UITWERKINGEN DEEL 1 | WISKUNDE | 12E EDITIE | 3 HAVO

# GETAL & RUIMTE

Noordhoff Uitgevers

# 2 Gelijkvormigheid en hellingen

## Voorkennis Rechthoekige driehoeken

### Bladzijde 50

**1** In $\triangle DEF$ is $\angle D = 90°$, dus $DE^2 + DF^2 = EF^2$.
In $\triangle KLM$ is $\angle K = 90°$, dus $KL^2 + KM^2 = LM^2$.
In $\triangle PQR$ is $\angle R = 90°$, dus $PR^2 + QR^2 = PQ^2$.

**2** In $\triangle ABC$ is $\angle A = 90°$, dus $AB^2 + AC^2 = BC^2$.
In $\triangle ABD$ is $\angle D = 90°$, dus $AD^2 + BD^2 = AB^2$.
In $\triangle ACD$ is $\angle D = 90°$, dus $AD^2 + CD^2 = AC^2$.

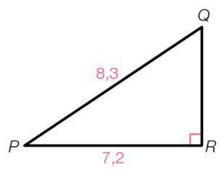
### Bladzijde 51

**3** In $\triangle ABC$ is $\angle C = 90°$, dus $AC^2 + BC^2 = AB^2$
$4^2 + 2^2 = AB^2$
$AB^2 = 16 + 4 = 20$
$AB = \sqrt{20} \approx 4{,}47$ cm
In $\triangle KLM$ is $\angle K = 90°$, dus $KL^2 + KM^2 = LM^2$
$2{,}5^2 + 5^2 = LM^2$
$LM = 6{,}25 + 25 = 31{,}25$
$LM = \sqrt{31{,}25} \approx 5{,}59$ cm

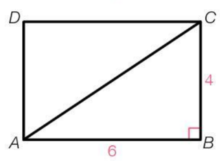
**4** In $\triangle ABC$ is $\angle A = 90°$, dus $AB^2 + AC^2 = BC^2$
$3{,}5^2 + AC^2 = 5^2$
$AC^2 = 25 - 12{,}25 = 12{,}75$
$AC = \sqrt{12{,}75} \approx 3{,}57$ cm
In $\triangle PQR$ is $\angle R = 90°$, dus $PR^2 + QR^2 = PQ^2$
$5{,}5^2 + QR^2 = 6{,}5^2$
$QR^2 = 42{,}25 - 30{,}25 = 12$
$QR = \sqrt{12} \approx 3{,}46$ cm

**5** $CD = 3 : 2 = 1{,}5$ cm
In $\triangle BCD$ is $\angle D = 90°$, dus $CD^2 + BD^2 = BC^2$
$1{,}5^2 + 4{,}2^2 = BC^2$
$BC^2 = 2{,}25 + 17{,}64 = 19{,}89$
$BC = \sqrt{19{,}89} \approx 4{,}46$ cm
In $\triangle DFG$ is $\angle G = 90°$, dus $DG^2 + FG^2 = DF^2$
$DG^2 + 4^2 = 4{,}6^2$
$DG^2 = 21{,}16 - 16 = 5{,}16$
$DG = \sqrt{5{,}16} = 2{,}271...$
Dus $DE = 2 \cdot 2{,}271... \approx 4{,}54$ cm.
In $\triangle PQR$ is $\angle Q = 90°$, dus $PQ^2 + QR^2 = PR^2$
$3{,}6^2 + QR^2 = 4{,}8^2$
$QR^2 = 23{,}04 - 12{,}96 = 10{,}08$
$QR = \sqrt{10{,}08} \approx 3{,}17$ cm

**6** **a** Zie de figuur hiernaast.
In $\triangle PQR$ is $\angle R = 90°$, dus $PR^2 + QR^2 = PQ^2$
$7{,}2^2 + QR^2 = 8{,}3^2$
$QR^2 = 68{,}89 - 51{,}84 = 17{,}05$
$QR = \sqrt{17{,}05} \approx 4{,}13$ cm




**b** Zie de figuur hiernaast.
In $\triangle ABC$ is $\angle B = 90°$, dus $AB^2 + BC^2 = AC^2$
$6^2 + 4^2 = AC^2$
$AC^2 = 36 + 16 = 52$
$AC = \sqrt{52} \approx 7{,}21$ cm
Dus elke diagonaal is 7,21 cm.



## 2.1 Kruisproducten

### Bladzijde 52

**1**

| | | | | |
|---|---|---|---|---|
| 3 | 12 | 2 | 20 | 300 |
| 5 | 20 | $3\frac{1}{3}$ | $33\frac{1}{3}$ | 500 |

**2** $2 \cdot 25 = 50$ en $10 \cdot 5 = 50$, dus $2 \cdot 25 = 10 \cdot 5$.
$10 \cdot 21 = 210$ en $14 \cdot 15 = 210$, dus $10 \cdot 21 = 14 \cdot 15$.
De twee vermenigvuldigingen hebben steeds dezelfde uitkomst.

### Bladzijde 53

**3** **a** $x = \frac{8 \cdot 96}{15} = 51{,}2$

**b** $7(x + 1) = 2(x - 5)$
$7x + 7 = 2x - 10$
$7x - 2x = -10 - 7$
$5x = -17$
$x = \frac{-17}{5} = 3{,}4$

**c** $2x = 4(1{,}5 - x)$
$2x = 6 - 4x$
$2x + 4x = 6$
$6x = 6$
$x = 1$

**4** **a** $x = \frac{4 \cdot 7}{2} = 14$

**b** $x = \frac{2{,}3 \cdot 12}{4} = 6{,}9$

**c** $x = \frac{18 \cdot 20}{16} = 22{,}5$

**5** **a** $5(x - 1) = 3(x + 3)$
$5x - 5 = 3x + 9$
$5x - 3x = 9 + 5$
$2x = 14$
$x = 7$

**b** $3(2x + 1) = 4(x - 1)$
$6x + 3 = 4x - 4$
$6x - 4x = -4 - 3$
$2x = -7$
$x = \frac{-7}{2} = -3{,}5$

**c** $12(x - 1) = 5 \cdot 7{,}2$
$12x - 12 = 36$
$12x = 36 + 12$
$12x = 48$
$x = 4$

**6** **a** $2(x - 5) = 7(x + 1)$
$2x - 10 = 7x + 7$
$2x - 7x = 7 + 10$
$-5x = 17$
$x = \frac{17}{-5} = 3{,}4$

**b** $7{,}9x = 2{,}3(3x + 2)$
$7{,}9x = 6{,}9x + 4{,}6$
$7{,}9x - 6{,}9x = 4{,}6$
$x = 4{,}6$

**c** $x = \frac{15 \cdot 9}{4} = 33{,}75$

### Bladzijde 54

**7** **a**

| | |
|---|---|
| 5 | 11 |
| $p$ | 18 |

geeft $p = \frac{5 \cdot 18}{11} \approx 8{,}2$

| | |
|---|---|
| 11 | $q$ |
| 18 | 10 |

geeft $q = \frac{11 \cdot 10}{18} \approx 6{,}1$

**b**

| | |
|---|---|
| $p$ | 1,6 |
| 5 | 2,1 |

geeft $p = \frac{5 \cdot 1{,}6}{2{,}1} \approx 3{,}8$

| | |
|---|---|
| 1,6 | $q$ |
| 2,1 | 1,5 |

geeft $q = \frac{1{,}6 \cdot 1{,}5}{2{,}1} \approx 1{,}1$

**c**

| | |
|---|---|
| 16 | $p$ |
| 45 | 43 |

geeft $p = \frac{16 \cdot 43}{45} \approx 15{,}3$

| | |
|---|---|
| 16 | 59 |
| 45 | $q$ |

geeft $q = \frac{45 \cdot 59}{16} \approx 165{,}9$

**8** $\begin{array}{c|c} 18 & x \\ \hline 23 & 17 \end{array}$ geeft $x = \frac{18 \cdot 17}{23} \approx 13{,}30$

$\begin{array}{c|c} 18 & y \\ \hline 23 & 53 \end{array}$ geeft $y = \frac{18 \cdot 53}{23} \approx 41{,}48$

$\begin{array}{c|c} 18 & 73 \\ \hline 23 & z \end{array}$ geeft $z = \frac{23 \cdot 73}{18} \approx 93{,}28$

**9** **a** $\begin{array}{c|c} 19 & x \\ \hline 6 & 11 \end{array}$ geeft $x = \frac{11 \cdot 19}{6} \approx 34{,}83$

$\begin{array}{c|c} 19 & 67 \\ \hline 6 & y \end{array}$ geeft $y = \frac{6 \cdot 67}{19} \approx 21{,}16$

**b** $\begin{array}{c|c} 8 & x-2 \\ \hline 23 & x \end{array}$ geeft $23(x-2) = 8x$

$23x - 46 = 8x$
$23x - 8x = 46$
$15x = 46$
$x = \frac{46}{15} \approx 3{,}07$

$\begin{array}{c|c} 8 & y-1 \\ \hline 23 & y+3 \end{array}$ geeft $23(y-1) = 8(y+3)$

$23y - 23 = 8y + 24$
$23y - 8y = 24 + 23$
$15y = 47$
$y = \frac{47}{15} \approx 3{,}13$

## 2.2 Gelijkvormigheid

### Bladzijde 55

**10** **a** $\frac{DE}{AB} = \frac{3}{2} = 1{,}5$, $\frac{DF}{AC} = \frac{2{,}7}{1{,}8} = 1{,}5$ en $\frac{EF}{BC} = \frac{4{,}5}{3} = 1{,}5$.
Dus $\triangle DEF$ is een vergroting van $\triangle ABC$ met vergrotingsfactor 1,5.

**b** $\angle D = \angle A$, $\angle E = \angle B$ en $\angle F = \angle C$

### Bladzijde 56

**11** **a** $\angle A = \angle Q$, $\angle B = \angle R$ en $\angle C = \angle P$

**b** $\triangle ABC \sim \triangle QRP$

**c** $\begin{array}{c|c|c} AB & BC & AC \\ \hline QR & RP & QP \end{array}$

**12** **a** $\triangle ABC \sim \triangle FDE$

**b** $\begin{array}{c|c|c} AB & BC & AC \\ \hline FD & DE & FE \end{array}$

## Bladzijde 57

**13** **a** $\triangle DEF \sim \triangle GHF$

**b** In $\triangle FGH$ is $\angle F = 90°$, dus $GH^2 = FG^2 + FH^2$

$$GH^2 = 5{,}1^2 + 6{,}8^2 = 72{,}25$$
$$GH = \sqrt{72{,}25} = 8{,}5$$

$$\begin{array}{c|c|c} DE & EF & DF \\ \hline GH & HF & GF \end{array} \text{ geeft } \begin{array}{c|c|c} 13 & EF & DF \\ \hline 8{,}5 & 6{,}8 & 5{,}1 \end{array}$$

$$\begin{array}{c|c} 13 & EF \\ \hline 8{,}5 & 6{,}8 \end{array} \text{ geeft } EF = \frac{13 \cdot 6{,}8}{8{,}5} = 10{,}4$$

$EH = EF - FH = 10{,}4 - 6{,}8 = 3{,}6$

**14** **a** $\triangle KLM \sim \triangle RQP$

**b**
$$\begin{array}{c|c|c} KL & LM & KM \\ \hline RQ & QP & RP \end{array} \text{ geeft } \begin{array}{c|c|c} 14 & LM & KM \\ \hline 23 & 35 & 31 \end{array}$$

**c**
$$\begin{array}{c|c} 14 & KM \\ \hline 23 & 31 \end{array} \text{ geeft } KM = \frac{14 \cdot 31}{23} \approx 18{,}9$$

$$\begin{array}{c|c} 14 & LM \\ \hline 23 & 35 \end{array} \text{ geeft } LM = \frac{14 \cdot 35}{23} \approx 21{,}3$$

**15** **a** $\triangle ABC \sim \triangle EBD$

**b**
$$\begin{array}{c|c|c} AB & BC & AC \\ \hline EB & BD & ED \end{array} \text{ geeft } \begin{array}{c|c|c} 6{,}1 & 3{,}2 & 4{,}3 \\ \hline EB & BD & 7{,}6 \end{array}$$

**c**
$$\begin{array}{c|c} 3{,}2 & 4{,}3 \\ \hline BD & 7{,}6 \end{array} \text{ geeft } BD = \frac{3{,}2 \cdot 7{,}6}{4{,}3} \approx 5{,}7$$

$$\begin{array}{c|c} 6{,}1 & 4{,}3 \\ \hline EB & 7{,}6 \end{array} \text{ geeft } BE = \frac{6{,}1 \cdot 7{,}6}{4{,}3} \approx 10{,}8$$

**16** **a** $\triangle PQT \sim \triangle RQS$

**b**
$$\begin{array}{c|c|c} PQ & QT & PT \\ \hline RQ & QS & RS \end{array} \text{ geeft } \begin{array}{c|c|c} PQ & 32{,}5 & PT \\ \hline 12 & QS & 5 \end{array}$$

Om $PQ$ te berekenen, heb je óf van de tweede kolom óf van de derde kolom beide getallen nodig, maar die zijn niet gegeven.

