{,}67}$ (m/s).

15c $h = 0{,}4$ (m) en $v = 1{,}2$ (m/s) geeft
$1{,}2 = 0{,}78 \cdot 0{,}4^{-1{,}16} \cdot s^{1{,}67}$ (intersect) $\Rightarrow s \approx 0{,}68$ (m).



15d $s = 0{,}65$ (m) en $v = 2$ (m/s) geeft
$2 = 0{,}78 \cdot h^{-1{,}16} \cdot 0{,}65^{1{,}67}$ (intersect) $\Rightarrow h \approx 0{,}24$ (m).



16a $\left.\begin{array}{l} P = a \cdot Q^{1{,}8} \\ Q = 5{,}9 \Rightarrow P = 18{,}3 \end{array}\right\} \Rightarrow 18{,}3 = a \cdot 5{,}9^{1{,}8} \Rightarrow a = \frac{18{,}3}{5{,}9^{1{,}8}} \approx 0{,}75.$

16b $P = 48 \Rightarrow 48 = 0{,}75 \cdot Q^{1{,}8}$ (intersect of) $\Rightarrow Q^{1{,}8} = \frac{48}{0{,}75} \Rightarrow Q = \sqrt[1{,}8]{\frac{48}{0{,}75}} \approx 10{,}1.$

17a $\left.\begin{array}{l} y = a \cdot x^{-1{,}35} \\ x = 15 \Rightarrow y = 31 \end{array}\right\} \Rightarrow 31 = a \cdot 15^{-1{,}35} \Rightarrow a = \frac{31}{15^{-1{,}35}} \approx 1200.$

17b $y = 80 \Rightarrow 80 = 1200 \cdot x^{-1{,}35}$ (intersect of) $\Rightarrow x^{-1{,}35} = \frac{80}{1200} \Rightarrow x = x_B = \sqrt[-1{,}35]{\frac{80}{1200}} \approx 7{,}4.$

18a $\left.\begin{array}{l} K = a \cdot P^{0{,}68} \\ P = 25\,000 \Rightarrow K = 15 \cdot 10^6 \end{array}\right\} \Rightarrow 15 \cdot 10^6 = a \cdot 25\,000^{0{,}68} \Rightarrow a = \frac{15 \cdot 10^6}{25000^{0{,}68}} \approx 15\,330.$

18b $K = 18{,}6 \cdot 10^6 \Rightarrow 18{,}6 \cdot 10^6 = 15\,330 \cdot P^{0{,}68}$ (intersect of) $\Rightarrow P^{0{,}68} = \frac{18{,}6 \cdot 10^6}{15330} \Rightarrow P = \sqrt[0{,}68]{\frac{18{,}6 \cdot 10^6}{15330}} \approx 34\,000$ (ton).

19a $K = 200 + 0{,}60 \cdot q = 0{,}6q + 200.$

19b $p = aq + b$ met $a = \frac{\Delta p}{\Delta q} = \frac{2{,}40 - 2}{800 - 1000} = \frac{0{,}40}{-200} = \frac{0{,}20}{-100} = -0{,}002.$
$\left.\begin{array}{l} p = -0{,}002q + b \\ q = 1000 \Rightarrow p = 2 \end{array}\right\} \Rightarrow 2 = -0{,}002 \cdot 1000 + b \Rightarrow b = 4.$ Dus $p = -0{,}002q + 4.$

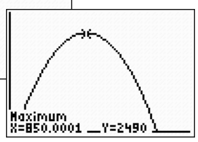
19c $q = 900 \Rightarrow p = -0{,}002 \cdot 900 + 4 = -1{,}8 + 4 = 2{,}20$ (€/broodje).
De opbrengst die week was $R = p \cdot q = 2{,}20 \cdot 900 = 1980$ (€).
De winst die week was $W = R - K = 1980 - (0{,}6 \cdot 900 + 200) = 1980 - 740 = 1240$ (€).

20a $W = R - K = pq - K = (-0{,}004q + 8)q - (1{,}2q + 400) = -0{,}004q^2 + 8q - 1{,}2q - 400 = -0{,}004q^2 + 6{,}8q - 400.$

20b $q = 450 \Rightarrow W = -0{,}004 \cdot 450^2 + 6{,}8 \cdot 450 - 400 = 1850$ (€).

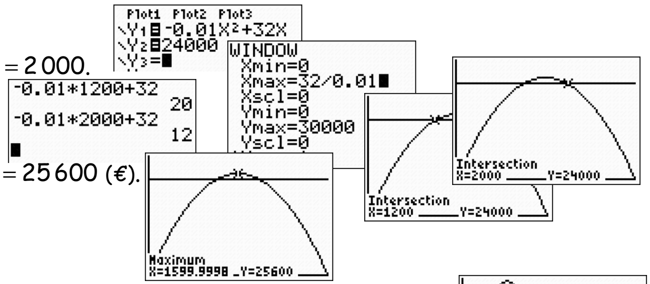
20c $p = 5 \Rightarrow 5 = -0{,}004q + 8 \Rightarrow 0{,}004q = 3 \Rightarrow q = \frac{3}{0{,}004} = \frac{3000}{4} = 750.$
$q = 750 \Rightarrow W = -0{,}004 \cdot 750^2 + 6{,}8 \cdot 750 - 400 = 2\,450$ (€).

20d $W = -0{,}004q^2 + 6{,}8q - 400$ (optie maximum) $\Rightarrow W_{max} = 2\,490$ (€) voor $q = 850.$
$q = 850 \Rightarrow p = -0{,}004 \cdot 850 + 8 = 4{,}60$ (€/artikel).
Bij een prijs van € 4,60 is de winst maximaal.



21a $p = aq + b$ met $a = \frac{\Delta p}{\Delta q} = \frac{28 - 20}{400 - 1200} = \frac{8}{-800} = \frac{1}{-100} = -0{,}01.$
$\left.\begin{array}{l} p = -0{,}001q + b \\ q = 400 \Rightarrow p = 28 \end{array}\right\} \Rightarrow 28 = -0{,}01 \cdot 400 + b \Rightarrow b = 28 + 4 = 32.$ Dus $p = -0{,}01q + 32$ en $R = pq = -0{,}01q^2 + 32q.$

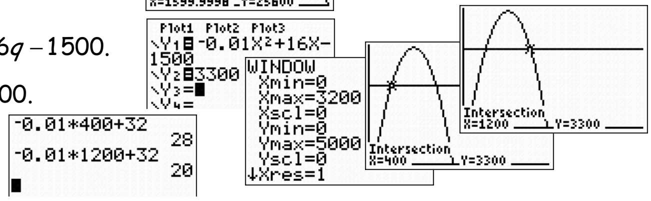
21b $R = -0{,}01q^2 + 32q = 24\,000$ (intersect) $\Rightarrow q = 1200 \vee q = 2\,000$.
$q = 1200 \Rightarrow p = -0{,}01 \cdot 1200 + 32 = -12 + 32 = 20$ (€).
$q = 2\,000 \Rightarrow p = -0{,}01 \cdot 2\,000 + 32 = -20 + 32 = 12$ (€).



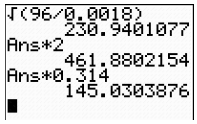
21c $R = -0{,}01q^2 + 32q$ (optie maximum) $\Rightarrow q = 1600$ en $R_{max} = 25\,600$ (€).
$q = 1600 \Rightarrow p = -0{,}01 \cdot 1600 + 32 = -16 + 32 = 16$ (€).

21d $K = 16q + 1500$.
$W = R - K = -0{,}01q^2 + 32q - (16q + 1500)$
$= -0{,}01q^2 + 32q - 16q - 1500 = -0{,}01q^2 + 16q - 1500$.

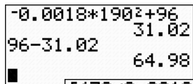
21e $W = -0{,}01q^2 + 16q - 1500 = 3300 \Rightarrow q = 400 \vee q = 1200$.
$q = 400 \Rightarrow p = -0{,}01 \cdot 400 + 32 = -4 + 32 = 28$ (€).
$q = 1200 \Rightarrow p = -0{,}01 \cdot 1200 + 32 = -12 + 32 = 20$ (€).
$W > 3300 \Rightarrow$ de prijzen liggen tussen 20 en 28 euro.



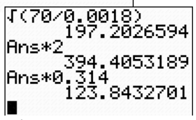
22a $h = 0 \Rightarrow -0{,}0018x^2 + 96 = 0 \Rightarrow 96 = 0{,}0018x^2 \Rightarrow x^2 = \frac{96}{0{,}0018} \Rightarrow x_A = -\sqrt{\frac{96}{0{,}0018}} \vee x_B = \sqrt{\frac{96}{0{,}0018}}$.
$AB = 2 \cdot \sqrt{\frac{96}{0{,}0018}}$ feet $\Rightarrow AB = 2 \cdot \sqrt{\frac{96}{0{,}0018}} \cdot 0{,}314 \approx 145$ meter.



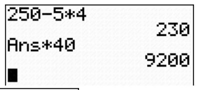
22b $PQ = 380$ feet $\Rightarrow x_Q = 190$ en $h_Q = -0{,}0018 \cdot 190^2 + 96$; $h_T = -0{,}0018 \cdot 0^2 + 96 = 96$.
Het water staat $h_T - h_Q \approx 65$ feet onder T.



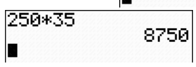
22c Het water staat 70 feet onder $T \Rightarrow h = 96 - 70 = 26$ feet.
$-0{,}0018 \cdot x^2 + 96 = 26 \Rightarrow -0{,}0018 \cdot x^2 = -70 \Rightarrow x^2 = \frac{70}{0{,}0018} \Rightarrow x = \pm\sqrt{\frac{70}{0{,}0018}}$.
De breedte van het wateroppervlak onder de boog is $2 \cdot \sqrt{\frac{70}{0{,}0018}}$ feet ofwel $2 \cdot \sqrt{\frac{28}{0{,}0018}} \cdot 0{,}314 \approx 123{,}8$ meter.



