1a $2x-3=5$
$2x=8$
$x=4$.

1b $2x-3=5x$
$-3x=3$
$x=-1$.

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

1d $x^2=9$
$x=3 \vee x=-3$.

1e $x^2-2x=0$
$x(x-2)=0$
$x=0 \vee x=2$.

1f $x^2-2x=3$
$x^2-2x-3=0$
$(x-3)(x+1)=0$
$x=3 \vee x=-1$.

TOETS VOORKENNIS

a $3-4(x+2)=x$
$3-4x-8=x$
$-5x=5$
$x=-1$.

b $\frac{1}{4}x-5=\frac{1}{3}x+2 \ (\times 12)$
$3x-60=4x+24$
$-x=84$
$x=-84$.

c $2x^2=7x$
$2x^2-7x=0$
$2x(x-3\frac{1}{2})=0$
$x=0 \vee x=3\frac{1}{2}$.

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

e $x^2+5x=14$
$x^2+5x-14=0$
$(x+7)(x-2)=0$
$x=-7 \vee x=2$.

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

2 Voorkennis vergelijkingen (bladzijden 144, 145 en 146)

3a $5x-2=3x+6$
$2x=8$
$x=4$.

3b $4-5(x-1)=3(2x-1)$
$4-5x+5=6x-3$
$-11x=-12$
$x=\frac{12}{11}=1\frac{1}{11}$.

3c $3x-0,8=2,4x+1,6$
$30x-8=24x+16$
$6x=24$
$x=4$.

3d $\frac{1}{3}x-1=\frac{1}{2}x+2$
$2x-6=3x+12$
$-x=18$
$x=-18$.

4a $x^2+5x=x(x+5)$.

4b $x^2+x=x(x+1)$.

4c $3x^2-7x=x(3x-7)$.

4d $5x^2+20x=5x(x+4)$.

4e $x^3-5x^2=x^2(x-5)$.

4f $-3x^2-8x=-x(3x+8)$.

5a $(x+3)(x+5)=x^2+5x+3x+15=x^2+8x+15$.

5b 15 is het product (de vermenigvuldiging) van 3 en 5; 8 is de som (de optelling) van 3 en 5.

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

6b $x^2+4x-5=(x+5)(x-1)$.

6c $x^2-x+30=(x-6)(x+5)$.

6d $x^2+7x+10=(x+5)(x+2)$.

6e $x^2+10x+9=(x+9)(x+1)$.

6f $x^2+18x-19=(x+19)(x-1)$.

6g $x^2-24x-52=(x-26)(x+2)$.

6h $x^2+x-56=(x+8)(x-7)$.

6i $x^2-x-2=(x-2)(x+1)$.

6j $x^2-4x+3=(x-3)(x-1)$.

6k $x^2-4x-12=(x-6)(x+2)$.

6l $x^2+5x-50=(x+10)(x-5)$.

7a $x^2-7x-18=0$
$(x-9)(x+2)=0$
$x=9 \vee x=-2$.

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

7c $x^2=5x$
$x^2-5x=0$
$x(x-5)=0$
$x=0 \vee x=5$.

7d $x^2+x=3x+15$
$x^2-2x-15=0$
$(x-5)(x+3)=0$
$x=5 \vee x=-3$.

7e $4x^2=8x$
$4x^2-8x=0$
$4x(x-2)=0$
$x=0 \vee x=2$.

7f $x^2=x+2$
$x^2-x-2=0$
$(x-2)(x+1)=0$
$x=2 \vee x=-1$.

8a $3x^2-12x=36$
$3x^2-12x-36=0$
$x^2-4x-12=0$
$(x-6)(x+2)=0$
$x=6 \vee x=-2$.

8b $-x^2=13x-48$
$-x^2-13x+48=0$
$x^2+13x-48=0$
$(x+16)(x-3)=0$
$x=-16 \vee x=3$.

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

8d $7x^2+8x=x+84$
$7x^2+7x-84=0$
$x^2+x-12=0$
$(x+4)(x-3)=0$
$x=-4 \vee x=3$.

8e $x(x-2)=48$
$x^2-2x-48=0$
$(x-8)(x+6)=0$
$x=8 \vee x=-6$.

8f $(x-1)(x-2)=12$
$x^2-2x-x+2=12$
$x^2-3x-10=0$
$(x-5)(x+2)=0$
$x=5 \vee x=-2$.

2a $x^2 - 5x = 5$
$x^2 - 5x - 5 = 0$
$D = (-5)^2 - 4 \cdot 1 \cdot -5 = 45$
$x = \frac{5 + \sqrt{45}}{2} \vee x = \frac{5 - \sqrt{45}}{2}$.

2b $x(x-1) = 12$
$x^2 - x = 12$
$x^2 - x - 12 = 0$
$(x-4)(x+3) = 0$
$x = 4 \vee x = -3$.

2c $2x^2 = 5x$
$2x^2 - 5x = 0$
$x(2x-5) = 0$
$x = 0 \vee 2x = 5$
$x = 0 \vee x = 2\frac{1}{2}$.

2d $x^2 = x + 1$
$x^2 - x - 1 = 0$
$D = (-1)^2 - 4 \cdot 1 \cdot -1 = 5$
$x = \frac{1 + \sqrt{5}}{2} \vee x = \frac{1 - \sqrt{5}}{2}$.

2e $x^2 = 11$
$x = \sqrt{11} \vee x = -\sqrt{11}$.

2f $x^2 + 4 = x$
$x^2 - x + 4 = 0$
$D = (-1)^2 - 4 \cdot 1 \cdot 4 = -15 < 0$
geen oplossingen.

3a $3x^2 - 6x = 24$
$3x^2 - 6x - 24 = 0$
$x^2 - 2x - 8 = 0$
$(x-4)(x+2) = 0$
$x = 4 \vee x = -2$.

3b $3x^2 - 6x = -3(x-6)$
$x^2 - 2x = -x + 6$
$x^2 - x - 6 = 0$
$(x-3)(x+2) = 0$
$x = 3 \vee x = -2$.

3c $2x^2 - 3x = 2$
$2x^2 - 3x - 2 = 0$
$D = (-3)^2 - 4 \cdot 2 \cdot -2 = 25 \Rightarrow \sqrt{D} = 5$
$x = \frac{3+5}{4} = \frac{8}{4} = 2 \vee x = \frac{3-5}{4} = \frac{-2}{4} = -\frac{1}{2}$.

3d $x^2 - 2x - 6 = 0$
$D = (-2)^2 - 4 \cdot 1 \cdot -6 = 28$
$x = \frac{2 + \sqrt{28}}{2} \vee x = \frac{2 - \sqrt{28}}{2}$.

3e $x^2 - 3x = 5(x-3)$
$x^2 - 3x = 5x - 15$
$x^2 - 8x + 15 = 0$
$(x-3)(x-5) = 0$
$x = 3 \vee x = 5$.

3f $2x^2 - 5x = x$
$2x^2 - 6x = 0$
$2x(x-3) = 0$
$x = 0 \vee x = 3$.

4a $(2x+1)^2 = 4x + 5$
$(2x+1)(2x+1) = 4x + 5$
$4x^2 + 4x + 1 = 4x + 5$
$4x^2 = 4$
$x^2 = 1$
$x = 1 \vee x = -1$.

4b $(x+3)^2 + (x+2)^2 = 25$
$x^2 + 6x + 9 + x^2 + 4x + 4 = 25$
$2x^2 + 10x - 12 = 0$
$x^2 + 5x - 6 = 0$
$(x+6)(x-1) = 0$
$x = -6 \vee x = 1$.

4c $3(x-2)^2 = 2x + 1$
$3(x^2 - 4x + 4) = 2x + 1$
$3x^2 - 12x + 12 = 2x + 1$
$3x^2 - 14x + 11 = 0$
$D = (-14)^2 - 4 \cdot 3 \cdot 11 = 64 \Rightarrow \sqrt{D} = 8$
$x = \frac{14+8}{6} = \frac{22}{6} = 3\frac{2}{3} \vee x = \frac{14-8}{6} = \frac{6}{6} = 1$.

4d $x^2 - (x+1)^2 = (x+3)^2$
$x^2 - (x^2 + 2x + 1) = x^2 + 6x + 9$
$x^2 - x^2 - 2x - 1 = x^2 + 6x + 9$
$-x^2 - 8x - 10 = 0$
$x^2 + 8x + 10 = 0$
$D = 8^2 - 4 \cdot 1 \cdot 10 = 24$
$x = \frac{-8 + \sqrt{24}}{2} \vee x = \frac{-8 - \sqrt{24}}{2}$.

5a 💻 $x^2 - 5x = 0$
$x(x-5) = 0$
$x = 0 \vee x = 5$.

5b 💻 $x^2 - 5x = 14$
$x^2 - 5x - 14 = 0$
$(x-7)(x+2) = 0$
$x = 7 \vee x = -2$.

5c 💻 $x^2 + 5 = 14$
$x^2 = 9$
$x = 3 \vee x = -3$.

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

5e 💻 $(3x-1)(2x+3) = -3$
$6x^2 + 9x - 2x - 3 = -3$
$6x^2 + 7x = 0$
$x(6x+7) = 0$
$x = 0 \vee 6x = -7$
$x = 0 \vee x = -1\frac{1}{6}$.

5f 💻 $(x+3)^2 = 16x$
$x^2 + 6x + 9 = 16x$
$x^2 - 10x + 9 = 0$
$(x-9)(x-1) = 0$
$x = 9 \vee x = 1$.

5g 💻 $(2x+3)^2 = -16$ ↯
geen oplossingen.

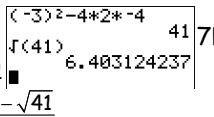
5h 💻 $(x+3)(x-3) = 8x$
$x^2 - 9 = 8x$
$x^2 - 8x - 9 = 0$
$(x-9)(x+1)$
$x = 9 \vee x = -1$.

6 De *abc*-formule kun je alleen gebruiken bij kwadratische vergelijkingen, dus (niet bij 6a, 6c en 6d, maar) alleen bij 6b.

