1a $\Delta x = 6 - 2 = 4$ (km) en $\Delta y = 9{,}6 - 5 = 4{,}6$ (€).

1b $\frac{4{,}6}{4} = 1{,}15$ (€ / km) $= \frac{\Delta y}{\Delta x}$.

1c $5 - 2 \cdot 1{,}15 = 5 - 2{,}30 = 2{,}70$ (€).

1d Uit 1b en 1c volgt: $y = 1{,}15x + 2{,}70$.

2a $P = aq + b$ met $a = \frac{\Delta P}{\Delta q} = \frac{125-57}{17-13} = \frac{68}{4} = 17$.
$\left.\begin{array}{l} P = 17q + b \\ q = 13 \Rightarrow P = 57 \end{array}\right\} \Rightarrow 57 = 17 \cdot 13 + b$
$57 - 17 \cdot 13 = b = -164$.
Dus $P = 17q - 164$.

```
57-17*13
            -164
```

2b $A = at + b$ met $a = \frac{\Delta A}{\Delta t} = \frac{300-360}{61-55} = \frac{-60}{6} = -10$.
$\left.\begin{array}{l} A = -10t + b \\ t = 61 \Rightarrow A = 300 \end{array}\right\} \Rightarrow 300 = -10 \cdot 61 + b$
$300 + 10 \cdot 61 = b = 910$.
Dus $A = -10t + 910$.

```
300+10*61
             910
```

3ab $K = 1{,}4q + 864$ en $R = 2{,}6q$. (volgt direct uit de gegevens)

3c $K = R$
$1{,}4q + 864 = 2{,}6q$
$-1{,}2q = -864$
$q = 720$ (vazen).

```
864/1.2
             720
```

3d $W = R - K = 900$
$2{,}6q - (1{,}4q + 864) = 900$
$1{,}2q - 864 = 900$
$1{,}2q = 1764$
$q = 1\,470$ (vazen).

```
900+864
            1764
Ans/1.2
            1470
```

4a $n = aT + b$ met $a = \frac{\Delta n}{\Delta T} = \frac{32-24}{24-19} = \frac{8}{5} = 1{,}6$.
$\left.\begin{array}{l} n = 1{,}6T + b \\ T = 24 \Rightarrow n = 32 \end{array}\right\} \Rightarrow 32 = 1{,}6 \cdot 24 + b$
$32 - 1{,}6 \cdot 24 = b = -6{,}4$.
Dus $n = 1{,}6T - 6{,}4$.

```
32-1.6*24
            -6.4
```

4b $n = 1{,}6T - 6{,}4$
$n + 6{,}4 = 1{,}6T$
$T = \frac{n+6{,}4}{1{,}6} = \frac{1}{1{,}6}n + \frac{6{,}4}{1{,}6} = 0{,}625n + 4$.

```
1/1.6
            .625
6.4/1.6
               4
0.625*22+4
           17.75
```

4c $n = \frac{88}{4} = 22 \Rightarrow T = 0{,}625 \cdot 22 + 4 = 17{,}75 \approx 18$ (°C).

5a $a = 150$ (per vrachtauto) $\Rightarrow K = 200$ (€ / TEU). Dus de totale kosten zijn $10 \cdot 200 = 2\,000$ euro.

5b 300 TEU per trein voor 69000 euro $\Rightarrow K = \frac{69000}{300} = 230$ (€ / TEU) $\Rightarrow a = 365$ (km).

5c Vrachtauto: lijn door (0, 50) en (50, 100) $\Rightarrow \frac{\Delta K}{\Delta a} = \frac{50}{50} = 1$ en $K = a + 50$.
Trein: lijn door (50, 150) en (250, 200) $\Rightarrow \frac{\Delta K}{\Delta a} = \frac{50}{200} = \frac{1}{4} = 0{,}25$ en $K = 0{,}25a + b$ door (250, 200) $\Rightarrow b = 137{,}5$.
Schip: lijn door (0, 150) en (250, 200) $\Rightarrow \frac{\Delta K}{\Delta a} = \frac{50}{250} = \frac{1}{5} = 0{,}2$ en $K = 0{,}2a + 150$.

```
200-0.25*250
           137.5
```

5d $a + 50 = 0{,}25a + 137{,}5$
$0{,}75a = 87{,}5$
$a = \frac{87{,}5}{0{,}75} \approx 117$.

```
87.5/0.75
     116.6666667
```

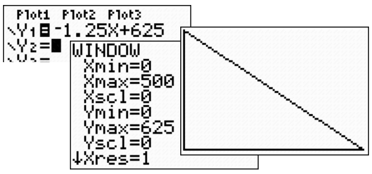
$0{,}25a + 137{,}5 = 0{,}2a + 150$
$0{,}05a = 12{,}5$
$a = \frac{12{,}5}{0{,}05} = 250$.

```
12.5/0.05
             250
```

Nu aflezen in de grafiek: voor afstanden tussen 117 en 250 km is vervoer per trein het voordeligst.

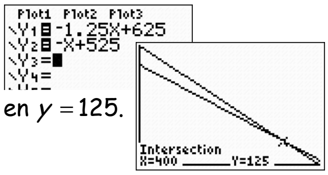
6a $30x + 24y = 15000$
(x keer € 30 en y keer € 24 levert € 15000 op)
$24y = -30x + 15000$
$y = -\frac{30x}{24} + \frac{15000}{24}$
$y = -1{,}25x + 625$. (zie een plot hiernaast)

```
-30/24
           -1.25
15000/24
             625
```



6b $x + y = 525$
(er worden 525 kaarten verkocht)
$y = -x + 525$. (zie de plot hiernaast)

6c $-1{,}25x + 625 = -x + 525$ (intersect) $\Rightarrow x = 400$ en $y = 125$.
Er waren dus 125 pashouders aanwezig.



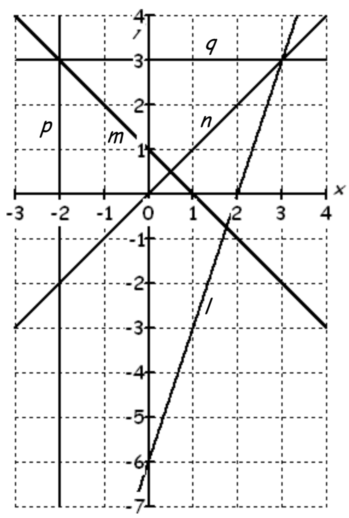
7ab l: $3x - y = 6$
$x = 0 \Rightarrow -y = 6 \Rightarrow y = -6$
$y = 0 \Rightarrow 3x = 6 \Rightarrow x = 2$
$rc_l = 3$ ($y = 3x - ...$)

m: $x + y = 1$
$x = 0 \Rightarrow y = 1$
$y = 0 \Rightarrow x = 1$
$rc_m = -1$ ($y = -x + ...$)

n: $x - y = 0$
$x = 0 \Rightarrow y = 0$
$y = 1 \Rightarrow x - 1 = 0 \Rightarrow x = 1$
$rc_n = 1$ ($y = x + ...$)

p: $y = 3$ (een horizontale lijn)
$x = 0 \Rightarrow y = 3$
$x = 1 \Rightarrow y = 3$
$rc_p = 0$ ($y = 0x + ...$)

q: $x = -2$ (een verticale lijn)
$y = 0 \Rightarrow x = -2$
$y = 1 \Rightarrow x = -2$
rc_q bestaat niet ($y = ???$)



8a $3x - 4y = 12$
$-4y = -3x + 12$
$y = \frac{3}{4}x - 3$.

8b $2x + 6 = 3y - 12$
$-3y = -2x - 18$
$y = \frac{2}{3}x + 6$.

8c $2x + 3y = y - 20$
$2y = -2x - 20$
$y = -x - 10$.

8d $2{,}5x - 3 = -6y + 30$
$6y = -2{,}5x + 33$
$y = -\frac{5}{12}x + 5\frac{1}{2}$.

9a Stel $x =$ het aantal stoelen en $y =$ het aantal tafels $\Rightarrow 350x + 850y = 22\,000$.

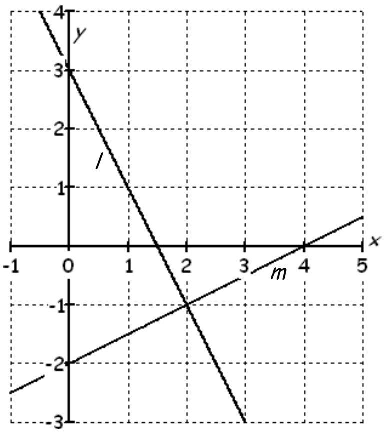
9b Stel $x =$ de prijs van 100 gram cashewnoten en $y =$ de prijs van 100 gram studentenhaver $\Rightarrow 4x + 7y = 8{,}40$.

9c Stel $x =$ het aantal ha groenten en $y =$ het aantal ha graan $\Rightarrow 10\,000x + 5\,000y = 250\,000$.

10a Stel $x =$ het aantal abrikozenvlaaien
en $y =$ het aantal rijstevlaaien $\Rightarrow 12x + 15y = 645$.

10b Bijv.: $x = 0$ en $y = 43$
of $x = 5$ en $y = 39$
of $x = 10$ en $y = 35$.

```
645/15             43
(645-12*5)/15      39
(645-12*10)/15     35
```



11a l: $2x + y = 3$
$x = 0 \Rightarrow y = 3$
$x = 1 \Rightarrow 2 + y = 3 \Rightarrow y = 1$.

m: $x - 2y = 4$
$x = 0 \Rightarrow -2y = 4 \Rightarrow y = -2$
$y = 0 \Rightarrow x = 4$.

11b Aflezen in de figuur: $(2,\ -1)$.
(of eerst y vrijmaken en dan algebraïsch oplossen)

12a $-2x + y = 7 \Rightarrow y = 2x + 7$.
$y = 2x + 7$ (invullen) in $3x + y = 29$
$3x + 2x + 7 = 29$
$5x = 22$
$x = 4{,}4$ in $y = 2x + 7$
$y = 2 \cdot 4{,}4 + 7 = 15{,}8$.

12b $x - 5y = -15 \Rightarrow x = 5y - 15$.
$x = 5y - 15$ in $x + y = 27$
$5y - 15 + y = 27$
$6y = 42$
$y = 7$ in $x = 5y - 15$
$x = 5 \cdot 7 - 15 = 20$.

12c $2x - y = 3 \Rightarrow y = 2x - 3$.
$y = 2x - 3$ in $-3x + 5y = 13$
$-3x + 10x - 15 = 13$
$7x = 28$
$x = 4$ in $y = 2x - 3$
$y = 2 \cdot 4 - 3 = 5$.

13a $a - b = 720 \Rightarrow a = b + 720$.
$a = b + 720$ in $a - 0{,}18b = 1130$
$b + 720 - 0{,}18b = 1130$
$0{,}82b = 410$
$b = 500$ in $a = b + 720$
$a = 500 + 720 = 1220$.

```
410/0.82          500
```

13b $3p + q = 18 \Rightarrow q = 18 - 3p$.
$q = 18 - 3p$ in $2p - 3q = 19$
$2p - 54 + 9p = 19$
$11p = 73$
$p = \frac{73}{11}$ in $q = 18 - 3p$
$q = 18 - 3 \cdot \frac{73}{11} = -\frac{21}{11}$.

```
3*18                 54
19+54                73
18-3*73/11▸Frac
                 -21/11
```

14 $x + 4y = 38 \Rightarrow x = 38 - 4y$.
$x = 38 - 4y$ in $3x - 2y = -12$
$114 - 12y - 2y = -12$
$-14y = -126$
$y = 9$ in $x = 38 - 4y$
$x = 38 - 4 \cdot 9 = 2$.

```
3*38              114
126/14              9
```

15a $x + y = 5000$. (totaal 5000 kg)

15b $5\,000 \cdot 12{,}80 = 64\,000$.

```
5000*12.8       64000
```

15 $x + y = 5\,000 \Rightarrow y = 5\,000 - x$.
$y = 5\,000 - x$ in $12x + 16y = 64\,000$
$12x + 80\,000 - 16x = 64\,000$
$-4x = -16\,000$
$x = 4\,000$ in $y = 5\,000 - x$
$y = 5\,000 - 4\,000 = 1\,000$.

16 Stel respectievelijk A en B euro.
$A + B = 150\,000 \Rightarrow B = 150\,000 - A$.
$B = 150\,000 - A$ in $0{,}06A + 0{,}08B = 11\,000$
$0{,}06A + 12\,000 - 0{,}08A = 11\,000$
$-0{,}02A = -1\,000 \Rightarrow A = 50\,000$.

```
0.08*150000     12000
1000/0.02       50000
```

17a $L = 207 - 0{,}85 \cdot 170 - 1{,}02 \cdot 18 = 44{,}14 \approx 44$.

```
207-0.85*170-1.0
2*18
                44.14
```

17b $99 = 207 - 0{,}85 \cdot 120 - 1{,}02W$
$1{,}02W = 6$
$W \approx 5{,}9$.

```
207-0.85*120-99
                    6
Ans/1.02
          5.882352941
```

17c Bij een moeilijk boek zullen S en W groot zijn.
Hoe groter S en W, hoe lager (de leesbaarheidsfactor) L is.

18a $a = 5b + 8 \Rightarrow 5b = a - 8 \Rightarrow b = \frac{1}{5}a - \frac{8}{5}$.
$b = \frac{1}{5}a - \frac{8}{5}$ in $K = 14\frac{1}{4}b + 518\frac{1}{4} \Rightarrow$
$K = 14\frac{1}{4}(\frac{1}{5}a - \frac{8}{5}) + 518\frac{1}{4} = 2{,}85a + 495{,}45$.

```
14.25*1/5
                 2.85
14.25*-8/5+518.2
5
               495.45
```

18b $2b = 6 - 8c \Rightarrow b = 3 - 4c$.
$b = 3 - 4c$ in $K = 14\frac{1}{4}b + 518\frac{1}{4}$
$K = 14\frac{1}{4}(3 - 4c) + 518\frac{1}{4} = -57c + 561$.

```
14.25*3+518.25
                  561
14.25*-4
                  -57
```

19a $t = -\frac{1}{2}p + 6 \Rightarrow \frac{1}{2}p = 6 - t \Rightarrow p = 12 - 2t$.
$p = 12 - 2t$ in $A = 2t + 5p + 9 \Rightarrow$
$A = 2t + 5(12 - 2t) + 9 = -8t + 69$.

19b $y = 2x + 6 \Rightarrow 2x = y - 6 \Rightarrow x = \frac{1}{2}y - 3$.
$x = \frac{1}{2}y - 3$ in $A = 6xy + 20 \Rightarrow$
$A = 6y(\frac{1}{2}y - 3) + 20 = 3y^2 - 18y + 20$.

19c $p = -3q + 6$ en $2q = -r + 8 \Rightarrow r = 8 - 2q$.
beide invullen in $K = 5p + 3q + 5r + 100 \Rightarrow$
$K = 5(-3q + 6) + 3q + 5(8 - 2q) + 100 = -22q + 170$.

19d $x + y + z = 50 \Rightarrow z = 50 - x - y$.
$z = 50 - x - y$ in $W = 18 - 0{,}02x - 0{,}6y - 0{,}5z \Rightarrow$
$W = 18 - 0{,}02x - 0{,}6y - 0{,}5(50 - x - y) = -7 + 0{,}48x - 0{,}1y$.

