



HOGERE ZEEVAARTSCHOOL ANTWERPEN

FACULTEIT WETENSCHAPPEN
VAKGROEP TOEGEPASTE EN EXACTE WETENSCHAPPEN

DRIEHOEKSMETING

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HOOFDSTUK 1

GEBRUIK VAN REKENMACHINES

- **1.1.** Bereken met behulp van je rekenmachine. Denk aan het gebruik van de “ANS” toets.

$$a = 17.35, \quad b = 12.56$$

1. $a + b$	7. $\frac{1}{a + b}, \quad \sqrt{\frac{1}{a + b}}$
2. $a \cdot b$	8. $\frac{1}{a} + \frac{1}{b^2}, \quad \sqrt{\frac{1}{a} + \frac{1}{b^2}}$
3. $a^2 + b^3$	9. $\frac{b^2}{a + b}, \quad \left(\frac{b^2}{a + b}\right)^4$
4. $a^3 b^2$	10. $\sqrt{a^2 - 4b}, \quad \frac{-a + \sqrt{a^2 - 4b}}{2}$
5. $\sqrt{a + b}$	
6. $\sqrt{a^2 + b}$	

- **1.2.** Maak gebruik van de geheugens die je rekenmachine heeft om de gegeven waarden op te slaan. Maak vervolgens de aangegeven berekeningen zonder de getallen opnieuw in te voeren.

$$A = 38, \quad B = 17, \quad C = -146$$

$$P = A \cdot B - C, \quad Q = B^2 - 4AC, \quad R = \sqrt{AB + BC - CA}$$

$$S = AR + PQ$$

- **1.3.** Bereken met behulp van je rekenmachine.

$$\sqrt{1027}, \quad \sqrt[5]{64}, \quad 6^{20}, \quad \sqrt[3]{27}$$

- **1.4.** Bereken met behulp van je rekenmachine.

$$e^5, \quad \ln 20, \quad \ln 5^7, \quad \log_{10}(4^3 \cdot 5^6)$$

- **1.5.** Bereken met behulp van je rekenmachine.

$$\alpha = 35^\circ 12' 17''$$

$$\sin \alpha, \quad \cos \alpha, \quad \operatorname{tg} \alpha, \quad \operatorname{cotg} \alpha$$

- **1.6.** Bereken met behulp van je rekenmachine.

$$\beta = 12^\circ 18,3'$$

$$\sin \beta, \quad \cos \beta, \quad \operatorname{tg} \beta, \quad \operatorname{cotg} \beta$$

$$\frac{\sin \beta}{\operatorname{tg} \beta + 1}$$

- **1.7.** Bereken met behulp van je rekenmachine.

$$\gamma = 1.7 \text{ rad}$$

$$\sin \gamma, \quad \cos \gamma, \quad \operatorname{tg} \gamma, \quad \operatorname{cotg} \gamma$$

$$\frac{\sin \gamma}{\operatorname{tg} \gamma + 1}$$

- **1.8.** Bereken met behulp van je rekenmachine.

$$\delta = \frac{\pi}{7} \text{ rad}$$

$$\sin \delta, \quad \cos \delta, \quad \operatorname{tg} \delta, \quad \operatorname{cotg} \delta$$

$$\frac{\sin \delta}{\operatorname{tg} \delta + 1}$$

- **1.9.** Bereken met behulp van je rekenmachine. Druk het resultaat uit in graden en minuten.

$$a = 0.1735$$

$$\arcsin a, \quad \arccos a, \quad \operatorname{arctg} a, \quad \operatorname{arccotg} a$$

- **1.10.** Bereken met behulp van je rekenmachine. Druk het resultaat uit in radialen.

$$a = 0.5735$$

$$\arcsin a, \quad \arccos a, \quad \operatorname{arctg} a, \quad \operatorname{arccotg} a$$

- **1.11.** Bereken met behulp van je rekenmachine. Gebruik de geheugens in je rekenmachine. Druk het eindresultaat uit in graden en minuten.

$$a = 70^\circ 18,3', \quad b = 35^\circ 12,7', \quad c = 15^\circ 38,4'$$

$$p = \cos a \cos b + \sin a \sin b \cos c, \quad \arccos(p)$$

$$A = \frac{\sin c}{\frac{\sin b}{\operatorname{tg} a} - \cos b \cos c}, \quad \operatorname{arctg}(A)$$

$$B = \frac{\sin b \operatorname{cotg} a - \cos b \cos c}{\sin c}, \quad \operatorname{arccotg}(B)$$

Oplossingen - Solutions

1.1.