23a De prijs is $250 - (40 - 35) \cdot 4 = 250 - 5 \cdot 4 = 230$ euro en de opbrengst is $230 \cdot 40 = 9\,200$ euro.

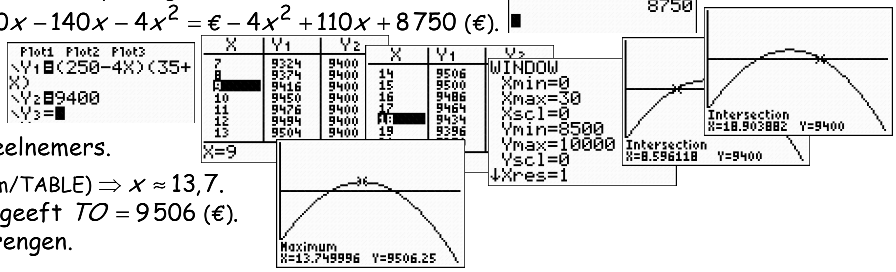


23b De prijs is $250 - 4x$ (€/deelnemer) en de totale opbrengst is
$TO = (250 - 4x) \cdot (35 + x) = 8\,750 + 250x - 140x - 4x^2 = € - 4x^2 + 110x + 8\,750$ (€).



23c $TO = (250 - 4x) \cdot (35 + x) > 9\,400$
(intersect/TABLE, omdat x geheel is, geeft)
$x = 9 \vee x = 10 \vee x = 11 \vee \ldots \vee x = 18$.
Dus er waren 44, 45, 46, 47, ... 53 deelnemers.

23d $TO = (250 - 4x) \cdot (35 + x)$ (optie maximum/TABLE) $\Rightarrow x \approx 13{,}7$.
$x = 13$ geeft $TO = 9\,504$ (€) en $x = 14$ geeft $TO = 9\,506$ (€).
Een busreis kan maximaal € 9 506 opbrengen.



24a $p = 6 \Rightarrow T = (6 - 6)(q - 8) = 0 \cdot (q - 8) = 0$.

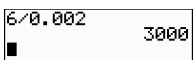
24b $q = 8 \Rightarrow T = (p - 6)(8 - 8) = (p - 6) \cdot 0 = 0$.

25a $1{,}2x(8 - x) = 0$
$1{,}2x = 0 \vee 8 - x = 0$
$x = 0 \vee x = 8$.

25b $(x - 5)(2x - 20) = 0$
$x = 5 \vee 2x = 20$
$x = 5 \vee x = 10$.

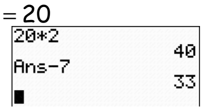
25c $100x(18 - 0{,}5x) = 0$
$x = 0 \vee 18 = 0{,}5x$
$x = 0 \vee x = 36$.

25d $0{,}002x^2 - 6x = 0$
$x(0{,}002x - 6) = 0$
$x = 0 \vee 0{,}002x = 6$
$x = 0 \vee x = 3000$.



25e $7x(x - 5) + 6 = 6$
$7x(x - 5) = 0$
$x = 0 \vee x = 5$.

25f $0{,}5(x + 7) = 20$
$x + 7 = 40$
$x = 33$.



26a $3a(20 - 0{,}2b) + 780 = 780$
$3a(20 - 0{,}2b) = 0$
$3a = 0 \vee 20 = 0{,}2b$
$a = 0 \vee b = 100$.

26b $\frac{1}{3}p(1 - \frac{1}{5}q) = 0$ en $p \neq 0$
$p = 0$ (mag niet) $\vee 1 = \frac{1}{5}q$
$q = 5$.

26c $200x - 80xy + 250 = 250$
$200x - 80xy = 0$
$x(200 - 80y) = 0$
$x = 0 \vee 200 = 80y$
$x = 0 \vee y = \frac{200}{80} = 2\frac{1}{2}$.

27a $0{,}01x(8 - 0{,}2x) = 0$
$0{,}01x = 0 \vee 8 = 0{,}2x$
$x = 0 \vee x = \frac{8}{0{,}2} = 40$.

27b $3x(10 - x) + 5 = 5$
$3x(10 - x) = 0$
$x = 0 \vee x = 10$.

27c $-0{,}02q^2 + 8q = 0$
$q(-0{,}02q + 8) = 0$
$q = 0 \vee 8 = 0{,}02q$
$q = 0 \vee q = \frac{8}{0{,}02} = \frac{800}{2} = 400$.

27d $0{,}4(p - 2) = 10$
$p - 2 = \frac{10}{0{,}4} = \frac{100}{4} = 25$
$p = 27$.

28a $5x(3-y)=0$
$x=0 \vee 3=y$
$x=0 \vee y=3.$

28b $7x(18-y)+325=325$
$7x(18-y)=0$
$x=0 \vee 18=y$
$x=0 \vee y=18.$

28c $5x-10xy+721=721$
$5x-10xy=0$
$x(5-10y)=0$
$x=0 \vee 5=10y$
$x=0 \vee y=2.$

28d $(2-x)(3+y)(5-2x)=0$
$2=x \vee 3=-y \vee 5=2x$
$x=2 \vee y=-3 \vee x=2\frac{1}{2}.$

29a $w=3$ (m) en $v=40$ (km/u) $\Rightarrow A=6(50-40)(3-2)+430=6\cdot 10\cdot 1+430=490$ (auto's/uur).

29b $w=3{,}5$ (m) $\Rightarrow A=6(50-v)(3{,}5-2)+430=6(50-v)\cdot 1{,}5+430=9(50-v)+430=450-9v+430=880-9v.$

29c $w=5$ (m) en $A=520$ (auto's/uur) geeft
$520=6(50-v)(5-2)+430$ (intersect of)
$90=6(50-v)\cdot 3$


$5=50-v$
$v=45$ (km/u).

29d $A=430$ (auto's/uur) geeft
$430=6(50-v)(w-2)+430$ (intersect of)
$6(50-v)(w-2)=0$
$50=v \vee w=2$
$v=50$ (km/u) $\vee$ $w=2$ (m).

30a $\sqrt{x}=7$ (kwadrateren)
$x=49.$

30b $\sqrt{x-1}=6$ (kwadrateren)
$x-1=36$
$x=37.$

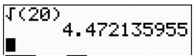
30c $\sqrt{2x-3}=5$ (kwadrateren)
$2x-3=25$
$2x=28$
$x=14.$

30d $x^2=10$
$x=\sqrt{10} \vee x=-\sqrt{10}.$

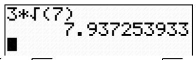
30e $x^2-1=24$
$x^2=25$
$x=5 \vee x=-5.$

30f $2x^2-1=7$
$2x^2=8$
$x^2=4$
$x=2 \vee x=-2.$

31a $y=\sqrt{16x}=\sqrt{16}\cdot\sqrt{x}=4\cdot\sqrt{x}.$



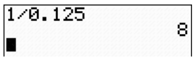
31b $y=\sqrt{20x}=\sqrt{20}\cdot\sqrt{x}\approx 4{,}47\cdot\sqrt{x}.$



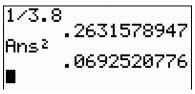
31c $y=3\cdot\sqrt{7x}=3\cdot\sqrt{7}\cdot\sqrt{x}\approx 7{,}94\cdot\sqrt{x}.$

32a $A=\sqrt{t-3}$ (kwadrateren)
$A^2=t-3$
$A^2+3=t$
$t=A^2+3.$

32b $S=4\cdot\sqrt{t+2}$
$\frac{1}{4}S=\sqrt{t+2}$ (kwadrateren)
$\frac{1}{16}S^2=t+2$
$\frac{1}{16}S^2-2=t$
$t=\frac{1}{16}S^2-2.$

32c


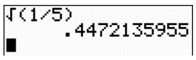
$y=0{,}125\cdot\sqrt{t-20}$
$8y=\sqrt{t-20}$ (kwadrateren)
$64y^2=t-20$
$64y^2+20=t$
$t=64y^2+20.$

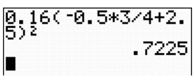
33a $E=3{,}8\cdot\sqrt{T-8}$
$\frac{1}{3{,}8}E=\sqrt{T-8}$ (kwadrateren)
$(\frac{1}{3{,}8}E)^2=T-8$


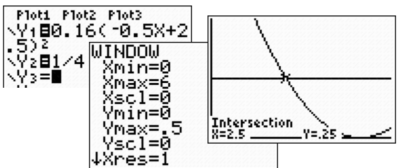
$0{,}07E^2+8\approx T.$
Dus $a\approx 0{,}07$ en $b=8.$

33b $s=3+\sqrt{5t}$
$s-3=\sqrt{5t}$ (kwadrateren)
$(s-3)^2=5t$
$\frac{1}{5}(s-3)^2=t.$
Dus $a=\frac{1}{5}$ en $b=3.$

34a $y=(x+5)^2$
$(x+5)^2=y$
$x+5=\sqrt{y}$
$x=-5+\sqrt{y}.$

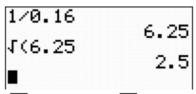
34b $L=5(t-3)^2$
$(t-3)^2=\frac{1}{5}L$
$t-3=\sqrt{\frac{1}{5}L}$
$t=3+\sqrt{\frac{1}{5}L}=3+\sqrt{\frac{1}{5}}\cdot\sqrt{L}\approx 3+0{,}45\cdot\sqrt{L}.$


35a $t=\frac{3}{4}\Rightarrow f=0{,}16(-0{,}5\cdot\frac{3}{4}+2{,}5)^2=0{,}7225.$
Dus ongeveer 72% van de maag is gevuld.


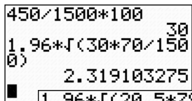


35b $f=0{,}16(-0{,}5t+2{,}5)^2=\frac{1}{4}$ (intersect) $\Rightarrow t=2{,}5.$
Dus na 2,5 uur is de maag nog voor een kwart gevuld.