20a $A = 10p$ in $q = -10p + 0{,}3A + 150$ geeft $q = -10p + 0{,}3 \cdot 10p + 150 = -7p + 150.$

```
-10+0.3*10          -7
```

20b $A = 30 + 5p$ in $q = -10p + 0{,}3A + 150$ geeft $q = -10p + 0{,}3 \cdot (30 + 5p) + 150 = -8{,}5p + 159.$

```
-10+0.3*5         -8.5
0.3*30+150         159
```

20c $q = 119$ én $p = 8{,}5$ in $q = -10p + 0{,}3A + 150$ geeft
$119 = -10 \cdot 8{,}5 + 0{,}3A + 150$
$-0{,}3A = -54$
$A = 180$

```
-10*8.5+150-119    -54
Ans/-0.3           180
```

21a $l = 50 \Rightarrow BMR = 66 + 13{,}7g + 5h - 6{,}8 \cdot 50 = 13{,}7g + 5h - 274.$

```
66-6.8*50         -274
```

21b $l = 28$, $g = 68$ en $BMR = 1700 \Rightarrow 1700 = 66 + 13{,}7 \cdot 68 + 5h - 6{,}8 \cdot 28 \Rightarrow 892{,}8 = 5h \Rightarrow h \approx 179$ (cm).

```
1700-66-13.7*68+
6.8*28           892.8
Ans/5           178.56
```

21c $l = 40$ en $g = h - 100 \Rightarrow BMR = 66 + 13{,}7 \cdot (h - 100) + 5h - 6{,}8 \cdot 40 = 18{,}7h - 1576.$

```
66+13.7*-100-6.8
*40              -1576
```

22 $y = 80$ en $z = 10x - 20 \Rightarrow P = \frac{80x}{10}(2 - \frac{10x - 20}{5}) = 8x(2 - (2x - 4) = 8x(2 - 2x + 4) = 8x(6 - 2x) = -16x^2 + 48x.$

23a $R = pq = (-0{,}002q + 4)q = -0{,}002q^2 + 4q.$

23b $\frac{dR}{dq} = 0 \Rightarrow -0{,}004q + 4 = 0 \Rightarrow -0{,}004q = -4 \Rightarrow q = 1000.$
De maximale opbrengst is $R_{max} = R(1000) = 2000$ euro.

```
-4/-0.004→X         1000
-0.002X²+4X         2000
```

23c $W = R - K = -0{,}002q^2 + 4q - (0{,}60q + 200) = -0{,}002q^2 + 3{,}4q - 200.$

23d $\frac{dW}{dq} = 0 \Rightarrow -0{,}004q + 3{,}4 = 0 \Rightarrow -0{,}004q = -3{,}4 \Rightarrow q = 850.$
De prijs is dan $p(850) = 2{,}30$ euro.

```
-3.4/-0.004→X        850
-0.002X+4            2.3
```

24a $20x^2 - 160x + 300 = 0$
$x^2 - 8x + 15 = 0$
$(x - 3)(x - 5) = 0$
$x = 3 \vee x = 5.$

24b $0{,}02x^2 - 8x = 0$
$x^2 - 400x = 0$
$x(x - 400) = 0$
$x = 0 \vee x = 400.$

```
50*0.02                1
```

24c $q(4 - 0{,}2q) = 15$
$4q - 0{,}2q^2 = 15$
$-0{,}2q^2 + 4q - 15 = 0$
$q^2 - 20q + 75 = 0$
$(q - 5)(q - 15) = 0$
$q = 5 \vee q = 15.$

```
-5*-0.2                1
```

24d $q(-0{,}01q + 40) = 0$
$q = 0 \vee -0{,}01q = -40$
$q = 0 \vee q = \frac{-40}{-0{,}01} = 4000.$

```
40/0.01             4000
```

25a $R = -0{,}002q^2 + 24q = 0$ (de grafiek van R is een bergparabool)
$q(-0{,}002q + 24) = 0$
$q = 0 \vee -0{,}002q = -24$
$q = 0 \vee q = 12000.$

```
-24/-0.002         12000
```

25b $\frac{dR}{dq} = 0 \Rightarrow -0{,}004q + 24 = 0 \Rightarrow -0{,}004q = -24 \Rightarrow q = 6000.$
De maximale opbrengst is $R_{max} = R(6000) = 72000$ euro.

```
-24/-0.004→X        6000
-0.002X²+24X       72000
```

25cd $R = -0{,}002q^2 + 24q = 64000$
$-0{,}002q^2 + 24q - 64000 = 0$
$q^2 - 12000q + 32000000 = 0$
$(q - 4000)(q - 8000) = 0$
$q = 4000 \vee q = 8000.$
Dus bij aantallen tussen 4000 en 8000.

```
-500*-0.002            1
-500*24           -12000
-500*-64000     32000000
```

26a $p = aq + b$ met $a = \frac{\Delta p}{\Delta q} = \frac{20 - 28}{1200 - 400} = \frac{-8}{800} = -0{,}01.$
$\left.\begin{array}{l} p = -0{,}01q + b \\ q = 400 \Rightarrow p = 28 \end{array}\right\} \Rightarrow 28 = -0{,}01 \cdot 400 + b$
$28 + 4 = b = 32.$
Dus $p = -0{,}01q + 32$ en $R = pq = -0{,}01q^2 + 32q.$

26b $R = -0{,}01q^2 + 32q = 24000$ ($\times -100$ en op 0 herleiden)
$q^2 - 3200q + 2400000 = 0$
$(q - 1200)(q - 2000) = 0$
$q = 1200 \vee q = 2000.$
$q = 1200 \Rightarrow p = -12 + 32 = 20$ (€).
$q = 2000 \Rightarrow p = -20 + 32 = 12$ (€).

```
-0.01*1200+32         20
-0.01*2000+32         12
```

26c $K = 16q + 1500.$
$W = R - K = -0{,}01q^2 + 32q - 16q - 1500$
$W = -0{,}01q^2 + 16q - 1500.$
$\frac{dW}{dq} = -0{,}02q + 16$
$\frac{dW}{dq} = 0 \Rightarrow -0{,}02q = -16 \Rightarrow q = 800.$
$W_{max} = W(800) = 4900$ (€) en $p = p(800) = 24$ (€).

```
-16/-0.02→X          800
-0.01X²+16X-1500
                    4900
-0.01X+32             24
```

26d $W = -0{,}01q^2 + 16q - 1500$ geeft $W_{max} = 4900$ (€).
Zonder vaste kosten $W_{max} = 6400$ (€).
De vaste kosten zijn nu 400 (€).

```
4900+1500           6400
Ans-400             6000
```

27a $h = -0{,}18x^2 + 0{,}96 = 0$
$-0{,}18x^2 = -0{,}96$
$x^2 = \frac{16}{3}$
$x_A = -\sqrt{\frac{16}{3}} \vee x_B = \sqrt{\frac{16}{3}}$ ($\times 100$ feet).
$AB = \sqrt{\frac{16}{3}} \times 100 \times 2 \times 0{,}314 \approx 145$ meter.

```
0.96/0.18▶Frac
                    16/3
√(16/3)*100*2*0.
314
             145.0303876
```

27b $PQ = 380$ feet $\Rightarrow x_Q = 1{,}9$ ($\times 100$ feet).
$h_Q = -0{,}18 \cdot 1{,}9^2 + 0{,}96 = 0{,}3102$ ($\times 100$ feet).
$h_T = -0{,}18 \cdot 0^2 + 0{,}96 = 0{,}96$ ($\times 100$ feet).
$h_T - h_Q = 0{,}96 - 0{,}3102 = 0{,}6498$ ($\times 100$ feet)
Dus het water staat $0{,}6498 \cdot 100 \approx 65$ feet onder T.

```
-0.18*1.9²+0.96
                   .3102
0.96-0.3102        .6498
```

27c $h_{\text{wateroppervlak}} = h_T - 0{,}7 = 0{,}96 - 0{,}7 = 0{,}26$ ($\times 100$ feet).

$h = -0{,}18 \cdot x^2 + 0{,}96 = 0{,}26 \Rightarrow -0{,}18 \cdot x^2 = -0{,}7 \Rightarrow x^2 = \frac{-0{,}7}{-0{,}18} = \frac{70}{18} = \frac{35}{9} \Rightarrow x = \pm\sqrt{\frac{35}{9}}$ ($\times 100$ feet).

De breedte van het wateroppervlak is $\sqrt{\frac{35}{9}} \cdot 100 \cdot 2 \cdot 0{,}314 \approx 123{,}8$ meter.

```
-0.7/-0.18▶Frac
            35/9
√(Ans)*100*2*0.3
14
     123.8432701
```

28a $x^2 = 16 \Rightarrow x = 4 \vee x = -4$, dus $(2x-1)^2 = 16 \Rightarrow 2x-1 = 4 \vee 2x-1 = -4$.

28b $(2x-1)^2 = 16 \Rightarrow 2x-1 = 4 \vee 2x-1 = -4 \Rightarrow 2x = 5 \vee 2x = -3 \Rightarrow x = \frac{5}{2} \vee x = -\frac{3}{2}$.

28c Een kwadraat kan nooit negatief zijn (of de wortel uit een negatief getal bestaat niet).

29a
$(x-3)(2x+1) = (x-3)(x+5)$
$2x^2 + x - 6x - 3 = x^2 + 5x - 3x - 15$
$x^2 - 7x + 12 = 0$
$(x-3)(x-4) = 0$
$x = 3 \vee x = 4$.

29bc
$2x + 1 = x + 5$
$x = 4$.
Leonard krijgt de oplossing $x = 4$, maar is $x = 3$ kwijt.
Het is niet toegestaan door letters (bijvoorbeeld $x - 3$) te delen.
(je mag wel delen als je vóór het delen door $x - 3$ eerst $x - 3 = 0$ stelt)

30a
$(3x-2)^2 = 49$
$3x - 2 = 7 \vee 3x - 2 = -7$
$3x = 9 \vee 3x = -5$
$x = 3 \vee x = -\frac{5}{3}$.

30c
$(x-3)^2 = (2x-7)^2$
$x - 3 = 2x - 7 \vee x - 3 = -(2x-7)$
$-x = -4 \vee 3x = 10$
$x = 4 \vee x = \frac{10}{3}$.

30b
$(3x-1)(5x-3) = (3x-1)(6x+5)$
$3x - 1 = 0 \vee 5x - 3 = 6x + 5$
$3x = 1 \vee -x = 8$
$x = \frac{1}{3} \vee x = -8$.

30d
$(x^2-1)(4x-3) - 5(x^2-1) = 0$
$(x^2-1)(4x-3) = 5(x^2-1)$
$x^2 - 1 = 0 \vee 4x - 3 = 5$
$x^2 = 1 \vee 4x = 8$
$x = 1 \vee x = -1 \vee x = 2$.

31a
$(x+2)(x^2+2x+1) = x + 2$
$x + 2 = 0 \vee x^2 + 2x + 1 = 1$
$x = -2 \vee x^2 + 2x = 0$
$x = -2 \vee x(x+2) = 0$
$x = -2 \vee x = 0$ ~~$\vee x = -2$~~.

31e
$7(x-3)^2 = (x+1)(x-3)^2$
$(x-3)^2 = 0 \vee x + 1 = 7$
$x - 3 = 0 \vee x = 6$
$x = 3 \vee x = 6$.

31b
$5 \cdot \sqrt{x^2-3} = (2x-1) \cdot \sqrt{x^2-3}$
$\sqrt{x^2-3} = 0 \vee 2x - 1 = 5$
$x^2 - 3 = 0 \vee 2x = 6$
$x^2 = 3 \vee x = 3$
$x = -\sqrt{3} \vee x = \sqrt{3} \vee x = 3$
$x \approx -1{,}73 \vee x \approx 1{,}73 \vee x = 3$.

```
√(3)
     1.732050808
```

31f
$(2x-1)^2 \cdot \sqrt{2x-1} = 25 \cdot \sqrt{2x-1}$
$\sqrt{2x-1} = 0 \vee (2x-1)^2 = 25$
$2x - 1 = 0 \vee 2x - 1 = -5 \vee 2x - 1 = 5$
$2x = 1 \vee 2x = -4 \vee 2x = 6$
$x = \frac{1}{2} \vee x = -2 \vee x = 3$.

31g
$(x^2-5)^3 = 9(x^2-5)$
$x^2 - 5 = 0 \vee (x^2-5)^2 = 9$
$x^2 = 5 \vee x^2 - 5 = -3 \vee x^2 - 5 = 3$
$x = -\sqrt{5} \vee x = \sqrt{5} \vee x^2 = 2 \vee x^2 = 8$
$x = -\sqrt{5} \vee x = \sqrt{5} \vee x = -\sqrt{2} \vee x = \sqrt{2} \vee x = -\sqrt{8} \vee x = \sqrt{8}$
$x \approx -2{,}24 \vee x \approx 2{,}24 \vee x \approx -1{,}41 \vee x \approx 1{,}41 \vee x \approx -2{,}83 \vee x \approx 2{,}83$.

```
√(5)
     2.236067977
√(2)
     1.414213562
√(8)
     2.828427125
```

31c
$(x-1)(x+3) = (x-1)(x^2+6x+3)$
$x - 1 = 0 \vee x^2 + 6x + 3 = x + 3$
$x = 1 \vee x^2 + 5x = 0$
$x = 1 \vee x(x+5) = 0$
$x = 1 \vee x = 0 \vee x = -5$.

31d
$5(3x-5) = (x-1)(3x-5)$
$3x - 5 = 0 \vee x - 1 = 5$
$3x = 5 \vee x = 6$
$x = \frac{5}{3} \vee x = 6$.

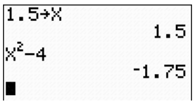
31h
$(2x-1)(x^2-36) = (x^2-36)(x+7)$
$x^2 - 36 = 0 \vee 2x - 1 = x + 7$
$x^2 = 36 \vee x = 8$
$x = -6 \vee x = 6 \vee x = 8$.

32a
$(5x^2-30)(3x+1) = 0$
$5x^2 - 30 = 0 \vee 3x + 1 = 0$
$5x^2 = 30 \vee 3x = -1$
$x^2 = 6 \vee x = -\frac{1}{3}$
$x = -\sqrt{6} \vee x = \sqrt{6} \vee x = -\frac{1}{3}$
$x \approx -2{,}45 \vee x \approx 2{,}45 \vee x \approx -0{,}33$.

```
√(6)
     2.449489743
1/3
     .3333333333
```

32b
$(5x^2-125)(3x+1) = (5x^2-125)(x^2+1)$
$5x^2 - 125 = 0 \vee x^2 + 1 = 3x + 1$
$5x^2 = 125 \vee x^2 - 3x = 0$
$x^2 = 25 \vee x(x-3) = 0$
$x = -5 \vee x = 5 \vee x = 0 \vee x = 3$.

32c $3x \cdot \sqrt{x^2-4} = (x+3) \cdot \sqrt{x^2-4}$
$\sqrt{x^2-4} = 0 \vee 3x = x+3$
$x^2-4=0 \vee 2x=3$
$x^2=4 \vee x=\frac{3}{2}$
$x=-2 \vee x=2 \vee x=\frac{3}{2}$ (voldoet niet).