1.	29.91	6.	17.708261	
2.	217.916	7.	0.0334336,	0.1828487
3.	2282.4077	8.	0.0639759,	0.2529346
4.	823906.1	9.	5.2742762,	773.84051
5.	5.4690036	10.	15.836114,	-0.7569431

1.2.

$$P = 792, \quad Q = 22481, \quad R = 60.926185, \quad S = 17807267$$

1.3.

$$32.046841, \quad 2.2973967, \quad 3.656 \cdot 10^{15}, \quad 5.0396842$$

1.4.

$$148.41316, \quad 2.9957323, \quad 11.266065, \quad 6$$

1.5.

$$0.5764997, \quad 0.8170974, \quad 0.7055458, \quad 1.4173424$$

1.6.

$$0.2131156, \quad 0.9770270, \quad 0.2181267, \quad 4.584492$$

$$0.1749536$$

1.7.

$$0.9916648, \quad -0.1288445, \quad -7.6966021, \quad -0.1299275$$

$$-0.1480848$$

1.8.

$$0.4338837, \quad 0.9009689, \quad 0.4815746, \quad 2.0765214$$

$$0.2928531$$

1.9.

$$9^{\circ}59,5', \quad 80^{\circ}0,5', \quad 9^{\circ}50,6', \quad 80^{\circ}9,4'$$

$$0.1743825 \text{ rad}, 1.3964139 \text{ rad}, 0.1717899 \text{ rad}, 1.3990065$$

1.10.

$$0.6107719, \quad 0.9600244, \quad 0.5207063, \quad 1.0500901$$
$$34^{\circ}59,7', \quad 55^{\circ}0,3', \quad 29^{\circ}50,1', \quad 60^{\circ}9,9'$$

1.11.

$$p = 0.7981167, \quad \arccos(p) = 37^{\circ}3,0'$$
$$A = -0.4645087, \quad \operatorname{arctg}(A) = -24^{\circ}54,9'$$
$$B = -2.1528121, \quad \operatorname{arccotg}(B) = -24^{\circ}54,9'$$

HOOFDSTUK 2

GONIOMETRIE EN DRIEHOEKSMETING

☞ 2.1. Bereken:

- | | |
|-----------------------------------|---|
| ▶1. $\sin 25^\circ 33,2'$ | ▶5. $\operatorname{tg} 25^\circ 33,2'$ |
| ▶2. $\cos 35^\circ 23,8'$ | 6. $\operatorname{cotg} 35^\circ 23,8'$ |
| 3. $\sin 125^\circ 31,5'$ | 7. $\operatorname{tg} 125^\circ 31,5'$ |
| 4. $\cos 56^\circ 16,4'$ | 8. $\operatorname{cotg} 56^\circ 16,4'$ |
| ▶9. $\arcsin 0,234$ | 13. $\arccos\left(-\frac{\sqrt{2}}{4}\right)$ |
| ▶10. $\arccos 0,234$ | 14. $\operatorname{arccotg} 1,678$ |
| ▶11. $\operatorname{arctg} 3,445$ | 15. $\operatorname{arctg} 0,342$ |
| 12. $\arcsin \frac{\sqrt{2}}{4}$ | 16. $\operatorname{arccotg} 0,112$ |

☞ 2.2. Bereken zonder rekenmachine:

- | | |
|-----------------------------------|-----------------------------------|
| 1. $\sin 75^\circ$ | 5. $\sin 15^\circ$ |
| 2. $\cos 75^\circ$ | 6. $\cos 15^\circ$ |
| 3. $\operatorname{tg} 75^\circ$ | 7. $\operatorname{tg} 15^\circ$ |
| 4. $\operatorname{cotg} 75^\circ$ | 8. $\operatorname{cotg} 15^\circ$ |

- ☸☸ **2.3.** De rechthoekszijden van een rechthoekige driehoek $\triangle ABC$ meten $a = 3\text{m}$ en $b = 4\text{m}$. Bepaal de lengte van de schuine zijde c . Bepaal verder de sinus, cosinus en tangens van de hoeken A en B . Bereken tenslotte de hoeken A en B .