**c** In $\triangle QRS$ is $\angle R = 90°$, dus $QS^2 = QR^2 + RS^2$

$$QS^2 = 12^2 + 5^2 = 169$$
$$QS = \sqrt{169} = 13$$

**d**
$$\begin{array}{c|c} PQ & 32{,}5 \\ \hline 12 & 13 \end{array} \text{ geeft } PQ = \frac{12 \cdot 32{,}5}{13} = 30$$

$$\begin{array}{c|c} 32{,}5 & PT \\ \hline 13 & 5 \end{array} \text{ geeft } PT = \frac{32{,}5 \cdot 5}{13} = 12{,}5$$

### Bladzijde 58

**17** **a** $\triangle PQR \sim \triangle PTS$

**b** $$\begin{array}{c|c|c} PQ & QR & PR \\ \hline PT & TS & PS \end{array} \text{ geeft } \begin{array}{c|c|c} 12 & 8 & 7 \\ \hline 5 & TS & PS \end{array}$$

$$\begin{array}{c|c} 12 & 7 \\ \hline 5 & PS \end{array} \text{ geeft } PS = \frac{5 \cdot 7}{12} \approx 2{,}9$$

$$\begin{array}{c|c} 12 & 8 \\ \hline 5 & TS \end{array} \text{ geeft } ST = \frac{5 \cdot 8}{12} \approx 3{,}3$$

**18** **a** $\triangle DEF \sim \triangle DGH$

**b** In $\triangle DEF$ is $\angle E = 90°$, dus $DE^2 + EF^2 = DF^2$

$$DE^2 + 12^2 = 20^2$$
$$DE^2 = 400 - 144 = 256$$
$$DE = \sqrt{256} = 16$$

**c** $$\begin{array}{c|c|c} DE & EF & DF \\ \hline DG & GH & DH \end{array} \text{ geeft } \begin{array}{c|c|c} 16 & 12 & 20 \\ \hline 5 & GH & DH \end{array}$$

$$\begin{array}{c|c} 16 & 12 \\ \hline 5 & GH \end{array} \text{ geeft } GH = \frac{5 \cdot 12}{16} = 3{,}75$$

$$\begin{array}{c|c} 16 & 20 \\ \hline 5 & DH \end{array} \text{ geeft } DH = \frac{5 \cdot 20}{16} = 6{,}25$$

**19** **a** $\triangle ABC \sim \triangle EBD$

**b** $$\begin{array}{c|c|c} AB & BC & AC \\ \hline EB & BD & ED \end{array} \text{ geeft } \begin{array}{c|c|c} AB & 12 & 8 \\ \hline 10 & BD & 5 \end{array}$$

$$\begin{array}{c|c} AB & 8 \\ \hline 10 & 5 \end{array} \text{ geeft } AB = \frac{10 \cdot 8}{5} = 16$$

$$\begin{array}{c|c} 12 & 8 \\ \hline BD & 5 \end{array} \text{ geeft } BD = \frac{12 \cdot 5}{8} = 7{,}5$$

$AD = AB - BD = 16 - 7{,}5 = 8{,}5$

## 2.3 Gelijkvormigheid aantonen

### Bladzijde 59

**20** $$\left.\begin{array}{l} \angle C = 180° - 80° - 30° = 70° \text{ (hoekensom driehoek)} \\ \angle P = 180° - 80° - 30° = 70° \text{ (hoekensom driehoek)} \end{array}\right\} \angle C = \angle P$$

### Bladzijde 60

**21** $$\left.\begin{array}{l} \angle P \text{ (in } \triangle PQR) = \angle P \text{ (in } \triangle PST) \\ \angle R = \angle S \ (= 90°) \end{array}\right\} \triangle PQR \sim \triangle PTS$$

In $\triangle PST$ is $\angle S = 90°$, dus $PT^2 = PS^2 + ST^2$

$$PT^2 = 12^2 + 6{,}4^2 = 184{,}96$$
$$PT = \sqrt{184{,}96} = 13{,}6$$

$$\begin{array}{c|c|c} PQ & QR & PR \\ \hline PT & TS & PS \end{array} \text{ geeft } \begin{array}{c|c|c} 20{,}4 & QR & PR \\ \hline 13{,}6 & 6{,}4 & 12 \end{array}$$

$$\begin{array}{c|c} 20{,}4 & QR \\ \hline 13{,}6 & 6{,}4 \end{array} \text{ geeft } QR = \frac{20{,}4 \cdot 6{,}4}{13{,}6} = 9{,}6$$

$$\begin{array}{c|c} 20{,}4 & PR \\ \hline 13{,}6 & 12 \end{array} \text{ geeft } PR = \frac{20{,}4 \cdot 12}{13{,}6} = 18$$

$RT = PR - PT = 18 - 13{,}6 = 4{,}4$

**22** **a** $\left.\begin{array}{l} \angle A_1 = \angle A_2 \text{ (gegeven)} \\ \angle B = \angle E \text{ (gegeven)} \end{array}\right\} \triangle ABC \sim \triangle AED$

**b** $$\begin{array}{c|c|c} AB & BC & AC \\ \hline AE & ED & AD \end{array} \text{ geeft } \begin{array}{c|c|c} 6 & 4 & 3 \\ \hline 8 & ED & AD \end{array}$$

$$\begin{array}{c|c} 6 & 3 \\ \hline 8 & AD \end{array} \text{ geeft } AD = \frac{8 \cdot 3}{6} = 4$$

$$\begin{array}{c|c} 6 & 4 \\ \hline 8 & ED \end{array} \text{ geeft } DE = \frac{8 \cdot 4}{6} \approx 5{,}3$$

$CD = AD - AC = 4 - 3 = 1$

**23** **a** $\left.\begin{array}{l} \angle A \text{ (in } \triangle ABC) = \angle A \text{ (in } \triangle ADE) \\ \angle C_1 = \angle D \ (= 90^\circ) \end{array}\right\} \triangle ABC \sim \triangle AED$

**b** In $\triangle ABC$ is $\angle C_1 = 90^\circ$, dus $AB^2 = AC^2 + BC^2$

$AB^2 = 3^2 + 4^2 = 25$

$AB = \sqrt{25} = 5$

$$\begin{array}{c|c|c} AB & BC & AC \\ \hline AE & ED & AD \end{array} \text{ geeft } \begin{array}{c|c|c} 5 & 4 & 3 \\ \hline AE & 9 & AD \end{array}$$

$$\begin{array}{c|c} 5 & 4 \\ \hline AE & 9 \end{array} \text{ geeft } AE = \frac{5 \cdot 9}{4} = 11{,}25$$

$$\begin{array}{c|c} 4 & 3 \\ \hline 9 & AD \end{array} \text{ geeft } AD = \frac{9 \cdot 3}{4} = 6{,}25$$

**24** $\left.\begin{array}{l} \angle Q_1 = \angle Q_2 \text{ (gegeven)} \\ \angle R = \angle S \text{ (gegeven)} \end{array}\right\} \triangle PQR \sim \triangle TQS$

$$\begin{array}{c|c|c} PQ & QR & PR \\ \hline TQ & QS & TS \end{array} \text{ geeft } \begin{array}{c|c|c} PQ & 10 & 8 \\ \hline 8 & 6 & TS \end{array}$$

$$\begin{array}{c|c} 10 & 8 \\ \hline 6 & TS \end{array} \text{ geeft } ST = \frac{6 \cdot 8}{10} = 4{,}8$$

$$\begin{array}{c|c} PQ & 10 \\ \hline 8 & 6 \end{array} \text{ geeft } PQ = \frac{8 \cdot 10}{6} \approx 13{,}3$$

$PT = PQ - QT = 13{,}33... - 8 \approx 5{,}3$

**25** $\left.\begin{array}{l} \angle B \text{ (in } \triangle ABC) = \angle B \text{ (in } \triangle BDE) \\ \angle A = \angle E \ (= 90^\circ) \end{array}\right\} \triangle ABC \sim \triangle EBD$

In $\triangle BDE$ is $\angle E = 90^\circ$, dus $BE^2 + DE^2 = BD^2$

$BE^2 + 5^2 = 13^2$

$BE^2 = 169 - 25 = 144$

$BE = \sqrt{144} = 12$

$$\begin{array}{c|c|c} AB & BC & AC \\ \hline EB & BD & ED \end{array} \text{ geeft } \begin{array}{c|c|c} 18 & BC & AC \\ \hline 12 & 13 & 5 \end{array}$$

$$\begin{array}{c|c} 18 & AC \\ \hline 12 & 5 \end{array} \text{ geeft } AC = \frac{18 \cdot 5}{12} = 7{,}5$$

$$\begin{array}{c|c} 18 & BC \\ \hline 12 & 13 \end{array} \text{ geeft } BC = \frac{18 \cdot 13}{12} = 19{,}5$$

## Bladzijde 61

**26** $$\left.\begin{array}{l}\angle B \text{ (in } \triangle BCF) = \angle C \text{ (in } \triangle ACD) \text{ (gegeven)} \\ \angle C \text{ (in } \triangle BCF) = \angle A \text{ (} = 90^\circ) \end{array}\right\} \triangle BCF \sim \triangle CAD$$

$$\begin{array}{c|c|c} BC & CF & BF \\ \hline CA & AD & CD \end{array} \text{ geeft } \begin{array}{c|c|c} 5 & CF & 7 \\ \hline 8 & AD & CD \end{array}$$

$$\begin{array}{c|c} 5 & 7 \\ \hline 8 & CD \end{array} \text{ geeft } CD = \frac{8 \cdot 7}{5} = 11{,}2$$

Dus de ladder $CD$ is 11,2 meter.