32d $5 \cdot \sqrt{x^2-4} - x \cdot \sqrt{x^2-4} = 0$
$5 \cdot \sqrt{x^2-4} = x \cdot \sqrt{x^2-4}$
$\sqrt{x^2-4} = 0 \vee x=5$
$x^2-4=0 \vee x=5$
$x^2=4 \vee x=5$
$x=-2 \vee x=2 \vee x=5.$

32e $6(5x-3)-(2x-3)(x+6)=0$
$30x-18-(2x^2+12x-3x-18)=0$
$-2x^2+21x=0$
$x(-2x+21)=0$
$x=0 \vee -2x=-21$
$x=0 \vee x=\frac{21}{2}=10\frac{1}{2}.$

32f $(x+2)(x+3)=(x+4)(x+5)$
$x^2+3x+2x+6=x^2+5x+4x+20$
$-4x=14$
$x=\frac{14}{-4}=-\frac{7}{2}=-3\frac{1}{2}.$

33a $q=0{,}6(a-3)^2$ invullen in $K=0{,}2q+25$
$K=0{,}2 \cdot 0{,}6(a-3)^2+25$
$K=0{,}12(a-3)^2+25.$

33b $K=0{,}12(a-3)^2+25=37$
$0{,}12(a-3)^2=12$
$(a-3)^2=100$
$a-3=-10 \vee a-3=10$
$a=-7 \vee a=13.$

34 (3, 5) op de grafiek van $y=ax^2+bx+8 \Rightarrow a \cdot 3^2+b \cdot 3+8=5 \Rightarrow 9a+3b+8=5.$

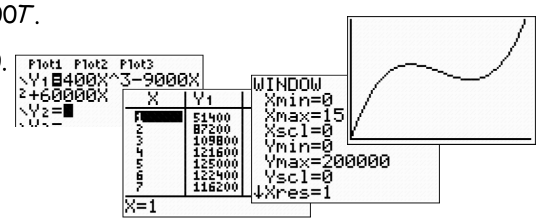
35 (−2, −24) op de grafiek van $y=ax^2+bx \Rightarrow 4a-2b=-24$ ofwel $2a-b=-12.$
(1, 3) op de grafiek van $y=ax^2+bx \Rightarrow a+b=3.$
$a+b=3 \Rightarrow b=3-a$ invullen in $2a-b=-12$ geeft
$2a-(3-a)=-12$
$2a-3+a=-12$
$3a=-9 \Rightarrow a=-3$ invullen in $a+b=3$ geeft $-3+b=3 \Rightarrow b=6.$

36 (0, 0) op de grafiek van $y=ax^2+bx+c \Rightarrow c=0,$
(1, 300) op de grafiek van $y=ax^2+bx+c \Rightarrow a+b+c=300$ en
(2, 500) op de grafiek van $y=ax^2+bx+c \Rightarrow 4a+2b+c=500.$
$c=0$ invullen in $a+b+c=300$ en $4a+2b+c=500$ geeft $a+b=300$ en $4a+2b=500.$
$a+b=300 \Rightarrow b=300-a$ invullen in $4a+2b=500$ geeft
$4a+2(300-a)=500$
$4a+600-2a=500$
$2a=-100 \Rightarrow a=-50$ invullen in $a+b=300$ geeft $-50+b=300 \Rightarrow b=350.$ Dus $a=-50,\ b=350$ en $c=0.$

37a $T=2{,}5 \Rightarrow A=40\,000 \Rightarrow 6{,}25a+2{,}5b+60\,000=40\,000$ ofwel $6{,}25a+2{,}5b=-20\,000$ of $25a+10b=-80\,000$ en
$T=5 \Rightarrow A=25\,000 \Rightarrow 25a+5b+60\,000=25\,000$ ofwel $25a+5b=-35\,000$ ofwel $5a+b=-7\,000.$
$5a+b=-7\,000 \Rightarrow b=-7\,000-5a$ invullen in $25a+10b=-80\,000$ geeft
$25a+10(-7\,000-5a)=-80\,000$
$25a-70\,000-50a=-80\,000$
$-25a=-10\,000 \Rightarrow a=400$ invullen in $5a+b=-7\,000$ geeft $2\,000+b=-7\,000 \Rightarrow b=-9\,000.$

37b $A=400T^2-9\,000T+60\,000.$
$R=T \cdot A=T \cdot (400T^2-9\,000T+60\,000)=400T^3-9\,000T^2+60\,000T.$

37c $R=400T^3-9\,000T^2+60\,000T \Rightarrow \frac{dR}{dT}=1200T^2-18\,000T+60\,000.$
$\frac{dR}{dT}=0 \Rightarrow 1200T^2-18\,000T+60\,000=0$
$T^2-15T+50=0$
$(T-5)(T-10)=0 \Rightarrow T=5 \vee T=10.$
R is maximaal (zie een plot) bij een toltarief van 5 euro.



38a Je krijgt $\frac{A}{B}=C \Rightarrow A=BC.$

38b Je krijgt $\frac{A}{B}=0 \Rightarrow A=0.$

39a $\frac{20}{x-3}=2$
$2(x-3)=20$
$x-3=10$
$x=13.$

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

39c $\frac{5}{x^2}-\frac{20}{x^3}=0$
$\frac{5x-20}{x^3}=0$ (teller = 0)
$5x=20$
$x=4.$

39d $\frac{-0{,}03x^2+18x}{x+7}=0$ (teller = 0)
$-0{,}03x^2+18x=0$
$x(-0{,}03x+18)=0$
$x=0 \vee -0{,}03x=-18$
$x=0 \vee x=600.$ `-18/-0.03  600`

39e $\frac{3(2x-5)-(x+3)(x-5)}{x+7}=0$ (teller = 0)
$6x-15-(x^2-5x+3x-15)=0$
$-x^2+8x=0$
$x(-x+8)=0 \Rightarrow x=0 \vee x=8.$

39f $\frac{x}{x-10}=\frac{5}{x}$
$x^2=5(x-10)$
$x^2-5x+50=0$
$D=(-5)^2-4\cdot 1\cdot 50<0 \Rightarrow$ geen oplossing.

40a $\frac{500}{a}-70=\frac{500}{a}-\frac{70}{1}=\frac{500-70a}{a}.$

40b $\frac{100}{a}+\frac{200}{b}=\frac{100b+200a}{ab}.$

40c $5+\frac{3}{x-2}=\frac{5}{1}+\frac{3}{x-2}=\frac{5(x-2)+3}{x-2}=\frac{5x-10+3}{x-2}=\frac{5x-7}{x-2}.$

40d $\frac{0{,}5}{x+3}-0{,}2x=\frac{0{,}5}{x+3}-\frac{0{,}2x}{1}=\frac{0{,}5-0{,}2x(x+3)}{x+3}=\frac{-0{,}2x^2-0{,}6x+0{,}5}{x+3}.$

40e $80+\frac{50}{3x-10}=\frac{80}{1}+\frac{50}{3x-10}=\frac{80(3x-10)+50}{3x-10}=\frac{240x-750}{3x-10}.$

40f $\frac{380}{x^2}-\frac{40}{x}=\frac{380-40x}{x^2}.$

41a $\frac{3}{x}\cdot\frac{5}{y}=\frac{15}{xy}.$

41b $\frac{3}{2x}\cdot\frac{x^3}{5y}=\frac{3x^3}{10xy}=\frac{3x^2}{10y}.$

41c $\frac{6000}{\left(\frac{2}{x-4}\right)}=\frac{6000}{\left(\frac{2}{x-4}\right)}\cdot\frac{x-4}{x-4}=\frac{6000(x-4)}{2}=3\,000x-12\,000.$

41d $\frac{350}{x}\left(1-\frac{2}{x}\right)=\frac{350}{x}-\frac{700}{x^2}=\frac{350x-700}{x^2}.$

41e $\frac{150}{x}:\frac{x-4}{x}=\frac{150}{x}\cdot\frac{x}{x-4}=\frac{150x}{x(x-4)}=\frac{150}{x-4}.$

41f $8x\left(3+\frac{5}{x^2}\right)=24x+\frac{40x}{x^2}=\frac{24x}{1}+\frac{40}{x}=\frac{24x^2+40}{x}.$

42 $\frac{15}{\left(\frac{5}{3}\right)}=\frac{15}{\left(\frac{5}{3}\right)}\cdot\frac{3}{3}=\frac{45}{5}=9$ of $\frac{15}{\left(\frac{5}{3}\right)}=15\cdot\frac{3}{5}=\frac{45}{5}=9.$

$\frac{\left(\frac{15}{5}\right)}{3}=\frac{3}{3}\cdot\frac{5}{5}=\frac{15}{15}=1$ of $\frac{\left(\frac{15}{5}\right)}{3}=\frac{\left(\frac{15}{5}\right)}{3}\cdot\frac{5}{5}=\frac{15}{15}=1$ of $\frac{\left(\frac{15}{5}\right)}{3}=\frac{15}{5}\cdot\frac{1}{3}=\frac{15}{15}=1.$

43a $\frac{15+\frac{3}{x}}{x}=\frac{15+\frac{3}{x}}{x}\cdot\frac{x}{x}=\frac{15x+3}{x^2}.$

43b $\frac{20a}{b+\frac{a^2}{2b}}=\frac{20a}{b+\frac{a^2}{2b}}\cdot\frac{2b}{2b}=\frac{40ab}{2b^2+a^2}.$

43d $\frac{50}{\left(\frac{10}{x}\right)}=\frac{50}{\left(\frac{10}{x}\right)}\cdot\frac{x}{x}=\frac{50x}{10}=5x.$

43c $\frac{\left(\frac{50}{x}\right)}{10}=\frac{\left(\frac{50}{x}\right)}{10}\cdot\frac{x}{x}=\frac{50}{10x}=\frac{5}{x}.$

43e $x+25\cdot\frac{\left(\frac{100}{x}\right)}{5}=x+5\cdot\frac{100}{x}=x+\frac{500}{x}.$

43f $\frac{3+\frac{2}{x}}{7-\frac{1}{x}}=\frac{3+\frac{2}{x}}{7-\frac{1}{x}}\cdot\frac{x}{x}=\frac{3x+2}{7x-1}.$

44a $A=18\cdot\frac{\left(\frac{500}{x}\right)}{10}+25x=9\cdot\frac{\left(\frac{500}{x}\right)}{5}\cdot\frac{x}{x}+25x=9\cdot\frac{500}{5x}+25x=9\cdot\frac{100}{x}+25x=\frac{900}{x}+25x.$

44b $T=\frac{50a}{\frac{a^2}{5b}+2b}=\frac{50a}{\frac{a^2}{5b}+2b}\cdot\frac{5b}{5b}=\frac{250ab}{a^2+10b^2}.$

44c $L=\left(21+\frac{180}{\frac{a}{b}\cdot 20}\right)\cdot a=\left(21+\frac{9}{\frac{a}{b}}\cdot\frac{b}{b}\right)\cdot a=\left(21+\frac{9b}{a}\right)\cdot a=21a+9b.$

45a $A=\frac{5x^2+4x+3}{x}=\frac{5x^2}{x}+\frac{4x}{x}+\frac{3}{x}=5x+4+\frac{3}{x}.$

45b $T=\frac{3x^2+6x+180}{3x}=\frac{3x^2}{3x}+\frac{6x}{3x}+\frac{180}{3x}=x+2+\frac{60}{x}.$

45c $y=\frac{5a^2+10a}{2a^2}=\frac{5a^2}{2a^2}+\frac{10a}{2a^2}=\frac{5}{2}+\frac{5}{a}.$

45d $K=\frac{q^2+3q+18}{q}=\frac{q^2}{q}+\frac{3q}{q}+\frac{18}{q}=q+3+\frac{18}{q}.$

46a $C=\frac{A}{B+3}\Rightarrow B+3=\frac{A}{C}\Rightarrow B=\frac{A}{C}-3.$

46b $C=5+\frac{A}{B}\Rightarrow C-5=\frac{A}{B}\Rightarrow B=\frac{A}{C-5}.$

47a $K=5+\frac{8}{q}\Rightarrow K-5=\frac{8}{q}\Rightarrow q=\frac{8}{K-5}.$

47b $K=\frac{8}{q-1}\Rightarrow q-1=\frac{8}{K}\Rightarrow q=\frac{8}{K}+1.$

47c $K=\frac{q+3}{2q-1}\Rightarrow K(2q-1)=q+3\Rightarrow$
$2Kq-K=q+3\Rightarrow 2Kq-q=K+3\Rightarrow$
$q(2K-1)=K+3\Rightarrow q=\frac{K+3}{2K-1}.$

47d $P=18-\frac{5}{q-2}\Rightarrow P-18=\frac{-5}{q-2}\Rightarrow q-2=\frac{-5}{P-18}\Rightarrow q=2-\frac{5}{P-18}.$

47e $P=\frac{7}{3q-2}\Rightarrow 3q-2=\frac{7}{P}\Rightarrow 3q=\frac{7}{P}+2\ (\times\frac{1}{3})\Rightarrow q=\frac{7}{3P}+\frac{2}{3}.$

47f $A=\frac{q}{q+4}\Rightarrow A(q+4)=q\Rightarrow$
$Aq+4A=q\Rightarrow Aq-q=-4A\Rightarrow$
$q(A-1)=-4A\Rightarrow q=-\frac{4A}{A-1}.$

48a $T = \frac{a}{a-6} \Rightarrow aT - 6T = a \Rightarrow aT - a = 6T \Rightarrow a(T-1) = 6T \Rightarrow a = \frac{6T}{T-1}$.

48b $L = 320 - \frac{18}{q-1} \Rightarrow L - 320 = \frac{-18}{q-1} \Rightarrow q - 1 = \frac{-18}{L-320} \Rightarrow q = 1 - \frac{18}{L-320}$.

48c $\frac{3x}{x+y} = 5 - x \Rightarrow \frac{3x}{5-x} = x + y \Rightarrow y = \frac{3x}{5-x} - x$.

49a $\frac{1}{T} = 5 + \frac{3}{A} \Rightarrow \frac{1}{T} - \frac{5}{1} = \frac{3}{A} \Rightarrow \frac{1-5T}{T} = \frac{3}{A} \Rightarrow \frac{T}{1-5T} = \frac{A}{3}\ (\times 3) \Rightarrow A = \frac{3T}{1-5T}$.

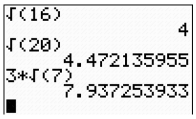
49b $\frac{1}{T} = 5 + \frac{3}{A} \Rightarrow \frac{1}{T} = \frac{5}{1} + \frac{3}{A} \Rightarrow \frac{1}{T} = \frac{5A+3}{A} \Rightarrow \frac{T}{1} = T = \frac{A}{5A+3}$.

50a $y = 15$ en $z = \frac{1}{2}x + 4$ invullen in $K = \frac{xy}{120}\left(4 - \frac{z}{4}\right)$ geeft
$K = \frac{15x}{120}\left(4 - \frac{\frac{1}{2}x + 4}{4}\right) = \frac{1}{8}x\left(4 - (\frac{1}{8}x + 1)\right) = \frac{1}{8}x\left(3 - \frac{1}{8}x\right) = -\frac{1}{64}x^2 + \frac{3}{8}x$. Dus $a = -\frac{1}{64}$ en $b = \frac{3}{8}$.