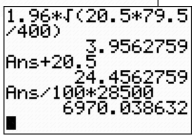
35c $f=0{,}16(-0{,}5t+2{,}5)^2=0$ (intersect of)
$(-0{,}5t+2{,}5)^2=0$
$-0{,}5t+2{,}5=0$
$2{,}5=0{,}5t$
$t=5.$
Dus na 5 uur is de maag leeg.

35d $f=0{,}16(-0{,}5t+2{,}5)^2$


$(-0{,}5t+2{,}5)^2=\frac{1}{0{,}16}f=6{,}25f$
$-0{,}5t+2{,}5=\sqrt{6{,}25f}=\sqrt{6{,}25}\cdot\sqrt{f}=2{,}5\cdot\sqrt{f}$
$-0{,}5t=-2{,}5+2{,}5\cdot\sqrt{f}$ (links en rechts keer -2)
$t=5-5\cdot\sqrt{f}$. Dus $a=5$ en $b=5.$

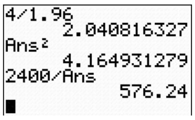


36a $n = 1500$ en $p = \frac{450}{1500} \cdot 100 = 30$ (%) $\Rightarrow a = 1{,}96 \cdot \sqrt{\frac{30 \cdot (100-30)}{1500}} \approx 2{,}3$ (%).

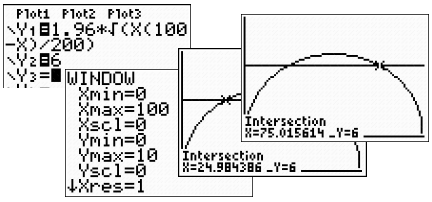


36b $n = 400$ en $p = \frac{82}{400} \cdot 100 = 20{,}5$ (%) $\Rightarrow a = 1{,}96 \cdot \sqrt{\frac{20{,}5 \cdot (100-20{,}5)}{400}} \approx 4{,}0$ (%).
Het werkelijke percentage ligt tussen $(20{,}5 - a)$% en $(20{,}5 + a)$%.
Dus maximaal $\frac{20{,}5 + a}{100} \cdot 28\,500 = 6\,970$ mensen.

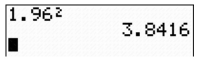
36c $a = 4$ (%) en $p = 40$ (%) geeft
$4 = 1{,}96 \cdot \sqrt{\frac{40 \cdot (100-40)}{n}}$ (intersect of)
$\frac{4}{1{,}96} = \sqrt{\frac{40 \cdot 60}{n}}$ (kwadrateren)
$(\frac{4}{1{,}96})^2 = \frac{2400}{n}$
$n = \frac{2400}{(\frac{4}{1{,}96})^2} \approx 576.$



36d $n = 200$ en $a = 6$ (%) geeft
$6 = 1{,}96 \cdot \sqrt{\frac{p \cdot (100-p)}{200}}$ (intersect) $\Rightarrow p \approx 25{,}0$ (%) $\vee\ p \approx 75{,}0$ (%).



36e $a = 1{,}96 \cdot \sqrt{\frac{p \cdot (100-p)}{n}}$
$\frac{a}{1{,}96} = \sqrt{\frac{p \cdot (100-p)}{n}}$ (kwadrateren)
$\frac{a^2}{1{,}96^2} = \frac{p \cdot (100-p)}{n}$



$a^2 \cdot n = 3{,}8416 \cdot p \cdot (100 - p)$
$n = \frac{384{,}16p - 3{,}8416p^2}{a^2} = \frac{-3{,}8416p^2 + 384{,}16p}{a^2}$
Dus $e \approx -3{,}84$ en $d \approx 384$.

37a $D = 1 \Rightarrow \frac{A}{B} = C$ geeft $A = BC$.

37b $C = 0$ en $D = 1 \Rightarrow \frac{A}{B} = 0$ geeft $A = 0$.

38a $\frac{6}{x-2} = 2$
$6 = 2(x-2)$
$6 = 2x - 4$
$-2x = -10$
$x = 5.$

38b $\frac{x-3}{x+2} = -4$
$x - 3 = -4(x+2)$
$x - 3 = -4x - 8$
$5x = -5$
$x = -1.$

38c $5 + \frac{8}{x-3} = 7$
$\frac{8}{x-3} = 2$
$8 = 2(x-3)$
$8 = 2x - 6$
$-2x = -14$
$x = 7.$

38d $\frac{2x-1}{3x+2} = \frac{3}{8}$
$8(2x-1) = 3(3x+2)$
$16x - 8 = 9x + 6$
$7x = 14$
$x = 2.$

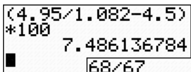
39a $1 - \frac{20}{x-3} = 5$
$-\frac{20}{x-3} = 4$
$-20 = 4(x-3)$
$-20 = 4x - 12$
$-4x = 8$
$x = -2.$

39b $\frac{800}{x-3} - 300 = 100$
$\frac{800}{x-3} = 400$
$800 = 400(x-3)$
$800 = 400x - 1200$
$-400x = -2\,000$
$x = 5.$

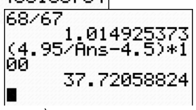
39c $\frac{(2x-1)(x+8)}{3x+7} = 0$
$(\Rightarrow$ teller $= 0)$
$(2x-1)(x+8) = 0$
$2x = 1 \vee x = -8$
$x = \frac{1}{2} \vee x = -8.$

39d $6 \cdot \frac{0{,}01x - 20}{x+12} = 0$
$(\Rightarrow$ teller $= 0)$
$0{,}01x - 20 = 0$
$0{,}01x = 20$ (keer 100)
$x = 200.$

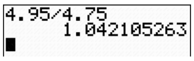
40a $D = 1{,}082 \Rightarrow P = \left(\frac{4{,}95}{1{,}082} - 4{,}5\right) \cdot 100 \approx 7{,}5$ (%).



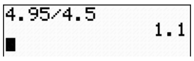
40b $D = \frac{68}{68-1} \approx 1{,}015 \Rightarrow P = \left(\frac{4{,}95}{D} - 4{,}5\right) \cdot 100 \approx 37{,}7$ (%).



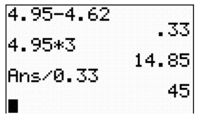
40c $P = \left(\frac{4{,}95}{D} - 4{,}5\right) \cdot 100 = 25$
$\frac{4{,}95}{D} - 4{,}5 = 0{,}25$
$\frac{4{,}95}{D} = 4{,}75$
$4{,}75D = 4{,}95$
$D = \frac{4{,}95}{4{,}75} \approx 1{,}042.$



40d $P = \left(\frac{4{,}95}{D} - 4{,}5\right) \cdot 100 = 0$
$\frac{4{,}95}{D} - 4{,}5 = 0$
$\frac{4{,}95}{D} = 4{,}5$
$4{,}5D = 4{,}95$
$D = \frac{4{,}95}{4{,}5} = 1{,}1.$



40e $P = \left(\frac{4{,}95}{D} - 4{,}5\right) \cdot 100 = 12$
$\frac{4{,}95}{D} - 4{,}5 = 0{,}12$
$\frac{4{,}95}{D} = 4{,}62$
$4{,}62D = 4{,}95$
$D = \frac{4{,}95}{4{,}62} = \frac{g}{g-3} \Rightarrow 4{,}95(g-3) = 4{,}62g$
$0{,}33g = 4{,}95 \cdot 3 \Rightarrow g = \frac{4{,}95 \cdot 3}{0{,}33} = 45$ (kg).



40f $D = \frac{g}{g-k} < 1 \Rightarrow g < g - k \Rightarrow k < 0.$

41a $\frac{6}{a} + 3 = \frac{6}{a} + \frac{3}{1} \cdot \frac{a}{a} = \frac{6}{a} + \frac{3a}{a} = \frac{6+3a}{a}.$

41b $\frac{5}{x} - 1 = \frac{6}{x} + \frac{1}{1} \cdot \frac{x}{x} = \frac{5}{x} - \frac{x}{x} = \frac{5-x}{x}.$

41c $5 \cdot \frac{3}{p} \cdot \frac{a}{7} = \frac{5}{1} \cdot \frac{3}{p} \cdot \frac{a}{7} = \frac{15a}{7p}.$

41d $18 \cdot \frac{a-2}{3a} = \frac{18}{1} \cdot \frac{a-2}{3a} = \frac{18(a-2)}{3a} = \frac{6(a-2)}{a}.$

41e $\frac{8}{a} + \frac{3}{b} = \frac{8}{a} \cdot \frac{b}{b} + \frac{3}{b} \cdot \frac{a}{a} = \frac{8b}{ab} + \frac{3a}{ab} = \frac{8b+3a}{ab}.$

41f $5 \cdot \frac{2}{a} \cdot \frac{3-a}{a-1} = \frac{5}{1} \cdot \frac{2}{a} \cdot \frac{3-a}{a-1} = \frac{10(3-a)}{a(a-1)}.$

42a $\frac{500}{a} - 70 = \frac{500}{a} - \frac{70}{1} \cdot \frac{a}{a} = \frac{500}{a} - \frac{70a}{a} = \frac{500-70a}{a}.$

42b $\frac{100}{a} + \frac{200}{b} = \frac{100}{a} \cdot \frac{b}{b} + \frac{200}{b} \cdot \frac{a}{a} = \frac{100b}{ab} + \frac{200a}{ab} = \frac{100b+200a}{ab}.$

42c $5+\frac{3}{x-2}=\frac{5}{1}\cdot\frac{x-2}{x-2}+\frac{3}{x-2}=\frac{5(x-2)}{x-2}+\frac{3}{x-2}=\frac{5x-10+3}{x-2}=\frac{5x-7}{x-2}.$