7a $2x^2 - 3x - 4 = 0$

$D = (-3)^2 - 4 \cdot 2 \cdot -4 = 41$

$x_1 = \frac{3+\sqrt{41}}{4} \vee x_2 = \frac{3-\sqrt{41}}{4}$.



7bc $x_1 + x_2 = \frac{3+\sqrt{41}}{4} + \frac{3-\sqrt{41}}{4} = \frac{3+\sqrt{41}+3-\sqrt{41}}{4} = \frac{6}{4} = 1\frac{1}{2}$.

$x_1 \cdot x_2 = \frac{3+\sqrt{41}}{4} \cdot \frac{3-\sqrt{41}}{4} = \frac{(3+\sqrt{41})(3-\sqrt{41})}{16} = \frac{9-3\sqrt{41}+3\sqrt{41}-41}{16} = \frac{-32}{16} = -2$.

7d De oplossingen van $ax^2 + bx + c = 0$ zijn $x = \frac{-b+\sqrt{D}}{2a}$ en $x = \frac{-b-\sqrt{D}}{2a}$.

De som van deze oplossingen is $\frac{-b+\sqrt{D}}{2a} + \frac{-b-\sqrt{D}}{2a} = \frac{-b+\sqrt{D}+-b-\sqrt{D}}{2a} = \frac{-2b}{2a} = -\frac{b}{a}$.

Het product is $\frac{-b+\sqrt{D}}{2a} \cdot \frac{-b-\sqrt{D}}{2a} = \frac{(-b+\sqrt{D})(-b-\sqrt{D})}{4a^2} = \frac{b^2+b\sqrt{D}-b\sqrt{D}-D}{4a^2} = \frac{b^2-(b^2-4ac)}{4a^2} = \frac{b^2-b^2+4ac}{4a^2} = \frac{4ac}{4a^2} = \frac{c}{a}$.

7e De oplossingen van $ax^2 + bx + c = 0$ zijn $x_1 = \frac{-b+\sqrt{D}}{2a}$ en $x_2 = \frac{-b-\sqrt{D}}{2a}$.

$x_1 + x_2 = \frac{-b+\sqrt{D}}{2a} + \frac{-b-\sqrt{D}}{2a} = \frac{-b+\sqrt{D}+-b-\sqrt{D}}{2a} = \frac{-2b}{2a} = -\frac{b}{a}$.

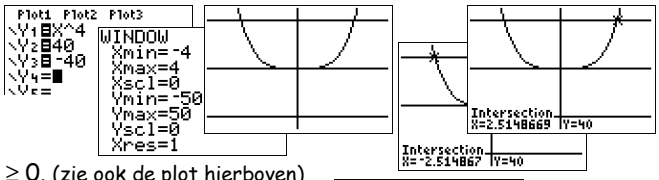
$x_1 \cdot x_2 = \frac{-b+\sqrt{D}}{2a} \cdot \frac{-b-\sqrt{D}}{2a} = \frac{(-b+\sqrt{D})(-b-\sqrt{D})}{4a^2} = \frac{b^2+b\sqrt{D}-b\sqrt{D}-D}{4a^2} = \frac{b^2-(b^2-4ac)}{4a^2} = \frac{b^2-b^2+4ac}{4a^2} = \frac{4ac}{4a^2} = \frac{c}{a}$.

7f Van de vergelijking $3x^2 + 4x - 5 = 0$ is $x_1 + x_2 = -\frac{b}{a} = -\frac{4}{3}$ en $x_1 \cdot x_2 = \frac{c}{a} = \frac{-5}{3}$.

8a Zie de plot hiernaast.

8b $x^4 = 40$ heeft twee oplossingen. (zie de plot hiernaast)

$x^4 = 40$ optie intersect $\Rightarrow x \approx -2{,}51 \vee x \approx 2{,}51$.

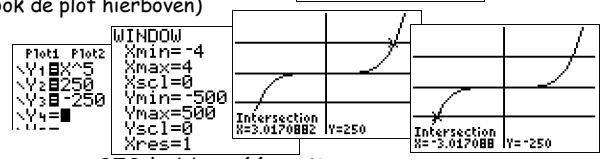


8c $x^4 = -40$ ↯ heeft geen oplossingen, want altijd: $x^4 \geq 0$. (zie ook de plot hierboven)

9a Zie de plot hiernaast.

9b $x^5 = 250$ heeft één oplossing, want in de plot is één snijpunt.

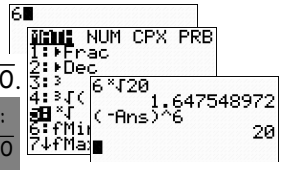
9c $x^5 = -250$ heeft één oplossing, want de grafieken van $y = x^5$ en $y = -250$ hebben één snijpunt. (zie de plot hierboven)



10a 💻 $x^6 = 20$

$x = \pm\sqrt[6]{20}$.

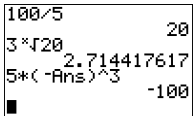
$x = \pm\sqrt[6]{20}$ betekent: $x = \sqrt[6]{20} \vee x = -\sqrt[6]{20}$



10b 💻 $5x^3 = 100$

$x^3 = 20$

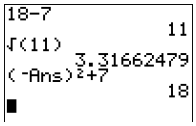
$x = \sqrt[3]{20}$.



10c 💻 $x^2 + 7 = 18$

$x^2 = 11$

$x = \pm\sqrt{11}$.

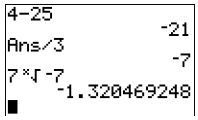


10d 💻 $3x^7 + 25 = 4$

$3x^7 = -21$

$x^7 = -7$

$x = \sqrt[7]{-7}$.

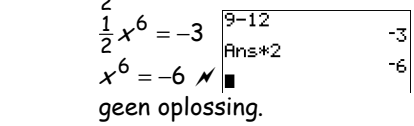


10e 💻 $\frac{1}{2}x^6 + 12 = 9$

$\frac{1}{2}x^6 = -3$

$x^6 = -6$ ↯

geen oplossing.

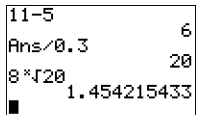


10f 💻 $0{,}3x^8 + 5 = 11$

$0{,}3x^8 = 6$

$x^8 = 20$

$x = \pm\sqrt[8]{20}$.

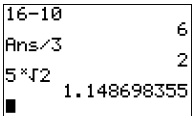


11a $3x^5 + 10 = 16$ (intersect of)

$3x^5 = 6$

$x^5 = 2$

$x = \sqrt[5]{2} \approx 1{,}15$.

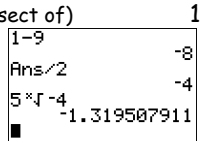


11b $2x^5 + 9 = 1$ (intersect of)

$2x^5 = -8$

$x^5 = -4$

$x = \sqrt[5]{-4} \approx -1{,}32$.

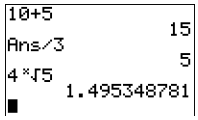


11c $3x^4 - 5 = 10$ (intersect of)

$3x^4 = 15$

$x^4 = 5$

$x = \pm\sqrt[4]{5} \approx \pm 1{,}50$.

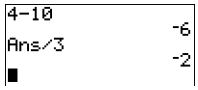


11d $3x^4 + 10 = 4$ (intersect of)

$3x^4 = -6$

$x^4 = -2$ ↯

geen oplossing.

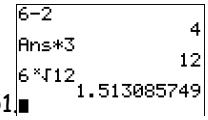


11e $\frac{1}{3}x^6 + 2 = 6$ (intersect of)

$\frac{1}{3}x^6 = 4$

$x^6 = 12$

$x = \pm\sqrt[6]{12} \approx \pm 1{,}51$.

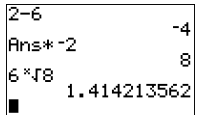


11f $-\frac{1}{2}x^6 + 6 = 2$ (intersect of)

$-\frac{1}{2}x^6 = -4$

$x^6 = 8$

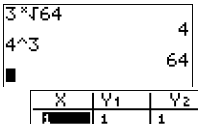
$x = \pm\sqrt[6]{8} \approx \pm 1{,}41$.

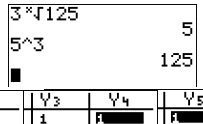


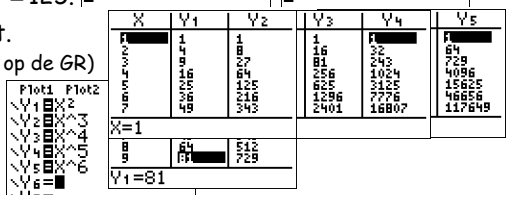
12a $4^3 = 64 \Rightarrow \sqrt[3]{64} = 4$.

12b $x = \sqrt[3]{125} = 5$, want $5^3 = 125$.