50b $xy = 120 \Rightarrow y = \frac{120}{x}$ invullen in $K = \frac{50}{x} + 8x + \frac{6}{y} + \frac{1}{15}y$ geeft
$K = \frac{50}{x} + 8x + \frac{6}{\left(\frac{120}{x}\right)} + \frac{1}{15} \cdot \frac{120}{x} = \frac{50}{x} + 8x + 6 \cdot \frac{x}{120} + \frac{8}{x} = \frac{58}{x} + 8\frac{1}{20}x$. Dus $a = 58$ en $b = 8\frac{1}{6}$.

51 $5\sqrt{x} = y \Rightarrow \sqrt{x} = \frac{y}{5} \Rightarrow x = \left(\frac{y}{5}\right)^2 = \frac{y^2}{25}$.
$\sqrt{x-5} = y \Rightarrow x - 5 = y^2 \Rightarrow x = y^2 + 5$.
$5 \cdot \sqrt{x-5} = y \Rightarrow \sqrt{x-5} = \frac{y}{5} \Rightarrow x - 5 = \left(\frac{y}{5}\right)^2 \Rightarrow x = \frac{y^2}{25} + 5$.

52a $y = \sqrt{16x} = \sqrt{16} \cdot \sqrt{x} = 4 \cdot \sqrt{x}$.
52b $y = \sqrt{20x} = \sqrt{20} \cdot \sqrt{x} \approx 4{,}47 \cdot \sqrt{x}$.
52c $y = 3 \cdot \sqrt{7x} = 3 \cdot \sqrt{7} \cdot \sqrt{x} \approx 7{,}94 \cdot \sqrt{x}$.



53a $A = \sqrt{t-3} \Rightarrow t - 3 = A^2 \Rightarrow t = A^2 + 3$.

53b $S = 2 \cdot \sqrt{\frac{1}{2}t + 4} \Rightarrow \sqrt{\frac{1}{2}t + 4} = \frac{1}{2}S \Rightarrow \frac{1}{2}t + 4 = \frac{1}{4}S^2 \Rightarrow \frac{1}{2}t = \frac{1}{4}S^2 - 4 \Rightarrow t = \frac{1}{2}S^2 - 8$.

53c $y = 3 - \frac{2}{\sqrt{t}} \Rightarrow \frac{2}{\sqrt{t}} = 3 - y \Rightarrow \frac{2}{3-y} = \sqrt{t} \Rightarrow t = \left(\frac{2}{3-y}\right)^2 = \frac{4}{(3-y)^2}$.

54a $z = 6 \cdot \sqrt{8 - \frac{1}{2}y} \Rightarrow \sqrt{8 - \frac{1}{2}y} = \frac{1}{6}z \Rightarrow 8 - \frac{1}{2}y = \frac{1}{36}z^2 \Rightarrow -\frac{1}{2}y = \frac{1}{36}z^2 - 8 \Rightarrow y = -\frac{1}{18}z^2 + 16$. Dus $a = -\frac{1}{18}$ en $b = 16$.

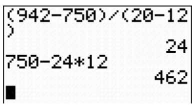
54b $A = 8 - \frac{20}{\sqrt{s}} \Rightarrow \frac{20}{\sqrt{s}} = 8 - A \Rightarrow \frac{20}{8-A} = \sqrt{s} \Rightarrow s = \frac{400}{(8-A)^2}$.

54c $\sqrt{At} = A + 2 \Rightarrow At = (A+2)^2 = (A+2)(A+2) = A^2 + 4A + 4 \Rightarrow t = \frac{A^2 + 4A + 4}{A} = \frac{A^2}{A} + \frac{4A}{A} + \frac{4}{A} = A + 4 + \frac{4}{A}$.

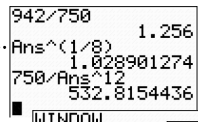
55a $\frac{\Delta N}{\Delta t} = \frac{90-50}{12-8} = \frac{40}{4} = 10$ (dit is de toename van N per tijdseenheid).

55b $g^{12-8} = \frac{90}{50} \Rightarrow g^4 = \frac{9}{5} = 1{,}8 \Rightarrow g = 1{,}8^{\frac{1}{4}} \approx 1{,}16$ (dit is de groeifactor per tijdseenheid).

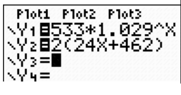
56a $N_1 = at + b$ met $a = \frac{\Delta N}{\Delta t} = \frac{942-750}{20-12} = \frac{192}{8} = 24$.
$\left.\begin{array}{l} N_1 = 24t + b \\ t = 12 \Rightarrow N_1 = 750 \end{array}\right\} \Rightarrow 750 = 24 \cdot 12 + b \Rightarrow b = 750 - 24 \cdot 12 = 462$.
Dus $N_1 = 24t + 462$.

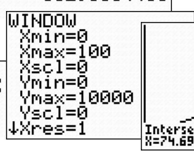


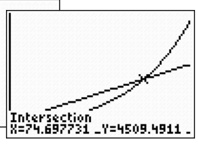
$N_2 = b \cdot g^t$ met $g^{20-12} = g^8 = \frac{942}{750} = 1{,}256 \Rightarrow g = 1{,}256^{\frac{1}{8}} = 1{,}0289...$
$\left.\begin{array}{l} N_2 = b \cdot 1{,}0289...^t \\ t = 12 \Rightarrow N_2 = 750 \end{array}\right\} \Rightarrow 750 = b \cdot 1{,}0289...^{12} \Rightarrow b = \frac{750}{1{,}0289...^{12}} \approx 533$.
Dus $N_2 \approx 533 \cdot 1{,}029^t$.



56b $N_2 = 2N_1$
$533 \cdot 1{,}029^t = 2(24t + 462)$ (intersect) $\Rightarrow t \approx 74{,}7$.







57a $N_1 = at + b$ met $a = \frac{\Delta N}{\Delta t} = \frac{1820 - 2180}{10 - 6} = \frac{-360}{4} = -90.$

$\left.\begin{array}{l} N_1 = -90t + b \\ t = 10 \Rightarrow N_1 = 1820 \end{array}\right\} \Rightarrow 1820 = -90 \cdot 10 + b \Rightarrow b = 1820 + 900 = 2720.$ Dus $N_1 = -90t + 2720.$

$N_2 = b \cdot g^t$ met $g^{10-6} = g^4 = \frac{1820}{2180} \Rightarrow g = \left(\frac{1820}{2180}\right)^{\frac{1}{4}} = 0{,}9558...$

```
(1820/2180)^(1/4
)
        .9558807675
1820/Ans^10
        2857.815267
```

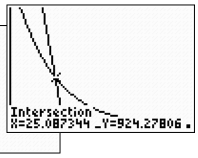
$\left.\begin{array}{l} N_2 = b \cdot 0{,}9558...^t \\ t = 10 \Rightarrow N_2 = 1820 \end{array}\right\} \Rightarrow 1820 = b \cdot 0{,}9558...^{10} \Rightarrow b = \frac{1820}{0{,}9558...^{10}} \approx 2858.$

Dus $N_2 \approx 2858 \cdot 0{,}956^t.$

57b $N_2 = 2N_1 \Rightarrow 2858 \cdot 0{,}956^t = 2(-90t + 2720)$ (intersect) $\Rightarrow t \approx 25{,}1.$

```
Plot1 Plot2 Plot3
\Y1=2858*0.956^X
\Y2=2(-90X+2720)
\Y3=
\Y4=
\Y5=
```

```
WINDOW
 Xmin=0
 Xmax=100
 Xscl=0
 Ymin=0
 Ymax=2200
 Yscl=0
 Xres=1
```



58a $\frac{1}{x^3} = x^{-3}.$

58b $\sqrt[4]{x^3} = x^{\frac{3}{4}}.$

58c $\sqrt{x} = x^{\frac{1}{2}}.$

58d $x^3 \cdot x^5 = x^8.$

58e $x^6 : x^2 = x^4.$

58f $x^3 \cdot \sqrt{x} = x^3 \cdot x^{\frac{1}{2}} = x^{3\frac{1}{2}}.$

59a $y = 5x^4 \cdot \sqrt{x} = 5x^4 \cdot x^{\frac{1}{2}} = 5x^{4\frac{1}{2}}.$

59b $y = \frac{5}{x} \cdot x^{1{,}3} = 5x^{-1} \cdot x^{1{,}3} = 5x^{0{,}3}.$

59c $y = (3x^{-1{,}8})^4 \cdot 2x^{3{,}6} = 81x^{-7{,}2} \cdot 2x^{3{,}6} = 162x^{-3{,}6}.$

```
3^4
                 81
```

60a $N = 25 \cdot 1{,}4^{3t-2} = 25 \cdot 1{,}4^{3t} \cdot 1{,}4^{-2} = 25 \cdot 1{,}4^{-2} \cdot (1{,}4^3)^t \approx 12{,}76 \cdot 2{,}74^t.$

```
25*1.4^-2
        12.75510204
1.4^3
              2.744
```

60b $N = 180 \cdot 0{,}8^{5-t} = 180 \cdot 0{,}8^5 \cdot 0{,}8^{-t} = 180 \cdot 0{,}8^5 \cdot (0{,}8^{-1})^t \approx 58{,}98 \cdot 1{,}25^t.$

```
180*0.8^5
            58.9824
0.8^-1
               1.25
```

60c $N = 92{,}6 \cdot 1{,}7^{-1{,}2t+0{,}5} = 92{,}6 \cdot 1{,}7^{-1{,}2t} \cdot 1{,}7^{0{,}5} = 92{,}6 \cdot 1{,}7^{0{,}5} \cdot (1{,}7^{-1{,}2})^t \approx 120{,}74 \cdot 0{,}53^t.$

```
92.6*1.7^0.5
        120.7356285
1.7^-1.2
        .5290068484
```

61a $y = 18 \cdot (2x^2)^{0{,}3} \cdot (5z)^{0{,}6} = 18 \cdot 2^{0{,}3} \cdot x^{0{,}6} \cdot 5^{0{,}6} \cdot z^{0{,}6} \approx 58{,}21x^{0{,}6}z^{0{,}6}.$

```
18*2^0.3*5^0.6
        58.20543059
```

61b $N = 18 - 5(6 - 1{,}5^{4t}) = 18 - 30 + 5 \cdot 1{,}5^{4t} = -12 + 5 \cdot (1{,}5^4)^t \approx -12 + 5 \cdot 5{,}06^t.$

```
1.5^4
             5.0625
```

61c $T = 27 \cdot 0{,}4^t(3 - 0{,}4^{2t}) = 81 \cdot 0{,}4^t - 27 \cdot 0{,}4^{3t} = 81 \cdot 0{,}4^t - 27 \cdot (0{,}4^3)^t = 81 \cdot 0{,}4^t - 27 \cdot 0{,}064^t.$

```
0.4^3
               .064
```

62a $L = 0{,}006 \cdot (5t)^{0{,}35} \cdot (5 \cdot \frac{1}{3}t^3)^{0{,}18} = 0{,}006 \cdot 5^{0{,}35} \cdot t^{0{,}35} \cdot 5^{0{,}18} \cdot \left(\frac{1}{3}\right)^{0{,}18} \cdot t^{0{,}54} \approx 0{,}01 \cdot t^{0{,}89}.$

```
0.006*5^0.35*5^0
.18*(1/3)^0.18
        .0115537649
```

62b $y = 0{,}12 \cdot \left(3 \cdot \frac{1}{2}z^{-0{,}4}\right)^{1{,}6} \cdot \left(\frac{1}{5}z\right)^{2{,}3} = 0{,}12 \cdot \left(\frac{3}{2}\right)^{1{,}6} z^{-0{,}64} \cdot \left(\frac{1}{5}\right)^{2{,}3} z^{2{,}3} \approx 0{,}01 \cdot z^{1{,}66}.$

```
0.12*(3/2)^1.6*(
1/5)^2.3
        .0056662568
-0.64+2.3
               1.66
```

62c $y = \frac{500}{\left(4 \cdot \sqrt{20 + a^2}\right)^4} = \frac{500}{\left(4 \cdot (20 + a^2)^{\frac{1}{2}}\right)^4} = \frac{500}{4^4 \cdot (20 + a^2)^2} = \frac{1{,}95}{(20 + a^2)^2} \approx 1{,}95\left(20 + a^2\right)^{-2}.$

```
500/4^4
           1.953125
```

63a $x^5 = 18 \Rightarrow x = \sqrt[5]{18}.$

```
5*√18
        1.782602458
18^(1/5)
        1.782602458
```

63b $\sqrt[3]{x} = 4 \Rightarrow x = 4^3 = 64.$

```
4^3
                 64
```

64a
$5x^{-1{,}2} = 20$
$x^{-1{,}2} = 4$
$x = 4^{\frac{1}{-1{,}2}} \approx 0{,}31.$

```
4^(1/-1.2)
        .3149802625
```

64b
$3 + 0{,}18x^{1{,}7} = 25$
$0{,}18x^{1{,}7} = 22$
$x^{1{,}7} = \frac{22}{0{,}18}$
$x = \left(\frac{22}{0{,}18}\right)^{\frac{1}{1{,}7}} \approx 16{,}89.$

```
(22/0.18)^(1/1.7
)
        16.89411311
```

64c
$5 \cdot \sqrt[4]{x} - 7 = 43$
$5 \cdot \sqrt[4]{x} = 50$
$\sqrt[4]{x} = 10$
$x = 10^4 = 10\,000.$

64d
$3x^6 = 57$
$x^6 = 19$
$x = 19^{\frac{1}{6}} \approx 1{,}63.$

```
57/3
                 19
Ans^(1/6)
        1.633524303
```

65a $y = 3x^{2{,}6} \Rightarrow x^{2{,}6} = \frac{1}{3}y \Rightarrow x = \left(\frac{1}{3}y\right)^{\frac{1}{2{,}6}} = \left(\frac{1}{3}\right)^{\frac{1}{2{,}6}} \cdot y^{\frac{1}{2{,}6}} \approx 0{,}66 \cdot y^{0{,}38}.$

```
(1/3)^(1/2.6)
        .6553779493
1/2.6
        .3846153846
```

65b $y = 0{,}18 \cdot (3x)^{-1{,}4} \Rightarrow (3x)^{-1{,}4} = \frac{1}{0{,}18}y \Rightarrow 3x = \left(\frac{1}{0{,}18}y\right)^{\frac{1}{-1{,}4}} \Rightarrow x = \frac{1}{3} \cdot \left(\frac{1}{0{,}18}\right)^{\frac{1}{-1{,}4}} \cdot y^{\frac{1}{-1{,}4}} \approx 0{,}10 \cdot y^{-0{,}71}.$

```
1/3*(1/0.18)^(1/
-1.4)
        .0979333329
1/-1.4
       -.7142857143
```

65c $y = 7 \cdot \sqrt[5]{3x} \Rightarrow \sqrt[5]{3x} = \frac{1}{7}y \Rightarrow 3x = \left(\frac{1}{7}y\right)^5 \Rightarrow x = \frac{1}{3} \cdot \left(\frac{1}{7}\right)^5 \cdot y^5 \approx 0{,}00 \cdot y^5.$

```
1/3*(1/7)^5
     1.983300609E-5
```

65d $y = 1{,}9 \cdot (2x)^{3{,}6} \cdot (3x)^{-1{,}7} = 1{,}9 \cdot 2^{3{,}6} x^{3{,}6} \cdot 3^{-1{,}7} x^{-1{,}7} \Rightarrow x^{1{,}9} = \frac{1}{1{,}9 \cdot 2^{3{,}6} \cdot 3^{-1{,}7}} y \Rightarrow x = \left(\frac{1}{1{,}9 \cdot 2^{3{,}6} \cdot 3^{-1{,}7}}\right)^{\frac{1}{1{,}9}} \cdot y^{\frac{1}{1{,}9}} \approx 0{,}51 \cdot y^{0{,}53}.$

```
(1/(1.9*2^3.6*3^
-1.7))^(1/1.9)
        .5126405073
1/1.9
        .5263157895
```

66a $P = 2{,}5q^{3,6} \Rightarrow q^{3,6} = \frac{1}{2{,}5}P \Rightarrow q = \left(\frac{1}{2{,}5}P\right)^{\frac{1}{3,6}} = \left(\frac{1}{2{,}5}\right)^{\frac{1}{3,6}} \cdot P^{\frac{1}{3,6}} \approx 0{,}78 \cdot P^{0,28}$.

```
(1/2.5)^(1/3.6)
       .7752845131
1/3.6
       .2777777778
```

66b $L = \frac{1}{6} \cdot \sqrt[3]{A} - 7 \Rightarrow \frac{1}{6} \cdot \sqrt[3]{A} = L + 7 \Rightarrow \sqrt[3]{A} = 6L + 42 \Rightarrow A = (6L + 42)^3$.