42d $6\,000\cdot\frac{2x}{x-4}=\frac{6000}{1}\cdot\frac{2x}{x-4}=\frac{12000x}{x-4}.$

42e $1-\frac{a}{b}=\frac{1}{1}\cdot\frac{b}{b}-\frac{a}{b}=\frac{b}{b}-\frac{a}{b}=\frac{b-a}{b}.$

42f $\frac{3}{a}\cdot 7\cdot\frac{b}{21}=\frac{3}{a}\cdot\frac{7}{1}\cdot\frac{b}{21}=\frac{21b}{21a}=\frac{b}{a}.$

43 $\frac{15}{\left(\frac{5}{3}\right)}=\frac{15}{\left(\frac{5}{3}\right)}\cdot\frac{3}{3}=\frac{45}{5}=9$ ofwel $\frac{15}{\left(\frac{5}{3}\right)}=15\cdot\frac{3}{5}=\frac{45}{5}=9$ en $\frac{\left(\frac{15}{5}\right)}{3}=\frac{\left(\frac{15}{5}\right)}{3}\cdot\frac{5}{5}=\frac{15}{15}=1$ ofwel $\frac{\left(\frac{15}{5}\right)}{3}=\frac{15}{5}\cdot\frac{1}{3}=\frac{15}{15}=1$ ofwel $\frac{\left(\frac{15}{5}\right)}{3}=\frac{3}{3}=1.$

44a $\frac{\left(\frac{50}{x}\right)}{10}=\frac{\left(\frac{50}{x}\right)}{10}\cdot\frac{x}{x}=\frac{50}{10x}=\frac{5}{x}.$

44b $\frac{50}{\left(\frac{x}{10}\right)}=\frac{50}{\left(\frac{x}{10}\right)}\cdot\frac{10}{10}=\frac{500}{x}.$

44c $6x+25\cdot\frac{\left(\frac{100}{x}\right)}{5}=6x+\frac{25}{1}\cdot\frac{\left(\frac{100}{x}\right)}{5}=6x+\frac{25}{5}\cdot\frac{\left(\frac{100}{x}\right)}{1}=6x+\frac{5}{1}\cdot\frac{100}{x}=6x+\frac{500}{x}.$

44d $720-12\cdot\frac{80}{\left(\frac{x}{3}\right)}=720-12\cdot 80\cdot\frac{3}{x}=720-\frac{2880}{x}.$

44e $2+6\cdot\frac{\left(\frac{8}{a}\right)}{4}=2+\frac{6}{1}\cdot\frac{\left(\frac{8}{a}\right)}{4}=2+\frac{6}{4}\cdot\frac{\left(\frac{8}{a}\right)}{1}=2+\frac{6}{4}\cdot\frac{8}{a}=2+\frac{12}{a}.$

44f $2+6\cdot\frac{8}{\left(\frac{a}{4}\right)}=2+6\cdot 8\cdot\frac{4}{a}=2+\frac{192}{a}.$

45 $A=18\cdot\frac{\left(\frac{500}{x}\right)}{10}+25x=18\cdot\frac{\left(\frac{500}{x}\right)}{10}\cdot\frac{x}{x}+25x=18\cdot\frac{500}{10x}+25x=\frac{9000}{10x}+25x=\frac{900}{x}+25x.$

46a $A=\frac{x^2+4x+3}{x}=\frac{x^2}{x}+\frac{4x}{x}+\frac{3}{x}=x+4+\frac{3}{x}.$

46b $T=\frac{3x^2+6x+180}{x}=\frac{3x^2}{x}+\frac{6x}{x}+\frac{180}{x}=3x+6+\frac{180}{x}.$

46c $y=\frac{x-1}{x}=\frac{x}{x}-\frac{1}{x}=1-\frac{1}{x}.$

46d $K=\frac{q^2-5q}{q}=\frac{q^2}{q}-\frac{5q}{q}=q-5.$

47a
$C=\frac{A}{B+3}$
$B+3=\frac{A}{C}$
$B=\frac{A}{C}-3.$

47b
$C=5+\frac{A}{B}$
$C-5=\frac{A}{B}$
$B=\frac{A}{C-5}.$

48a
$K=\frac{8}{q-1}$
$q-1=\frac{8}{K}$
$B=1+\frac{8}{K}.$

48b
$K=5+\frac{8}{q}$
$K-5=\frac{8}{q}$
$q=\frac{8}{K-5}.$

48c
$K=18-\frac{5}{q+3}$
$K-18=-\frac{5}{q+3}$
$q+3=-\frac{5}{K-18}$
$q=-3-\frac{5}{K-18}.$

48d
$K=\frac{K+8}{q-1}$
$q-1=\frac{K+8}{K}$
$q=1+\frac{K+8}{K}$
$q=1+1+\frac{8}{K}=2+\frac{8}{K}.$

48e
$K=\frac{4}{5-q}$
$5-q=\frac{4}{K}$
$-q=-5+\frac{4}{K}$
$q=5-\frac{4}{K}.$

48f
$K=\frac{12}{\sqrt{q}}$
$\sqrt{q}=\frac{12}{K}$
$q=\left(\frac{12}{K}\right)^2=\frac{144}{K^2}.$

49a
$Z=\frac{5+t}{p}$
$5+t=pZ$
$t=pZ-5.$

49b
$K=\frac{3-t}{20}$
$20K=3-t$
$t=3-20K.$

49c
$L=\frac{5+t}{a}+1$
$L-1=\frac{5+t}{a}$
$5+t=a(L-1)$
$t=a(L-1)-5.$

50a
$T=30+\frac{8}{a-50}$
$T-30=\frac{8}{a-50}$
$a-50=\frac{8}{T-30}$
$a=50+\frac{8}{T-30}.$

50b
$L=320-\frac{18}{q-1}$
$L-320=-\frac{18}{q-1}$
$q-1=-\frac{18}{L-320}$
$q=1-\frac{18}{L-320}.$

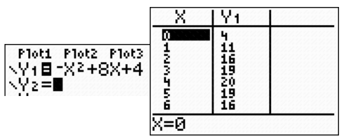
50c
$A=\frac{6}{\sqrt{t}}+2$
$A-2=\frac{6}{\sqrt{t}}$
$\sqrt{t}=-\frac{6}{A-2}$
$t=\frac{36}{(A-2)^2}.$

50d
$A=\frac{5-y}{6}$
$6A=5-y$
$y=5-6A.$

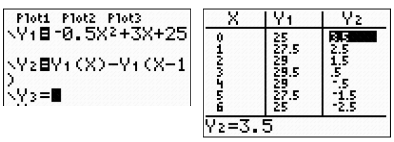
50e
$A=\frac{2A-3}{p+1}$
$p+1=\frac{2A-3}{A}$
$p+1=2-\frac{3}{A}$
$p=1-\frac{3}{A}.$

51a x neemt toe van 0 tot 1 $\Rightarrow$ y neemt toe met $\Delta y=y(1)-y(0)=11-4=7.$

51b x neemt toe van 1 tot 2 $\Rightarrow$ y neemt toe met $\Delta y=y(2)-y(1)=16-11=5.$



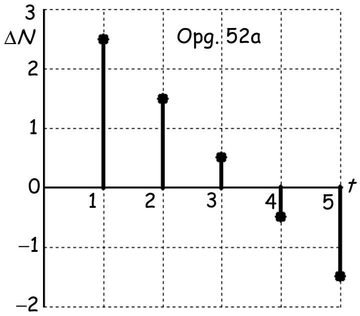
52a



Maak met TABLE op de GR in je huiswerkschrift steeds de tabel met toenamen (zie hiernaast).
(de eerste toename komt bij $t=1$)

t	0	1	2	3	4	5
N	25	27,5	29	29,5	29	27,5
ΔN	---	2,5	1,5	0,5	-0,5	-1,5

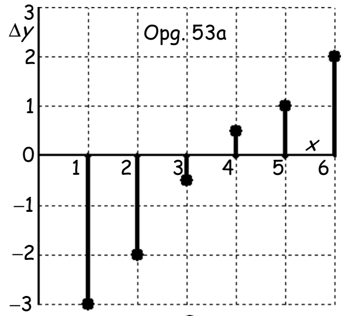
52a Zie hieronder het toenamediagram.

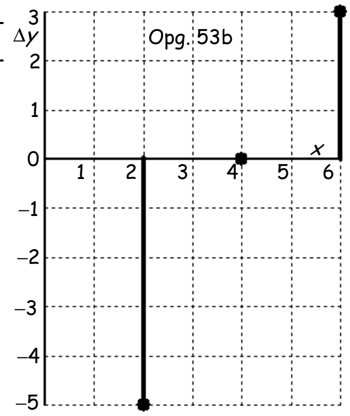


52b Eerst een afnemende stijging
(de staafjes boven de t-as worden korter)
opgevolgd door een toenenemde daling
(de staafjes onder de t-as worden langer).

53ab Maak eerst de tabel toenamen (zie hieronder).

x	0	1	2	3	4	5	6
y	4	1	-1	-1,5	-1	0	2
Δy (53a)	---	-3	-2	-0,5	0,5	1	2
Δy (53b)	---	---	-5	---	0	---	3

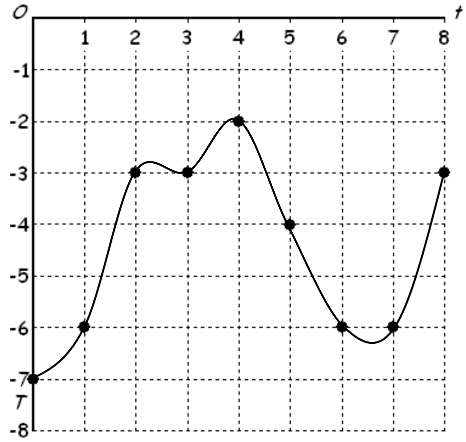




54a

t	0	1	2	3	4	5	6	7	8
ΔT	---	1	3	0	1	−2	−2	0	3
T	−7	−6	−3	−3	−2	−4	−6	−6	−3

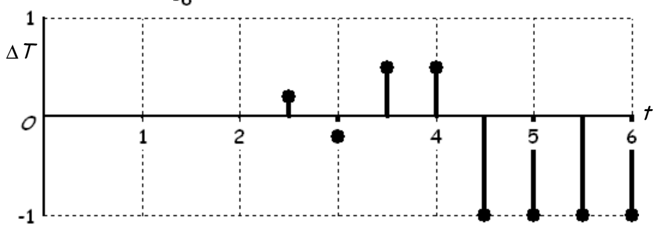
$\xleftarrow{-1}$ $\xleftarrow{-3}$ $\xrightarrow{+0}$ $\xrightarrow{+1}$ $\xrightarrow{-2}$ $\xrightarrow{-2}$ $\xrightarrow{+0}$ $\xrightarrow{+3}$



54b Zie een mogelijke grafiek van het temperatuurverloop hiernaast.
(de dikke stippen liggen vast, dus deze mogen nergens anders liggen).