## Bladzijde 62

**27** **a** $$\left.\begin{array}{l}\angle E = \angle H \text{ (Z-hoeken)} \\ \angle F_1 = \angle F_2 \text{ (overstaande hoeken)} \end{array}\right\} \triangle DEF \sim \triangle GHF$$

$$\begin{array}{c|c|c} DE & EF & DF \\ \hline GH & HF & GF \end{array} \text{ geeft } \begin{array}{c|c|c} 2{,}2 & 1{,}4 & 2{,}6 \\ \hline GH & 4{,}2 & GF \end{array}$$

$$\begin{array}{c|c} 2{,}2 & 1{,}4 \\ \hline GH & 4{,}2 \end{array} \text{ geeft } GH = \frac{2{,}2 \cdot 4{,}2}{1{,}4} = 6{,}6$$

$$\begin{array}{c|c} 1{,}4 & 2{,}6 \\ \hline 4{,}2 & GF \end{array} \text{ geeft } FG = \frac{2{,}6 \cdot 4{,}2}{1{,}4} = 7{,}8$$

**b** $DG = DF + FG = 2{,}6 + 7{,}8 = 10{,}4$

**28** $$\left.\begin{array}{l}\angle P = \angle R \text{ (} = 90^\circ) \\ \angle T = \angle S \text{ (Z-hoeken)} \end{array}\right\} \triangle PQT \sim \triangle RQS$$

In $\triangle QRS$ is $\angle R = 90^\circ$, dus $QS^2 = QR^2 + RS^2$

$QS^2 = 8^2 + 6^2 = 100$

$QS = \sqrt{100} = 10$

$$\begin{array}{c|c|c} PQ & QT & PT \\ \hline RQ & QS & RS \end{array} \text{ geeft } \begin{array}{c|c|c} 20 & QT & PT \\ \hline 8 & 10 & 6 \end{array}$$

$$\begin{array}{c|c} 20 & PT \\ \hline 8 & 6 \end{array} \text{ geeft } PT = \frac{20 \cdot 6}{8} = 15$$

$$\begin{array}{c|c} 20 & QT \\ \hline 8 & 10 \end{array} \text{ geeft } QT = \frac{20 \cdot 10}{8} = 25$$

**29** $$\left.\begin{array}{l}\angle C = \angle D_1 \text{ (F-hoeken)} \\ \angle B = \angle E_1 \text{ (F-hoeken)} \end{array}\right\} \triangle ABC \sim \triangle AED$$

$$\begin{array}{c|c|c} AB & BC & AC \\ \hline AE & ED & AD \end{array} \text{ geeft } \begin{array}{c|c|c} AB & BC & 26 \\ \hline 27 & 20 & 18 \end{array}$$

$$\begin{array}{c|c} AB & 26 \\ \hline 27 & 18 \end{array} \text{ geeft } AB = \frac{27 \cdot 26}{18} = 39$$

$$\begin{array}{c|c} BC & 26 \\ \hline 20 & 18 \end{array} \text{ geeft } BC = \frac{20 \cdot 26}{18} \approx 28{,}89$$

$BE = AB - AE = 39 - 27 = 12$

**30** $\left.\begin{array}{l}\angle E = \angle C \text{ (in } \triangle BCF\text{) (Z-hoeken)} \\ \angle A \text{ (in } \triangle AEF\text{)} = \angle B \text{ (Z-hoeken)}\end{array}\right\} \triangle AEF \sim \triangle BCF$

$$\begin{array}{c|c|c} AE & EF & AF \\ \hline BC & CF & BF \end{array} \text{ geeft } \begin{array}{c|c|c} 2 & EF & 1{,}5 \\ \hline 3 & CF & BF \end{array}$$

$$\begin{array}{c|c} 2 & 1{,}5 \\ \hline 3 & BF \end{array} \text{ geeft } BF = \frac{3 \cdot 1{,}5}{2} = 2{,}25$$

**31** $\left.\begin{array}{l}\angle A = \angle B \text{ (= } 90°\text{)} \\ \angle C \text{ (in } \triangle BCE\text{)} = \angle C \text{ (in } \triangle ACD\text{)}\end{array}\right\} \triangle BCE \sim \triangle ACD$

$$\begin{array}{c|c|c} BC & CE & BE \\ \hline AC & CD & AD \end{array} \text{ geeft } \begin{array}{c|c|c} 1{,}3 & CE & 1{,}75 \\ \hline 21{,}3 & CD & AD \end{array}$$

$$\begin{array}{c|c} 1{,}3 & 1{,}75 \\ \hline 21{,}3 & AD \end{array} \text{ geeft } AD = \frac{21{,}3 \cdot 1{,}75}{1{,}3} \approx 28{,}7$$

Dus de hoogte van de boom is 28,7 meter.

## Bladzijde 63

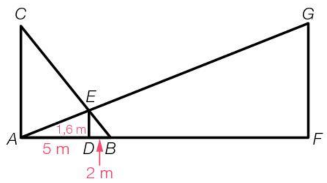
**32** $\left.\begin{array}{l}\angle B = \angle D \text{ (= } 90°\text{)} \\ \angle A = \angle E \text{ (Z-hoeken)}\end{array}\right\} \triangle ABC \sim \triangle EDC$

$$\begin{array}{c|c|c} AB & BC & AC \\ \hline ED & DC & EC \end{array} \text{ geeft } \begin{array}{c|c|c} 25 & 8 & AC \\ \hline DE & 20 & EC \end{array}$$

$$\begin{array}{c|c} 25 & 8 \\ \hline DE & 20 \end{array} \text{ geeft } DE = \frac{25 \cdot 20}{8} = 62{,}5 \text{ meter}$$

Dus de breedte van het kanaal is 62,5 meter.

**33** **a** Zie de figuur hiernaast.




$\left.\begin{array}{l}\angle A \text{ (in } \triangle ABC\text{)} = \angle D \text{ (in } \triangle BDE\text{) (= } 90°\text{)} \\ \angle B \text{ (in } \triangle ABC\text{)} = \angle B \text{ (in } \triangle BDE\text{)}\end{array}\right\} \triangle ABC \sim \triangle DBE$

$$\begin{array}{c|c|c} AB & BC & AC \\ \hline DB & BE & DE \end{array} \text{ geeft } \begin{array}{c|c|c} 7 & BC & AC \\ \hline 2 & BE & 1{,}6 \end{array}$$

$$\begin{array}{c|c} 7 & AC \\ \hline 2 & 1{,}6 \end{array} \text{ geeft } AC = \frac{7 \cdot 1{,}6}{2} = 5{,}6$$

Dus de hoogte van de lantaarnpalen is 5,6 meter.

**b** $\left.\begin{array}{l}\angle A \text{ (in } \triangle AFG\text{)} = \angle A \text{ (in } \triangle ADE\text{)} \\ \angle F = \angle D \text{ (= } 90°\text{)}\end{array}\right\} \triangle AFG \sim \triangle ADE$

$$\begin{array}{c|c|c} AF & FG & AG \\ \hline AD & DE & AE \end{array} \text{ geeft } \begin{array}{c|c|c} AF & 5{,}6 & AG \\ \hline 5 & 1{,}6 & AE \end{array}$$

$$\begin{array}{c|c} AF & 5{,}6 \\ \hline 5 & 1{,}6 \end{array} \text{ geeft } AF = \frac{5 \cdot 5{,}6}{1{,}6} = 17{,}5$$

Dus de afstand tussen de lantaarnpalen is 17,5 meter.

**34** Zie de figuur hiernaast.
In $\triangle FST'$ is $\angle F = 90°$, dus $ST'^2 = FS^2 + FT'^2$

$$ST'^2 = 115^2 + 315^2 = 112\,450$$
$$ST' = \sqrt{112\,450} = 335{,}33...$$

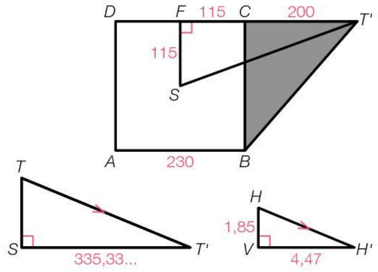
Bram geven we aan met het lijnstuk $HV$ en zijn schaduw met het lijnstuk $H'V$. Zie de figuur hiernaast.

$$\left.\begin{array}{l}\angle S = \angle V\ (= 90°)\\ \angle T' = \angle H'\ \text{(F-hoeken)}\end{array}\right\}\ \triangle STT' \sim \triangle VHH'$$

$$\begin{array}{c|c|c} ST & TT' & ST' \\ \hline VH & HH' & VH' \end{array} \text{ geeft } \begin{array}{c|c|c} ST & TT' & 335{,}33... \\ \hline 1{,}85 & HH' & 4{,}47 \end{array}$$

$$\begin{array}{c|c} ST & 335{,}33... \\ \hline 1{,}85 & 4{,}47 \end{array} \text{ geeft } ST = \frac{1{,}85 \cdot 335{,}33...}{4{,}47} \approx 139$$

Dus de hoogte van de piramide is 139 meter.

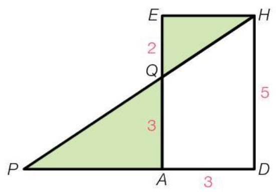



**35** **a** Zie de figuur hiernaast.

$$\left.\begin{array}{l}\angle P = \angle H\ \text{(in } \triangle EHQ)\ \text{(Z-hoeken)}\\ \angle A = \angle E\ (= 90°)\end{array}\right\}\triangle APQ \sim \triangle EHQ$$

$$\begin{array}{c|c|c} AP & PQ & AQ \\ \hline EH & HQ & EQ \end{array} \text{ geeft } \begin{array}{c|c|c} AP & PQ & 3 \\ \hline 3 & HQ & 2 \end{array}$$

$$\begin{array}{c|c} AP & 3 \\ \hline 3 & 2 \end{array} \text{ geeft } AP = \frac{3 \cdot 3}{2} = 4{,}5$$

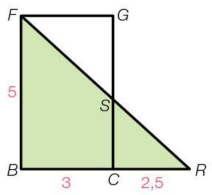



**b** Zie de figuur hiernaast.

$$\left.\begin{array}{l}\angle R\ \text{(in } \triangle BRF) = \angle R\ \text{(in } \triangle CRS)\\ \angle B = \angle C\ (= 90°)\end{array}\right\}\triangle BFR \sim \triangle CSR$$

$$\begin{array}{c|c|c} BF & FR & BR \\ \hline CS & SR & CR \end{array} \text{ geeft } \begin{array}{c|c|c} 5 & FR & 5{,}5 \\ \hline CS & SR & 2{,}5 \end{array}$$

$$\begin{array}{c|c} 5 & 5{,}5 \\ \hline CS & 2{,}5 \end{array} \text{ geeft } CS = \frac{2{,}5 \cdot 5}{5{,}5} \approx 2{,}27$$




## 2.4 Een lengte *x* stellen

### Bladzijde 64

**36** **a** Uit $\triangle PQT \sim \triangle PRS$ volgt de verhoudingstabel $\begin{array}{c|c|c} PQ & QT & PT \\ \hline PR & RS & PS \end{array}$, en hieruit volgt de verhoudingstabel $\begin{array}{c|c} PQ & QT \\ \hline PR & RS \end{array}$.

**b** Je kunt $PQ$ niet berekenen met $PQ = \dfrac{PR \cdot QT}{RS}$ omdat je $PR$ niet weet.

### Bladzijde 65

**37** **a**

$$\left.\begin{array}{l}\angle E\ \text{(in } \triangle ADE) = \angle E\ \text{(in } \triangle CEF)\\ \angle D = \angle C\ (= 90°)\end{array}\right\}\triangle ADE \sim \triangle FCE$$

Stel $CE = x$, dan is $DE = 8{,}4 + x$.

$$\begin{array}{c|c} AD & DE \\ \hline FC & CE \end{array} \text{ geeft } \begin{array}{c|c} 6 & 8{,}4 + x \\ \hline 1{,}8 & x \end{array}$$

$6x = 1{,}8(8{,}4 + x)$
$6x = 15{,}12 + 1{,}8x$
$4{,}2x = 15{,}12$
$x = \dfrac{15{,}12}{4{,}2} = 3{,}6$, dus $CE = 3{,}6$.