66c $O = 8a^2 \Rightarrow a^2 = \frac{1}{8}O \Rightarrow a = \left(\frac{1}{8}O\right)^{\frac{1}{2}}$ in $K = 4a^3$ geeft $K = 4 \cdot \left(\left(\frac{1}{8}O\right)^{\frac{1}{2}}\right)^3 = 4 \cdot \left(\frac{1}{8}\right)^{1,5} \cdot O^{1,5} \approx 0{,}18 \cdot O^{1,5}$.

```
4*(1/8)^1.5
        .1767766953
```

$K = 4 \cdot \left(\frac{1}{8}\right)^{1,5} \cdot O^{1,5} \Rightarrow O^{1,5} = \frac{1}{4} \cdot \left(\frac{1}{8}\right)^{\frac{1}{1,5}} \cdot K \Rightarrow O = \left(\frac{1}{4} \cdot \left(\frac{1}{8}\right)^{\frac{1}{1,5}} \cdot K\right)^{\frac{1}{1,5}} = \left(\frac{1}{4} \cdot \left(\frac{1}{8}\right)^{\frac{1}{1,5}}\right)^{\frac{1}{1,5}} \cdot K^{\frac{1}{1,5}} \approx 0{,}16K^{0,67}$.

```
(1/4*(1/8)^(1/1.
5))^(1/1.5)
        .1574901312
1/1.5
        .6666666667
```

67a $^3\log(81) = {}^3\log(3^4) = 4$.

67b $^5\log(5) = {}^5\log(5^1) = 1$.

67c $^2\log(\frac{1}{2}) = {}^2\log(2^{-1}) = -1$.

67d $^{10}\log(1000) = {}^{10}\log(10^3) = 3$.

67e $^6\log(1) = {}^6\log(6^0) = 0$.

67f $^3\log(3^{1,9}) = 1{,}9$.

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

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

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

$^g\log(a^b) = b \cdot {}^g\log(a)$

68a $\log(N) = 1{,}17 + 0{,}3t \Rightarrow N = 10^{1,17+0,3t} = 10^{1,17} \cdot 10^{0,3t} = 10^{1,17} \cdot \left(10^{0,3}\right)^t \approx 15 \cdot 2{,}00^t$.

```
10^1.17
        14.79108388
10^0.3
        1.995262315
```

68b $\log(a) = 2{,}16 + 1{,}3 \cdot \log(b) \Rightarrow a = 10^{2,16+1,3\cdot\log(b)} = 10^{2,16} \cdot 10^{1,3\cdot\log(b)} = 10^{2,16} \cdot 10^{\log(b^{1,3})} \approx 145 \cdot b^{1,3}$.

```
10^2.16
        144.5439771
```

68c $^2\log(p) = 1{,}18 - 0{,}8 \cdot {}^2\log(q) \Rightarrow p = 2^{1,18-0,8\cdot{}^2\log(q)} = 2^{1,18} \cdot 2^{-0,8\cdot{}^2\log(q)} = 2^{1,18} \cdot 2^{{}^2\log(q^{-0,8})} \approx 2{,}27 \cdot q^{-0,8}$.

```
2^1.18
        2.265767771
```

68d $N = \log(3L + 6) \Rightarrow \log(3L + 6) = N \Rightarrow 3L + 6 = 10^N \Rightarrow 3L = 10^N - 6 \Rightarrow L = \frac{1}{3} \cdot 10^N - 2$.

69a
$0{,}5k = \log(2T + 5) - 1{,}8$
$\log(2T + 5) = 0{,}5k + 1{,}8$
$2T + 5 = 10^{0,5k+1,8}$
$2T = 10^{0,5k} \cdot 10^{1,8} - 5$
$T = \frac{1}{2} \cdot 10^{1,8} \cdot (10^{0,5})^k - \frac{5}{2}$
$T \approx -2{,}5 + 31{,}55 \cdot 3{,}16^k$.

```
1/2*10^1.8
        31.54786722
10^0.5
        3.16227766
```

69b
$3 \cdot \log(M) = 1{,}6 + \log(4S - 1)$
$\log(4S - 1) = 3 \cdot \log(M) - 1{,}6$
$4S - 1 = 10^{3\cdot\log(M)-1,6}$
$4S = 10^{\log(M^3)} \cdot 10^{-1,6} + 1$
$S = \frac{1}{4} \cdot 10^{-1,6} \cdot M^3 + \frac{1}{4}$
$S \approx 0{,}25 + 0{,}01M^3$.

```
1/4*10^-1.6
        .0062797161
```

70a $g = 185$ (cm) $\Rightarrow S = 290 \cdot \log(185 + 100) - 550 \approx 162$ (cm).

```
290*log(185+100)
-550
        161.9050094
```

70b
$S = 210$ (cm)
$210 = 290 \cdot \log(g + 100) - 550$
$290 \cdot \log(g + 100) = 760$
$\log(g + 100) = \frac{760}{290}$
$g + 100 = 10^{\frac{760}{290}}$
$g = 10^{\frac{760}{290}} - 100 \approx 318$ (cm).

```
10^(760/290)-100
        317.5318937
```

70c
$S = 290 \cdot \log(g + 100) - 550$
$290 \cdot \log(g + 100) = S + 550$
$\log(g + 100) = \frac{1}{290}S + \frac{550}{290}$
$g + 100 = 10^{\frac{1}{290}S + \frac{550}{290}} = 10^{\frac{1}{290}S} \cdot 10^{\frac{550}{290}}$
$g = 10^{\frac{550}{290}} \cdot (10^{\frac{1}{290}})^S - 100 \approx 78{,}8 \cdot 1{,}008^S - 100$.

```
10^(550/290)
        78.80462816
10^(1/290)
        1.007971554
```

71a $D = 50$ (cm) $\Rightarrow \log(N) = 5{,}3 - 1{,}7 \cdot \log(50) \Rightarrow N = 10^{5,3-1,7\cdot\log(50)} \approx 258$ (bomen/ha).

```
5.3-1.7*log(50)
        2.411750993
10^Ans
        258.0780049
```

71b
$N = \frac{2000}{8} = 250$ (bomen/ha)
$\log(250) = 5{,}3 - 1{,}7 \cdot \log(D)$ (intersect/of)
$1{,}7 \cdot \log(D) = 5{,}3 - \log(250)$
$\log(D) = \frac{5{,}3 - \log(250)}{1{,}7} = 1{,}707\ldots$
$D = 10^{1,707\ldots} \approx 51$ (cm).

```
5.3-log(250)
        2.902059991
Ans/1.7
        1.707094113
10^Ans
        50.94412561
```

71c
$\log(N) = 5{,}3 - 1{,}7 \cdot \log(D)$
$1{,}7 \cdot \log(D) = 5{,}3 - \log(N)$
$\log(D) = \frac{5{,}3}{1{,}7} - \frac{1}{1{,}7} \cdot \log(N)$
$D = 10^{\frac{5,3}{1,7} - \frac{1}{1,7}\cdot\log(N)} = 10^{\frac{5,3}{1,7}} \cdot 10^{-\frac{1}{1,7}\cdot\log(N)}$
$= 10^{\frac{5,3}{1,7}} \cdot 10^{\log(N^{-\frac{1}{1,7}})} \approx 1310 \cdot N^{-\frac{1}{1,7}} \approx 1310 \cdot N^{-0,59}$.

```
10^(5.3/1.7)
        1311.133937
-1/1.7
        -.5882352941
```

72a $p = 350\,000 \Rightarrow v = 0{,}86 \cdot \log(350\,000) + 0{,}04 \approx 4{,}81$ (feet/sec).
Dit is een snelheid van (ongeveer) 5,4 km/uur.

```
0.86*log(350000)
+0.04
        4.807898518
Ans*0.314/1000*6
0*60
        5.434848485
```

72b $v = \frac{6 \cdot 1000}{3600 \cdot 0{,}314} \approx 5{,}31$ (feet) $\Rightarrow \frac{6 \cdot 1000}{3600 \cdot 0{,}314} = 0{,}86 \cdot \log(p) + 0{,}04$ (intersect of)
$\log(p) = (\frac{6 \cdot 1000}{3600 \cdot 0{,}314} - 0{,}04) : 0{,}86 \Rightarrow p = 10^{Ans} \approx 1\,335\,000$. Dit is ongeveer 11,2% meer.

```
6000/(3600*0.314
)
        5.307855626
(Ans-0.04)/0.86
        6.125413519
10^(Ans)
        1334791.766
Ans/1200000
        1.112326472
Ans*100-100
        11.23264718
```

72c $v = 0{,}86 \cdot \log(p) + 0{,}04 \Rightarrow 0{,}86 \cdot \log(p) = v - 0{,}04 \Rightarrow \log(p) = \frac{1}{0{,}86}v - \frac{0{,}04}{0{,}86} \Rightarrow$
$p = 10^{\frac{1}{0{,}86}v - \frac{0{,}04}{0{,}86}} = 10^{\frac{1}{0{,}86}v} \cdot 10^{-\frac{0{,}04}{0{,}86}} = 10^{-\frac{0{,}04}{0{,}86}} \cdot (10^{\frac{1}{0{,}86}})^v \approx 0{,}9 \cdot 14{,}5^v.$

```
10^(-0.04/0.86)
          .8984385372
10^(1/0.86)
           14.54757811
```

REKENREGELS:
$^g\log(ab) = {}^g\log(a) + {}^g\log(b)$
$^g\log(\frac{a}{b}) = {}^g\log(a) - {}^g\log(b)$
$^g\log(a^b) = b \cdot {}^g\log(a)$

73a $3^x = 200$ ($^3\log$... nemen) $\Rightarrow x = {}^3\log(200) = \frac{\log(200)}{\log(3)} \approx 4{,}82.$

```
log(200)/log(3)
           4.822736302
```

73b $3^x = 200$ (log... nemen) $\Rightarrow \log(3^x) = \log(200) \Rightarrow x \cdot \log(3) = \log(200) \Rightarrow x = \frac{\log(200)}{\log(3)} \approx 4{,}82.$

74a $1{,}2^x = 13$ (log... nemen) $\Rightarrow \log(1{,}2^x) = \log(13) \Rightarrow x \cdot \log(1{,}2) = \log(13) \Rightarrow x = \frac{\log(13)}{\log(1{,}2)} \approx 14{,}07.$

```
log(13)/log(1.2)
           14.06827258
```

74b $x^{1{,}2} = 13 \Rightarrow x = 13^{\frac{1}{1{,}2}} \approx 8{,}48.$

```
13^(1/1.2)
           8.477857782
```

74c $3 \cdot 1{,}5^x + 1 = 19 \Rightarrow 3 \cdot 1{,}5^x = 18 \Rightarrow 1{,}5^x = 6$ (log... nemen) $\Rightarrow \log(1{,}5^x) = \log(6) \Rightarrow x \cdot \log(1{,}5) = \log(6) \Rightarrow x = \frac{\log(6)}{\log(1{,}5)} \approx 4{,}42.$

```
log(6)/log(1.5)
           4.419022583
```

74d $5 \cdot x^{1{,}74} + 8 = 29 \Rightarrow 5 \cdot x^{1{,}74} = 21 \Rightarrow x^{1{,}74} = 4{,}2 \Rightarrow x = 4{,}2^{\frac{1}{1{,}74}} \approx 2{,}28.$

```
21/5
                   4.2
Ans^(1/1.74)
           2.281335966
```

74e $^3\log(4x) = 1{,}7$ ($3^{\cdots}$ nemen) $\Rightarrow 4x = 3^{1{,}7} \Rightarrow x = \frac{1}{4} \cdot 3^{1{,}7} \approx 1{,}62.$

```
1/4*3^1.7
            1.61825196
```

74f $2 \cdot 1{,}7^{3x-1} = 46 \Rightarrow 1{,}7^{3x-1} = 23$ (log... nemen) $\Rightarrow \log(1{,}7^{3x-1}) = \log(23) \Rightarrow (3x-1) \cdot \log(1{,}7) = \log(23) \Rightarrow$
$3x - 1 = \frac{\log(23)}{\log(1{,}7)} \Rightarrow 3x = \frac{\log(23)}{\log(1{,}7)} + 1 \Rightarrow x = \left(\frac{\log(23)}{\log(1{,}7)} + 1\right) \cdot \frac{1}{3} \approx 2{,}30.$

```
log(23)/log(1.7)
           5.909022389
Ans+1
           6.909022389
Ans/3
           2.303007463
```

75a
$y = 3 \cdot 5^x$
$5^x = \frac{1}{3}y$ (log... nemen)
$\log(5^x) = \log(\frac{y}{3})$
$x \cdot \log(5) = \log(y) - \log(3)$
$x = \frac{\log(y)}{\log(5)} - \frac{\log(3)}{\log(5)}$
$x \approx 1{,}43 \cdot \log(y) - 0{,}68.$

```
1/log(5)
           1.430676558
-log(3)/log(5)
          -.6826061945
```

75b
$y = 7 \cdot 1{,}6^x$
$1{,}6^x = \frac{1}{7}y$ (log... nemen)
$\log(1{,}6^x) = \log(\frac{y}{7})$
$x \cdot \log(1{,}6) = \log(y) - \log(7)$
$x = \frac{\log(y)}{\log(1{,}6)} - \frac{\log(7)}{\log(1{,}6)}$
$x \approx 4{,}90 \cdot \log(y) - 4{,}14.$

```
1/log(1.6)
           4.899079389
-log(7)/log(1.6)
           -4.14020239
```