12c Zie de tabel hiernaast.
(maak gebruik van TABLE op de GR)

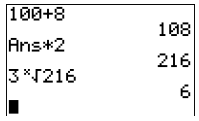




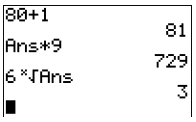


x	1	2	3	4	5	6	7	8	9
x^2	1	4	9	16	25	36	49	64	81
x^3	1	8	27	64	125	216	343		
x^4	1	16	81	256	625				
x^5	1	32	243	1024					
x^6	1	64	729						

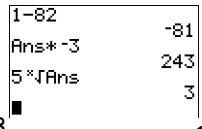
13a 💻 $0{,}5x^3 - 8 = 100$
$0{,}5x^3 = 108$
$x^3 = 216$
$x = \sqrt[3]{216} = 6.$



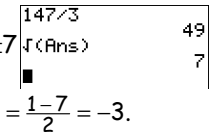
13b 💻 $\frac{1}{9}x^6 - 1 = 80$
$\frac{1}{9}x^6 = 81$
$x^6 = 729$
$x = \pm\sqrt[6]{729} = \pm 3.$



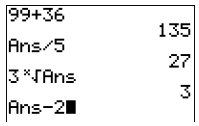
13c 💻 $82 - \frac{1}{3}x^5 = 1$
$-\frac{1}{3}x^5 = -81$
$x^5 = 243$
$x = \sqrt[5]{243} = 3.$



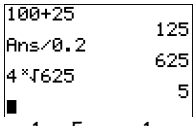
13d 💻 $3(2x-1)^2 = 147$
$(2x-1)^2 = 49$
$2x - 1 = \pm\sqrt{49} = \pm 7$
$2x = 1 \pm 7$
$x = \frac{1+7}{2} = 4 \ \vee \ x = \frac{1-7}{2} = -3.$



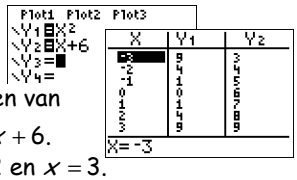
13e 💻 $5(x+2)^3 - 36 = 99$
$5(x+2)^3 = 135$
$(x+2)^3 = 27$
$x + 2 = \sqrt[3]{27} = 3$
$x = 1.$

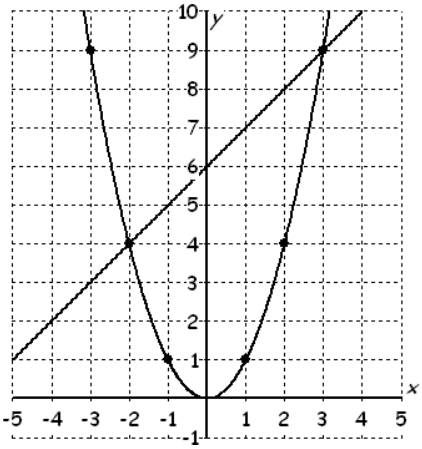


13f 💻 $0{,}2(4x+1)^4 - 25 = 100$
$0{,}2(4x+1)^4 = 125$
$(4x+1)^4 = 625$
$4x + 1 = \pm\sqrt[4]{625} = \pm 5$
$4x = -1 \pm 5$
$x = -\frac{1}{4} + \frac{5}{4} = 1 \ \vee \ x = -\frac{1}{4} - \frac{5}{4} = -1\frac{1}{2}.$



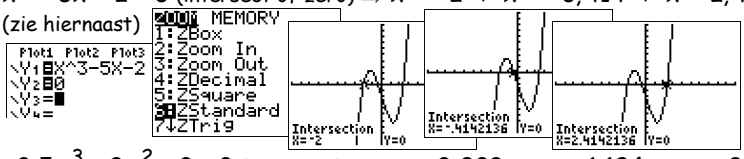
14a Zie de grafieken in een figuur hiernaast.
(geef duidelijk punten aan die komen uit TABLE)



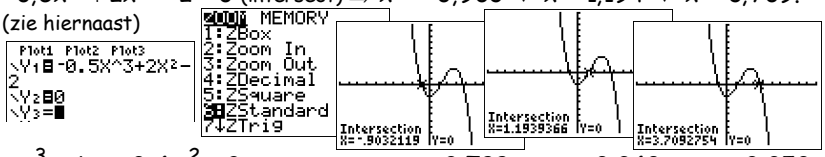


14b De oplossingen van $x^2 = x + 6$ zijn de x-coördinaten van de snijpunten van de grafieken van $y = x^2$ en $y = x + 6$.
In de grafiek lees je af: de oplossingen zijn $x = -2$ en $x = 3$.

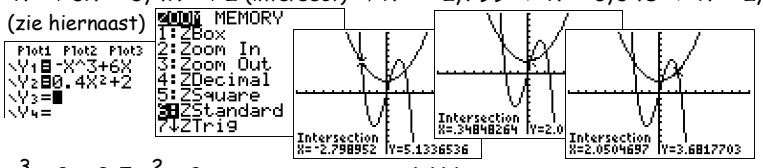
15a $x^3 - 5x - 2 = 0$ (intersect of zero) $\Rightarrow x = -2 \ \vee \ x \approx -0{,}414 \ \vee \ x \approx 2{,}414.$
(zie hiernaast)



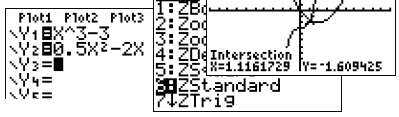
15b $-0{,}5x^3 + 2x^2 - 2 = 0$ (intersect) $\Rightarrow x \approx -0{,}903 \ \vee \ x \approx 1{,}194 \ \vee \ x \approx 3{,}709.$
(zie hiernaast)



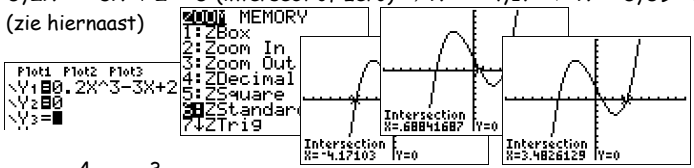
15c $-x^3 + 6x = 0{,}4x^2 + 2$ (intersect) $\Rightarrow x \approx -2{,}799 \ \vee \ x \approx 0{,}348 \ \vee \ x \approx 2{,}050.$
(zie hiernaast)



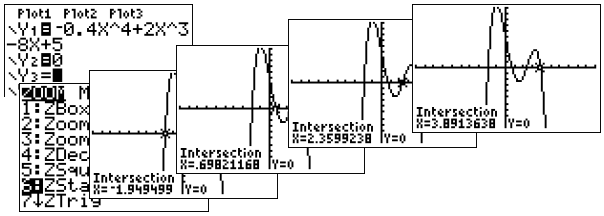
15d $x^3 - 3 = 0{,}5x^2 - 2x$ (intersect) $\Rightarrow x \approx 1{,}116.$ (zie hiernaast)



16a $0{,}2x^3 - 3x + 2 = 0$ (intersect of zero) $\Rightarrow x \approx -4{,}17 \ \vee \ x \approx 0{,}69 \ \vee \ x \approx 3{,}48.$
(zie hiernaast)



16b $-0{,}4x^4 + 2x^3 - 8x + 5 = 0$ (intersect of zero) $\Rightarrow$
$x \approx -1{,}95 \ \vee \ x \approx 0{,}70 \ \vee \ x \approx 2{,}36 \ \vee \ x \approx 3{,}89.$ (zie hiernaast)

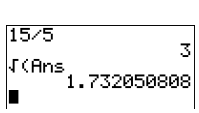


17a Zie de uitwerking bij 15a. (met intersect hoeft de cursor minder verplaatst te worden)

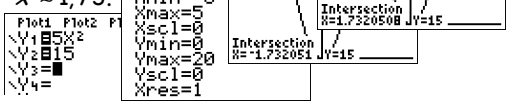
17b $x^3 - 3 = 0{,}5x^2 - 2x$ met de optie intersect ofwel $x^3 - 3 - 0{,}5x^2 + 2x = 0$ met de optie zero of intersect.

17c Ja , elke vergelijking is op nul te herleiden.

18a $5x^2 = 15$
$x^2 = 3$
$x = \pm\sqrt{3}$
dus $x = \sqrt{3} \ \vee \ x = -\sqrt{3}$.

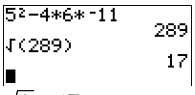


18b $5x^2 = 15.$
Intersect $\Rightarrow x \approx -1{,}73 \ \vee \ x \approx 1{,}73.$
(zie hiernaast)



19a $(2x+3)(3x-2)=0$
$2x=-3 \ \vee \ 3x=2$
$x=-1\frac{1}{2} \ \vee \ x=\frac{2}{3}$.

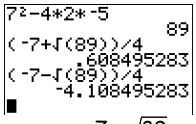
19b $(2x+3)(3x-2)=5$
$6x^2-4x+9x-6=5$
$6x^2+5x-11=0$
$D=5^2-4\cdot 6\cdot -11=289 \Rightarrow \sqrt{D}=17$
$x=\frac{-5+17}{12}=\frac{12}{12}=1 \ \vee \ x=\frac{-5-17}{12}=\frac{-22}{12}=-1\frac{5}{6}$.



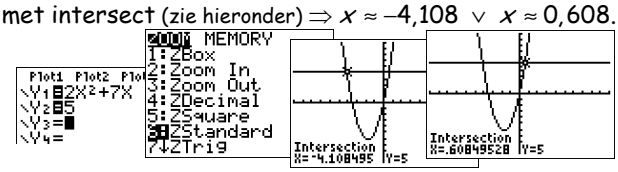
19c $2x^2+7x=1$
$2x^2+7x-1=0$
$D=7^2-4\cdot 2\cdot -1=57$
$x=\frac{-7+\sqrt{57}}{4} \ \vee \ x=\frac{-7-\sqrt{57}}{4}$.

19d $2x^2+7x=-5$
$2x^2+7x+5=0$
$D=7^2-4\cdot 2\cdot 5=9 \Rightarrow \sqrt{D}=3$
$x=\frac{-7+3}{4}=\frac{-4}{4}=-1 \ \vee \ x=\frac{-7-3}{4}=\frac{-10}{4}=-2\frac{1}{2}$.

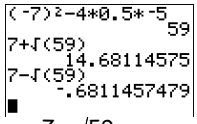
20a $2x^2+7x=5$
$2x^2+7x-5=0$
$D=7^2-4\cdot 2\cdot -5=89$
$x=\frac{-7+\sqrt{89}}{4}\approx 0{,}608 \ \vee \ x=\frac{-7-\sqrt{89}}{4}\approx -4{,}108$.



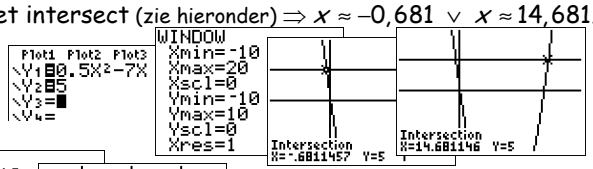
of met intersect (zie hieronder) $\Rightarrow x\approx -4{,}108 \ \vee \ x\approx 0{,}608$.



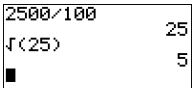
20b $0{,}5x^2-7x=5$
$0{,}5x^2-7x-5=0$
$D=(-7)^2-4\cdot 0{,}5\cdot -5=59$
$x=\frac{7+\sqrt{59}}{1}\approx 14{,}681 \ \vee \ x=\frac{7-\sqrt{59}}{1}\approx -0{,}681$.