**b** In $\triangle CEF$ is $\angle C = 90°$, dus $EF^2 = CE^2 + CF^2$

$$EF^2 = 3{,}6^2 + 1{,}8^2 = 16{,}2$$
$$EF = \sqrt{16{,}2} \approx 4{,}0$$

**38** **a** $\left.\begin{array}{l}\angle B = \angle E \text{ (Z-hoeken)}\\ \angle A = \angle D\ (= 90°)\end{array}\right\}\triangle ABC \sim \triangle DEC$

Stel $AC = x$, dan is $CD = 6{,}6 - x$.

$$\begin{array}{c|c} BC & AC \\ \hline EC & DC \end{array} \text{ geeft } \begin{array}{c|c} 6{,}2 & x \\ \hline 2{,}6 & 6{,}6 - x \end{array}$$

$2{,}6x = 6{,}2(6{,}6 - x)$
$2{,}6x = 40{,}92 - 6{,}2x$
$8{,}8x = 40{,}92$
$x = \dfrac{40{,}92}{8{,}8} = 4{,}65$, dus $AC = 4{,}65$.

**b** In $\triangle ABC$ is $\angle A = 90°$, dus $AB^2 + AC^2 = BC^2$
$AB^2 + 4{,}65^2 = 6{,}2^2$
$AB^2 = 6{,}2^2 - 4{,}65^2 = 16{,}8175$
$AB = \sqrt{16{,}8175} = 4{,}100...$

opp $\triangle ABC = \frac{1}{2} \cdot 4{,}100... \cdot 4{,}65 \approx 9{,}5$

**39** $\left.\begin{array}{l}\angle A \text{ (in } \triangle ABD) = \angle A \text{ (in } \triangle ACE)\\ \angle D \text{ (in } \triangle ABD) = \angle E \text{ (F-hoeken)}\end{array}\right\}\triangle ABD \sim \triangle ACE$

Stel $AB = x$, dan is $AC = x + 26$.

$$\begin{array}{c|c} AB & AD \\ \hline AC & AE \end{array} \text{ geeft } \begin{array}{c|c} x & 158 \\ \hline x + 26 & 178 \end{array}$$

$178x = 158(x + 26)$
$178x = 158x + 4108$
$20x = 4108$
$x = \dfrac{4108}{20} = 205{,}4$, dus $AB = 205{,}4$ meter.

**40** $\left.\begin{array}{l}\angle A = \angle D \text{ (in } \triangle BDS) \text{ (F-hoeken)}\\ \angle B \text{ (in } \triangle ABC) = \angle B \text{ (in } \triangle BDS)\end{array}\right\}\triangle ABC \sim \triangle DBS$

Stel $BS = x$, dan is $BC = 5 + x$.

$$\begin{array}{c|c} BC & AC \\ \hline BS & DS \end{array} \text{ geeft } \begin{array}{c|c} 5 + x & 11 \\ \hline x & 4 \end{array}$$

$11x = 4(x + 5)$
$11x = 4x + 20$
$7x = 20$
$x = \frac{20}{7}$, dus $BS = \frac{20}{7}$.

$\left.\begin{array}{l}\angle D \text{ (in } \triangle DEF) = \angle D \text{ (in } \triangle BDS)\\ \angle E = \angle B \text{ (in } \triangle BDS) \text{ (F-hoeken)}\end{array}\right\}\triangle DEF \sim \triangle DBS$

$$\begin{array}{c|c} EF & DF \\ \hline BS & DS \end{array} \text{ geeft } \begin{array}{c|c} EF & 18 \\ \hline \frac{20}{7} & 4 \end{array}$$

$EF = \dfrac{18 \cdot \frac{20}{7}}{4} \approx 12{,}9$

## 2.5 Hellingsgetal

### Bladzijde 66

**41** **a** Bij een horizontale verplaatsing van één meter is de verticale verplaatsing $\frac{9}{40} = 0{,}225$ meter.

**b** Bij een horizontale verplaatsing van één meter is van helling b de verticale verplaatsing $\frac{12}{60} = 0{,}2$ meter, en is van helling c de verticale verplaatsing $\frac{11}{50} = 0{,}22$ meter. Bij helling a is bij een horizontale verplaatsing van één meter de verticale verplaatsing het grootst, dus helling a is het steilst.

## Bladzijde 67

**42** **a** hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = \dfrac{159}{562} \approx 0{,}28$

**b** $\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 0{,}37$ geeft $\begin{array}{c|c} \text{verticale verplaatsing} & 0{,}37 \\ \hline 300 & 1 \end{array}$

verticale verplaatsing $= 300 \cdot 0{,}37 = 111$

**c** $\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 0{,}22$ geeft $\begin{array}{c|c} 53 & 0{,}22 \\ \hline \text{horizontale verplaatsing} & 1 \end{array}$

horizontale verplaatsing $= \dfrac{53}{0{,}22} \approx 240{,}91$

**43** **a** hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = \dfrac{388{,}8}{4050} = 0{,}096$, dus hellingspercentage = 9,6%.

**b** hellingspercentage = 27%, dus hellingsgetal = 0,27.

$\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 0{,}27$ geeft $\begin{array}{c|c} 112 & 0{,}27 \\ \hline \text{horizontale verplaatsing} & 1 \end{array}$

horizontale verplaatsing $= \dfrac{112}{0{,}27} \approx 414{,}8$

**c** hellingspercentage = 7,6%, dus hellingsgetal = 0,076.

$\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 0{,}076$ geeft $\begin{array}{c|c} \text{verticale verplaatsing} & 0{,}076 \\ \hline 170 & 1 \end{array}$

verticale verplaatsing $= 170 \cdot 0{,}076 \approx 12{,}9$

## Bladzijde 68

**44** hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = \dfrac{29{,}6}{185} = 0{,}16$, dus hellingspercentage = 16%.

**45** hellingspercentage = 142%, dus hellingsgetal = 1,42.

$\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 1{,}42$ geeft $\begin{array}{c|c} 177{,}5 & 1{,}42 \\ \hline \text{horizontale verplaatsing} & 1 \end{array}$

horizontale verplaatsing $= \dfrac{177{,}5}{1{,}42} = 125$ meter

**46** **a** $AB$: hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = \dfrac{5}{300} \approx 0{,}017$, dus hellingspercentage ≈ 1,7%.

$CD$: hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = \dfrac{35}{300} \approx 0{,}117$, dus hellingspercentage ≈ 11,7%.

$GH$: hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = \dfrac{30}{300} = 0{,}1$, dus hellingspercentage = 10%.

**b** $KI$: hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = \dfrac{60}{400} = 0{,}15$, dus hellingspercentage = 15%.

$FE$: hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = \dfrac{10}{100} = 0{,}1$, dus hellingspercentage = 10%.

**47** Op helling $BC$:
hellingspercentage = 8%, dus hellingsgetal = 0,08.

$\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 0{,}08$ geeft $\begin{array}{c|c} \text{verticale verplaatsing} & 0{,}08 \\ \hline 80 & 1 \end{array}$

verticale verplaatsing $= 80 \cdot 0{,}08 = 6{,}4$ meter
Op helling $AB$:
hellingspercentage = 13%, dus hellingsgetal = 0,13.

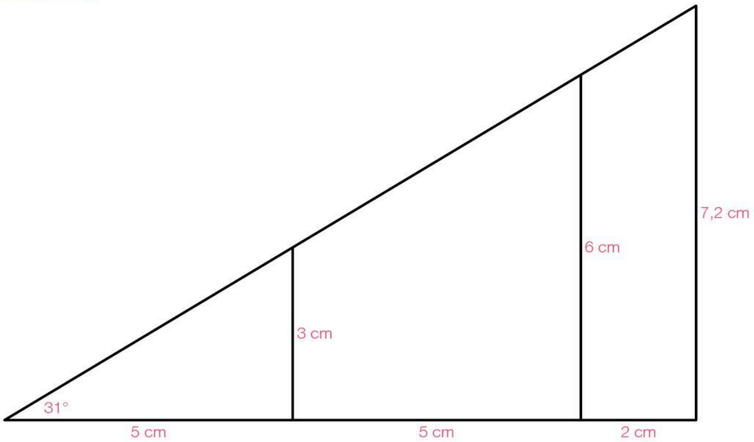
$\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 0{,}13$ geeft $\begin{array}{c|c} \text{verticale verplaatsing} & 0{,}13 \\ \hline 160 & 1 \end{array}$

verticale verplaatsing $= 160 \cdot 0{,}13 = 20{,}8$ meter
Dus de skiër daalt $6{,}4 + 20{,}8 = 27{,}2$ meter.

## 2.6 Tangens

### Bladzijde 69

**48** **a**




verticale verplaatsing ≈ 3 cm geeft hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} \approx \dfrac{3}{5} = 0{,}6$

**b** verticale verplaatsing ≈ 6 cm geeft hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} \approx \dfrac{6}{10} = 0{,}6$

**c** verticale verplaatsing ≈ 7,2 cm geeft hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} \approx \dfrac{7{,}2}{12} = 0{,}6$

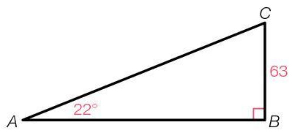
**49** **a** $\tan(28°) \approx 0{,}53$ **c** $\tan(40°) \approx 0{,}84$ **e** $\tan(1°) \approx 0{,}02$
**b** $\tan(4°) \approx 0{,}07$ **d** $\tan(15°) \approx 0{,}27$ **f** $\tan(89°) \approx 57{,}29$

### Bladzijde 70

**50** **a** $15\tan(74°) \approx 52{,}31$ **b** $\dfrac{\tan(15°)}{74} \approx 0{,}00$ **c** $\dfrac{8{,}4}{\tan(9°)} \approx 53{,}04$

### Bladzijde 71

**51** **a** Zie de figuur hiernaast.



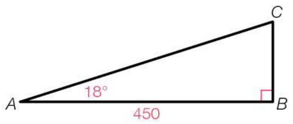

$\tan(\angle A) = \dfrac{BC}{AB}$ geeft $\begin{array}{c|c} \tan(22°) & 63 \\ \hline 1 & AB \end{array}$

$AB = \dfrac{63}{\tan(22°)} \approx 155{,}9$

Dus de horizontale verplaatsing is 155,9 meter.

**b** $\angle B = 90°$, dus $AC^2 = AB^2 + BC^2$
$AC^2 = 155{,}93...^2 + 63^2 = 28\,283{,}3...$
$AC = \sqrt{28\,283{,}3...} \approx 168$
Dus de lengte van de helling is 168 meter.

**52** Zie de figuur hiernaast.




$\tan(\angle A) = \dfrac{BC}{AB}$ geeft $\begin{array}{c|c} \tan(18°) & BC \\ \hline 1 & 450 \end{array}$

$BC = 450\tan(18°) = 146{,}2...$
$\angle B = 90°$, dus $AC^2 = AB^2 + BC^2$
$AC^2 = 450^2 + 146{,}2...^2 = 223\,878{,}4...$
$AC = \sqrt{223\,878{,}4...} \approx 473$
Dus de lengte van de helling is 473 meter.