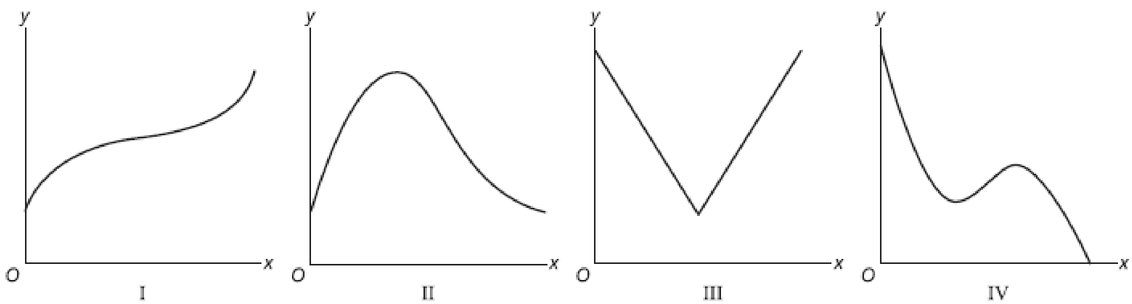
t	2	2,5	3	3,5	4	4,5	5	5,5	6
T	−3		−3		−2		−4		−6
ΔT	---	0,2	-0,2	0,5	0,5	-1	-1	-1	-1

Bij het bepalen van de toenamen ΔT hierboven is min of meer gebruik gemaakt van de mogelijke temperatuurgrafiek hiernaast. Het toenamediagram dat zo ontstaat, vind je hieronder.



55a
I Eerst afnemend stijgend, dan toenemend stijgend.
II Eerst afnemend stijgend, dan toenemend dalend en aan het eind afnemend dalend.
III Eerst constant dalend, dan constant stijgend.
IV Eerst afnemend dalend, dan (toenemend en afnemend) stijgend en aan het eind toenemend dalend.

55b



56ab $\Delta x = 6 - 1 = 5$ en $\Delta y = 5 - 1 = 4 \Rightarrow$ de gemiddelde toename $\frac{\Delta y}{\Delta x} = \frac{4}{5} = 0{,}8$.

57a De gemiddelde verandering op [2, 5] is $\frac{\Delta y}{\Delta x} = \frac{6-5}{5-2} = \frac{1}{3}$.

57b Het differentiequotiënt op [−1, 5] is $\frac{\Delta y}{\Delta x} = \frac{6-2}{5--1} = \frac{4}{6} = \frac{2}{3}$.

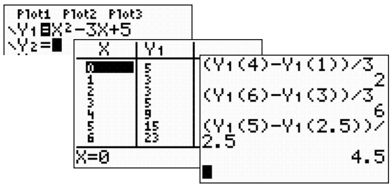
57c Bijvoorbeeld de gemiddelde verandering op [2, 6]. Deze is $\frac{\Delta y}{\Delta x} = \frac{5-5}{6-2} = 0$.

57d Bijvoorbeeld de gemiddelde verandering op [−1, 2]. Deze is $\frac{\Delta y}{\Delta x} = \frac{5-2}{2--1} = \frac{3}{3} = 1$.

58a Het differentiequotiënt op [1, 4] is $\frac{\Delta y}{\Delta x} = \frac{y(4) - y(3)}{4 - 1} = \frac{9 - 3}{4 - 1} = \frac{6}{3} = 2.$

58b Het differentiequotiënt op [3, 6] is $\frac{\Delta y}{\Delta x} = \frac{y(6) - y(3)}{6 - 3} = \frac{23 - 5}{6 - 3} = \frac{18}{3} = 6.$

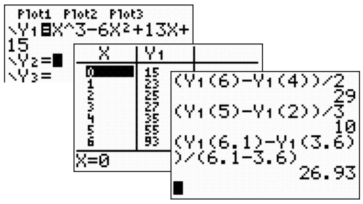
58c Het differentiequotiënt op [2,5; 5] is $\frac{\Delta y}{\Delta x} = \frac{y(5) - y(2{,}5)}{5 - 2{,}5} = 4{,}5.$



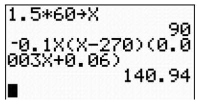
59a Het differentiequotiënt op [4, 6] is $\frac{\Delta K}{\Delta q} = \frac{K(6) - K(4)}{6 - 4} = \frac{93 - 35}{2} = \frac{58}{2} = 29$ (€/stuk).

59b De gemiddelde toename van K op [2, 5] is $\frac{\Delta K}{\Delta q} = \frac{K(5) - K(2)}{5 - 2} = 10$ (€/stuk).

59c De gemiddelde snelheid op [3,6; 6,1] is $\frac{\Delta K}{\Delta q} = \frac{K(6{,}1) - K(3{,}6)}{6{,}1 - 3{,}6} = 26{,}93$ (€/stuk).

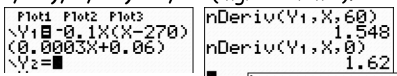


60a Na 1,5 uur is $t = 90 \Rightarrow C = -0{,}1 \cdot 90 \cdot (90 - 270)(0{,}0003 \cdot 90 + 0{,}06) = 140{,}94$ (mg/liter).



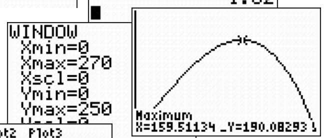
60b Na 1 uur is $t = 60 \Rightarrow \left[\frac{dC}{dt}\right]_{t=60} = \text{nDeriv}(-0{,}1x(x - 270)(0{,}0003x + 0{,}06), x, 60) \approx 1{,}55$ (mg/liter/min).

60c $\left[\frac{dC}{dt}\right]_{t=0} = \text{nDeriv}(-0{,}1x(x - 270)(0{,}0003x + 0{,}06), x, 0) = 1{,}62 > 0.$



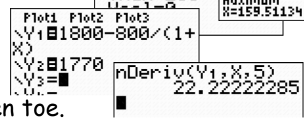
De snelheid $\left[\frac{dC}{dt}\right]_{t=0}$ is postief dus op $t = 0$ stijgt de concentratie.

60d $C = -0{,}1t(t - 270)(0{,}0003t + 0{,}06)$ (optie maximum) $\Rightarrow t \approx 159{,}5$ (minuten).



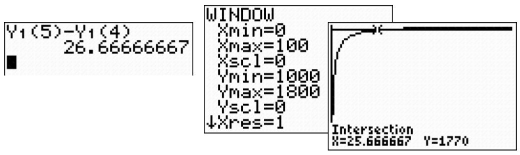
61a $\left[\frac{dN}{dt}\right]_{t=5} = \text{nDeriv}(1800 - \frac{800}{1 + x}, x, 5) \approx 22{,}2 > 0.$

De snelheid $\left[\frac{dN}{dt}\right]_{t=5}$ is postief dus op $t = 5$ neemt het aantal insecten toe.



61b De vijfde dag loopt van $t = 4$ tot $t = 5$.
$N(5) - N(4) \approx 27 \Rightarrow$ er zijn de vijfde dag 27 insecten bij gekomen.

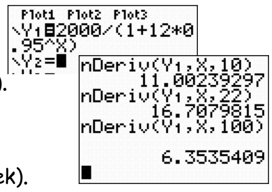
61c $N = 1800 - \frac{800}{1 + t} = 1770 \Rightarrow t \approx 25{,}7$. Dus op de 26^e dag.



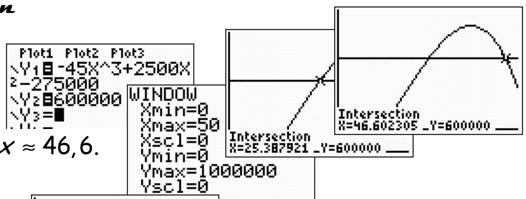
62a $\left[\frac{dN}{dt}\right]_{t=10} = \text{nDeriv}(\frac{2000}{1 + 12 \cdot 0{,}95^x}, x, 10) \approx 11{,}0$ (vissen/week).

62b $\left[\frac{dN}{dt}\right]_{t=33} = \text{nDeriv}(\frac{2000}{1 + 12 \cdot 0{,}95^x}, x, 33) \approx 22{,}0$ (vissen/week).
Dus Arjan heeft gelijk.

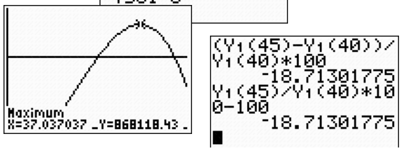
62c $\left[\frac{dN}{dt}\right]_{t=100} = \text{nDeriv}(\frac{2000}{1 + 12 \cdot 0{,}95^x}, x, 100) \approx 6{,}35$ (vissen/week).
De snelheid op $t = 100$ is kleiner dan de snelheid op $t = 10$.
Dus de snelheid waarmee het aantal vissen toeneemt met $0 \le t \le 120$ wordt niet steeds groter.