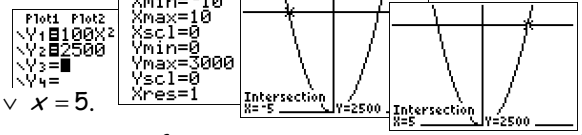


of met intersect (zie hieronder) $\Rightarrow x\approx -0{,}681 \ \vee \ x\approx 14{,}681$.



20c $100x^2=2500$
$x^2=25$
$x=5 \ \vee \ x=-5$.

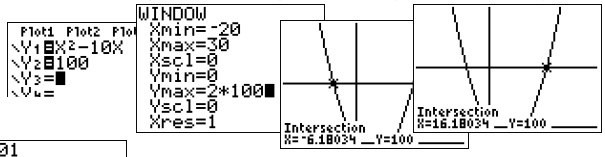




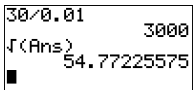
of met intersect (zie hiernaast) $\Rightarrow x=-5 \ \vee \ x=5$.

20d $x^2-10x=100$
$x^2-10x-100=0$
$D=(-10)^2-4\cdot 1\cdot -100=500$
$x=\frac{10+\sqrt{500}}{2}\approx 16{,}180 \ \vee \ x=\frac{10-\sqrt{500}}{2}\approx -6{,}180$.

of met intersect (zie hieronder) $\Rightarrow x\approx -4{,}108 \ \vee \ x\approx 0{,}608$.



21 $30=0{,}01v^2 \Rightarrow v^2=3000 \Rightarrow v=\sqrt{3000}\approx 55$ (km/u).



TOETS VOORKENNIS

a $2x-5<3x+2$
$-x<7$
$x>-7$.

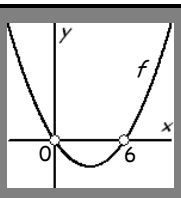
b $4x+3>2x-5$
$2x>-8$
$x>-4$.

c $3(x-1)<6x-1$
$3x-3<6x-1$
$-3x<2$
$x>-\frac{2}{3}$.

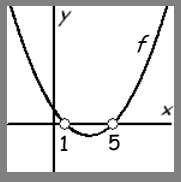
d $x-6>3(x-2)$
$x-6>3x-6$
$-2x>0$
$x<0$.

TOETS VOORKENNIS

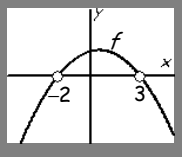
a $x^2-6x>0$
$f(x)=x^2-6x=0$
$x(x-6)=0$
$x=0 \ \vee \ x=6$.
Een schets (of plot) van f geeft:
$f(x)>0 \Rightarrow x<0 \ \vee \ x>6$.



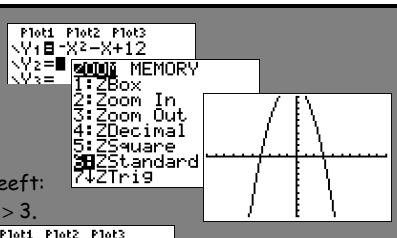
b $x^2-6x-5<0$
$f(x)=x^2-6x-5=0$
$(x-5)(x-1)=0$
$x=5 \ \vee \ x=1$.
Een schets (of plot) van f geeft:
$f(x)<0 \Rightarrow 1<x<5$.



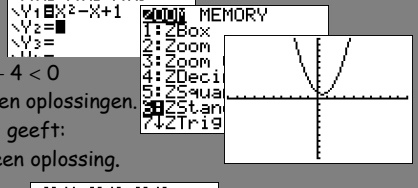
c $-x^2+x+6>0$
$f(x)=-x^2+x+6=0$
$x^2-x-6=0$
$(x-3)(x+2)=0$
$x=3 \ \vee \ x=-2$.
Een schets (of plot) van f geeft:
$f(x)>0 \Rightarrow -2<x<3$.



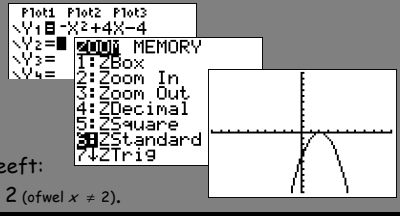
d $-x^2-x+12<0$
$f(x)=-x^2-x+12=0$
$x^2+x-12=0$
$(x+4)(x-3)=0$
$x=-4 \ \vee \ x=3$.
Een plot (of schets) van f geeft:
$f(x)<0 \Rightarrow x<-4 \ \vee \ x>3$.



e $x^2-x+1>0$
$f(x)=x^2-x+1=0$
$D=(-1)^2-4\cdot 1\cdot 1=1-4<0$
dus $f(x)=0$ heeft geen oplossingen.
Een plot (of schets) van f geeft:
$f(x)>0 \Rightarrow$ elke x is een oplossing.



f $-x^2+4x-4<0$
$f(x)=-x^2+4x-4=0$
$x^2-4x+4=0$
$(x-2)(x-2)=0$
$x=2 \ \vee \ x=2$.
Een plot (of schets) van f geeft:
$f(x)<0 \Rightarrow x<2 \ \vee \ x>2$ (ofwel $x\neq 2$).



3 Lineaire ongelijkheden (bladzijden 147 en 148)

9a $7x - 12 < 5x + 3$
$2x < 15$
$x = \frac{15}{2}$.

9b $4(x-3) > 3(x-4)$
$4x - 12 > 3x - 12$
$x > 0$.

9c $6(a+1) < 3(a-2) + 4$
$6a + 6 < 3a - 6 + 4$
$3a < -8$
$a < -\frac{8}{3}$.

9d $5 - 2(a-3) > 5(3-a)$
$5 - 2a + 6 > 15 - 5a$
$3a > 4$
$a > \frac{4}{3}$.

10 Nee, 1 is groter dan -2.

11a $4x + 5 < 6x - 3$
$-2x < -8$
$x > 4$.

11b $3x + 1 < 7x + 5$
$-4x < 4$
$x > -1$.

11c $\frac{1}{3}x + 10 > \frac{1}{2}x \quad (\times 6)$
$2x + 60 > 3x$
$-x > -60$
$x < 60$.

11d $x + 6 < 2 - \frac{3}{4}x \quad (\times 4)$
$4x + 24 < 8 - 3x$
$7x < -16$
$x < -\frac{16}{7}$.

12a $5(x-1) < 7x - 1$
$5x - 5 < 7x - 1$
$-2x < 4$
$x > -2$.

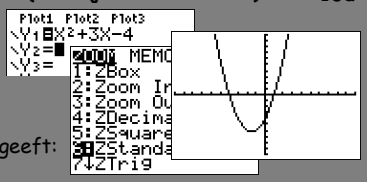
12b $2(3x-1) < 5 - (2 - 9x)$
$6x - 2 < 5 - 2 + 9x$
$-3x < 5$
$x > -\frac{5}{3}$.

12c $-3(4x-1) > 2 - (x-1)$
$-12x + 3 > 2 - x + 1$
$-11x > 0$
$x < 0$.

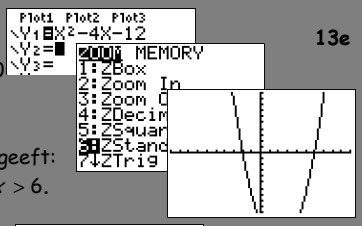
12d $2(x-1) - 3(x-2) > 6$
$2x - 2 - 3x + 6 > 6$
$-x > 2$
$x < -2$.

4 Kwadratische ongelijkheden (bladzijden 149 en 150)

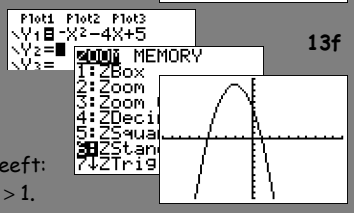
13a $x^2 + 3x - 4 < 0$
$f(x) = x^2 + 3x - 4 = 0$
$(x+4)(x-1) = 0$
$x = -4 \vee x = 1$.
Een plot (of schets) van f geeft:
$f(x) > 0 \Rightarrow -4 < x < 1$.



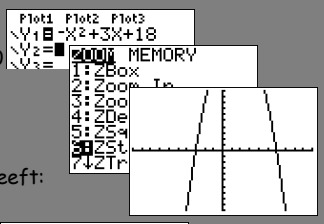
13b $x^2 - 4x - 12 > 0$
$f(x) = x^2 - 4x - 12 = 0$
$(x-6)(x+2) = 0$
$x = 6 \vee x = -2$.
Een plot (of schets) van f geeft:
$f(x) > 0 \Rightarrow x < -2 \vee x > 6$.



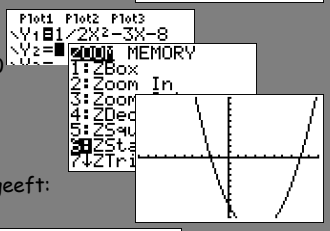
13c $-x^2 - 4x + 5 < 0$
$f(x) = -x^2 - 4x + 5 = 0$
$x^2 + 4x - 5 = 0$
$(x+5)(x-1) = 0$
$x = -5 \vee x = 1$.
Een plot (of schets) van f geeft:
$f(x) < 0 \Rightarrow x < -5 \vee x > 1$.



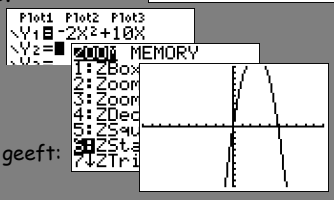
13d $-x^2 + 3x + 18 > 0$
$f(x) = -x^2 + 3x + 18 = 0$
$x^2 - 3x - 18 = 0$
$(x-6)(x+3) = 0$
$x = 6 \vee x = -3$.
Een plot (of schets) van f geeft:
$f(x) > 0 \Rightarrow -3 < x < 6$.



13e $\frac{1}{2}x^2 - 3x - 8 < 0$
$f(x) = \frac{1}{2}x^2 - 3x - 8 = 0$
$x^2 - 6x - 16 = 0$
$(x-8)(x+2) = 0$
$x = 8 \vee x = -2$.
Een plot (of schets) van f geeft:
$f(x) < 0 \Rightarrow -2 < x < 8$.