**53** **a** Zijde $AC$ is de verticale verplaatsing en zijde $AB$ is de horizontale verplaatsing.

**b** $\tan(\angle B) = \dfrac{AC}{AB}$ geeft $\begin{array}{c|c} \tan(22^\circ) & AC \\ \hline 1 & 4{,}5 \end{array}$

$AC = 4{,}5\tan(22^\circ) \approx 1{,}8$ cm

**54** **a** $\tan(\angle A) = \dfrac{BC}{AB}$ geeft $\begin{array}{c|c} \tan(15^\circ) & BC \\ \hline 1 & 98 \end{array}$

$BC = 98\tan(15^\circ) \approx 26{,}3$ meter

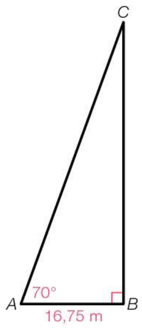
**b** $\angle B = 90^\circ$, dus $AC^2 = AB^2 + BC^2$

$AC^2 = 98^2 + 26{,}25...^2 = 10\,293{,}5...$

$AC = \sqrt{10\,293{,}5...} \approx 101{,}5$ meter

**c** De oppervlakte van de piste is $24 \cdot 101{,}45... \approx 2435$ m$^2$.

**55** Zie de figuur hiernaast.




$\tan(\angle A) = \dfrac{BC}{AB}$ geeft $\begin{array}{c|c} \tan(70^\circ) & BC \\ \hline 1 & 16{,}75 \end{array}$

$BC = 16{,}75\tan(70^\circ) = 46{,}02...$

$\angle B = 90^\circ$, dus $AC^2 = AB^2 + BC^2$

$AC^2 = 16{,}75^2 + 46{,}02...^2 = 2398{,}42...$

$AC = \sqrt{2398{,}42...} = 48{,}97...$

De snelheid is $\dfrac{48{,}97...}{44} = 1{,}11...$ meter per seconde.

Dat is $\dfrac{1{,}11... \cdot 3600}{1000} \approx 4{,}0$ km per uur.

**56** **a** hellingshoek $\approx 35^\circ$
**b** hellingshoek $\approx 11^\circ$
**c** hellingshoek $= 45^\circ$
**d** hellingshoek $\approx 6^\circ$

## Bladzijde 72

**57** **a** $\tan(\angle A) = \frac{17}{9}$ geeft $\angle A \approx 62{,}1^\circ$
**b** $\tan(\angle A) = 0{,}821$ geeft $\angle A \approx 39{,}4^\circ$
**c** $\tan(\angle A) = 9{,}6$ geeft $\angle A \approx 84{,}1^\circ$
**d** $\tan(\angle A) = 1$ geeft $\angle A = 45^\circ$
**e** $\tan(\angle A) = \sqrt{3}$ geeft $\angle A = 60^\circ$
**f** $\tan(\angle A) = 1\frac{3}{7}$ geeft $\angle A \approx 55{,}0^\circ$

## Bladzijde 73

**58**

| hellingshoek | 11,3° | 17° | 69,7° | 39° | 77,5° | 79,5° | 80,2° |
|---|---|---|---|---|---|---|---|
| hellingsgetal | 0,2 | 0,3 | 2,7 | 0,8 | 4,5 | 5,4 | 5,8 |

**59** $\tan(\angle A) = \dfrac{BC}{AB} = \dfrac{22}{40}$ geeft $\angle A \approx 28{,}8^\circ$

$\tan(\angle E) = \dfrac{DF}{DE} = \dfrac{29}{39}$ geeft $\angle E \approx 36{,}6^\circ$

$\tan(\angle K) = \dfrac{LM}{KL} = \dfrac{36}{28}$ geeft $\angle K \approx 52{,}1^\circ$

**60** hellingspercentage = 50%, dus hellingsgetal = 0,5.
Dit geeft hellingshoek $\approx 26{,}6^\circ$.
Dus de maximale hellingshoek die deze pistebully aankan is ongeveer $26{,}6^\circ$.

**61** $PZ = 2950 - 996 = 1954$

$\angle P = 90^\circ$, dus $EP^2 + PZ^2 = EZ^2$

$EP^2 + 1954^2 = 2200^2$

$EP^2 = 2200^2 - 1954^2 = 1\,021\,884$

$EP = \sqrt{1\,021\,884} = 1010{,}88...$

$\tan(\angle E) = \dfrac{PZ}{EP} = \dfrac{1954}{1010{,}88...}$ geeft $\angle E \approx 62{,}6^\circ$

Dus de hellingshoek van de baan is ongeveer $62{,}6^\circ$.

**62** De verticale verplaatsing is 3218 − 2489 = 729 meter.
Meten geeft $AB$ = 4 cm, dus de horizontale verplaatsing is in werkelijkheid 20 000 · 4 = 80 000 cm = 800 meter.

$\tan(\text{hellingshoek}) = \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = \dfrac{729}{800}$ geeft hellingshoek ≈ 42,3°.

## Gemengde opgaven

### Bladzijde 74

**1** **a** $\begin{array}{c|c} 11 & a \\ \hline 29 & 40 \end{array}$ geeft $a = \dfrac{11 \cdot 40}{29} \approx 15{,}17$

$\begin{array}{c|c} 11 & 3 \\ \hline 29 & b \end{array}$ geeft $b = \dfrac{29 \cdot 3}{11} \approx 7{,}91$

**b** $\begin{array}{c|c} c+3 & 8 \\ \hline c-3 & 5 \end{array}$ geeft $5(c+3) = 8(c-7)$

$$\begin{aligned} 5c + 15 &= 8c - 56 \\ 5c - 8c &= -56 - 15 \\ -3c &= -71 \\ c &= \frac{-71}{-3} \approx 23{,}67 \end{aligned}$$

$\begin{array}{c|c} 8 & 3d-11 \\ \hline 5 & d+9 \end{array}$ geeft $8(d+9) = 5(3d-11)$

$$\begin{aligned} 8d + 72 &= 15d - 55 \\ 8d - 15d &= -55 - 72 \\ -7d &= -127 \\ d &= \frac{-127}{-7} \approx 18{,}14 \end{aligned}$$

**2** $\left.\begin{array}{l} \angle P \text{ (in } \triangle PQT) = \angle P \text{ (in } \triangle PRS) \\ \angle Q \text{ (in } \triangle PQT) = \angle R \text{ (F-hoeken)} \end{array}\right\} \triangle PQT \sim \triangle PRS$

$\begin{array}{c|c|c} PQ & QT & PT \\ \hline PR & RS & PS \end{array}$ geeft $\begin{array}{c|c|c} 26 & 18 & PT \\ \hline PR & 30 & 62 \end{array}$

$\begin{array}{c|c} 26 & 18 \\ \hline PR & 30 \end{array}$ geeft $PR = \dfrac{30 \cdot 26}{1} \approx 43{,}3$

$QR = PR - PQ = 43{,}33... - 26 \approx 17{,}3$

$\begin{array}{c|c} 18 & PT \\ \hline 30 & 62 \end{array}$ geeft $PT = \dfrac{18 \cdot 62}{30} = 37{,}2$

$ST = PS - PT = 62 - 37{,}2 = 24{,}8$

**3** $\left.\begin{array}{l} \angle A = \angle D \ (= 90°) \\ \angle S \text{ (in } \triangle AST) = \angle S \text{ (in } \triangle DHS) \end{array}\right\} \triangle AST \sim \triangle DSH$

$\begin{array}{c|c|c} AS & ST & AT \\ \hline DS & SH & DH \end{array}$ geeft $\begin{array}{c|c|c} 8{,}4 & ST & AT \\ \hline 0{,}6 & SH & 1{,}7 \end{array}$

$\begin{array}{c|c} 8{,}4 & AT \\ \hline 0{,}6 & 1{,}7 \end{array}$ geeft $AT = \dfrac{8{,}4 \cdot 1{,}7}{0{,}6} = 23{,}8$

De hoogte van de toren is 23,8 meter.

**4** **a** $\left.\begin{array}{l}\angle A = \angle E \ (= 90°) \\ \angle B \text{ (in } \triangle ABC) = \angle B \text{ (in } \triangle BDE)\end{array}\right\} \triangle ABC \sim \triangle EBD$

In $\triangle ABC$ is $\angle A = 90°$, dus $BC^2 = AB^2 + AC^2$

$BC^2 = 12^2 + 5^2 = 169$

$BC = \sqrt{169} = 13$

| $AB$ | $BC$ | $AC$ |
|---|---|---|
| $EB$ | $BD$ | $ED$ |

geeft

| 12 | 13 | 5 |
|---|---|---|
| 5 | $BD$ | $ED$ |

| 12 | 5 |
|---|---|
| 5 | $ED$ |

geeft $DE = \dfrac{5 \cdot 5}{12} \approx 2{,}08$

| 12 | 13 |
|---|---|
| 5 | $BD$ |

geeft $BD = \dfrac{5 \cdot 13}{12} = 5{,}416...$

$AD = AB - BD = 12 - 5{,}416... \approx 6{,}58$

**b** $\tan(\angle B) = \dfrac{AC}{AB} = \dfrac{5}{12}$ geeft $\angle B = 22{,}61...°$

$\angle D_2 = 180° - 90° - 22{,}61...° = 67{,}38...°$ (hoekensom driehoek)
$\angle D_1 = 180° - 67{,}38...° \approx 112{,}6°$ (gestrekte hoek)

**5** **a** $\left.\begin{array}{l}\angle E \text{ (in } \triangle ABE) = \angle E \text{ (in } \triangle CEF) \\ \angle A \text{ (in } \triangle ABE) = \angle F \text{ (in } \triangle CEF) \text{ (F-hoeken)}\end{array}\right\} \triangle ABE \sim \triangle FCH$

| $AB$ | $BE$ | $AE$ |
|---|---|---|
| $FC$ | $CE$ | $FE$ |

geeft

| 6 | 8 | $AE$ |
|---|---|---|
| $FC$ | 3 | $FE$ |

| 6 | 8 |
|---|---|
| $FC$ | 3 |

geeft $CF = \dfrac{6 \cdot 3}{8} = 2{,}25$

**b** $\left.\begin{array}{l}\angle G = \angle B \text{ (in } \triangle BCH) \text{ (Z-hoeken)} \\ \angle H \text{ (in } \triangle DGH) = \angle H \text{ (in } \triangle BCH) \text{ (overstaande hoeken)}\end{array}\right\} \triangle DGH \sim \triangle CBH$

| $DG$ | $GH$ | $DH$ |
|---|---|---|
| $CB$ | $BH$ | $CH$ |

geeft

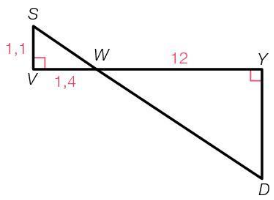
| $CG$ | $GH$ | 2 |
|---|---|---|
| 5 | $BH$ | 4 |

| $DG$ | 2 |
|---|---|
| 5 | 4 |

geeft $DG = \dfrac{2 \cdot 5}{4} = 2{,}5$

## Bladzijde 75

**6** **a** Zie de figuur hiernaast.




$\left.\begin{array}{l}\angle V = \angle Y \ (= 90°) \\ \angle S = \angle D \text{ (Z-hoeken)}\end{array}\right\} \triangle SVW \sim \triangle DYW$

| $SV$ | $VW$ | $SW$ |
|---|---|---|
| $DY$ | $YW$ | $DW$ |

geeft

| 1,1 | 1,4 | $SW$ |
|---|---|---|
| $DY$ | 12 | $DW$ |

| 1,1 | 1,4 |
|---|---|
| $DY$ | 12 |

geeft $DY = \dfrac{1{,}1 \cdot 12}{1{,}4} \approx 9{,}4$

Dus de diepte van de duiker is 9,4 meter.