Diagnostische toets

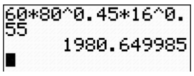


D1a $W = -45x^3 + 2500x^2 - 275\,000 = 600\,000$ (intersect) $\Rightarrow x \approx 25{,}4 \vee x \approx 46{,}6$.
$W > 600\,000$ (zie een plot) $\Rightarrow 25{,}4 < x < 46{,}6$ ($\times 10000$ euro).
De reclamekosten liggen tussen 254000 en 466000 euro.

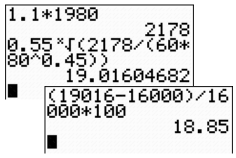


D1b $W = -45x^3 + 2500x^2 - 275\,000$ (optie maximum) $\Rightarrow W_{max} \approx 868\,000$ (€).

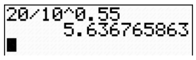
D1c $\frac{W(45) - W(40)}{W(40)} \times 100\% = -18{,}7\%$. Dus de afname is (ongeveer) 18,7%.



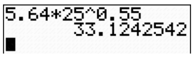
D2a $a = 80$ en $b = 16 \Rightarrow q = 60 \cdot 80^{0,45} \cdot 16^{0,55} \approx 1980$ (stoelen).



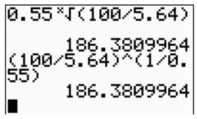
D2b $a = 80$ en $q = 1{,}10 \cdot 1980 = 2178$ geeft
$2178 = 60 \cdot 80^{0,45} \cdot b^{0,55}$ (intersect of) $\Rightarrow b^{0,55} = \frac{2178}{60 \cdot 80^{0,45}} \Rightarrow b = \sqrt[0,55]{\frac{2178}{60 \cdot 80^{0,45}}} \approx 19{,}016$.
Het beschikbare kapitaal is toegenomen met $\frac{19016 - 16000}{16000} \times 100\% \approx 18{,}9\%$.



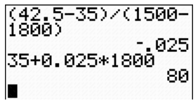
D3a $\left.\begin{array}{l} N = a \cdot p^{0,55} \\ p = 10 \Rightarrow N = 20 \end{array}\right\} \Rightarrow 20 = a \cdot 10^{0,55} \Rightarrow a = \frac{20}{10^{0,55}} \approx 5{,}64$.



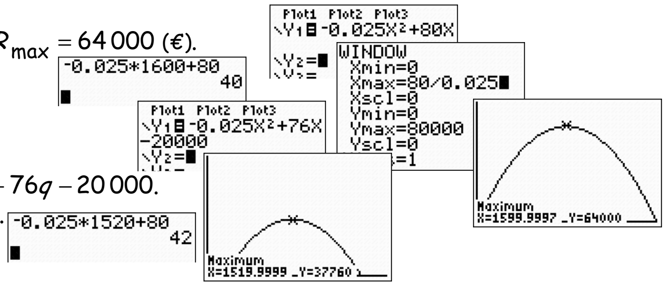
D3b $p = 25 \Rightarrow N = 5{,}64 \cdot 25^{0,55} \approx 33$.



D3c $N = 100 \Rightarrow 100 = 5{,}64 \cdot p^{0,55}$ (intersect of) $\Rightarrow p^{0,55} = \frac{100}{5{,}64} \Rightarrow p = \sqrt[0,55]{\frac{100}{5{,}64}} \approx 186$.



D4a $p = aq + b$ met $a = \frac{\Delta p}{\Delta q} = \frac{42{,}5 - 35}{1500 - 1800} = \frac{7{,}5}{-300} = \frac{2{,}5}{-100} = -0{,}025$.
$\left.\begin{array}{l} p = -0{,}025q + b \\ q = 1800 \Rightarrow p = 35 \end{array}\right\} \Rightarrow 35 = -0{,}025 \cdot 1800 + b \Rightarrow b = 35 + 45 = 80$. Dus $p = -0{,}025q + 80$.



D4b $R = pq = -0{,}025q^2 + 80q$ (optie maximum) $\Rightarrow q = 1600$ en $R_{max} = 64\,000$ (€).
$q = 1600 \Rightarrow p = -0{,}025 \cdot 1600 + 80 = -40 + 80 = 40$ (€).

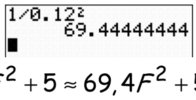
D4c $K = 4q + 20\,000$.
$W = R - K = -0{,}025q^2 + 80q - (4q + 20\,000)$
$= -0{,}025q^2 + 80q - 4q - 20\,000 = -0{,}025q^2 + 76q - 20\,000$.
De optie maximum geeft $q = 1520$ en $W_{max} = 37\,760$ (€).
$q = 1520 \Rightarrow p = -0{,}025 \cdot 1520 + 80 = -38 + 80 = 42$ (€).

D5a $0{,}05x(16 - 0{,}8x) = 0$
$0{,}05x \vee 16 = 0{,}08x$
$x = 0 \vee x = \frac{16}{0{,}08} = \frac{1600}{8} = 200$.

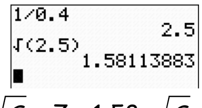
D5b $0{,}04x^2 - 100x = 0$
$x(0{,}04x - 100) = 0$
$x = 0 \vee 0{,}04x = 100$
$x = 5 \vee x = \frac{100}{0{,}04} = \frac{10000}{4} = 2500$.

D6a $10x(24 - 3y) = 0$
$10x = 0 \vee 24 = 3y$
$x = 0 \vee y = \frac{24}{3} = 8$.

D6b $6x - 30xy + \cancel{335} = \cancel{335}$
$x(6 - 30y) = 0$
$x = 0 \vee 6 = 30y$
$x = 0 \vee y = \frac{6}{30} = \frac{1}{5}$.



D7a $F = 0{,}12 \cdot \sqrt{p - 5}$
$\sqrt{p - 5} = \frac{F}{0{,}12}$ (kwadrateren)
$p - 5 = (\frac{F}{0{,}12})^2$
$p = \frac{F^2}{0{,}12^2} + 5 = \frac{1}{0{,}12^2} \cdot F^2 + 5 \approx 69{,}4F^2 + 5$.



D7b $S = 0{,}4(R - 7)^2$
$(R - 7)^2 = \frac{1}{0{,}4} S = 2{,}5S$
$R - 7 = \sqrt{2{,}5S}$
$R = 7 + \sqrt{2{,}5S} = 7 + \sqrt{2{,}5} \cdot \sqrt{S} \approx 7 + 1{,}58 \cdot \sqrt{S}$.

D8a $10 - \frac{15}{2x + 1} = 7$
$3 = \frac{15}{2x + 1}$
$2x + 1 = \frac{15}{3}$
$2x + 1 = 5$
$2x = 4$
$x = 2$.

D8b $\frac{(2x + 5)(3x - 12)}{4x + 1} = 0$
($\Rightarrow$teller=0)
$(2x + 5)(3x - 12) = 0$
$2x = -5 \vee 3x = 12$
$x = -2\frac{1}{2} \vee x = 4$.

D9a $\frac{20}{a} - 5 = \frac{20}{a} - \frac{5}{1} \cdot \frac{a}{a} = \frac{20}{a} - \frac{5a}{a} = \frac{20 - 5a}{a}$.

D9b $\frac{60}{p} + \frac{50}{q} = \frac{60}{p} \cdot \frac{q}{q} + \frac{50}{q} \cdot \frac{p}{p} = \frac{60q}{pq} + \frac{50p}{pq} = \frac{60q + 50p}{pq}$.

D9c $\frac{30}{x} + 3 = \frac{30}{x} + \frac{3}{1} \cdot \frac{x}{x} = \frac{30}{x} + \frac{3x}{x} = \frac{30 + 3x}{x}$.

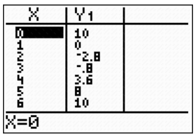
D10a $N = \frac{10t^2+5t-6}{t} = \frac{10t^2}{t} + \frac{5t}{t} - \frac{6}{t} = 10t + 5 - \frac{6}{t}.$

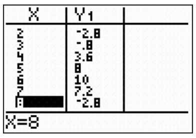
D10b $y = \frac{x^2+x+1}{x} = \frac{x^2}{x} + \frac{x}{x} + \frac{1}{x} = x + 1 + \frac{1}{x}.$

D11a $M = 20 + \frac{150}{t-6}$
$M - 20 = \frac{150}{t-6}$
$t - 6 = \frac{150}{M-20}$
$t = 6 + \frac{150}{M-20}.$

D11b $N = \frac{F+6}{p} + 5$
$N - 5 = \frac{F+6}{p}$
$F + 6 = p(N-5)$
$F = pN - 5p - 6.$

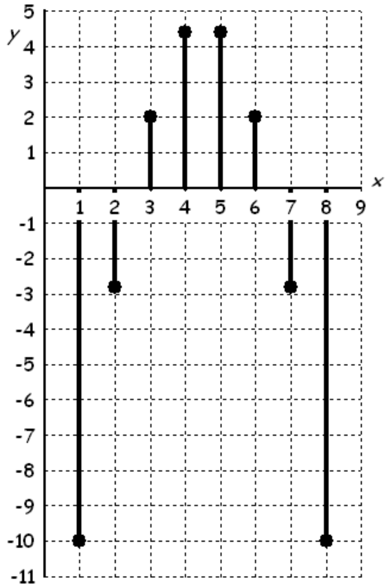
D12a 





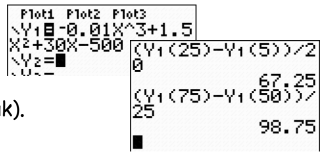
d	0	1	2	3	4	5	6	7	8
P	10	0	-2,8	-0,8	3,6	8	10	7,2	-2,8
ΔP	---	-10	-2,8	2	4,4	4,4	2	-2,8	-10

Zie hiernaast het gevraagde toenamediagram.