13f $-2x^2 + 10x > 0$
$f(x) = -2x^2 + 10x = 0$
$-2x(x-5) = 0$
$x = 0 \vee x = 5$.
Een plot (of schets) van f geeft:
$f(x) > 0 \Rightarrow 0 < x < 5$.



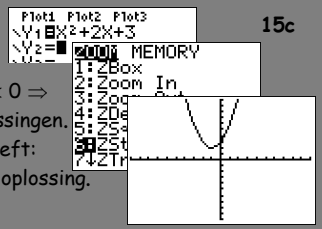
14a $f(x) = 0$ geeft $x^2 + x + 6 = 0$ met $D = b^2 - 4ac = 1^2 - 4 \cdot 1 \cdot 6 = -23 < 0 \Rightarrow$ geen oplossingen.

14b De grafiek van f is een dalparabool en de grafiek van f snijdt de x-as niet $\Rightarrow$ grafiek van f ligt helemaal boven de x-as.

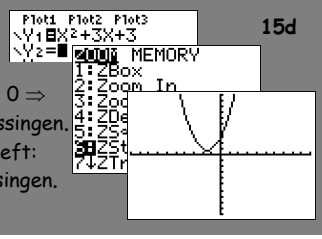
14c Omdat de grafiek van f boven de x-as ligt, is $f(x) > 0$ voor elke $x \Rightarrow x^2 + x + 6 > 0$ voor elke x.

14d Omdat de grafiek van f boven de x-as ligt, heeft $f(x) < 0$ geen oplossingen $\Rightarrow x^2 + x + 6 < 0$ heeft geen oplossingen.

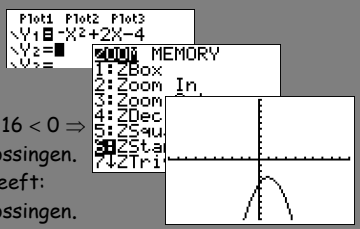
15a $x^2 + 2x + 3 > 0$
$f(x) = x^2 + 2x + 3 = 0$
$D = 2^2 - 4 \cdot 1 \cdot 3 = 4 - 12 < 0 \Rightarrow$
$f(x) = 0$ heeft geen oplossingen.
Een plot (of schets) van f geeft:
$f(x) > 0 \Rightarrow$ elke x is een oplossing.



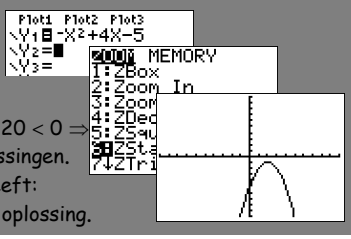
15b $x^2 + 3x + 3 < 0$
$f(x) = x^2 + 3x + 3 = 0$
$D = 3^2 - 4 \cdot 1 \cdot 3 = 3 - 12 < 0 \Rightarrow$
$f(x) = 0$ heeft geen oplossingen.
Een plot (of schets) van f geeft:
$f(x) < 0$ heeft een oplossingen.



15c $-x^2 + 2x - 4 > 0$
$f(x) = -x^2 + 2x - 4 = 0$
$x^2 - 2x + 4 = 0$
$D = (-2)^2 - 4 \cdot 1 \cdot 4 = 4 - 16 < 0 \Rightarrow$
$f(x) = 0$ heeft geen oplossingen.
Een plot (of schets) van f geeft:
$f(x) > 0$ heeft geen oplossingen.



15d $-x^2 + 4x - 5 < 0$
$f(x) = -x^2 + 4x - 5 = 0$
$x^2 - 4x + 5 = 0$
$D = (-4)^2 - 4 \cdot 1 \cdot 5 = 16 - 20 < 0 \Rightarrow$
$f(x) = 0$ heeft geen oplossingen.
Een plot (of schets) van f geeft:
$f(x) < 0 \Rightarrow$ elke x is een oplossing.



15e $x^2 - 12x + 36 > 0$

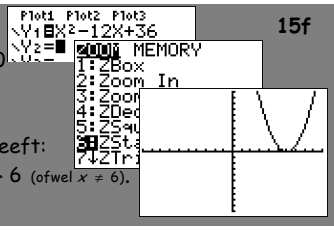
$f(x) = x^2 - 12x + 36 = 0$

$(x-6)(x-6) = 0$

$x = 6 \vee x = 6.$

Een plot (of schets) van f geeft:

$f(x) > 0 \Rightarrow x < 6 \vee x > 6$ (ofwel $x \neq 6$).



15f $-x^2 + 2x - 1 < 0$

$f(x) = -x^2 + 2x - 1 = 0$

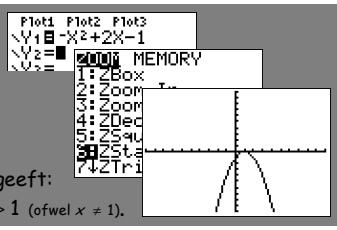
$x^2 - 2x + 1 = 0$

$(x-1)(x-1) = 0$

$x = 1 \vee x = 1.$

Een plot (of schets) van f geeft:

$f(x) < 0 \Rightarrow x < 1 \vee x > 1$ (ofwel $x \neq 1$).



22a Aan beide kanten van het $=$ teken moet je er dan $5x$ vanaf trekken.

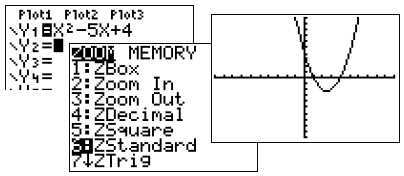
22b $x^2 + 4 < 5x$

$x^2 - 5x + 4 < 0$

$f(x) = x^2 - 5x + 4 = 0$

$(x-4)(x-1) = 0$

$x = 4 \vee x = 1.$



22c In een plot (of schets) van $f(x) = x^2 - 5x + 4$ lees je dan af $f(x) < 0 \Rightarrow 1 < x < 4$.

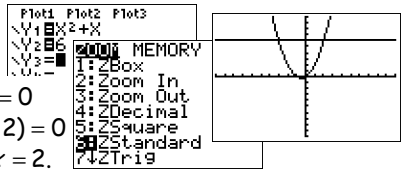
23a 💻 $x^2 + x > 6$

$x^2 + x = 6$

$x^2 + x - 6 = 0$

$(x+3)(x-2) = 0$

$x = -3 \vee x = 2.$



Een plot geeft: $f(x) > g(x) \Rightarrow x < -3 \vee x > 2.$

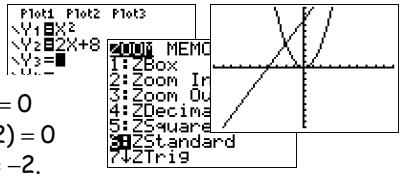
23b 💻 $x^2 < 2x + 8$

$x^2 = 2x + 8$

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

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

$x = 4 \vee x = -2.$



Een plot geeft: $f(x) < g(x) \Rightarrow -2 < x < 4.$

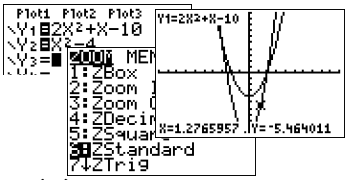
23c 💻 $2x^2 + x - 10 > x^2 - 4$

$2x^2 + x - 10 = x^2 - 4$

$x^2 + x - 6 = 0$

$(x+3)(x-2) = 0$

$x = -3 \vee x = 2.$



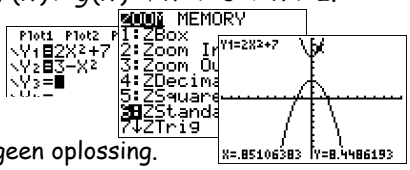
Een plot geeft: $f(x) > g(x) \Rightarrow x < -3 \vee x > 2.$

23d 💻 $2x^2 + 7 < 3 - x^2$

$2x^2 + 7 = 3 - x^2$

$3x^2 = -4$

$x^2 = -\frac{4}{3}$ heeft geen oplossing.

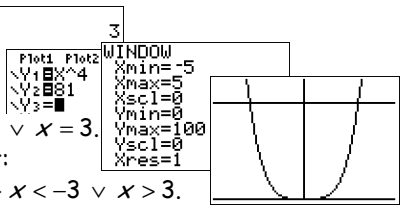


Een plot geeft: $f(x) < g(x)$ heeft geen oplossingen.

24a 💻 $x^4 > 81$

$x^4 = 81$

$x = -\sqrt[4]{81} = -3 \vee x = 3.$



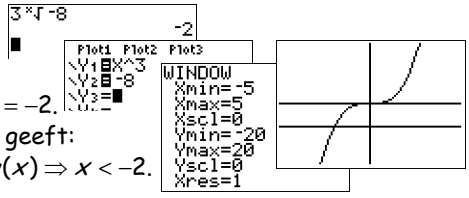
Een plot geeft:

$f(x) > g(x) \Rightarrow x < -3 \vee x > 3.$

24b 💻 $x^3 < -8$

$x^3 = -8$

$x = \sqrt[3]{-8} = -2.$



Een plot geeft:

$f(x) < g(x) \Rightarrow x < -2.$

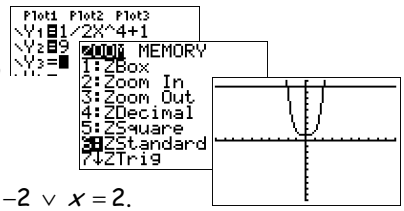
24c 💻 $\frac{1}{2}x^4 + 1 < 9$

$\frac{1}{2}x^4 + 1 = 9$

$\frac{1}{2}x^4 = 8$

$x^4 = 16$

$x = -\sqrt[4]{16} = -2 \vee x = 2.$



Een plot geeft: $f(x) < g(x) \Rightarrow -2 < x < 2.$

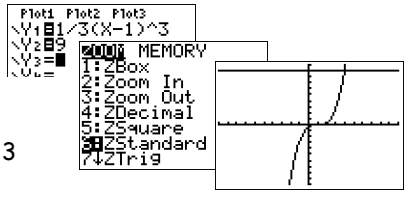
24d 💻 $\frac{1}{3}(x-1)^3 > 9$

$\frac{1}{3}(x-1)^3 = 9$

$(x-1)^3 = 27$

$x - 1 = \sqrt[3]{27} = 3$

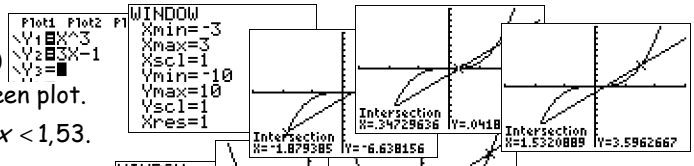
$x = 4.$



Een plot geeft: $f(x) > g(x) \Rightarrow x > 4.$

25a $x^3 = 3x - 1$ (intersect) $\Rightarrow$

$x \approx -1{,}88 \vee x \approx 0{,}35 \vee x \approx 1{,}53.$ (zie hiernaast)

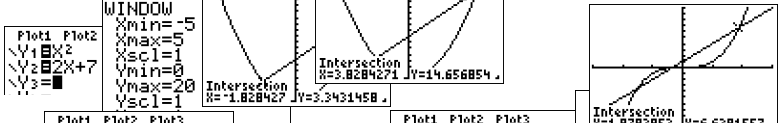


25b Maak (in je schrift of proefwerk) een schets van een plot.