75c
$y = 1{,}8 \cdot 1{,}3^{2x-5}$
$1{,}3^{2x-5} = \frac{1}{1{,}8}y$ (log... nemen)
$\log(1{,}3^{2x-5}) = \log(\frac{y}{1{,}8})$
$(2x-5) \cdot \log(1{,}3) = \log(y) - \log(1{,}8)$
$2x - 5 = \frac{\log(y)}{\log(1{,}3)} - \frac{\log(1{,}8)}{\log(1{,}3)}$
$2x = \frac{\log(y)}{\log(1{,}3)} + 5 - \frac{\log(1{,}8)}{\log(1{,}3)}$
$x = \frac{\log(y)}{2 \cdot \log(1{,}3)} + \frac{5}{2} - \frac{\log(1{,}8)}{2 \cdot \log(1{,}3)}$
$x \approx 4{,}39 \cdot \log(y) + 1{,}38.$

```
1/(2*log(1.3))
           4.388145424
5/2-1/2*log(1.8)
/log(1.3)
           1.379827125
```

76a
$P = 25 \cdot 3^{2q+4}$ (log... nemen)
$\log(P) = \log(25 \cdot 3^{2q+4})$
$\log(P) = \log(25) + \log(3^{2q+4})$
$\log(P) = \log(25) + (2q+4)\log(3)$
$2q + 4 = \frac{\log(P)}{\log(3)} - \frac{\log(25)}{\log(3)}$
$2q = \frac{\log(P)}{\log(3)} - \frac{\log(25)}{\log(3)} - 4$
$q = \frac{1}{2} \cdot \frac{\log(P)}{\log(3)} - \frac{1}{2} \cdot \frac{\log(25)}{\log(3)} - 2$
$q \approx -3{,}46 + 1{,}05 \cdot \log(P).$

```
-1/2*log(25)/log
(3)-2
          -3.464973521
1/2*1/log(3)
           1.047951637
```

76c
$P = 27 \cdot q^{1{,}8}$
$q^{1{,}8} = \frac{1}{27}P$
$q = \left(\frac{1}{27}P\right)^{\frac{1}{1{,}8}}$
$q = \left(\frac{1}{27}\right)^{\frac{1}{1{,}8}} \cdot P^{\frac{1}{1{,}8}}$
$q \approx 0{,}16P^{0{,}56}.$

```
(1/27)^(1/1.8)
           .1602499523
1/1.8
           .5555555556
```

76b
$P \cdot 1{,}5^{q+2} = 18$ (log... nemen)
$\log(P \cdot 1{,}5^{q+2}) = \log(18)$
$\log(P) + \log(1{,}5^{q+2}) = \log(18)$
$\log(P) + (q+2)\log(1{,}5) = \log(18)$
$q + 2 = \frac{\log(18)}{\log(1{,}5)} - \frac{\log(P)}{\log(1{,}5)}$
$q = \frac{\log(18)}{\log(1{,}5)} - 2 - \frac{\log(P)}{\log(1{,}5)}$
$q \approx 5{,}13 - 5{,}68 \cdot \log(P).$

```
log(18)/log(1.5)
-2
           5.128533874
-1/log(1.5)
          -5.678873587
```

76d
$P = 3{,}5 + 4{,}2\log(q)$
$4{,}2\log(q) = P - 3{,}5$
$\log(q) = \frac{P}{4{,}2} - \frac{3{,}5}{4{,}2}$ ($10^{\cdots}$ nemen)
$q = 10^{\frac{P}{4{,}2} - \frac{3{,}5}{4{,}2}}$
$q = 10^{\frac{1}{4{,}2}P} \cdot 10^{-\frac{3{,}5}{4{,}2}}$
$q = 10^{-\frac{3{,}5}{4{,}2}} \cdot (10^{\frac{1}{4{,}2}})^P$
$q \approx 0{,}15 \cdot 1{,}73^P.$

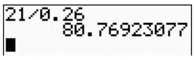
```
10^(-3.5/4.2)
           .1467799268
10^(1/4.2)
           1.730195739
```

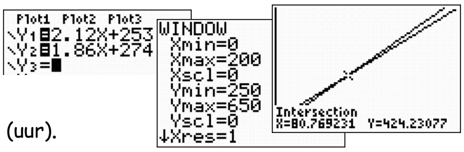
Diagnostische toets

D1 $K = aq + b$ met $a = \frac{\Delta K}{\Delta q} = \frac{1030 - 575}{460 - 200} = \frac{455}{260} = 1{,}75.$

$\left.\begin{array}{l} K = 1{,}75q + b \\ q = 200 \Rightarrow K = 575 \end{array}\right\} \Rightarrow 575 = 1{,}75 \cdot 200 + b \Rightarrow 575 - 1{,}75 \cdot 200 = b = 225.$ Dus $K = 1{,}75q + 225.$

```
455/260
                  1.75
575-1.75*200
                   225
```

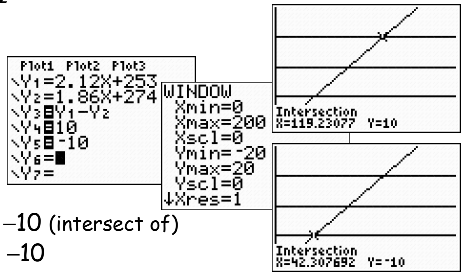
D2a $2{,}12t + 253 = 1{,}86t + 274$
$0{,}26t = 21$


$t \approx 80{,}8.$


$K_I > K_{II}$ (zie een plot) $\Rightarrow t \geq 81$ (uur).

D2b $K_I - K_{II} = 10$ (intersect of)
$2{,}12t + 253 - (1{,}86t + 274) = 10$
$0{,}26t - 21 = 10$
$0{,}26t = 31$
$t \approx 119$

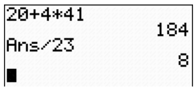
$K_{II} - K_I = 10$ of $K_I - K_{II} = -10$ (intersect of)
$2{,}12t + 253 - (1{,}86t + 274) = -10$
$0{,}26t - 21 = -10$
$0{,}26t = 11$
$t \approx 42.$

$-10 < K_I - K_{II} < 10$ (zie een plot) $\Rightarrow 42 < t < 119$ (uur).


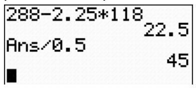
D3a $6x - 5y = 20 \Rightarrow -5y = -6x + 20 \Rightarrow y = 1{,}2x - 4.$

D3b $15x - 4 = 23 - 3y \Rightarrow 3y = -15x + 27 \Rightarrow y = -5x + 9.$

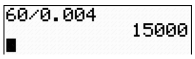
D4a $x - 5y = 1 \Rightarrow x = 5y + 1.$
$x = 5y + 1$ in $2x + y = 13$
$2(5y + 1) + y = 13$
$11y = 11$
$y = 1$ in $x = 5y + 1$
$x = 5 + 1 = 6.$

D4b $5x - y = 41 \Rightarrow -y = -5x + 41 \Rightarrow y = 5x - 41.$
$y = 5x - 41$ in $3x + 4y = 20$
$3x + 4(5x - 41) = 20$
$23x = 184$
$x = 8$ in $y = 5x - 41$
$y = 40 - 41 = -1.$


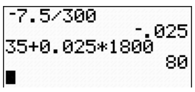
D5a $\left.\begin{array}{l} M + C = 118 \\ 2{,}75M + 2{,}25C = 288 \end{array}\right\}$

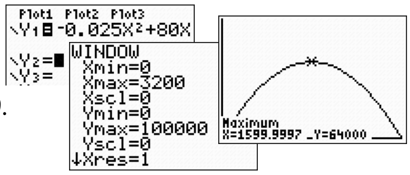
D5b $M + C = 118 \Rightarrow C = 118 - M$ in $2{,}75M + 2{,}25C = 288$
$2{,}75M + 2{,}25(118 - M) = 288$
$0{,}5M = 22{,}5 \Rightarrow M = 45.$


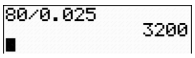
D6 $a + 2b - 3c = 36 \Rightarrow -3c = -a - 2b + 36 \Rightarrow c = \frac{1}{3}a + \frac{2}{3}b - 12.$
$P = 20 - 0{,}3a + 0{,}8b - 1{,}5(\frac{1}{3}a + \frac{2}{3}b - 12) = 20 - 0{,}3a + 0{,}8b - 0{,}5a - b + 18 = 38 - 0{,}8a - 0{,}2b.$

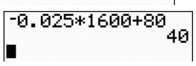
D7a $0{,}004x^2 - 60x = 0$
$x(0{,}004x - 60) = 0$
$x = 0 \vee 0{,}004x - 60 = 0$
$x = 0 \vee 0{,}004x = 60$
$x = 0 \vee x = 15\,000.$


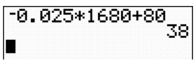
D7b $q(-0{,}25q + 50) = 900$
$-0{,}25q^2 + 50q - 900 = 0$
$q^2 - 200q + 3\,600 = 0$
$(q - 180)(q - 20) = 0$
$q = 180 \vee q = 20.$

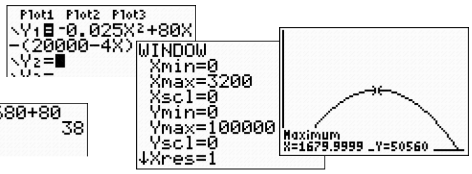
D8a $p = aq + b$ met $a = \frac{\Delta p}{\Delta q} = \frac{35 - 42{,}50}{1800 - 1500} = \frac{-7{,}50}{300} = -0{,}025.$


$\left.\begin{array}{l} p = -0{,}025q + b \\ q = 1800 \Rightarrow p = 35 \end{array}\right\} \Rightarrow 35 = -0{,}025 \cdot 1800 + b$
$35 + 0{,}025 \cdot 1800 = b = 80.$ Dus $p = -0{,}025q + 80.$


D8b $R = p \cdot q = (-0{,}025q + 80) \cdot q = -0{,}025q^2 + 80q.$


De optie maximum (of met de afgeleide) $\Rightarrow q = 1600.$
De prijs is dan $p = -0{,}025 \cdot 1600 + 80 = 40$ (€).


D8c $W = R - K = -0{,}025q^2 + 80q - (20\,000 - 4q).$
De optie maximum geeft Wmax $= 50\,560$ (€) voor $q = 1680.$
De prijs is dan $p = -0{,}025 \cdot 1680 + 80 = 38$ (€).




D9a $(4x - 5)^2 = 36$
$4x - 5 = -6 \vee 4x - 5 = 6$
$4x = -1 \vee 4x = 11$
$x = -\frac{1}{4} \vee x = \frac{11}{4}.$

D9b $(4x - 5)^2 = (2x - 3)^2$
$4x - 5 = -(2x - 3) \vee 4x - 5 = 2x - 3$
$6x = 8 \vee 2x = 2$
$x = \frac{8}{6} = \frac{4}{3} \vee x = 1.$

D9c $6(4x - 5) = (2x - 3)(4x - 5)$
$4x - 5 = 0 \vee 2x - 3 = 6$
$4x = 5 \vee 2x = 9$
$x = \frac{5}{4} \vee x = \frac{9}{2}.$

D9d $(x^2 - 6)\sqrt{x^2 - 16} = x\sqrt{x^2 - 16}$
$\sqrt{x^2 - 16} = 0 \vee x^2 - 6 = x$
$x^2 - 16 = 0 \vee x^2 - x - 6 = 0$
$x^2 = 16 \vee (x - 3)(x + 2) = 0$
$x = -4 \vee x = 4 \vee x = 3 \vee x = -2.$

D9e $(x^2 - 9)(x^2 + 5x + 5) = x^2 - 9$
$x^2 - 9 = 0 \vee x^2 + 5x + 5 = 1$
$x^2 = 9 \vee x^2 + 5x + 4 = 0$
$x = -3 \vee x = 3 \vee (x + 4)(x + 1) = 0$
$x = -3 \vee x = 3 \vee x = -4 \vee x = -1.$

D9f $(x^2 - 10)(x - 10)^2 = x^2 - 10$
$x^2 - 10 = 0 \vee (x - 10)^2 = 1$
$x^2 = 10 \vee x - 10 = -1 \vee x - 10 = 1$
$x = -\sqrt{10} \vee x = \sqrt{10} \vee x = 9 \vee x = 11.$

D10 $P(2,\ -2)$ op de grafiek van $y = ax^2 + bx + 5 \Rightarrow -2 = 4a + 2b + 5$ ofwel $4a + 2b = -7$.
$Q(6, 2)$ op de grafiek van $y = ax^2 + bx + 5 \Rightarrow 2 = 36a + 6b + 5$ ofwel $36a + 6b = -3$.
$36a + 6b = -3 \Rightarrow 12a + 2b = -1 \Rightarrow 2b = -12a - 1$.
$2b = -12a - 1$ in $4a + 2b = -7 \Rightarrow 4a - 12a - 1 = -7 \Rightarrow -8a = -6 \Rightarrow a = \frac{3}{4}$ in $2b = -12a - 1 \Rightarrow 2b = -9 - 1 = -10 \Rightarrow b = -5$.

D11a $\frac{0{,}04x^2 - 5x}{x+7} = 0$ (teller = 0)
$0{,}04x^2 - 5x = 0$
$x(0{,}04x - 5) = 0$
$x = 0 \vee 0{,}04x = 5$
$x = 0 \vee x = 125$.

D11b $\frac{4}{x^2} - \frac{10}{x^3} = 0$
$\frac{4x-10}{x^3} = 0$ (teller = 0)
$4x - 10 = 0$
$4x = 10$
$x = \frac{10}{4} = 2\frac{1}{2}$.

D11c $\frac{90}{x^2-4} = 2$
$45 = x^2 - 4$
$x^2 = 49$
$x = -7 \vee x = 7$.

D11d $\frac{2x}{x-1} = \frac{x}{x+1}$
$2x(x+1) = x(x-1)$
$2x^2 + 2x = x^2 - x$
$x^2 + 3x = 0$
$x(x+3) = 0$
$x = 0 \vee x = -3$.

D12a $\frac{20}{x} - 5 = \frac{20}{x} - \frac{5}{1} = \frac{20-5x}{x}$.

D12b $\frac{20}{x}\left(5 - \frac{4}{x}\right) = \frac{100}{x} - \frac{80}{x^2} = \frac{100x-80}{x^2}$.

D12c $20 + \frac{5}{2x+1} = \frac{20}{1} + \frac{5}{2x+1} = \frac{20(2x+1)+5}{2x+1} = \frac{40x+25}{2x+1}$.

D12d $\frac{20}{x} : \frac{5}{2x-1} = \frac{20}{x} \cdot \frac{2x-1}{5} = \frac{20(2x-1)}{5x} = \frac{4(2x-1)}{x} = \frac{8x-4}{x}$.

D13 $K = \frac{20p}{\frac{p^2}{3q} + 2q} = \frac{20p}{\frac{p^2}{3q} + 2q} \cdot \frac{3q}{3q} = \frac{60pq}{p^2 + 6q^2}$.

D14a $F = 4 + \frac{3}{p-5} \Rightarrow F - 4 = \frac{3}{p-5} \Rightarrow p - 5 = \frac{3}{F-4} \Rightarrow p = \frac{3}{F-4} + 5$.

D14b $G = \frac{3q-1}{4q+5} \Rightarrow G(4q+5) = 3q - 1 \Rightarrow 4Gq + 5G = 3q - 1 \Rightarrow 5G + 1 = 3q - 4Gq \Rightarrow 5G + 1 = q(3 - 4G) \Rightarrow q = \frac{5G+1}{3-4G}$.

D14c $\frac{2a}{a+10} = a + 2b \Rightarrow 2b = \frac{2a}{a+10} - a \Rightarrow b = \frac{a}{a+10} - \frac{1}{2}a$.