**b** In $\triangle SVW$ is $\angle V = 90°$, dus $SW^2 = SV^2 + VW^2$

$SW^2 = 1{,}1^2 + 1{,}4^2 = 3{,}17$

$SW = \sqrt{3{,}17} = 1{,}78...$

In $\triangle DYW$ is $\angle Y = 90°$, dus $DW^2 = DY^2 + WY^2$

$DW^2 = 9{,}42...^2 + 12^2 = 232{,}89...$

$DW = \sqrt{232{,}89...} = 15{,}26...$

$DS = 15{,}26... + 1{,}78... \approx 17{,}0$

Dus de lengte van de veiligheidslijn is 17,0 meter.

**c** $\tan(\angle W) = \dfrac{SV}{VW} = \dfrac{1{,}1}{1{,}4}$ geeft $\angle W \approx 38{,}2°$

Dus de lijn maakt een hoek van 38,2° met het water.

**7** **a** hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = \dfrac{1}{37} \approx 0{,}027$, dus hellingspercentage $\approx 2{,}7\%$.

**b** hellingsgetal $= 0{,}0270...$ geeft hellingshoek $\approx 1{,}55°$.

**c** hellingshoek $= 1{,}15°$ geeft hellingsgetal $= \tan(1{,}15°) = 0{,}020...$

hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}}$ geeft $\begin{array}{c|c} 0{,}020... & 1 \\ \hline 1 & \text{horizontale verplaatsing} \end{array}$,

dus horizontale verplaatsing $= \dfrac{1}{0{,}020...} \approx 50$.

Dus het glijgetal is 50.

**8** **a** $\tan(\angle B) = \dfrac{AC}{BC}$ geeft $\begin{array}{c|c} \tan(41°) & AC \\ \hline 1 & 120 \end{array}$ dus $AC = 120\tan(41°) \approx 104$.

Dus de kist raakt de muur op een hoogte van 104 cm.

**b** In $\triangle ABC$ is $\angle C = 90°$, dus $AB^2 = BC^2 + AC^2$

$AB^2 = 120^2 + 104{,}3...^2 = 25\,281{,}4...$

$AB = \sqrt{25\,281{,}4...} = 159{,}0...\text{ cm} = 15{,}90...\text{ dm}$

De inhoud van de kist is $(15{,}90...)^3 \approx 4020\text{ dm}^3 = 4020$ L.

**9** $\left.\begin{array}{l} \angle A = \angle E\ (= 90°) \\ \angle C_1 = \angle C_2 \text{ (overstaande hoeken)} \end{array}\right\} \triangle ABC \sim \triangle EDC$

In $\triangle ABC$ is $\angle A = 90°$, dus $AB^2 + AC^2 = BC^2$

$AB^2 + 7^2 = 25^2$

$AB^2 = 625 - 49 = 576$

$AB = \sqrt{576} = 24$

$\begin{array}{c|c|c} AB & BC & AC \\ \hline ED & DC & EC \end{array}$ geeft $\begin{array}{c|c|c} 24 & 25 & 7 \\ \hline 60 & DC & EC \end{array}$

$\begin{array}{c|c} 24 & 25 \\ \hline 60 & DC \end{array}$ geeft $CD = \dfrac{60 \cdot 25}{24} = 62{,}5$

In $\triangle ABD$ is $\angle A = 90°$, dus $BD^2 = AB^2 + AD^2$

$BD^2 = 576 + (7 + 62{,}5)^2 = 5406{,}25$

$BD = \sqrt{5406{,}25} \approx 73{,}5$

**10** $\left.\begin{array}{l} \angle A = \angle D_2 \text{ (F-hoeken)} \\ \angle B = \angle E_2 \text{ (F-hoeken)} \end{array}\right\} \triangle ABC \sim \triangle DEC$

Stel $CE = x$, dan is $BC = 2 + x$.

$\begin{array}{c|c} AB & BC \\ \hline DE & EC \end{array}$ geeft $\begin{array}{c|c} 5{,}6 & 2+x \\ \hline 4 & x \end{array}$

$5{,}6x = 4(2 + x)$

$5{,}6x = 8 + 4x$

$1{,}6x = 8$

$x = \dfrac{8}{1{,}6} = 5$, dus $CE = 5$ en $BC = 7$.

$\begin{array}{c|c} AB & AC \\ \hline DE & DC \end{array}$ geeft $\begin{array}{c|c} 5{,}6 & AC \\ \hline 4 & 7 \end{array}$ dus $AC = \dfrac{5{,}6 \cdot 7}{4} = 9{,}8$.

Dus de omtrek van $\triangle ABC$ is $5{,}6 + 7 + 9{,}8 = 22{,}4$.

## Diagnostische toets

### Bladzijde 78

**1** **a** $\begin{array}{c|c} 6 & x \\ \hline 13 & 17 \end{array}$ geeft $x = \dfrac{6 \cdot 17}{13} \approx 7{,}8$

$\begin{array}{c|c} 6 & 17 \\ \hline 13 & y \end{array}$ geeft $y = \dfrac{13 \cdot 17}{6} \approx 36{,}8$

**b** $\begin{array}{c|c} 13 & x-6 \\ \hline 21 & 7 \end{array}$ geeft $21(x-6) = 13 \cdot 7$

$$\begin{aligned} 21x - 126 &= 91 \\ 21x &= 91 + 126 \\ 21x &= 217 \\ x &= \frac{217}{21} \approx 10{,}3 \end{aligned}$$

$\begin{array}{c|c} 13 & 3 \\ \hline 21 & 2y-1 \end{array}$ geeft $13(2y-1) = 21 \cdot 3$

$$\begin{aligned} 26y - 13 &= 63 \\ 26y &= 63 + 13 \\ 26y &= 76 \\ y &= \frac{76}{26} \approx 2{,}9 \end{aligned}$$

**c** $\begin{array}{c|c} x-1 & 2x+3 \\ \hline 5 & 4 \end{array}$ geeft $5(2x+3) = 4(x-1)$

$$\begin{aligned} 10x + 15 &= 4x - 4 \\ 10x - 4x &= -4 - 15 \\ 6x &= -19 \\ x &= \frac{-19}{6} \approx -3{,}2 \end{aligned}$$

**2** **a** $\triangle ABC \sim \triangle DEC$

**b** In $\triangle CDE$ is $\angle E = 90°$, dus $CE^2 + DE^2 = CD^2$

$$\begin{aligned} CE^2 + 12^2 &= 20^2 \\ CE^2 &= 400 - 144 = 256 \\ CE &= \sqrt{256} = 16 \end{aligned}$$

Uit $\triangle ABC \sim \triangle DEC$ volgt $\begin{array}{c|c|c} AB & BC & AC \\ \hline DE & EC & DC \end{array}$ en dit geeft $\begin{array}{c|c|c} AB & 35 & AC \\ \hline 12 & 16 & 20 \end{array}$.

$\begin{array}{c|c} 35 & AC \\ \hline 16 & 20 \end{array}$ geeft $AC = \dfrac{35 \cdot 20}{16} = 43{,}75$

$\begin{array}{c|c} AB & 35 \\ \hline 12 & 16 \end{array}$ geeft $AB = \dfrac{35 \cdot 12}{16} = 26{,}25$

**3** **a** $\triangle PQR \sim \triangle PTS$

**b** Uit $\triangle PQR \sim \triangle PTS$ volgt $\begin{array}{c|c|c} PQ & QR & PR \\ \hline PT & TS & PS \end{array}$ en dit geeft $\begin{array}{c|c|c} 9{,}6 & QR & 14{,}4 \\ \hline PT & 3{,}5 & 6 \end{array}$.

$\begin{array}{c|c} 9{,}6 & 14{,}4 \\ \hline PT & 6 \end{array}$ geeft $PT = \dfrac{9{,}6 \cdot 6}{14{,}4} = 4$

$\begin{array}{c|c} QR & 14{,}4 \\ \hline 3{,}5 & 6 \end{array}$ geeft $QR = \dfrac{3{,}5 \cdot 14{,}4}{6} = 8{,}4$

**4** $\left.\begin{array}{l} \angle C = \angle D \ (= 90°) \\ \angle B \text{ (in } \triangle ABC) = \angle B \text{ (in } \triangle BDE) \end{array}\right\} \triangle ABC \sim \triangle EBD$

In $\triangle ABC$ is $\angle C = 90°$, dus $AB^2 = AC^2 + BC^2$

$$\begin{aligned} AB^2 &= 6^2 + 8^2 = 100 \\ AB &= \sqrt{100} = 10 \end{aligned}$$

$\begin{array}{c|c|c} AB & BC & AC \\ \hline EB & BD & ED \end{array}$ geeft $\begin{array}{c|c|c} 10 & 8 & 6 \\ \hline 6{,}5 & BD & ED \end{array}$

$\begin{array}{c|c} 10 & 6 \\ \hline 6{,}5 & ED \end{array}$ geeft $DE = \dfrac{6{,}5 \cdot 6}{10} = 3{,}9$

$\begin{array}{c|c} 10 & 8 \\ \hline 6{,}5 & BD \end{array}$ geeft $BD = \dfrac{6{,}5 \cdot 8}{10} = 5{,}2$

**5** $\left.\begin{array}{l}\angle A = \angle D \text{ (Z-hoeken)} \\ \angle B = \angle E \text{ (Z-hoeken)}\end{array}\right\} \triangle ABC \sim \triangle DEC$

$\begin{array}{c|c|c} AB & BC & AC \\ \hline DE & EC & DC \end{array}$ geeft $\begin{array}{c|c|c} 6{,}2 & 9{,}8 & 5{,}3 \\ \hline DE & 3{,}1 & DC \end{array}$

$\begin{array}{c|c} 6{,}2 & 9{,}8 \\ \hline DE & 3{,}1 \end{array}$ geeft $DE = \dfrac{3{,}1 \cdot 6{,}2}{9{,}8} \approx 2{,}0$

$\begin{array}{c|c} 9{,}8 & 5{,}3 \\ \hline 3{,}1 & DC \end{array}$ geeft $CD = \dfrac{3{,}1 \cdot 5{,}3}{9{,}8} \approx 1{,}7$, dus $AD \approx 5{,}3 + 1{,}7 = 7{,}0$.

## Bladzijde 79

**6** $\left.\begin{array}{l}\angle B = \angle E \ (= 90°) \\ \angle A = \angle D \text{ (F-hoeken)}\end{array}\right\} \triangle ABC \sim \triangle DEF$

$\begin{array}{c|c|c} AB & BC & AC \\ \hline DE & EF & DF \end{array}$ geeft $\begin{array}{c|c|c} 30 & BC & AC \\ \hline 1{,}27 & 1{,}50 & DF \end{array}$

$\begin{array}{c|c} 30 & BC \\ \hline 1{,}27 & 1{,}50 \end{array}$ geeft $BC = \dfrac{30 \cdot 1{,}50}{1{,}27} \approx 35$

Dus de lengte van de zendmast is 35 meter.

**7** $\left.\begin{array}{l}\angle A = \angle B \text{ (in } \triangle BCD\text{) (F-hoeken)} \\ \angle E = \angle D \text{ (in } \triangle BCD\text{) (F-hoeken)}\end{array}\right\} \triangle ACE \sim \triangle BCD$

Stel $BC = x$, dan is $AC = 7{,}3 + x$.