$x^3 < 3x - 1$ (zie een plot) $\Rightarrow x < -1{,}88 \vee 0{,}35 < x < 1{,}53.$

26a $x^2 = 2x + 7$ (intersect) $\Rightarrow x \approx -1{,}83 \vee x \approx 3{,}83.$

Een plot geeft: $x^2 < 2x + 7 \Rightarrow -1{,}83 < x < 3{,}83.$

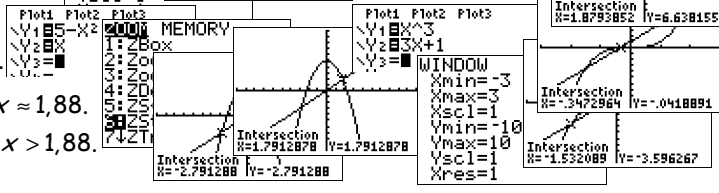


26b $5 - x^2 = x$ (intersect) $\Rightarrow x \approx -2{,}79 \vee x \approx 1{,}79.$

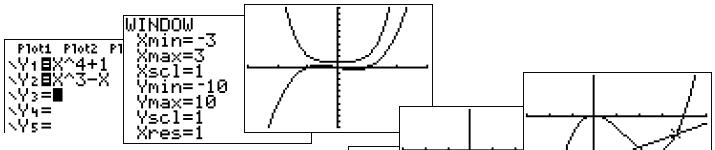
Een plot geeft: $5 - x^2 < x \Rightarrow x < -2{,}79 \vee x > 1{,}79.$

26c $x^3 = 3x + 1$ (intersect) $\Rightarrow x \approx -1{,}53 \vee x \approx -0{,}35 \vee x \approx 1{,}88.$

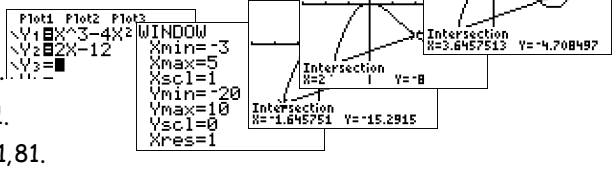
Een plot geeft: $x^3 > 3x + 1 \Rightarrow -1{,}53 < x < -0{,}35 \vee x > 1{,}88.$



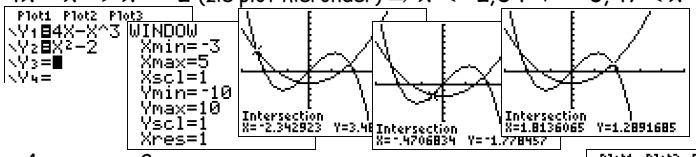
26d $x^4+1=x^3-x$ (intersect) $\Rightarrow$ er zijn geen oplossingen.
Een plot geeft: $x^4+1>x^3-x \Rightarrow$ voor geen enkele x.



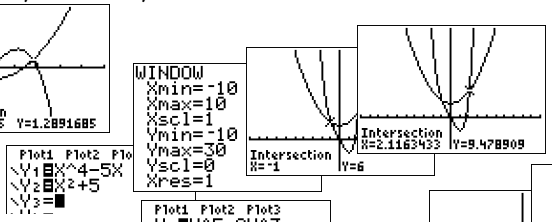
27a $x^3-4x^2=2x-12$ (intersect) $\Rightarrow x\approx -1{,}65 \vee x=2 \vee x\approx 3{,}65$.
$x^3-4x^2<2x-12$ (zie plot hiernaast) $\Rightarrow x<-1{,}65 \vee 2<x<3{,}65$.



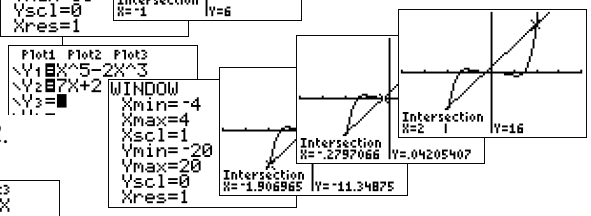
27b $4x-x^3=x^2-2$ (intersect) $\Rightarrow x\approx -2{,}34 \vee x\approx -0{,}47 \vee x\approx 1{,}81$.
$4x-x^3>x^2-2$ (zie plot hieronder) $\Rightarrow x<-2{,}34 \vee -0{,}47<x<1{,}81$.



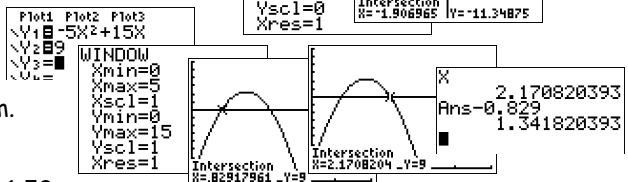
27c $x^4-5x=x^2+5$ (intersect) $\Rightarrow x=-1 \vee x\approx 2{,}12$.
$x^4-5x<x^2+5$ (zie plot hiernaast) $\Rightarrow -1<x<2{,}12$.



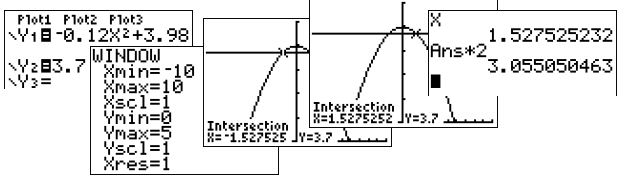
27d $x^5-2x^3=7x+2$ (intersect) $\Rightarrow x\approx -1{,}91 \vee x\approx -0{,}28 \vee x=2$.
$x^5-2x^3>7x+2$ (zie plot hiernaast) $\Rightarrow -1{,}91<x<-0{,}28 \vee x>2$.



28 $-5t^2+15t=9$ (intersect) $\Rightarrow t\approx 0{,}829 \vee t\approx 2{,}171$.
$-5t^2+15t>9$ (zie plot hiernaast) $\Rightarrow 0{,}829<t<2{,}171$.
De bal is $2{,}171-0{,}829\approx 1{,}3$ seconden hoger dan 9 m.



29 $-0{,}12x^2+3{,}98=3{,}7$ (intersect) $\Rightarrow x\approx -1{,}52... \vee x\approx 1{,}52...$
$-0{,}12x^2+3{,}98<3{,}7$ (zie plot hiernaast) $\Rightarrow -1{,}52...<x<1{,}52...$
De breedte is $1{,}52... - -1{,}52...\approx 3{,}05$ m (na 2 decimalen afkappen).



Diagnostische toets

D1a 💻 $5(x-3)-2x=-3(2x-4)$
$5x-15-2x=-6x+12$
$9x=27$
$x=3$.

D1b 💻 $3x^2-9=18$
$3x^2=27$
$x^2=9$
$x=3 \vee x=-3$.

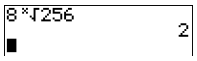
D1c 💻 $x^2+12x=28$
$x^2+12x-28=0$
$(x+14)(x-2)$
$x=-14 \vee x=2$.

D1d 💻 $(2x-5)(4-x)=0$
$2x=5 \vee 4=x$
$x=2\frac{1}{2} \vee x=4$.

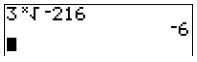
D1e 💻 $5x^2+6x+1=0$
$D=6^2-4\cdot5\cdot1=16 \Rightarrow \sqrt{D}=4$
$x=\frac{-6+4}{10}=\frac{-2}{10}=-\frac{1}{5} \vee x=\frac{-6-4}{10}=-1$.

D1f 💻 $6x^2+27x=0$
$3x(2x+9)=0$
$x=0 \vee 2x=-9$
$x=0 \vee x=-4\frac{1}{2}$.

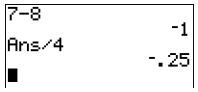
D2a 💻 $x^8=256$
$x=\pm\sqrt[8]{256}=\pm2$.



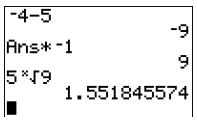
D2b 💻 $x^3=-216$
$x=\sqrt[3]{-216}=-6$.



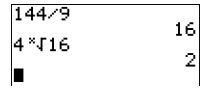
D2c 💻 $4x^4+8=7$
$4x^4=-1$
$x^4=-\frac{1}{4}$ ↯



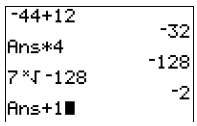
D2d 💻 $5-x^5=-4$
$-x^5=-9$
$x^5=9$
$x=\sqrt[5]{9}$.



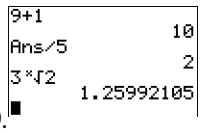
D2e 💻 $9(x-1)^4=144$
$(x-1)^4=16$
$x-1=\pm\sqrt[4]{16}=\pm2$
$x=1+2=3 \vee x=1-2=-1$.



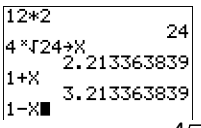
D2f 💻 $\frac{1}{4}(2x-1)^7-12=-44$
$\frac{1}{4}(2x-1)^7=-32$
$(2x-1)^7=-128$
$2x-1=\sqrt[7]{-128}=-2$
$2x=-1$
$x=-\frac{1}{2}$.