Oplossingen - Solutions

2.1.

- | | |
|-----------------------|------------------------|
| 1. 0,43135 | 5. 0,47812 |
| 2. 0,81516 | 6. 1,40731 |
| 3. 0,81386 | 7. -1,40066 |
| 4. 0,55523 | 8. 0,66759 |
| 9. $13^{\circ}32,0'$ | 13. $110^{\circ}42,3'$ |
| 10. $76^{\circ}28,0'$ | 14. $30^{\circ}47,6'$ |
| 11. $73^{\circ}48,8'$ | 15. $18^{\circ}52,8'$ |
| 12. $20^{\circ}42,3'$ | 16. $83^{\circ}36,6'$ |

2.2.

- | | |
|--|--|
| 1. $\frac{\sqrt{6} + \sqrt{2}}{4} \sim 0,97$ | 5. $\frac{\sqrt{6} - \sqrt{2}}{4} \sim 0,26$ |
| 2. $\frac{\sqrt{6} - \sqrt{2}}{4} \sim 0,26$ | 6. $\frac{\sqrt{6} + \sqrt{2}}{4} \sim 0,97$ |
| 3. $2 + \sqrt{3} \sim 3,73$ | 7. $2 - \sqrt{3} \sim 0,27$ |
| 4. $2 - \sqrt{3} \sim 0,27$ | 8. $2 + \sqrt{3} \sim 3,73$ |

2.3.

$$c = 5\text{m},$$

$$\sin A = \cos B = \frac{3}{5},$$

$$\cos A = \sin B = \frac{4}{5},$$

$$\text{tg } A = \frac{3}{4},$$

$$\text{tg } B = \frac{4}{3},$$

$$A = 36^{\circ}52,2',$$

$$B = 53^{\circ}7,8'$$

HOOFDSTUK 3

BOLDRIEHOEKSMETING

© **3.1.** (Labo T1) In de boldriehoek $\triangle ABC$ is

$$a = 126^{\circ}29,6', \quad b = 128^{\circ}1,8', \quad c = 30^{\circ}46,4'.$$

Bereken A , B en C .

© **3.2.** (Labo T1) In de boldriehoek $\triangle ABC$ is

$$A = 67^{\circ}40,2', \quad b = 86^{\circ}45,2', \quad c = 108^{\circ}36,8'.$$

Bereken a , B en C .

- ⊙ **3.3.** (Labo T1) In de boldriehoek $\triangle KLM$ is

$$k = 83^\circ 35,4', \quad l = 113^\circ 45,8', \quad m = 66^\circ 28'.$$

Bereken K , L en M .

- ⊙ **3.4.** (Labo T1) In de boldriehoek $\triangle PQZ$ is

$$Q = 79^\circ 15,6', \quad p = 103^\circ 10,1', \quad z = 47^\circ 8,9'.$$

Bereken q , P en Z .

- ⊙ **3.5.** (Labo T1) In de boldriehoek $\triangle RST$ is

$$T = 80^\circ 15,7', \quad r = 101^\circ 10,1', \quad s = 34^\circ 11,9'.$$

Bereken t , R en S .

- ⊙ **3.6.** (Labo T1) In de boldriehoek $\triangle PQZ$ is

$$p = 156^\circ 42,2', \quad q = 33^\circ 34,4', \quad z = 144^\circ 6,6'.$$

Bereken P , Q en Z .

- ⊙ **3.7.** (Labo T1) In de boldriehoek $\triangle ABC$ is

$$B = 68^\circ 35,4', \quad a = 58^\circ 15,7', \quad c = 40^\circ 15,8'.$$

Bereken b , A en C .

- ⊙ **3.8.** (Labo T1) In de boldriehoek $\triangle PQR$ is

$$p = 44^\circ 32,1', \quad q = 104^\circ 27,4', \quad r = 67^\circ 8'.$$

Bereken P , Q en R .