D12b Achtereenvolgens afnemend dalend, toenemend stijgend, afnemend stijgend en toenemend dalend.

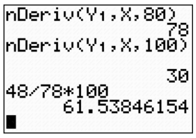
D13a Op [5, 25] is $\frac{\Delta W}{\Delta q} = \frac{W(25) - W(5)}{25-5} = 67{,}25$ (€/stuk).



D13b Op [50, 75] is $\frac{\Delta W}{\Delta q} = \frac{W(75) - W(50)}{75-50} = 98{,}75$ (€/stuk).

D13c $\left[\frac{dW}{dq}\right]_{q=80} = \text{nDeriv}(-0.1x^3 + 1.5x^2 + 30x - 500, x, 80) = 78$ (€/stuk).

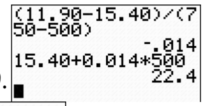
D13d $\left[\frac{dW}{dq}\right]_{q=100} = \text{nDeriv}(-0.1x^3 + 1.5x^2 + 30x - 500, x, 100) = 30$ (€/stuk).



De afname van de snelheid is $\frac{78-30}{78} \times 100\% \approx 61{,}5\%.$

Gemengde opgaven 15. Formules en grafieken

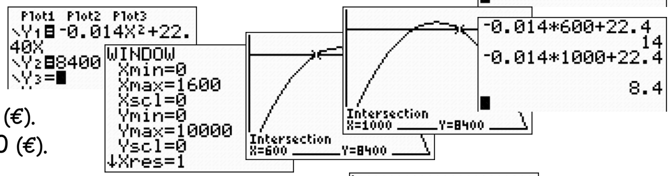
G23a $p = aq + b$ met $a = \frac{\Delta p}{\Delta q} = \frac{11{,}90 - 15{,}40}{750 - 500} = \frac{-3{,}50}{250} = \frac{-14}{1000} = -0{,}014.$



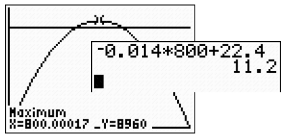
$\left.\begin{array}{l} p = -0{,}014q + b \\ q = 500 \Rightarrow p = 15{,}40 \end{array}\right\} \Rightarrow 15{,}40 = -0{,}014 \cdot 500 + b \Rightarrow b = 15{,}40 + 7 = 22{,}40.$ Dus $p = -0{,}014q + 22{,}40.$

$R = p \cdot q = -0{,}014q^2 + 22{,}40q.$

G23b $R = -0{,}014q^2 + 22{,}40q = 8\,400 \Rightarrow q = 600 \vee q = 1\,000.$
$q = 600 \Rightarrow p = -0{,}014 \cdot 600 + 22{,}40 = -8{,}40 + 22{,}40 = 14$ (€).
$q = 1000 \Rightarrow p = -0{,}014 \cdot 100 + 22{,}40 = -14 + 22{,}40 = 8{,}40$ (€).

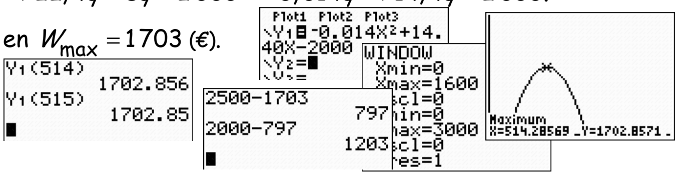


G23c $R = -0{,}014q^2 + 22{,}40q$ (optie maximum) $\Rightarrow q = 800$ en $R_{max} = 8\,960$ (€).
$q = 800 \Rightarrow p = -0{,}014 \cdot 800 + 22{,}40 = -11{,}20 + 22{,}40 = 11{,}20$ (€).
De maximale dagopbrengst krijg je als de prijs per artikel € 11,20 is.

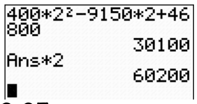


G23d $K = 8q + 2\,000.$
$W = R - K = -0{,}014q^2 + 22{,}4q - (8q + 2\,000) = -0{,}014q^2 + 22{,}4q - 8q - 2\,000 = -0{,}014q^2 + 14{,}4q - 2\,000.$

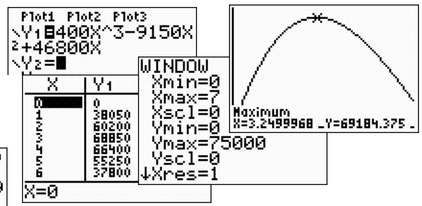
G23e $W = -0{,}014q^2 + 14{,}4q - 2\,000$ (optie maximum) $\Rightarrow q \approx 514$ en $W_{max} = 1703$ (€).
Om $W_{max} = 2\,500$ (€) te krijgen moeten
de vaste kosten met $2\,500 - 1703 = 797$ (€) afnemen.
De nieuwe vaste kosten zijn dan $2\,000 - 797 = 1203$ (€).



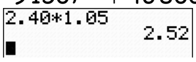
G24a $T = 2$ (€) $\Rightarrow A = 400 \cdot 2^2 - 9150 \cdot 2 + 46\,800 = 30\,100$ (auto's).
De totale dagopbrengst is $R = A \cdot T = 30\,100 \cdot 2 = 60\,200$ (€).



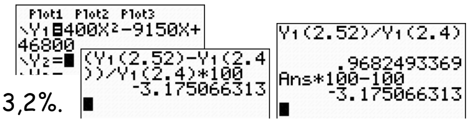
G24b $R = AT = 400T^3 - 9150T^2 + 46\,800T$ (optie maximum) $\Rightarrow T \approx 3{,}25$ (€).



G24c $2{,}40 \cdot 1{,}05 = 2{,}52.$

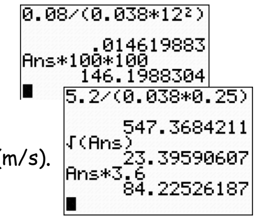


$\frac{A(2{,}40) - A(2{,}52)}{A(2{,}40)} \times 100\% \approx -3{,}2\%.$
Dus het aantal auto's neemt af met 3,2%.



G25a $G = \frac{80}{1000} = 0{,}08$ (kg) en $v = 12$ (m/s) $\Rightarrow 0{,}038 \cdot 12^2 \cdot A = 0{,}08 \Rightarrow A = \frac{0{,}08}{0{,}038 \cdot 12^2} \approx 0{,}0146$ (m²).
De vleugeloppervlakte is $0{,}0146$ m² $= 146$ cm².

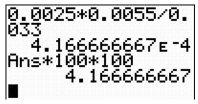
G25b $G = 5{,}2$ (kg) en $A = \frac{25}{100} = 0{,}25$ (m²) $\Rightarrow 0{,}038 \cdot v^2 \cdot 0{,}25 = 5{,}2 \Rightarrow v^2 = \frac{5{,}2}{0{,}038 \cdot 0{,}25} \Rightarrow v \approx 23{,}4$ (m/s).
De kruissnelheid is v m/s $= v \cdot 3{,}6$ km/uur ≈ 84 km/uur.



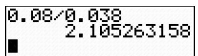
G25c Een veldleeuwerik:
$G = \frac{33}{1000} = 0{,}033$ (kg) en $A = \frac{25}{100 \cdot 100} = 0{,}0025$ (m²)
$0{,}038 \cdot v^2 \cdot 0{,}0025 = 0{,}033$
$v^2 = \frac{0{,}033}{0{,}038 \cdot 0{,}0025}.$

Een kolibri:
$G = \frac{5{,}5}{1000} = 0{,}0055$ (kg)
$0{,}038 \cdot v^2 \cdot A = 0{,}0055$
$v^2 = \frac{0{,}0055}{0{,}038 \cdot A}.$

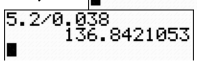
$\frac{0{,}033}{\cancel{0{,}038} \cdot 0{,}0025} = \frac{0{,}0055}{\cancel{0{,}038} \cdot A}$
$0{,}033A = 0{,}0025 \cdot 0{,}0055$
$A = \frac{0{,}0025 \cdot 0{,}0055}{0{,}033} \approx 0{,}0004$ (m²).
Dus 4 cm².



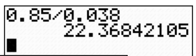
G25d $G = \frac{80}{1000} = 0{,}08$ (kg) $\Rightarrow 0{,}038 \cdot v^2 \cdot A = 0{,}08 \Rightarrow A = \frac{0{,}08}{0{,}038 \cdot v^2} \approx \frac{2{,}11}{v^2}.$



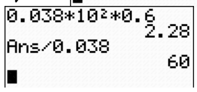
$G = 5{,}2$ (kg) $\Rightarrow 0{,}038 \cdot v^2 \cdot A = 5{,}2 \Rightarrow A = \frac{5{,}2}{0{,}038 \cdot v^2} \approx \frac{136{,}84}{v^2}.$



G25e $G = \frac{850}{1000} = 0{,}85$ (kg) $\Rightarrow 0{,}038 \cdot v^2 \cdot A = 0{,}85 \Rightarrow A = \frac{0{,}85}{0{,}038 \cdot v^2} \approx \frac{22{,}37}{v^2}.$



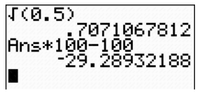
G25f De rode grafiek gaat door het punt (10; 0,6).
$v = 10$ (m/s) en $A = 0{,}6$ (m²) $\Rightarrow G = 0{,}038 \cdot 10^2 \cdot 0{,}6 = 2{,}28$ (kg).
$G = 2{,}28$ (kg) $\Rightarrow 0{,}038 \cdot v^2 \cdot A = 2{,}28 \Rightarrow A = \frac{2{,}28}{0{,}038 \cdot v^2} = \frac{60}{v^2}$. Het gewicht van de vogels (bij de rode grafiek) is 2,28 kg.