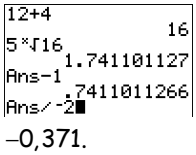
D3a 💻 $5x^3-1=9$
$5x^3=10$
$x^3=2$
$x=\sqrt[3]{2}\approx1{,}260$.



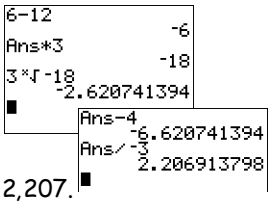
D3b 💻 $\frac{1}{2}(x-1)^4=12$
$(x-1)^4=24$
$x-1=\pm\sqrt[4]{24}$
$x=1+\sqrt[4]{24}\approx3{,}213 \vee x=1-\sqrt[4]{24}\approx-1{,}213$.



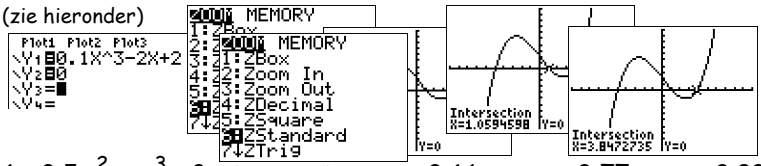
D3c 💻 $(1-2x)^5-4=12$
$(1-2x)^5=16$
$1-2x=\sqrt[5]{16}$
$-2x=-1+\sqrt[5]{16}$
$x=\frac{1}{2}-\frac{1}{2}\sqrt[5]{16}\approx-0{,}371$.

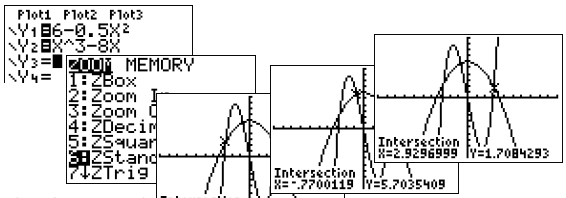


D3d 💻 $\frac{1}{3}(4-3x)^3+12=6$
$\frac{1}{3}(4-3x)^3=-6$
$(4-3x)^3=-18$
$4-3x=\sqrt[3]{-18}$
$-3x=-4+\sqrt[3]{-18}$
$x=\frac{4}{3}-\frac{1}{3}\sqrt[3]{-18}\approx2{,}207$.



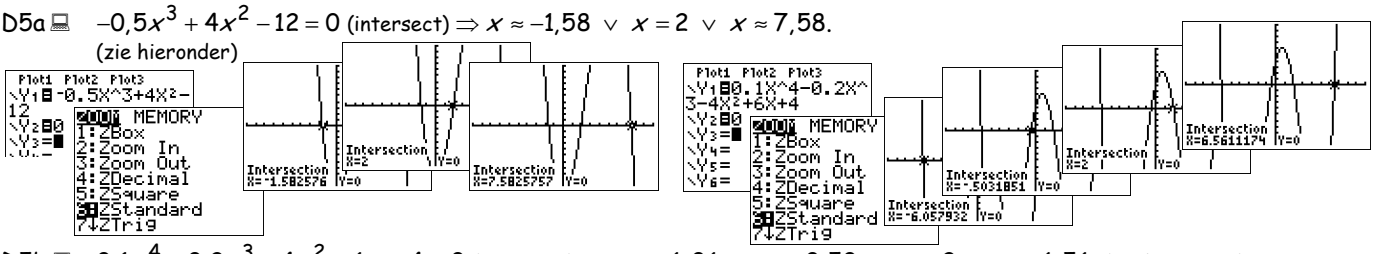
D4a 💻 $0{,}1x^3-2x+2=0$ (intersect) $\Rightarrow x\approx-4{,}91 \vee x\approx1{,}06 \vee x\approx3{,}85$.
(zie hieronder)





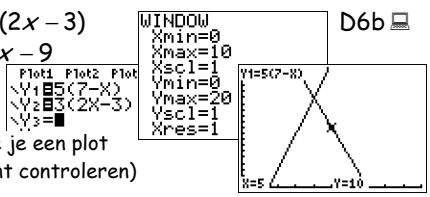
D4b 💻 $6-0{,}5x^2=x^3-8x$ (intersect) $\Rightarrow x\approx-2{,}66 \vee x\approx-0{,}77 \vee x\approx2{,}93$. (zie hiernaast)

D5a 💻 $-0{,}5x^3+4x^2-12=0$ (intersect) $\Rightarrow x\approx-1{,}58 \vee x=2 \vee x\approx7{,}58$.
(zie hieronder)

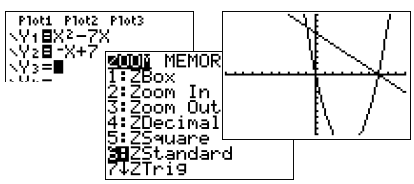


D5b 💻 $0{,}1x^4-0{,}2x^3-4x^2+6x+4=0$ (intersect) $\Rightarrow x\approx-6{,}06 \vee x\approx0{,}50 \vee x=2 \vee x\approx6{,}56$. (zie hierboven)

D6a 💻 $5(7-x)>3(2x-3)$
$35-5x>6x-9$
$-11x>-44$
$x<4$.
(hiernaast zie je een plot waarin je kunt controleren)



D6b 💻 $x^2-7x<-x+7$
$x^2-7x=-x+7$
$x^2-6x-7=0$
$(x-7)(x+1)=0$
$x=7 \vee x=-1$.
$x^2-7x<-x+7$ (zie een plot hierboven) $\Rightarrow -1<x<7$.



D6c 💻 $2x^2+5x-12>x^2+6x$

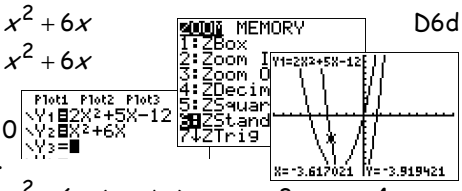
$2x^2+5x-12=x^2+6x$

$x^2-x-12=0$

$(x-4)(x+3)=0$

$x=4 \vee x=-3.$

$2x^2+5x-12>x^2+6x$ (zie plot) $\Rightarrow x<-3 \vee x>4.$



D6d 💻 $x^2-9=2x^2+11x+9$

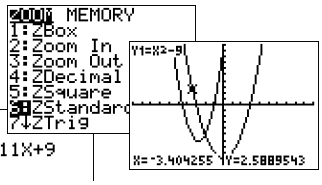
$-x^2-11x-18=0$

$x^2+11x+18=0$

$(x+9)(x+2)=0$

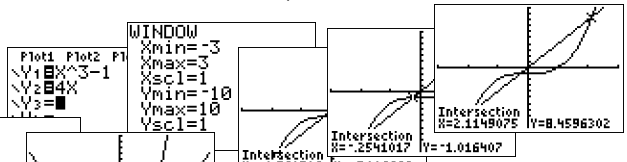
$x=-9 \vee x=-2.$

$x^2-9>2x^2+11x+9$ (zie plot) $\Rightarrow -9<x<-2.$



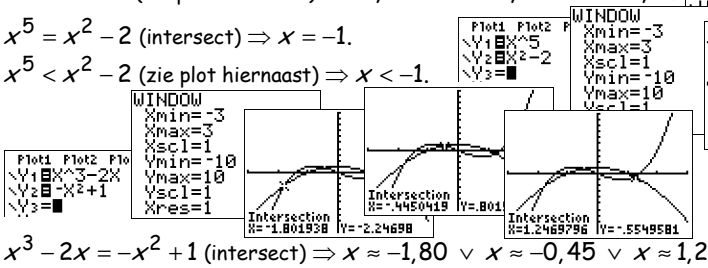
D7a 💻 $x^3-1=4x$ (intersect) $\Rightarrow x\approx -1{,}86 \vee x\approx -0{,}25 \vee x\approx 2{,}11.$

$x^3-1>4x$ (zie plot hiernaast) $\Rightarrow -1{,}86<x<-0{,}25 \vee x>2{,}11.$



D7b 💻 $x^5=x^2-2$ (intersect) $\Rightarrow x=-1.$

$x^5<x^2-2$ (zie plot hiernaast) $\Rightarrow x<-1.$

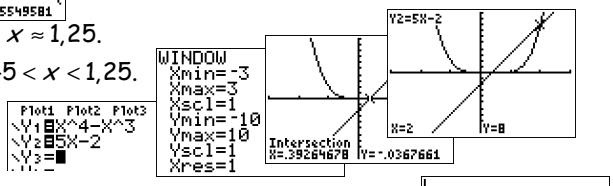


D7c 💻 $x^3-2x=-x^2+1$ (intersect) $\Rightarrow x\approx -1{,}80 \vee x\approx -0{,}45 \vee x\approx 1{,}25.$

$x^3-2x<-x^2+1$ (zie plot hierboven) $\Rightarrow x<-1{,}80 \vee -0{,}45<x<1{,}25.$

D7d 💻 $x^4-x^3=5x-2$ (intersect) $\Rightarrow x\approx 0{,}39 \vee x=2.$

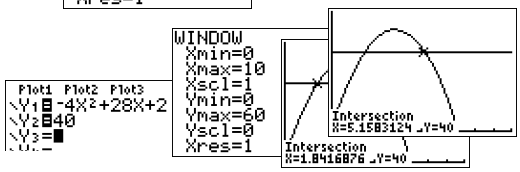
$x^4-x^3>5x-2$ (zie plot hiernaast) $\Rightarrow x<0{,}39 \vee x>2.$



D8 💻 $-4t^2+28t+2=40$ (intersect) $\Rightarrow t\approx 1{,}84 \vee t\approx 5{,}16.$

$-4t^2+28t+2>40$ (zie plot hiernaast) $\Rightarrow 1{,}84<t<5{,}16.$

De pijll is $5{,}16-1{,}84\approx 3{,}3$ seconden hoger dan 40 m.



Gemengde opgaven 3. Vergelijkingen en ongelijkheden

G23a $2x^2+8x=0$
$2x(x+4)=0$
$x=0 \vee x=-4$.