- ⊙ **3.9.** (Labo T1) Bereken de kortste afstand tussen de twee plaatsen:

$$\begin{aligned} \text{Honolulu } 21^\circ 19' \text{NB, } 157^\circ 50' \text{WL,} \\ \text{Brussel } 50^\circ 50' \text{NB, } 4^\circ 21' \text{OL.} \end{aligned}$$

© **3.10.** (Labo T1) Bereken de kortste afstand BI, IH, en HB.

Bordeaux (B) $44^{\circ}30'$ NB, $0^{\circ}20,4'$ WL,
 Istanbul (I) $41^{\circ}1,2'$ NB, $28^{\circ}34,2'$ OL,
 Helsinki (H) $60^{\circ}4,8'$ NB, 25° OL.

☆ **3.11.** In een boldriehoek zijn volgende afmetingen gegeven. Bereken de overige afmetingen.

$\triangle PQZ$: $p = 86^{\circ}45,2'$, $q = 108^{\circ}36,6'$, $Z = 67^{\circ}40,2'$
 $\triangle RST$: $r = 55^{\circ}5,5'$, $s = 66^{\circ}54,3'$, $t = 79^{\circ}27,3'$
 $\triangle KLM$: $K = 64^{\circ}26,4'$, $l = 76^{\circ}24,3'$, $m = 109^{\circ}1,5'$
 $\triangle RST$: $R = 59^{\circ}24,3'$, $s = 71^{\circ}26,4'$, $t = 111^{\circ}1,8'$
 $\triangle PQZ$: $p = 86^{\circ}45,2'$, $q = 108^{\circ}36,6'$, $Z = 67^{\circ}40,2'$
 $\triangle PRZ$: $Z = 65^{\circ}31,2'$, $p = 126^{\circ}2,8'$, $r = 28^{\circ}36,7'$
 $\triangle RST$: $R = 65^{\circ}31,2'$, $s = 126^{\circ}2,8'$, $t = 25^{\circ}1,8'$
 $\triangle KLM$: $K = 68^{\circ}32,2'$, $l = 119^{\circ}2,8'$, $m = 35^{\circ}36,7'$
 $\triangle PRZ$: $Z = 64^{\circ}32,2'$, $p = 121^{\circ}2,8'$, $r = 30^{\circ}36,7'$
 $\triangle KLM$: $K = 67^{\circ}40,2'$, $p = 108^{\circ}36,8'$, $r = 86^{\circ}45,2'$

☆ **3.12.** In een boldriehoek zijn volgende afmetingen gegeven. Bereken de overige afmetingen.

$\triangle RST$: $r = 56^{\circ}22,1'$, $s = 65^{\circ}54,2'$, $t = 78^{\circ}27,4'$
 $\triangle RST$: $r = 53^{\circ}5,5'$, $s = 103^{\circ}4,3'$, $t = 59^{\circ}1,3'$
 $\triangle KLM$: $l = 51^{\circ}5,6'$, $m = 104^{\circ}5,3'$, $k = 59^{\circ}1,3'$
 $\triangle KLM$: $l = 53^{\circ}5,5'$, $m = 103^{\circ}4,3'$, $k = 59^{\circ}1,3'$
 $\triangle RST$: $r = 55^{\circ}5,5'$, $s = 66^{\circ}54,3'$, $t = 79^{\circ}27,3'$
 $\triangle RST$: $r = 56^{\circ}22,1'$, $s = 65^{\circ}54,2'$, $t = 78^{\circ}27,4'$
 $\triangle RST$: $r = 51^{\circ}5,6'$, $s = 104^{\circ}5,3'$, $t = 59^{\circ}1,3'$

© **3.13.** (Labo T2) In de boldriehoek $\triangle ABC$ is

$$a = 110^\circ 13,3', \quad b = 58^\circ 21,2', \quad C = 90^\circ.$$

Bereken A , B en c .

© **3.14.** (Labo T2) In de boldriehoek $\triangle ABC$ is

$$a = 105^\circ 24,7', \quad B = 28^\circ 36,2', \quad C = 90^\circ.$$

Bereken A , b en c .

© **3.15.** (Labo T2) In de boldriehoek $\triangle KLM$ is

$$k = 78^\circ 9,8', \quad L = 148^\circ 18,4', \quad K = 90^\circ.$$

Bereken l , M en m .