$\begin{array}{c|c} AC & AE \\ \hline BC & BD \end{array}$ geeft $\begin{array}{c|c} 7{,}3 + x & 4{,}6 \\ \hline x & 1{,}2 \end{array}$

$4{,}6x = 1{,}2(7{,}3 + x)$
$4{,}6x = 8{,}76 + 1{,}2x$
$3{,}4x = 8{,}76$
$x = \dfrac{8{,}76}{3{,}4} \approx 2{,}6$, dus $BC \approx 2{,}6$.

**8** **a** hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = \dfrac{26}{19} \approx 1{,}4$

**b** $\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 0{,}29$ geeft $\begin{array}{c|c} \text{verticale verplaatsing} & 0{,}29 \\ \hline 24{,}1 & 1 \end{array}$

verticale verplaatsing $= 24{,}1 \cdot 0{,}29 \approx 7{,}0$

**c** hellingspercentage = 57%, dus hellingsgetal = 0,57.

$\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 0{,}57$ geeft $\begin{array}{c|c} 70 & 0{,}57 \\ \hline \text{horizontale verplaatsing} & 1 \end{array}$

horizontale verplaatsing $= \dfrac{70}{0{,}57} \approx 122{,}8$

**9** **a** In $\triangle ABE$ is $\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 0{,}48$ en dit geeft $\begin{array}{c|c} BE & 0{,}48 \\ \hline 20 & 1 \end{array}$.

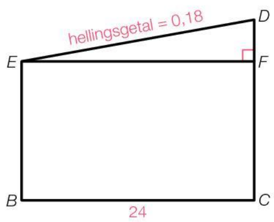
$BE = 0{,}48 \cdot 20 = 9{,}6$ meter

**b** Zie de figuur hiernaast.

In $\triangle DEF$ is $\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 0{,}18$ en dit geeft $\begin{array}{c|c} DF & 0{,}18 \\ \hline 24 & 1 \end{array}$,

dus $DF = 0{,}18 \cdot 24 = 4{,}32$.

$CD = DF + CF = 9{,}6 + 4{,}32 \approx 13{,}9$ meter



**10** **a** $\tan(\angle A) = \dfrac{BC}{AB}$ geeft $\begin{array}{c|c} \tan(65°) & BC \\ \hline 1 & 20 \end{array}$

$BC = 20\tan(65°) \approx 42{,}9$

Dus de kabel $AC$ is op een hoogte van 42,9 meter aan de zendmast bevestigd.

**b** In $\triangle ABC$ is $\angle B = 90°$, dus $AC^2 = AB^2 + BC^2$

$AC^2 = 20^2 + 42{,}89...^2 = 2239{,}5...$

$AC = \sqrt{2239{,}5...} \approx 47{,}3$ meter

**11** **a** tan(hellingshoek) = 0,27 geeft hellingshoek ≈ 15,1°

**b** hellingsgetal = tan(27°) = 0,5095..., dus hellingspercentage ≈ 51,0%.

## Herhaling

### Bladzijde 80

**1** **a** $\begin{array}{c|c} 6 & 3{,}5 \\ \hline 9 & x \end{array}$ geeft $x = \dfrac{9 \cdot 3{,}5}{6} \approx 5{,}3$

$\begin{array}{c|c} 6 & 17 \\ \hline 9 & y \end{array}$ geeft $y = \dfrac{9 \cdot 17}{6} = 25{,}5$

**b** $\begin{array}{c|c} 5 & x \\ \hline 2{,}1 & 9 \end{array}$ geeft $x = \dfrac{5 \cdot 9}{2{,}1} \approx 21{,}4$

$\begin{array}{c|c} 5 & y \\ \hline 2{,}1 & 7 \end{array}$ geeft $y = \dfrac{5 \cdot 7}{2{,}1} \approx 16{,}7$

**c** $\begin{array}{c|c} x & 6{,}1 \\ \hline 44 & 58 \end{array}$ geeft $x = \dfrac{6{,}1 \cdot 44}{58} \approx 4{,}6$

$\begin{array}{c|c} 6{,}1 & 2 \\ \hline 58 & y \end{array}$ geeft $y = \dfrac{58 \cdot 2}{6{,}1} \approx 19{,}0$

**2** **a** $\begin{array}{c|c} 3x - 2 & x + 4 \\ \hline 4 & 7 \end{array}$ geeft $7(3x - 2) = 4(x + 4)$

$21x - 14 = 4x + 16$

$21x - 4x = 16 + 14$

$17x = 30$

$x = \dfrac{30}{17} \approx 1{,}8$

**b** $\begin{array}{c|c} 3 & 5 + x \\ \hline 11 & 8x - 2 \end{array}$ geeft $3(8x - 2) = 11(5 + x)$

$24x - 6 = 55 + 11x$

$24x - 11x = 55 + 6$

$13x = 61$

$x = \dfrac{61}{13} \approx 4{,}7$

$\begin{array}{c|c} 3 & 7 \\ \hline 11 & 2y - 3 \end{array}$ geeft $3(2y - 3) = 11 \cdot 7$

$6y - 9 = 77$

$6y = 77 + 9$

$6y = 86$

$y = \dfrac{86}{6} \approx 14{,}3$

**3** **a** Omdat $\angle A = \angle L$, $\angle B = \angle K$ en $\angle C = \angle M$ is $\triangle ABC \sim \triangle LKM$.

Hieruit volgt de verhoudingstabel $\begin{array}{c|c|c} AB & BC & AC \\ \hline LK & KM & LM \end{array}$.

**b** $\begin{array}{c|c|c} AB & BC & AC \\ \hline LK & KM & LM \end{array}$ geeft $\begin{array}{c|c|c} 7 & 6 & 5 \\ \hline 9 & KM & LM \end{array}$

$\begin{array}{c|c} 7 & 6 \\ \hline 9 & KM \end{array}$ geeft $KM = \dfrac{9 \cdot 6}{7} \approx 7{,}7$

$\begin{array}{c|c} 7 & 5 \\ \hline 9 & LM \end{array}$ geeft $LM = \dfrac{9 \cdot 5}{7} \approx 6{,}4$

**4** **a** In $\triangle QST$ is $\angle S = 90°$, dus $QT^2 = QS^2 + ST^2$

$QT^2 = 2^2 + 1{,}5^2 = 6{,}25$

$QT = \sqrt{6{,}25} = 2{,}5$

**b** $\triangle PQR \sim \triangle SQT$

**c** $\begin{array}{c|c|c} PQ & QR & PR \\ \hline SQ & QT & ST \end{array}$ geeft $\begin{array}{c|c|c} 7 & QR & PR \\ \hline 2 & 2{,}5 & 1{,}5 \end{array}$

**d** $\begin{array}{c|c} 7 & PR \\ \hline 2 & 1{,}5 \end{array}$ geeft $PR = \dfrac{7 \cdot 1{,}5}{2} = 5{,}25$

$\begin{array}{c|c} 7 & QR \\ \hline 2 & 2{,}5 \end{array}$ geeft $QR = \dfrac{7 \cdot 2{,}5}{2} = 8{,}75$

## Bladzijde 81

**5** **a** $\triangle KLM \sim \triangle NLO$

**b** $\begin{array}{c|c|c} KL & LM & KM \\ \hline NL & LO & NO \end{array}$ geeft $\begin{array}{c|c|c} 8{,}7 & LM & 5{,}3 \\ \hline NL & 4{,}6 & 3{,}3 \end{array}$

**c** $\begin{array}{c|c} 8{,}7 & 5{,}3 \\ \hline NL & 3{,}3 \end{array}$ geeft $LN = \dfrac{8{,}7 \cdot 3{,}3}{5{,}3} \approx 5{,}4$

$KN = KL - LN = 8{,}7 - 5{,}416... \approx 3{,}3$

**d** $\begin{array}{c|c} LM & 5{,}3 \\ \hline 4{,}3 & 3{,}3 \end{array}$ geeft $LM = \dfrac{4{,}6 \cdot 5{,}3}{3{,}3} \approx 7{,}4$

$MO = LM - LO = 7{,}387... - 4{,}6 \approx 2{,}8$

**6** **a** In $\triangle ABC$ is $\angle B = 90°$, dus $AC^2 = AB^2 + BC^2$

$AC^2 = 5^2 + 12^2 = 169$

$AC = \sqrt{169} = 13$

**b** $\left.\begin{array}{l} \angle B = \angle D \ (= 90°) \\ \angle C \text{ (in } \triangle ABC) = \angle C \text{ (in } \triangle CDE) \end{array}\right\} \triangle ABC \sim \triangle EDC$

**c** $\begin{array}{c|c|c} AB & BC & AC \\ \hline ED & DC & EC \end{array}$ geeft $\begin{array}{c|c|c} 5 & 12 & 13 \\ \hline ED & DC & 5 \end{array}$

**d** $\begin{array}{c|c} 5 & 13 \\ \hline ED & 5 \end{array}$ geeft $DE = \dfrac{5 \cdot 5}{13} \approx 1{,}9$

$\begin{array}{c|c} 12 & 13 \\ \hline DC & 5 \end{array}$ geeft $CD = \dfrac{12 \cdot 5}{13} \approx 4{,}6$

**7** **a** $\angle D_1$ is gelijk aan $\angle B$.

**b** $\left.\begin{array}{l}\angle A = \angle E_1 \text{ (F-hoeken)} \\ \angle B = \angle D_1 \text{ (F-hoeken)}\end{array}\right\} \triangle ABC \sim \triangle EDC$

**c**

| $AB$ | $BC$ | $AC$ |
|---|---|---|
| $ED$ | $DC$ | $EC$ |

geeft

| $3{,}6$ | $BC$ | $5{,}4$ |
|---|---|---|
| $ED$ | $1{,}1$ | $1{,}6$ |

**d**

| $3{,}6$ | $5{,}4$ |
|---|---|
| $ED$ | $1{,}6$ |

geeft $DE = \dfrac{1{,}6 \cdot 3{,}6}{5{,}4} \approx 1{,}1$

| $BC$ | $5{,}4$ |
|---|---|
| $1{,}1$ | $1{,}6$ |

geeft $BC = \dfrac{5{,}4 \cdot 1{,}1}{1{,}6} \approx 3{,}7$

$BD = BC - CD = 3{,}7125 - 1{,}1 \approx 2{,}6$

**8** **a** $\left.\begin{array}{l}\angle P = \angle T \text{ (Z-hoeken)} \\ \angle Q_1 = \angle Q_2 \text{ (overstaande hoeken)}\end{array}\right\} \triangle PQR \sim \triangle TQS$