D14d $y = \frac{1}{5} \cdot \sqrt{2x-3} \Rightarrow \sqrt{2x-3} = 5y \Rightarrow 2x - 3 = 25y^2 \Rightarrow 2x = 25y^2 + 3 \Rightarrow x = 12\frac{1}{2}y^2 + 1\frac{1}{2}$.

D15a $N_1 = at + b$ met $a = \frac{\Delta N}{\Delta t} = \frac{265-150}{9-4} = \frac{115}{5} = 23$.
$\left.\begin{array}{l} N_1 = 23t + b \\ t = 4 \Rightarrow N_1 = 150 \end{array}\right\} \Rightarrow 150 = 23 \cdot 4 + b \Rightarrow b = 150 - 92 = 58$. Dus $N_1 = 23t + 58$.

D15b $N_2 = b \cdot g^t$ met $g^{9-4} = g^5 = \frac{265}{150} \Rightarrow g = \left(\frac{265}{150}\right)^{\frac{1}{5}} = 1{,}1205...$
$\left.\begin{array}{l} N_2 = b \cdot 1{,}1205...^t \\ t = 4 \Rightarrow N_2 = 150 \end{array}\right\} \Rightarrow 150 = b \cdot 1{,}1205...^4 \Rightarrow b = \frac{150}{1{,}1205...^4} \approx 95$. Dus $N_2 \approx 95 \cdot 1{,}121^t$.

```
265/150
        1.766666667
Ans^(1/5)
        1.120549182
150/Ans^4
         95.1409683
```

D16a $y = 180 \cdot (2x^{-1{,}3})^3 \cdot (\frac{1}{6}x^{2{,}4})^2 = 180 \cdot 2^3 \cdot x^{-3{,}9} \cdot (\frac{1}{6})^2 \cdot x^{4{,}8} = 40x^{0{,}9}$.

```
180*2^3*(1/6)²
                 40
```

D16b $N = 50 - 4(5 - 1{,}6^{2t}) = 50 - 20 + 4 \cdot 1{,}6^{2t} = 30 + 4 \cdot (1{,}6^2)^t = 30 + 4 \cdot 2{,}56^t$.

```
1.6²
               2.56
```

D17 $N = 200 \cdot 1{,}85^{3t-4} = 200 \cdot 1{,}85^{3t} \cdot 1{,}85^{-4} = 200 \cdot 1{,}85^{-4} \cdot (1{,}85^3)^t \approx 17 \cdot 6{,}33^t$.

```
200*1.85^-4
        17.07430685
1.85^3
           6.331625
```

```
(1/(20*5^1.5))^(
1/1.5)
       .0271441762
1/1.5
       .6666666667
```

D18a $F = 20 \cdot (5p)^{1{,}5} = 20 \cdot 5^{1{,}5} \cdot p^{1{,}5} \Rightarrow p^{1{,}5} = \frac{1}{20 \cdot 5^{1{,}5}} \cdot F \Rightarrow p = \left(\frac{1}{20 \cdot 5^{1{,}5}} \cdot F\right)^{\frac{1}{1{,}5}} = \left(\frac{1}{20 \cdot 5^{1{,}5}}\right)^{\frac{1}{1{,}5}} \cdot F^{\frac{1}{1{,}5}} \approx 0{,}027 \cdot F^{0{,}667}$.

D18b $y = 2{,}5 \cdot \sqrt[5]{x} - 5 \Rightarrow 2{,}5 \cdot \sqrt[5]{x} = y + 5 \Rightarrow \sqrt[5]{x} = \frac{1}{2{,}5}y + 2 \Rightarrow x = (0{,}4y + 2)^5$.

```
1/2.5
                 .4
```

D19a $\log(N) = 0{,}76t + 3{,}6$ ($10^{\cdots}$ nemen)
$N = 10^{0{,}76t+3{,}6}$
$N = 10^{0{,}76t} \cdot 10^{3{,}6}$
$N = 10^{3{,}6} \cdot (10^{0{,}76})^t$
$N \approx 3981 \cdot 5{,}75^t$.

```
10^3.6
        3981.071706
10^0.76
        5.754399373
```

D19b $\log(R) = 3{,}2 + 1{,}6 \cdot \log(S)$
$\log(R) - \log(S^{1{,}6}) = 3{,}2$
$\log(\frac{R}{S^{1{,}6}}) = 3{,}2$ ($10^{\cdots}$ nemen)
$\frac{R}{S^{1{,}6}} = 10^{3{,}2} \approx 1585$
$R \approx 1585 \cdot S^{1{,}6}$.

```
10^3.2
        1584.893192
```

D19c $N = 12{,}5 \cdot 1{,}75^t$ (log... nemen)
$\log(N) = \log(12{,}5 \cdot 1{,}75^t)$
$\log(N) = \log(12{,}5) + \log(1{,}75^t)$
$\log(N) = \log(12{,}5) + t \cdot \log(1{,}75)$
$t \cdot \log(1{,}75) = \log(N) - \log(12{,}5)$
$t = -\frac{\log(12{,}5)}{\log(1{,}75)} + \frac{\log(N)}{\log(1{,}75)}$
$t \approx -4{,}5 + 4{,}1 \cdot \log(N)$.

```
-log(12.5)/log(1
.75)
       -4.513326283
1/log(1.75)
         4.11458208
```

Gemengde opgaven 14. Algebraïsche vaardigheden

G11a $K_A = \begin{cases} 150 + 3{,}75a & \text{voor } a \le 80 \\ 150 + 3{,}75 \cdot 80 + 0{,}9(a - 80) & \text{voor } a > 80 \end{cases}$ en $K_B = \begin{cases} 225 + 1{,}9a & \text{voor } a \le 200 \\ 225 + 1{,}9 \cdot 200 + 0{,}75(a - 200) & \text{voor } a > 200. \end{cases}$

of $K_A = \begin{cases} 3{,}75a + 150 & \text{voor } a \le 80 \\ 0{,}9a + 378 & \text{voor } a > 80 \end{cases}$

```
150+3.75*80-0.9*
80
             378
```

en $K_B = \begin{cases} 1{,}9a + 225 & \text{voor } a \le 200 \\ 0{,}75a + 455 & \text{voor } a > 200. \end{cases}$

```
225+1.9*200-0.75
*200
             455
```

G11 Er moeten drie snijpunten worden berekend.
Voor $a \le 80$ — $3{,}75a + 150 = 1{,}9a + 225$ (intersect of) $\Rightarrow 1{,}85a = 75 \Rightarrow a \approx 40{,}5$.
Voor $80 < x \le 200$ — $0{,}9a + 378 = 1{,}9a + 225$ (intersect of) $\Rightarrow -a = -153 \Rightarrow a = 153$.
Voor $x > 200$ — $0{,}9a + 378 = 0{,}75a + 455$ (intersect of) $\Rightarrow 0{,}15a = 77 \Rightarrow a \approx 513{,}3$.

```
75/1.85
     40.54054054
77/0.15
     513.3333333
```

Agterberg is goedkoper dan van Bulten voor $a < 41$ (Agterberg begint goedkoper) en voor $153 < x < 153$.

G11c $GK_A = \frac{K_A}{a} = \begin{cases} 3{,}75 + \frac{150}{a} & \text{voor } a \le 80 \\ 0{,}9 + \frac{378}{a} & \text{voor } a > 80 \end{cases}$ en $GK_B = \frac{K_B}{a} = \begin{cases} 1{,}9 + \frac{225}{a} & \text{voor } a \le 200 \\ 0{,}75 + \frac{455}{a} & \text{voor } a > 200. \end{cases}$

G11d $a = 80 \Rightarrow GK_A = 3{,}75 + \frac{150}{80} = 5{,}625 > 4{,}50$. Dus $0{,}9 + \frac{378}{a} = 4{,}5 \Rightarrow \frac{378}{a} = 3{,}6 \Rightarrow 3{,}6a = 378 \Rightarrow a = 105$.
Dus vanaf 105 km zijn de gemiddelde transportkosten bij Agterberg minder dan 4,50 €/km.

```
378/3.6
             105
```

G12a $p = aq + b$ met $a = \frac{\Delta p}{\Delta q} = \frac{11{,}90 - 15{,}40}{750 - 500} = \frac{-3{,}50}{250} = -0{,}014$.
$p = -0{,}014q + b$
$q = 500 \Rightarrow p = 15{,}40$ $\Rightarrow 15{,}4 = -0{,}014 \cdot 500 + b$
$15{,}4 + 7 = b = 22{,}4$.
Dus $p = -0{,}014q + 22{,}4$ en $R = pq = -0{,}014q^2 + 22{,}4q$.

G12b $R = -0{,}014q^2 + 22{,}4q = 8\,400$
$q^2 - 1000q + 600\,000 = 0$
$(q - 60)(q - 1000) = 0$
$q = 600 \vee q = 1000$.
$q = 600 \Rightarrow p = 14$ (€).
$q = 1000 \Rightarrow p = 8{,}40$ (€).

```
22.4/-0.014
           -1600
-8400/-0.014
          600000
-0.014*600+22.4
              14
-0.014*1000+22.4
             8.4
```

G12c $R = -0{,}014q^2 + 22{,}4q$ (de grafiek is een bergparabool)
$\frac{dR}{dq} = -0{,}028q + 22{,}4 = 0$ geeft
$-0{,}028q = -22{,}4 \Rightarrow q = 800$.
$R_{max} = R(800) = 8\,960$ (€) en
$p = p(800) = 11{,}20$ (€).

```
-22.4/-0.028→X
             800
-0.014X²+22.4X
            8960
-0.014X+22.4
            11.2
```

G12de $K = 8q + 2\,000$.
$W = R - K = -0{,}014q^2 + 22{,}4q - 8q - 2\,000 = -0{,}014q^2 + 14{,}4q - 2\,000$.
$\frac{dW}{dq} = -0{,}028q + 14{,}4 = 0 \Rightarrow q = \frac{-14{,}4}{-0{,}028} \approx 514$ en
$W_{max} = W(514) = 1703$ (€ bij €2000 vaste kosten).
Als $W_{max} = 2500 \Rightarrow$ vaste kosten 797 (€) lager,
dus de nieuwe vaste kosten zijn 1203 (€).

```
-14.4/-0.028
     514.2857143
-0.014*514²+14.4
*514-2000
        1702.856
```

```
2500-1703
             797
2000-797
            1203
```

G13a Stel v = het aantal pakken van 5 kg en t = het aantal pakken van 2 kg.
Je krijgt de vergelijkingen $5v + 2t = 36\,000$ (in de eerste oplage fout) en $v + t = 8\,580$.
$v + t = 8\,580 \Rightarrow t = 8\,580 - v$ invullen in $5v + 2t = 36\,000$ geeft
$5v + 2(8\,580 - v) = 36\,000 \Rightarrow 3v = 18\,840 \Rightarrow v = 6\,280$ in $v + t = 8\,580 \Rightarrow t = 8\,580 - 6\,280 = 2\,300$.

```
36000-2*8580
           18840
Ans/3
            6280
8580-6280
            2300
```

G13b Je krijgt de vergelijkingen $5v + 2t = 36\,000$ en $t = 2v$.
$t = 2v$ invullen in $5v + 2t = 36\,000$ geeft $5v + 4v = 36\,000 \Rightarrow 9v = 36\,000 \Rightarrow v = 4\,000$ in $t = 2v \Rightarrow t = 8\,000$.

G13c Je krijgt de vergelijkingen $5v + 2t = 36\,000$ en $2v + t = 15\,780$.
$2v + t = 15\,780 \Rightarrow t = 15\,780 - 2v$ invullen in $5v + 2t = 36\,000$ geeft
$5v + 2(15\,780 - 2v) = 36\,000 \Rightarrow v = 4\,440$ in $2v + t = 15\,780 \Rightarrow t = 15\,780 - 8\,880 = 6\,900$.

```
36000-2*15780
            4440
15780-2*4440
            6900
```

G13d Je krijgt de vergelijkingen $5v + 2t = 36\,000$ en $7v + 3t = 51\,040$ (in de eerste oplage fout).
$5v + 2t = 36\,000 \Rightarrow 2t = 36\,000 - 5v \Rightarrow t = 18\,000 - 2\frac{1}{2}v$ invullen in $7v + 3t = 51\,040$ geeft
$7v + 3(18\,000 - 2\frac{1}{2}v) = 51\,040 \Rightarrow -\frac{1}{2}v = -2\,960 \Rightarrow v = 5\,920$ in $5v + 2t = 36\,000 \Rightarrow t = \frac{36000 - 5 \cdot 5920}{2} = 3\,200$.

```
51040-3*18000
           -2960
Ans*-2
            5920
(36000-5*Ans)/2
            3200
```

G14a $(4x - 1)^2 = \frac{1}{4}$
$4x - 1 = -\frac{1}{2} \vee 4x - 1 = \frac{1}{2}$
$4x = \frac{1}{2} \vee 4x = 1\frac{1}{2}$
$x = \frac{1}{8} \vee x = \frac{3}{8}$.

G14b $(4x - 1)^2 \cdot (4x^2 - 1) = 0$
$4x - 1 = 0 \vee 4x^2 = 1$
$4x = 1 \vee x^2 = \frac{1}{4}$
$x = \frac{1}{4} \vee x = -\frac{1}{2} \vee x = \frac{1}{2}$.

G14c $(4x - 1)^2 = (x - 4)^2$
$4x - 1 = x - 4 \vee 4x - 1 = -(x - 4)$
$3x = -3 \vee 5x = 5$
$x = -1 \vee x = 1$.

G14d $\frac{4x - 1}{x - 4} = \frac{3x - 4}{x}$
$x(4x - 1) = (3x - 4)(x - 4)$
$4x^2 - x = 3x^2 - 12x - 4x + 16$
$x^2 + 15x - 16 = 0$
$(x + 16)(x - 1) = 0$
$x = -16 \vee x = 1$.

G14e $6 \cdot \sqrt{4x - 1} = (x - 4) \cdot \sqrt{4x - 1}$
$\sqrt{4x - 1} = 0 \vee x - 4 = 6$
$4x - 1 = 0 \vee x = 10$
$4x = 1 \vee x = 10$
$x = \frac{1}{4} \vee x = 10$.

G14f $\frac{4x - 1}{x - 4} = 0$ (teller = 0)
$4x - 1 = 0$
$4x = 1$
$x = \frac{1}{4}$.

G14g $4x^{-1{,}5} + 45 = 301$
$4x^{-1{,}5} = 256$
$x^{-1{,}5} = 64$

```
64^(1/-1.5)
           .0625
```

$x = 64^{\frac{1}{-1{,}5}} = 0{,}0625$.

G14h $4 \cdot \sqrt[3]{x} + 5 = 33$
$4 \cdot \sqrt[3]{x} = 28$
$\sqrt[3]{x} = 7$
$x = 7^3 = 343$.

```
7^3
             343
```

G15a $(0,5)$ op de grafiek van $y = ax^2 + b \Rightarrow b = 5$.
$(500,105)$ op de grafiek $\Rightarrow 105 = a \cdot 500^2 + 5$ (want $b = 5$) $\Rightarrow a \cdot 250\,000 = 100 \Rightarrow a = \frac{100}{250000} = \frac{1}{2500} = 0{,}0004$.