© **3.16.** (Labo T2) In de boldriehoek $\triangle ABC$ is

$$a = 51^\circ 13,9', \quad c = 79^\circ 51,8', \quad C = 90^\circ.$$

Bereken A , b en B .

© **3.17.** (Labo T2) In de boldriehoek $\triangle KLM$ is

$$l = 141^\circ 33,5', \quad L = 127^\circ 9,7', \quad K = 90^\circ.$$

Bereken k , m en M .

⊙ **3.18.** (Labo T2) In de boldriehoek $\triangle ABC$ is

$$A = 71^{\circ}32,1', \quad b = 49^{\circ}23,7', \quad C = 90^{\circ}.$$

Bereken a , B en c .

⊙ **3.19.** (Labo T2) In de boldriehoek $\triangle PQZ$ is

$$P = 136^{\circ}24,9', \quad z = 63^{\circ}17,4', \quad Z = 90^{\circ}.$$

Bereken p , Q en q .

⊙ **3.20.** (Labo T2) In de boldriehoek $\triangle ABC$ is

$$A = 156^{\circ}17,4', \quad b = 72^{\circ}12,3', \quad B = 90^{\circ}.$$

Bereken a , C en c .

⊙ **3.21.** (Labo T2) In de boldriehoek $\triangle ABC$ is

$$b = 138^{\circ}46,3', \quad B = 125^{\circ}10,4', \quad C = 90^{\circ}.$$

Bereken a , C en c .

⊙ **3.22.** (Labo T2) In de boldriehoek $\triangle RST$ is

$$r = 35^{\circ}34,3', \quad t = 45^{\circ}48,2', \quad T = 90^{\circ}.$$

Bereken R , s en S .

⊕ **3.23.** In een boldriehoek zijn volgende afmetingen gegeven. Bereken de overige afmetingen.

$$\triangle ABC : A = 90^{\circ}, b = 155^{\circ}12,6', c = 72^{\circ}13,1'$$

$$\triangle ABC : A = 90^{\circ}, b = 55^{\circ}12,6', B = 72^{\circ}13,1'$$

$$\triangle ABC : A = 90^{\circ}, b = 125^{\circ}15,3', B = 100^{\circ}12,8'$$

$$\triangle ABC : A = 90^{\circ}, a = 134^{\circ}56,9', b = 145^{\circ}22,8'$$

$$\triangle ABC : A = 90^{\circ}, a = 21^{\circ}56,9', b = 15^{\circ}22,8'$$

$$\triangle ABC : A = 90^{\circ}, b = 35^{\circ}34,3', C = 75^{\circ}22,8'$$

$$\triangle ABC : A = 90^{\circ}, b = 135^{\circ}34,3', C = 120^{\circ}21,5'$$

$$\triangle ABC : A = 90^{\circ}, a = 95^{\circ}34,3', C = 120^{\circ}21,5'$$

$$\triangle ABC : A = 90^{\circ}, a = 85^{\circ}24,3', C = 118^{\circ}21,5'$$

$$\triangle ABC : A = 90^{\circ}, a = 86^{\circ}24,3', C = 35^{\circ}22,4'$$

$$\triangle ABC : A = 90^{\circ}, B = 85^{\circ}24,3', C = 118^{\circ}21,5'$$

☆ **3.24.** In een boldriehoek zijn volgende afmetingen gegeven. Bereken de overige afmetingen.