**b**

| $PQ$ | $QR$ | $PR$ |
|---|---|---|
| $TQ$ | $QS$ | $TS$ |

geeft

| $3{,}6$ | $3{,}5$ | $4{,}5$ |
|---|---|---|
| $TQ$ | $QS$ | $2{,}9$ |

**c**

| $3{,}5$ | $4{,}5$ |
|---|---|
| $QS$ | $2{,}9$ |

geeft $QS = \dfrac{3{,}5 \cdot 2{,}9}{4{,}5} \approx 2{,}3$

$RS = QR + QS = 3{,}5 + 2{,}25... \approx 5{,}8$

**d**

| $3{,}6$ | $4{,}5$ |
|---|---|
| $TQ$ | $2{,}9$ |

geeft $QT = \dfrac{3{,}6 \cdot 2{,}9}{4{,}5} = 2{,}32$

$PT = PQ + QT = 3{,}6 + 2{,}32 \approx 5{,}9$

## Bladzijde 82

**9** **a** $\left.\begin{array}{l}\angle D = \angle E_1 \text{ (F-hoeken)} \\ \angle H = \angle G_1 \text{ (F-hoeken)}\end{array}\right\} \triangle FDH \sim \triangle FEG$

| $FD$ | $DH$ | $FH$ |
|---|---|---|
| $FE$ | $EG$ | $FG$ |

geeft

| $3{,}6$ | $2{,}4$ | $FH$ |
|---|---|---|
| $2{,}0$ | $EG$ | $3{,}0$ |

| $3{,}6$ | $2{,}4$ |
|---|---|
| $2{,}0$ | $EG$ |

geeft $EG = \dfrac{2{,}0 \cdot 2{,}4}{3{,}6} \approx 1{,}3$

| $3{,}6$ | $FH$ |
|---|---|
| $2{,}0$ | $3{,}0$ |

geeft $FH = \dfrac{3{,}6 \cdot 3{,}0}{2{,}0} = 5{,}4$

$GH = FH - FG = 5{,}4 - 3{,}0 = 2{,}4$

**b** $\left.\begin{array}{l}\angle P = \angle S \text{ (Z-hoeken)} \\ \angle Q = \angle T \text{ (Z-hoeken)}\end{array}\right\} \triangle PQR \sim \triangle STR$

| $PQ$ | $QR$ | $PR$ |
|---|---|---|
| $ST$ | $TR$ | $SR$ |

geeft

| $3{,}1$ | $2{,}9$ | $1{,}1$ |
|---|---|---|
| $ST$ | $1{,}1$ | $SR$ |

| $3{,}1$ | $2{,}9$ |
|---|---|
| $ST$ | $1{,}1$ |

geeft $ST = \dfrac{3{,}1 \cdot 1{,}1}{2{,}9} \approx 1{,}2$

| $2{,}9$ | $1{,}1$ |
|---|---|
| $1{,}1$ | $SR$ |

geeft $SR = \dfrac{1{,}1 \cdot 1{,}1}{2{,}9} = 0{,}417...$

$PS = PR + RS = 1{,}1 + 0{,}417... \approx 1{,}5$

**10** **a** $\left.\begin{array}{l} \angle E = \angle D \text{ (Z-hoeken)} \\ \angle A = \angle C\ (= 90^\circ) \end{array}\right\}\ \triangle ABE \sim \triangle CBD$

**b** $\begin{array}{c|c|c} AB & BE & AE \\ \hline CB & BD & CD \end{array}$ geeft $\begin{array}{c|c|c} 40 & BE & AE \\ \hline 10 & BD & 17 \end{array}$

$\begin{array}{c|c} 40 & AE \\ \hline 10 & 17 \end{array}$ geeft $AE = \dfrac{40 \cdot 17}{10} = 68$

Dus de breedte van het kanaal is 68 meter.

**11** **a** $AB = x + 1{,}2$

**b** $\begin{array}{c|c} x + 1{,}2 & 1{,}8 \\ \hline x & 1{,}2 \end{array}$

**c** $1{,}8x = 1{,}2(x + 1{,}2)$
$1{,}8x = 1{,}2x + 1{,}44$
$0{,}6x = 1{,}44$
$x = 2{,}4$

**d** $AB = x + 1{,}2 = 2{,}4 + 1{,}2 = 3{,}6$

**12** **a** $\left.\begin{array}{l} \angle P = \angle S \text{ (Z-hoeken)} \\ \angle Q = \angle T \text{ (Z-hoeken)} \end{array}\right\}\ \triangle PQR \sim \triangle STR$

**b** Stel $QR = x$, dan is $TR = 3{,}5 - x$.

$\begin{array}{c|c} PQ & QR \\ \hline ST & TR \end{array}$ geeft $\begin{array}{c|c} 2{,}8 & x \\ \hline 1{,}6 & 3{,}5 - x \end{array}$

$1{,}6x = 2{,}8(3{,}5 - x)$
$1{,}6x = 9{,}8 - 2{,}8x$
$4{,}4x = 9{,}8$
$x = \dfrac{9{,}8}{4{,}4} \approx 2{,}2$, dus $QR \approx 2{,}2$.

**c** $RT = 3{,}5 - x = 3{,}5 - 2{,}227... \approx 1{,}3$

## Bladzijde 83

**13** **a** hellingsgetal $= \dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = \dfrac{11}{39} \approx 0{,}28$

**b** $\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 0{,}62$ geeft $\begin{array}{c|c} 23 & 0{,}62 \\ \hline \text{horizontale verplaatsing} & 1 \end{array}$

horizontale verplaatsing $= \dfrac{23}{0{,}62} \approx 37{,}10$

**c** hellingspercentage = 11%, dus hellingsgetal = 0,11.

$\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 0{,}11$ geeft $\begin{array}{c|c} \text{verticale verplaatsing} & 0{,}11 \\ \hline 170 & 1 \end{array}$

verticale verplaatsing $= 0{,}11 \cdot 170 = 18{,}7$

**14** In $\triangle ABE$ is $\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 0{,}38$, dus $\begin{array}{c|c} BE & 0{,}38 \\ \hline 5{,}2 & 1 \end{array}$ en dit geeft $BE = 5{,}2 \cdot 0{,}38 = 1{,}976$.

In $\triangle DEF$ is $\dfrac{\text{verticale verplaatsing}}{\text{horizontale verplaatsing}} = 0{,}82$, dus $\begin{array}{c|c} DF & 0{,}82 \\ \hline 2{,}9 & 1 \end{array}$ en dit geeft $DF = 2{,}9 \cdot 0{,}82 = 2{,}378$.

Dus $CD = 1{,}976 + 2{,}378 = 4{,}354$.

**15** $AC = 18 \tan(27^\circ) \approx 9{,}2$

**16** **a** $\tan(\angle B) = \dfrac{LW}{BL}$ geeft

| $\tan(16°)$ | $LW$ |
|---|---|
| 1 | 3000 |

$LW = 3000 \tan(16°) = 860{,}23... \approx 860$ meter

**b** In $\triangle BLW$ is $\angle L = 90°$, dus $BW^2 = BL^2 + LW^2$

$BW^2 = 3000^2 + 860{,}23...^2 = 9\,740\,006{,}246...$

$BW = \sqrt{9\,740\,006{,}246} \approx 3121$

Dus de afstand van Bilal tot $W$ is 3121 meter.

**17** **a** $\tan(\angle A) = 0{,}1$ geeft $\angle A \approx 5{,}7°$

**b** $\tan(\angle A) = 11{,}1$ geeft $\angle A \approx 84{,}9°$

**c** hellingspercentage = 7%, dus hellingsgetal = 0,07 geeft hellingshoek ≈ 4,0°.

**d** hellingspercentage = 17%, dus hellingsgetal = 0,17 geeft hellingshoek ≈ 9,6°.

**e** hellingshoek = 12,7° geeft hellingsgetal = tan(12,7°) ≈ 0,225, dus hellingspercentage ≈ 22,5%.

**f** hellingshoek = 56° geeft hellingsgetal = tan(56°) ≈ 1,483, dus hellingspercentage ≈ 148,3%.

## Onderzoek Vergrotingen tekenen

### Bladzijde 84

**1** **a**
$$\left.\begin{array}{l} PA' = 2{,}5 \cdot PA \\ PC' = 2{,}5 \cdot PC \\ \angle P \text{ (in } \triangle PAC) = \angle P \text{ (in } \triangle PA'C') \end{array}\right\} \triangle PAC \backsim \triangle PA'C'$$

**b** Uit $\triangle PAC \backsim \triangle PA'C'$ volgt de verhoudingstabel

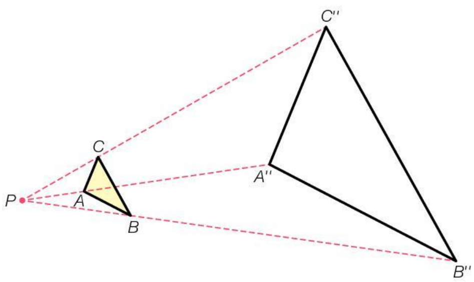
| $PA$ | $AC$ | $PC$ |
|---|---|---|
| $PA'$ | $A'C'$ | $PC'$ |

, en omdat geldt

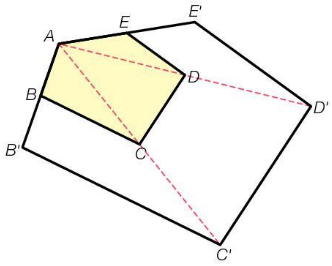
$\dfrac{PA'}{PA} = \dfrac{PC'}{PC} = 2{,}5$ is dus ook $\dfrac{A'C'}{AC} = 2{,}5$.

Op dezelfde manier als hiervoor kan aangetoond worden dat $\triangle PAB \backsim \triangle PA'B'$ en $\triangle PBC \backsim \triangle PB'C'$ en dat hieruit volgt dat $\dfrac{A'B'}{AB} = 2{,}5$ en $\dfrac{B'C'}{BC} = 2{,}5$. Dus $\triangle A'B'C'$ is een vergroting van $\triangle ABC$.

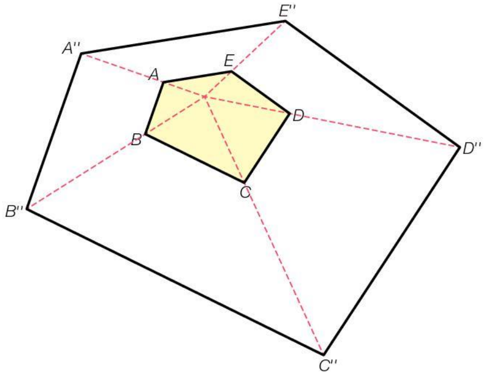
**c**



**2** **a**




**b**

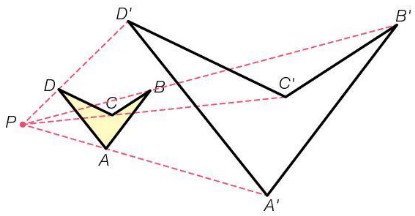



## Bladzijde 85

**3** *Aanpak*

- Teken de lijnstukken $DD'$ en $AA'$ en verleng deze lijnstukken zodat ze elkaar snijden. Het snijpunt $P$ is het centrum van de vergroting.
- Bereken de vergrotingsfactor $k$ met $k = \frac{PA'}{PA} = \frac{PD'}{PD}$, en gebruik dit om $PB'$ en $PC'$ te tekenen.
- Teken de vergroting $A'B'C'D'$.

*Uitwerking*




**4** **a** *

**b** Door in een pantograaf het volgpunt en het tekenpunt te verwisselen, kun je in plaats van een vergroting ook een verkleining tekenen.

**5** **a** $BDEF$ is een parallellogram, dus $BF$ // $DE$ en $EF$ // $BD$. Dus

$$\left.\begin{array}{l}\angle F_1 = \angle E \text{ (F-hoeken)} \\ \angle B_1 = \angle C \text{ (F-hoeken)}\end{array}\right\} \triangle ABF \sim \triangle ACE$$

**b** Is punt $B$ het volgpunt en punt $C$ het tekenpunt, dan is de vergrotingsfactor $\frac{AC}{AB} = \frac{11{,}0}{3{,}9} \approx 2{,}82$.

Is punt $C$ het volgpunt en punt $B$ het tekenpunt, dan is de vergrotingsfactor $\frac{AB}{AC} = \frac{3{,}9}{11{,}0} \approx 0{,}35$.

**6** *