G23b $x^2+6x=40$
$x^2+6x-40=0$
$(x+10)(x-4)=0$
$x=-10 \vee x=4$.

G23c $(2x+4)^2=81$
$2x+4=9 \vee 2x+4=-9$
$2x=5 \vee 2x=-13$
$x=2\frac{1}{2} \vee x=-6\frac{1}{2}$.

G23d $(x+4)(2x+7)=0$
$x=-4 \vee 2x=-7$
$x=-4 \vee x=-3\frac{1}{2}$.

G24a $(x-6)^2=x$
$x^2-12x+36=x$
$x^2-13x+36=0$
$(x-9)(x-4)=0$
$x=9 \vee x=4$.

G24b $(2x+3)(x-4)=-14$
$2x^2-8x+3x-12=-14$
$2x^2-5x+2=0$
$D=(-5)^2-4\cdot2\cdot2=9 \Rightarrow \sqrt{D}=3$
$x=\frac{5+3}{4}=\frac{8}{4}=2 \vee x=\frac{5-3}{4}=\frac{2}{4}=\frac{1}{2}$.

G24c $4(x-3)^2=5x-9$
$4(x^2-6x+9)=5x-9$
$4x^2-24x+36=5x-9$
$4x^2-29x+45=0$
$D=(-29)^2-4\cdot4\cdot45=121 \Rightarrow \sqrt{D}=11$
$x=\frac{29+11}{8}=\frac{40}{8}=5 \vee x=\frac{29-11}{8}=\frac{18}{8}=2\frac{1}{4}$.

G24d $x^2-(x-2)^2=3x$
$x^2-(x^2-4x+4)=3x$
$x^2-x^2+4x-4=3x$
$x=4$.

G25a $x^8=80$
$x=\sqrt[8]{80} \vee x=-\sqrt[8]{80}$.

G25c $2x^4+5=17$
$2x^4=12$
$x^4=6$
$x=\sqrt[4]{6} \vee x=-\sqrt[4]{6}$.

G25e $(3x+1)^5=-32$
$3x+1=\sqrt[5]{-32}=-2$
$3x=-3$
$x=-1$.

G 25b $6x^3=216$
$x^3=36$
$x=\sqrt[3]{36}$.

G 25d $(\frac{1}{2}x)^5=10$
$\frac{1}{2}x=\sqrt[5]{10}$
$x=2\cdot\sqrt[5]{10}$.

G25f $81(1-4x)^4=1$
$(1-4x)^4=\frac{1}{81}$
$1-4x=\pm\sqrt[4]{\frac{1}{81}}=\pm\frac{1}{3}$
$-4x=-1+\frac{1}{3}=-\frac{2}{3} \vee -4x=-1-\frac{1}{3}=-\frac{4}{3}$
$x=\frac{1}{6} \vee x=\frac{1}{3}$.

G26a $2x^5=25$
$x^5=12\frac{1}{2}$
$x=\sqrt[5]{12\frac{1}{2}} \approx 1{,}66$.

G26c $(x-3)^4=120$
$x-3=\pm\sqrt[4]{120}$
$x=3\pm\sqrt[4]{120}$
$x \approx 6{,}31 \vee x \approx -0{,}31$.

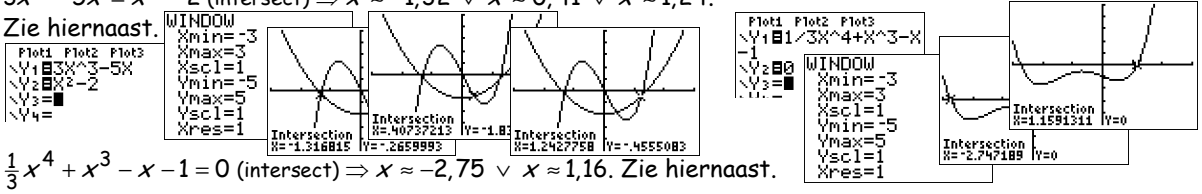
G26e $(3x-1)^5=100$
$3x-1=\sqrt[5]{100}$
$3x=1+\sqrt[5]{100}$
$x=\frac{1}{3}+\frac{1}{3}\sqrt[5]{100} \approx 1{,}17$.

G26b $(2x)^5=25$
$2x=\sqrt[5]{25}$
$x=\frac{1}{2}\cdot\sqrt[5]{25} \approx 0{,}95$.

G26d $3x^4=120$
$x^4=40$
$x=\pm\sqrt[4]{40}$
$x \approx 2{,}51 \vee x \approx -2{,}51$.

G26f $(3x-1)^6=100$
$3x-1=\pm\sqrt[6]{100}$
$3x=1\pm\sqrt[6]{100}$
$x=\frac{1}{3}\pm\frac{1}{3}\sqrt[6]{100} \Rightarrow x \approx 1{,}05 \vee x \approx -0{,}38$.

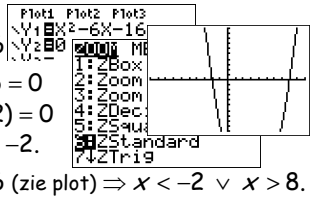
G27a $3x^3-5x=x^2-2$ (intersect) $\Rightarrow x \approx -1{,}32 \vee x \approx 0{,}41 \vee x \approx 1{,}24$.
Zie hiernaast.



G27b $\frac{1}{3}x^4+x^3-x-1=0$ (intersect) $\Rightarrow x \approx -2{,}75 \vee x \approx 1{,}16$. Zie hiernaast.

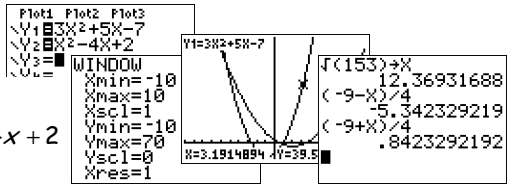
G28a $x<5x-6$
$-4x<-4$
$x>1\frac{1}{2}$.

G28b $x^2=6x+16$
$x^2-6x-16=0$
$(x-8)(x+2)=0$
$x=8 \vee x=-2$.
$x^2>6x+16$ (zie plot) $\Rightarrow x<-2 \vee x>8$.



G28c $2-(x-6)>16$
$2-x+6>16$
$-x>8$
$x<-8$.

G28d $3x^2+5x-7=x^2-4x+2$
$2x^2+9x-9=0$
$D=9^2-4\cdot2\cdot-9=81+72=153 \Rightarrow x=\frac{-9-\sqrt{153}}{4} \vee x=\frac{-9+\sqrt{153}}{4}$.
$3x^2+5x-7>x^2-4x+2$ (zie plot) $\Rightarrow x<\frac{-9-\sqrt{153}}{4} \vee x>\frac{-9+\sqrt{153}}{4}$.



G29a $x^4 = 40 \Rightarrow$ (intersect of) $x = \sqrt[4]{40} \approx 2{,}5 \ \vee \ x = -\sqrt[4]{40} \approx -2{,}5$.

$x^4 < 40$ (zie plot hiernaast) $\Rightarrow -2{,}5 < x < 2{,}5$.

G29b $x^5 = 40 \Rightarrow$ (intersect of) $x = \sqrt[5]{40} \approx 2{,}1$.

$x^5 < 40$ (zie plot hiernaast) $\Rightarrow x < 2{,}1$.

G29c $x^3 + 2x^2 - 1 = -x^2 + 2$ (intersect) $\Rightarrow x \approx -2{,}5 \ \vee \ x \approx -1{,}3 \ \vee \ x \approx 0{,}9$.

$x^3 + 2x^2 - 1 > -x^2 + 2$ (zie plot hieronder) $\Rightarrow -2{,}5 < x < -1{,}3 \ \vee \ x > 0{,}9$.

G29d $x(x+2)(x-3) = x - 3$ (intersect) $\Rightarrow x \approx -2{,}4 \ \vee \ x \approx 0{,}4 \ \vee \ x = 3$.

$x(x+2)(x-3) < x - 3$ (zie plot hiernaast) $\Rightarrow x < -2{,}4 \ \vee \ 0{,}4 < x < 3$.

G30 I(hele piramide) $= \frac{1}{3}Gh = \frac{1}{3} \cdot 6 \cdot 6 \cdot 9 = 108$.

Het afgeknotte deel is meer dan het dubbele van de piramide die eraf wordt gesneden,
dus is het afgeknotte deel meer dan $\frac{2}{3}$ deel van de gehele piramide.

Dus op te lossen: $\frac{4}{27}h^3 - 4h^2 + 36h$ (met $h \le 9$) $> \frac{2}{3} \cdot 108$.

$\frac{4}{27}h^3 - 4h^2 + 36h = 72$ (intersect) $\Rightarrow x \approx 2{,}76$.

$\frac{4}{27}h^3 - 4h^2 + 36h > 72$ (zie plot hiernaast) $\Rightarrow 2{,}76 < h \le 9$.

G31a $2x^2 - 2x = 1$ (intersect $\Rightarrow x \approx -0{,}366 \ \vee \ x \approx 1{,}366$ of)

$2x^2 - 2x - 1 = 0$

$D = (-2)^2 - 4 \cdot 2 \cdot -1 = 4 + 8 = 12$

$x = \frac{2 + \sqrt{12}}{4} \ \vee \ x = \frac{2 - \sqrt{12}}{4}$.

$AB = \frac{2 + \sqrt{12}}{4} - \frac{2 - \sqrt{12}}{4} \approx 1{,}73$.

G31b $(2x^2 - 2x)^2 = (2x^2 - 2x)(2x^2 - 2x) = 4x^4 - 4x^3 - 4x^3 + 4x^2 = 4x^4 - 8x^3 + 4x^2$.

G31c $x = \frac{1}{2}$ invullen in $y = (2x^2 - 2x)^n$ (met $n = 1, 2, 3, 4, \ldots$) geeft $y = (2 \cdot \frac{1}{4} - 2 \cdot \frac{1}{2})^n = (-\frac{1}{2})^n$ (met $n = 1, 2, 3, 4, \ldots$).

TABLE laat zien:

$n = 9 \Rightarrow y = -0{,}002$

$n = 10 \Rightarrow y \approx -0{,}00098$

$n = 11 \Rightarrow y \approx -0{,}00049$

...

Dus vanaf $n = 10$.