G25g Grotere vogels hebben ook een groter gewicht. Bekijk de formule $G = 0{,}038v^2A \Rightarrow 0{,}038v^2 = \frac{G}{A}$ ofwel $v^2 = \frac{G}{0{,}038A}$.
Als G en A beide twee keer zo groot worden, dan blijft de kruissnelheid gelijk. (zie de formule hierboven)
Als alleen A groter wordt, dan wordt v^2, dus ook de kruissnelheid v, zelfs lager.
De bewering van Annelies is in het algemeen niet waar.

G25h Uit $G = 0{,}038v^2A \Rightarrow v^2 = \frac{G}{0{,}038A}$ volgt: als G kleiner wordt, dan wordt v^2 kleiner $\Rightarrow$ kruissnelheid v wordt lager.

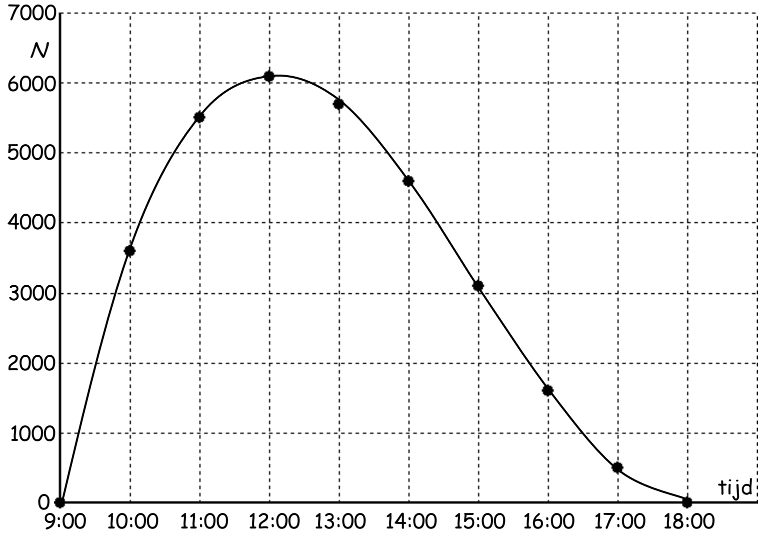
G25i v^2 is evenredig met G (want het vleugeloppervlak A van de vogels verandert niet).
$v^2 = \frac{G}{0{,}038A} = \frac{1}{0{,}038A} \cdot G = a \cdot G \Rightarrow v = \sqrt{a \cdot G} = \sqrt{a} \cdot \sqrt{G} = b \cdot \sqrt{G}$ (dus v evenredig met $\sqrt{G}$).
Als G halveert dan wordt v dus $\sqrt{0{,}5} \approx 0{,}707$ (nog maar 70,7%) keer zo groot.
De kruissnelheid neemt af met 29,3%.



G26a Om 11:00 uur waren er (ongeveer) $3600 + 1900 = 5500$ bezoekers.

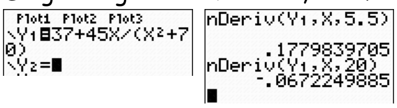
G26b Maak met het toenamediagram G.13 eerst de tabel hiernaast.
Nu zijn elk uur de aantallen bekend.
Teken een vloeiende kromme door de punten (zie een voorbeeld hiernaast).

tijd	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
ΔN	---	3600	1900	600	-400	-1100	-1500	-1500	-1100	-500
N	0	3600	5500	6100	5700	4600	3100	1600	500	0



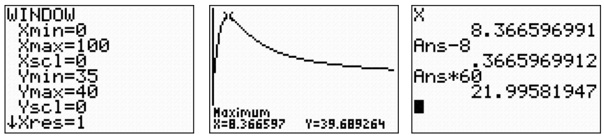
G26c De directeur zou gelijk kunnen hebben.
(er zijn alleen de veranderingen per uur bijgehouden)
Het is mogelijk dat er tussen 11:00 uur en 12:00 uur 6500 bezoekers in het park waren.
Om 12:00 uur was het aantal wel weer 6100.

G27a Op 1 mei om 17:30 uur is $t = 5{,}5$.
$\left[\frac{dT}{dt}\right]_{t=5{,}5} = \text{nDeriv}(37 + \frac{45x}{x^2+70}, x, 5.5) \approx 0{,}18.$
De gevraagde snelheid is 0,18 °C/uur.

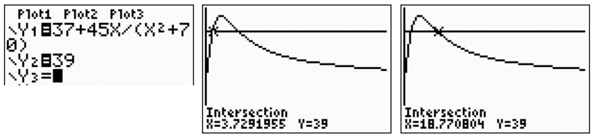


G27b Op 2 mei om 8:00 uur is $t = 20$.
$\left[\frac{dT}{dt}\right]_{t=20} = \text{nDeriv}(37 + \frac{45x}{x^2+70}, x, 20) \approx -0{,}07.$
De gevraagde snelheid is 0,07 °C/uur.

G27c $T = 37 + \frac{45t}{t^2+70}$ (optie maximum) $\Rightarrow t \approx 8{,}37$ en $T \approx 39{,}7$.
De maximale temperatuur is 39,7 (°C).
Bij $t = 8{,}37$ hoort het tijdstip 1 mei om 20:22 uur.



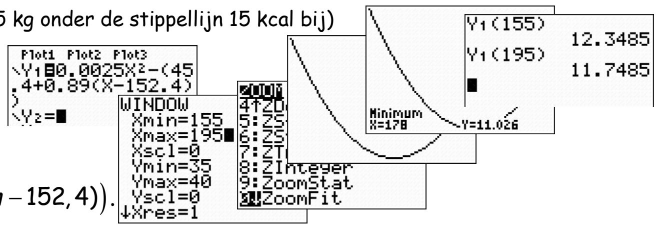
G27d $T = 37 + \frac{45t}{t^2+70} = 39$ (intersect) $\Rightarrow t \approx 3{,}73 \vee t \approx 18{,}77$.
De lichaamstemperatuur is iets meer dan 15 uur boven 39 °C.



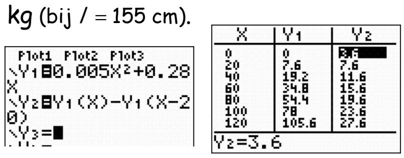
G28a De getallen zijn 1310, 1325, 1340, 1355, 1370.
(het gemiddelde van de laatste twee kolommen of voor ieder 0,5 pond meer afvallen ook 200 kcal/dag minder)

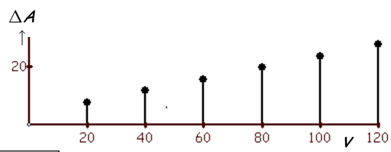
G28b De toename per kg is 3 kcal. (in elke kolom komt er bij elke 5 kg onder de stippellijn 15 kcal bij)
$E_{\text{behoud}} = 3 \cdot gewicht + 1700$
$E_{\text{1 pond afvallen}} = 3 \cdot gewicht + 1300$
$E_{x \text{ pond afvallen}} = 3 \cdot gewicht + 1700 - 400 \cdot x$
(voor ieder pond meer afvallen ook 400 kcal/dag minder)

G28c $V = 0{,}0025 \cdot (lengte\ in\ cm)^2 - \left(45{,}4 + 0{,}89 \cdot (lengte\ in\ cm - 152{,}4)\right)$.
De optie minimum geeft 11,0 (of 11) kg (bij $l = 178$ cm) en
het maximum (op het gegeven domein) is 12,3 kg (bij $l = 155$ cm).



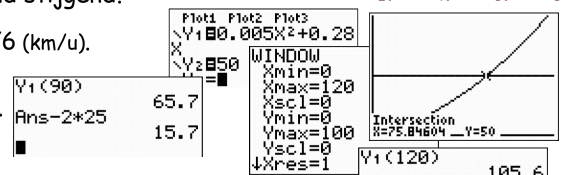
G29a De toenamen zijn achtereenvolgens 7,6; 11,6; 15,6; 19,6; 23,6 en 27,6.
Teken het toenamediagram (zie hiernaast).
De toenamen worden steeds groter $\Rightarrow A$ is toenemend stijgend.



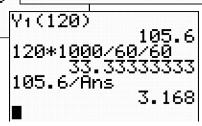


G29b $0{,}005v^2 + 0{,}28v = 50$ (abc-formule of intersect) $\Rightarrow v \approx 76$ (km/u).

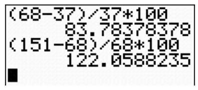
G29c Bij 90 km/u (25 m/s) is twee seconden $2 \cdot 25 = 50$ m.
De formule geeft bij $v = 90$ (km/u) $A = 65{,}7$ (of 66) m.
Het verschil is 15,7 (of 16) m.



G29d $v = 120$ (km/u) $\Rightarrow A = 105{,}6$ (m)
120 km/u is $33\frac{1}{3}$ m/s
$\Rightarrow \frac{105{,}6}{33\frac{1}{3}} = 3{,}168$ seconden, dus ruim 3 seconden.

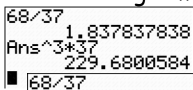


G30a In de periode 7 maart - 4 april een toename van $\frac{68-37}{37} \times 100\% \approx 83{,}8\%$.
In de periode 4 april - 2 mei een toename van $\frac{151-68}{68} \times 100\% \approx 122{,}1\%$.



G30b De grafiek in figuur G.14 neemt eerst steeds sneller toe en neemt daarna een steeds langzamere toe $\Rightarrow$ diagram A.

G30c $g_{4\text{ weken}} = \frac{68}{37} \Rightarrow$ aantal bedrijven op $n = 16$ (3 periodes van 4 weken na $n = 4$) is dan $37 \cdot \left(\frac{68}{37}\right)^3 \approx 230$.



of $g_{4\text{ weken}} = \frac{68}{37} \Rightarrow g_{\text{week}} = \left(\frac{68}{37}\right)^{\frac{1}{4}} \approx 1{,}164 \Rightarrow$ het aantal op $n = 16$ is dan $37 \cdot 1{,}164^{12} \approx 230$ (of 229).