$$\triangle KLM : K = 90^\circ, L = 155^\circ 12, 6', k = 72^\circ 13, 1'$$

$$\triangle KLM : K = 90^\circ, L = 150^\circ 15, 3', k = 70^\circ 14, 6'$$

$$\triangle KLM : K = 90^\circ, k = 49^\circ 15, 3', M = 103^\circ 24, 6'$$

$$\triangle PQR : Q = 90^\circ, q = 45^\circ 24, 6', R = 112^\circ 15, 6'$$

$$\triangle KLM : K = 90^\circ, k = 79^\circ 56, 7', L = 125^\circ 24, 3'$$

$$\triangle KLM : K = 90^\circ, k = 79^\circ 56, 7', L = 54^\circ 35, 7'$$

$$\triangle ABC : A = 90^\circ, a = 73^\circ 15, 3', b = 125^\circ 12, 9'$$

$$\triangle KLM : K = 90^\circ, L = 147^\circ 15, 3', k = 72^\circ 14, 6'$$

$$\triangle ABC : A = 90^\circ, B = 67^\circ 38, 8', C = 155^\circ 12, 6'$$

Oplossingen - Solutions

- 3.1. $A = 99^{\circ}20,3'$, $B = 104^{\circ}48,1'$, $C = 38^{\circ}54,1'$
- 3.2. $a = 70^{\circ}2,2'$, $B = 79^{\circ}17,1'$, $C = 111^{\circ}8,7'$
- 3.3. $K = 71^{\circ}2,8'$, $L = 119^{\circ}25,2'$, $M = 60^{\circ}45,6'$
- 3.4. $q = 91^{\circ}15,3'$, $P = 106^{\circ}53,2'$, $Z = 46^{\circ}5,5'$
- 3.5. $t = 93^{\circ}50,3'$, $R = 104^{\circ}16,8'$, $S = 33^{\circ}43,5'$
- 3.6. $P = 138^{\circ}40,8'$, $Q = 67^{\circ}24,2'$, $Z = 101^{\circ}50,7'$
- 3.7. $b = 52^{\circ}59'$, $A = 82^{\circ}34,9'$, $C = 48^{\circ}54,1'$
- 3.8. $P = 24^{\circ}49,1'$, $Q = 144^{\circ}34,9'$, $R = 33^{\circ}28'$

3.9.

$$106^{\circ}9,7'$$

3.10.

$$BI = 21^{\circ}23,6', \quad IH = 19^{\circ}11,3', \quad HB = 21^{\circ}43'.$$

3.11.

$$\begin{aligned} P &= 79^{\circ}17,2', & Q &= 111^{\circ}8,5', & z &= 70^{\circ}2,2' \\ R &= 56^{\circ}23,8', & S &= 69^{\circ}6,4', & T &= 93^{\circ}9,1' \\ L &= 67^{\circ}44,4', & M &= 115^{\circ}49,4', & k &= 71^{\circ}20,8' \\ S &= 60^{\circ}2,8', & T &= 121^{\circ}27,0', & r &= 70^{\circ}21,5' \\ P &= 79^{\circ}17,2', & Q &= 111^{\circ}8,5', & z &= 70^{\circ}2,2' \\ P &= 128^{\circ}2,9', & R &= 27^{\circ}48,1', & z &= 110^{\circ}51,8' \\ S &= 126^{\circ}54,1', & T &= 24^{\circ}44,2', & r &= 113^{\circ}2,6' \\ L &= 123^{\circ}42,5', & M &= 33^{\circ}38,8', & k &= 102^{\circ}1,9' \\ P &= 126^{\circ}50,7', & R &= 28^{\circ}24,1', & z &= 104^{\circ}51,0' \\ P &= 111^{\circ}8,7', & R &= 79^{\circ}17,1', & k &= 70^{\circ}2,2' \end{aligned}$$

3.12.

$$\begin{aligned} R &= 58^{\circ}8,2', & S &= 68^{\circ}37,0', & T &= 91^{\circ}57,7' \\ R &= 30^{\circ}51,3', & S &= 141^{\circ}20,0', & T &= 33^{\circ}21,7' \\ K &= 27^{\circ}48,6', & L &= 25^{\circ}3,1', & M &= 148^{\circ}8,7' \\ K &= 33^{\circ}21,7', & L &= 30^{\circ}51,3', & M &= 141^{\circ}20,0' \\ R &= 56^{\circ}23,8', & S &= 69^{\circ}6,4', & T &= 93^{\circ}9,1' \\ R &= 58^{\circ}8,2', & S &= 68^{\circ}37,0', & T &= 91^{\circ}57,7' \\ R &= 25^{\circ}3,1', & S &= 148^{\circ}8,7', & T &= 27^{\circ}48,6' \end{aligned}$$

3.13. $A = 107^{\circ}24,6', \quad B = 59^{\circ}57,5', \quad c = 100^{\circ}26,9'$