100/250000 → 4E-4

G15b $x = 500 - 200 = 300 \Rightarrow y = 0{,}0004 \cdot 300^2 + 5 = 36 + 5 = 41$. Dus de hoogte is 41 meter.

0.0004*300²+5 → 41

G15c $0{,}0004 \cdot x^2 + 5 = 50 \Rightarrow 0{,}0004 \cdot x^2 = 45 \Rightarrow x^2 = 112\,500 \Rightarrow x = \pm\sqrt{112\,500}$.
De lengte is $2 \cdot \sqrt{112\,500} \approx 671$ meter.

45/0.0004 → 112500; √(Ans) → 335.4101966; Ans*2 → 670.8203932

G15d $(0,5)$ op de grafiek van $y = \frac{450x^2}{a - x^2} + b \Rightarrow \frac{0}{a} + b = 5 \Rightarrow b = 5$.
$(500,105)$ geeft $105 = \frac{450 \cdot 500^2}{a - 500^2} + 5 \Rightarrow 100 = \frac{450 \cdot 500^2}{a - 500^2} \Rightarrow 100a - 100 \cdot 500^2 = 450 \cdot 500^2 \Rightarrow a = 5{,}5 \cdot 500^2 = 1375\,000$.

550*500² → 137500000; Ans/100 → 1375000

G15e $x = 300 \Rightarrow y = \frac{450 \cdot 300^2}{1375000 - 300^2} + 5 \approx 36{,}5$. Dus de hoogte is (ongeveer) 36,5 meter.

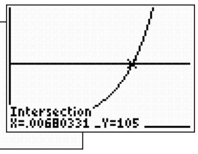
450*300²/(1375000-300²)+5 → 36.51750973

$\frac{450x^2}{1375000 - x^2} + 5 = 50 \Rightarrow \frac{450x^2}{1375000 - x^2} = 45 \Rightarrow 450x^2 = 45 \cdot 1375\,000 - 45x^2 \Rightarrow x^2 = \frac{45 \cdot 1375000}{495} \Rightarrow x = \pm\sqrt{\frac{45 \cdot 1375000}{495}}$.
De lengte is $2 \cdot \sqrt{\frac{45 \cdot 1375000}{495}} \approx 707$ meter.

2*√(45*1375000/495) → 707.1067812

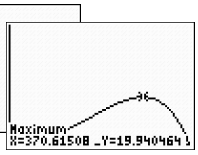
G15f $(0,5)$ op de grafiek van $y = a(3^{bx} + 3^{-bx}) \Rightarrow a(3^0 + 3^0) = 5 \Rightarrow 2a = 5 \Rightarrow a = 2\frac{1}{2}$.
$(500,105)$ geeft $2{,}5(3^{500b} + 3^{-500b}) = 105$ (intersect) $\Rightarrow b \approx 0{,}0068$.

Y1=2.5(3^(500X)+3^(-500X)); Y2=105
WINDOW Xmin=0, Xmax=.01, Xscl=0, Ymin=0, Ymax=200, Yscl=0, Xres=1



G15g $V = 0{,}0004 \cdot x^2 + 5 - 2{,}5(3^{0{,}0068x} + 3^{-0{,}0068x})$
(optie maximum geeft) $x \approx 370{,}62$ en $V_{max} \approx 19{,}94$.
De best formule geeft hier (ongeveer) 40.
De maximale afwijking is $\frac{V_{max}}{40} \times 100\% \approx 49{,}8\%$.

Y1=2.5(3^(0.0068X)+3^(-0.0068X)); Y2=0.0004X²+5-Y1
WINDOW Xmin=0, Xmax=500, Xscl=0, Ymin=0, Ymax=50, Yscl=0, Xres=1



X → 370.6150791; Y1(X) → 40.00175109; Y2(X)/Y1(X)*100 → 49.84897686

G16a $D = 100 + \frac{200}{\frac{a}{2b} + 10} = 100 \cdot \frac{a + 20b}{a + 20b} + \frac{200}{\frac{a}{2b} + 10} \cdot \frac{2b}{2b} = \frac{100a + 2000b}{a + 20b} + \frac{400b}{a + 20b} = \frac{100a + 2400b}{a + 20b}$.

G16b $A = \frac{6x^2 + 15}{3x^2} + \frac{\frac{x^3 + 4x}{2}}{x^3} = \frac{3(2x^2 + 5)}{3x^2} + \frac{\frac{x^3 + 4x}{2}}{x^3} \cdot \frac{2}{2} = \frac{2x^2 + 5}{x^2} + \frac{x^3 + 4x}{2x^3} = \frac{2x^2}{x^2} + \frac{5}{x^2} + \frac{x^3}{2x^3} + \frac{4x}{2x^3} = 2 + \frac{5}{x^2} + \frac{1}{2} + \frac{2}{x^2} = 2\frac{1}{2} + \frac{7}{x^2}$.

G16c $E = (10x^{1{,}2})^2 \cdot (5y^{-1{,}8})^3 \cdot (\frac{1}{25}x^{-1{,}1} \cdot y^{3{,}4})^2 = 10^2 \cdot x^{2{,}4} \cdot 5^3 \cdot y^{-5{,}4} \cdot (\frac{1}{25})^2 \cdot x^{-2{,}2} \cdot y^{6{,}8} = 20 \cdot x^{0{,}2} \cdot y^{1{,}4}$.

10²*5^3*(1/25)² → 20

G16d $N = 2\,025 \cdot 1{,}5^{3t-4} + 300 \cdot 1{,}5^t \cdot (1 - 2{,}25^t) = 2\,025 \cdot (1{,}5^3)^t \cdot 1{,}5^{-4} + 300 \cdot 1{,}5^t - 300 \cdot 1{,}5^t \cdot 2{,}25^t$
$= 400 \cdot 3{,}375^t + 300 \cdot (1{,}5)^t - 300 \cdot 3{,}375^t = 100 \cdot 3{,}375^t + 300 \cdot 1{,}5^t$.

2025*1.5^-4 → 400; 1.5^3 → 3.375; 1.5*2.25 → 3.375

G17a $A = 20 - \frac{5}{2p + 3} \Rightarrow \frac{5}{2p + 3} = \frac{20 - A}{1} \Rightarrow \frac{2p + 3}{5} = \frac{1}{20 - A} \Rightarrow \frac{2p + 3}{1} = \frac{5}{20 - A} \Rightarrow$
$2p = \frac{5}{20 - A} - 3 = \frac{5}{-A + 20} - 3 \cdot \frac{-A + 20}{-A + 20} = \frac{3A - 55}{-A + 20} \Rightarrow p = \frac{1}{2} \cdot \frac{3A - 55}{-A + 20} = \frac{3A - 55}{-2A + 40}$.

G17b $B = \frac{20k - 16}{5k - 3} \Rightarrow B(5k - 3) = 20k - 16 \Rightarrow 5Bk - 3B - 20k = -16 \Rightarrow k(5B - 20) = 3B - 16 \Rightarrow k = \frac{3B - 16}{5B - 20}$.

G17c $6Z = \frac{2}{5} \cdot \sqrt{2y + 80} + 4 \Rightarrow \frac{2}{5} \cdot \sqrt{2y + 80} = 6Z - 4 \Rightarrow \sqrt{2y + 80} = 15Z - 10 \Rightarrow 2y + 80 = (15Z - 10)^2 \Rightarrow$
$2y + 80 = (15Z - 10)(15Z - 10) = 225Z^2 - 150Z - 150Z + 100 = 225Z^2 - 300Z + 100 \Rightarrow$
$2y = 225Z^2 - 300Z + 20 \Rightarrow y = 112{,}5Z^2 - 150Z + 10$.

6/(2/5) → 15; -4/(2/5) → -10; 15² → 225

G17d $5 \cdot \log(N) = 2t + 13 \Rightarrow \log(N) = 0{,}4t + 2{,}6 \Rightarrow N = 10^{0{,}4t + 2{,}6} = 10^{0{,}4t} \cdot 10^{2{,}6} = 10^{2{,}6} \cdot (10^{0{,}4})^t \approx 398 \cdot 2{,}51^t$.

10^2.6 → 398.1071706; 10^0.4 → 2.511886432

G17e $4 \cdot \log(S) = 1{,}8 - 2{,}4 \cdot \log(T) \Rightarrow \log(S) = 0{,}45 - 0{,}6 \cdot \log(T) \Rightarrow$
$S = 10^{0{,}45 - 0{,}6 \cdot \log(T)} = 10^{0{,}45} \cdot 10^{-0{,}6 \cdot \log(T)} = 10^{0{,}45} \cdot 10^{\log(T^{-0{,}6})} \approx 2{,}8 \cdot T^{-0{,}6}$.

1.8/4 → .45; 10^0.45 → 2.818382931

G17f $N = 0{,}15 \cdot 6{,}25^t \Rightarrow 6{,}25^t = \frac{1}{0{,}15}N$ (log... nemen) $\Rightarrow \log(6{,}25^t) = \log(\frac{N}{0{,}15}) \Rightarrow$
$t \cdot \log(6{,}25) = \log(N) - \log(0{,}15) \Rightarrow t = \frac{\log(N)}{\log(6{,}25)} - \frac{\log(0{,}15)}{\log(6{,}25)} \approx 1{,}0 + 1{,}3\log(N)$.

-log(0.15)/log(6.25) → 1.035217273; 1/log(6.25) → 1.256470797

G18a Aflezen en meten in figuur G.2 geeft onderstaande tabel.
Je ziet dat de toename van N_{max} niet steeds hetzelfde is.

L	70	65	60
N_{max}	270000	590000	1270000

12/44*1000000 → 272727.2727; 26/44*1000000 → 590909.0909; 56/44*1000000 → 1272727.273
1270000-590000 → 680000; 590000-270000 → 320000
1/20 → .05; 61/20 → 3.05

G18b $B = 20 \cdot \log(N) + \frac{4}{3} \cdot 72 - 157 = 20 \cdot \log(N) - 61 \Rightarrow 20 \cdot \log(N) = B + 61 \Rightarrow \log(N) = 0{,}05B + 3{,}05 \Rightarrow$
$N = 10^{0{,}05B + 3{,}05} = 10^{0{,}05B} \cdot 10^{3{,}05} = 10^{3{,}05} \cdot (10^{0{,}05})^B \approx 1122 \cdot 1{,}122^B$.

10^3.05 → 1122.018454; 10^0.25 → 1.77827941

G18c $45 = 10 \cdot \log(N_{max}) + L - 79 = 10 \cdot \log(N_{max}) = 45 - L + 79 \Rightarrow 10 \cdot \log(N_{max}) = 124 - L \Rightarrow$
$\log(N_{max}) = 12{,}4 - 0{,}1L \Rightarrow N_{max} = 10^{12{,}4-0{,}1L} = 10^{12{,}4} \cdot 10^{-0{,}1L} = 10^{12{,}4} \cdot (10^{-0{,}1})^L \approx 2{,}512 \cdot 10^{12} \cdot 0{,}794^L$.

```
10^12.4
   2.511886432E12
10^-0.1
     .7943282347
```

G18d Maak met de formule boven G18c de tabel hieronder.

L	62	63	64	65	66	67	68	69	70	71
N_{max} ($\times 1000$)	1545	1227	974	773	614	488	387	307	244	194

```
Plot1 Plot2 Plot3
\Y1■2.512*10^12*
0.794^X/1000
\Y2=■
TABLE SETUP
 TblStart=62
 ΔTbl=1
Indpnt: Auto
Depend: Auto
```

```
X    Y1
62   1544.9
63   1226.6
64   973.94
65   773.31
66   614.01
67   487.52
68   387.09
69   307.35
70   244.04
71   193.76
X=71
```

Het wordt aan de lezer overgelaten de schets in het werkboek af te maken.
(rechts van $L = 69$ (dus voor $L < 69$) komt de grafiek van formule(2) boven de grafiek van formule(1))
Bij afname van L geeft formule(2) een hogere waarde van N_{max} dan formule(1) $\Rightarrow$ vaker lawaai.

G19a $W = \frac{90}{1000} = 0{,}09$ (kg); $S = \frac{200}{10000} = 0{,}02$ (m^2) en $d = 1{,}25$ (kg/m^3) geeft
$0{,}09 = 0{,}03 \cdot 1{,}25 \cdot V^2 \cdot 0{,}02 \Rightarrow V^2 = \frac{0{,}09}{0{,}03 \cdot 1{,}25 \cdot 0{,}02} = 120 \Rightarrow V \approx 11$ (m/s).

```
0.09/(0.03*1.25*
0.02)
              120
√(Ans)
      10.95445115
```

G19b $S = 511$ (m^2); $V = \frac{900 \cdot 1000}{3600} = 250$ (m/s) en $d = 0{,}3125$ (kg/m^3) geeft $vb = \frac{W}{S} = \frac{0{,}03 \cdot 0{,}3125 \cdot 250^2 \cdot 511}{511} \approx 586$ (kg/m^2).

```
0.03*0.3125*250²
         585.9375
```

G19c $vb = \frac{W}{S} = \frac{0{,}0375 \cdot V^2 \cdot S}{S} = 0{,}0375 \cdot V^2$ (kg/m^2). Dus de vleugelbelasting is $1{,}5^2 = 2{,}25$ keer zo groot.

```
1.5²
             2.25
```

G19d $\frac{W}{S} = 5{,}5 \cdot W^{\frac{1}{3}} \Rightarrow \frac{W}{5{,}5 \cdot W^{\frac{1}{3}}} = S \Rightarrow S = \frac{1}{5{,}5} \cdot W^{\frac{2}{3}}$. Dus $a = \frac{1}{5{,}5} \approx 0{,}18$ en $b = \frac{2}{3} \approx 0{,}67$.

```
1/5.5
      .1818181818
2/3
      .6666666667
```

G20a $T = ah + b$ met $a = \frac{\Delta T}{\Delta h} = \frac{-50-15}{10-0} = \frac{-65}{10} = -6{,}5$ en $b = 15$ (want $h = 0 \Rightarrow T = 15$) $\Rightarrow T = -6{,}5h + 15$.
$T = -6{,}5h + 15$ in $V = 331 \cdot \sqrt{1 + \frac{T}{273}} \Rightarrow V = 331 \cdot \sqrt{1 + \frac{-6{,}5h+15}{273}} = 331 \cdot \sqrt{1 + \frac{-6{,}5}{273}h + \frac{15}{273}} \approx 331 \cdot \sqrt{1{,}0549 - 0{,}0238h}$.

```
1+15/273
      1.054945055
-6.5/273
     -.0238095238
```

G20b $270{,}8 = 0{,}9 \cdot V \Rightarrow V = \frac{270{,}8}{0{,}9} = 331 \cdot \sqrt{1{,}0549 - 0{,}0238h} \Rightarrow \sqrt{1{,}0549 - 0{,}0238h} = \frac{270{,}8}{0{,}9 \cdot 331}$ (kwadrateren) $\Rightarrow$
$1{,}0549 - 0{,}0238h = \left(\frac{270{,}8}{0{,}9 \cdot 331}\right)^2 \Rightarrow -0{,}0238h = \left(\frac{270{,}8}{0{,}9 \cdot 331}\right)^2 - 1{,}0549 \Rightarrow h \approx 9{,}6$ (km).

```
270.8/0.9/331
      .9090298758
Ans²
      .8263353151
Ans-1.0549
     -.2285646849
Ans/-0.0238
```