3.14. $A = 97^{\circ}18,6', \quad b = 27^{\circ}43,8', \quad c = 103^{\circ}36,3'$

3.15. $l = 149^{\circ}3,4', \quad m = 103^{\circ}50,2', \quad M = 97^{\circ}13,1'$

3.16. $A = 52^{\circ}22,6', \quad b = 73^{\circ}40,6', \quad B = 77^{\circ}8,2'$

3.17. $k = 51^{\circ}16,4', \quad m = 143^{\circ}0,6', \quad M = 129^{\circ}32,1'$
 $k = 128^{\circ}43,6', \quad m = 36^{\circ}59,4', \quad M = 50^{\circ}27,9'$

3.18. $a = 66^{\circ}15,6', \quad B = 51^{\circ}52,7', \quad c = 74^{\circ}48,6'$

3.19. $p = 141^{\circ}59,1', \quad q = 124^{\circ}47,1', \quad Q = 113^{\circ}9,7'$

3.20. $a = 157^{\circ}29,3', \quad c = 109^{\circ}19,1', \quad C = 97^{\circ}38,7'$

3.21.

$$\begin{aligned} a &= 38^\circ 8,3', & c &= 126^\circ 16,0', & A &= 49^\circ 59,4' \\ a &= 141^\circ 51,7', & c &= 53^\circ 44,0', & A &= 130^\circ 0,6' \end{aligned}$$

3.22.

$$R = 54^\circ 13,9', \quad S = 45^\circ 56,4', \quad s = 31^\circ 0,7'$$

3.23.

$$\begin{aligned} B &= 154^\circ 7,5', & C &= 82^\circ 20,5', & a &= 106^\circ 5,8' \\ C &= 32^\circ 21,6', & a &= 59^\circ 35,6', & c &= 27^\circ 29,5' & C &= 147^\circ 38,4', & a &= 120^\circ 24,4', & c &= 152^\circ 30,5' \\ C &= 162^\circ 6,6', & a &= 56^\circ 4,3', & c &= 165^\circ 14,0' & C &= 17^\circ 53,4', & a &= 123^\circ 55,7', & c &= 14^\circ 46,0' \\ B &= 126^\circ 36,5', & C &= 46^\circ 26,3', & c &= 30^\circ 51,3' \\ B &= 45^\circ 12,0', & C &= 46^\circ 57,2', & c &= 15^\circ 51,1' \\ B &= 38^\circ 5,3', & a &= 70^\circ 33,6', & c &= 65^\circ 50,9' \\ B &= 128^\circ 2,4', & a &= 62^\circ 43,5', & c &= 129^\circ 55,2' \\ B &= 80^\circ 35,3', & b &= 79^\circ 4,5', & c &= 120^\circ 49,0' \\ B &= 98^\circ 26,5', & b &= 99^\circ 36,2', & c &= 118^\circ 41,9' \\ B &= 87^\circ 27,1', & b &= 85^\circ 35,6', & c &= 35^\circ 17,6' \\ a &= 92^\circ 29,2', & b &= 84^\circ 46,6', & c &= 118^\circ 27,5' \end{aligned}$$

3.24.

$$\begin{aligned} l &= 156^\circ 28,1', & M &= 98^\circ 1,7', & m &= 109^\circ 27,4' \\ l &= 152^\circ 9,9', & M &= 100^\circ 56,0', & m &= 112^\circ 28,4' \\ l &= 164^\circ 56,0', & L &= 159^\circ 56,0', & m &= 132^\circ 31,6' \\ P &= 149^\circ 45,4', & p &= 158^\circ 58,8', & r &= 138^\circ 46,2' \\ l &= 126^\circ 37,5', & M &= 103^\circ 48,0', & m &= 107^\circ 1,0' \\ l &= 53^\circ 22,5', & M &= 76^\circ 12,0', & m &= 72^\circ 59,0' \\ B &= 121^\circ 26,5', & C &= 115^\circ 13,9', & c &= 119^\circ 58,6' \\ l &= 148^\circ 59,6', & M &= 101^\circ 5,8', & m &= 110^\circ 50,6' \\ a &= 152^\circ 55,1', & b &= 24^\circ 54,0', & c &= 168^\circ 59,7' \end{aligned}$$