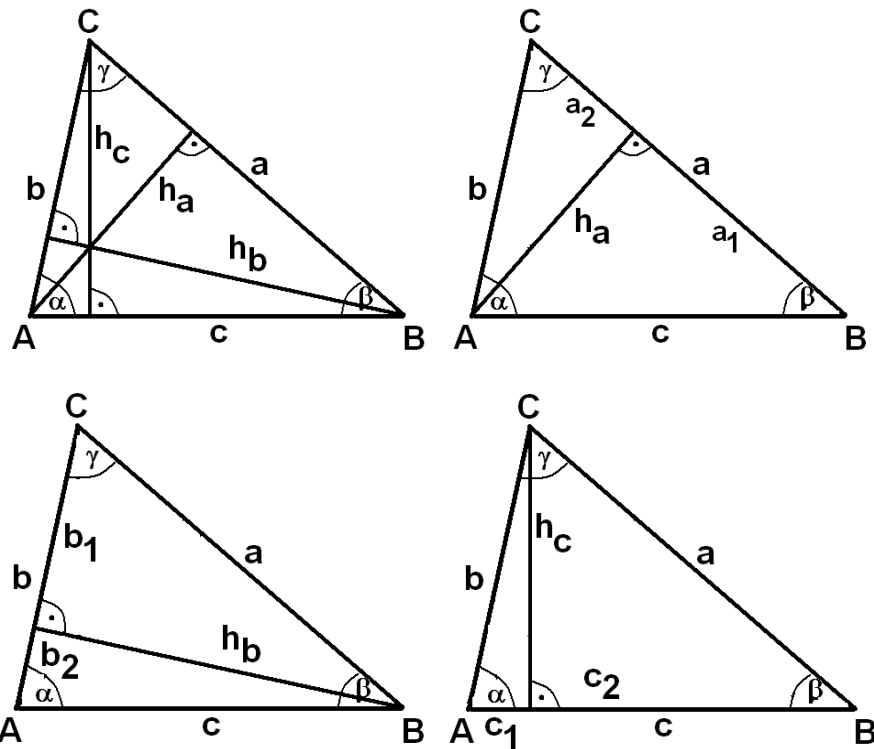


# Mathematik-Aufgabenpool

## > Trigonometrie III (allgemeine Dreiecke)

**Einleitung:** In einem allgemeinen Dreieck  $\triangle ABC$  mit den Seiten  $a, b, c$  und den Winkeln  $\alpha, \beta, \gamma$  lassen sich Seiten und Winkel berechnen, indem bei vorgegebenen zwei Seiten und einem Winkel bzw. bei vorgegebenen zwei Winkeln und einer Seite das Dreieck so durch eine Höhe  $h_a, h_b, h_c$  in zwei rechtwinklige Dreiecke aufgeteilt wird, dass nicht der einzige vorgegebene Winkel oder die einzige vorgegebene Seite durch die Höhe geteilt wird. Sind drei Seiten vorgegeben, so sind Sinus- und Kosinussatz anzuwenden.




Allgemeines Dreieck: Seiten  $a, b, c$ ; Winkel  $\alpha, \beta, \gamma$ , Höhen  $h_a, h_b, h_c$

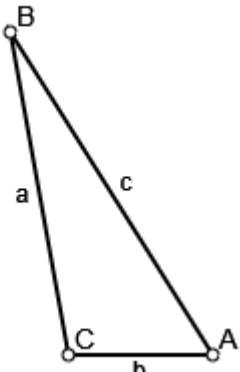
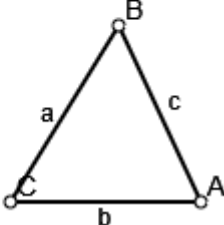
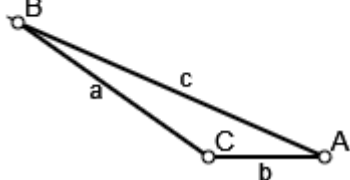
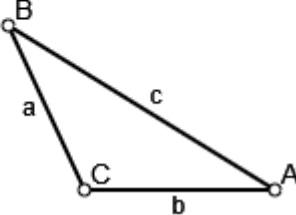
**Formelsammlung:**

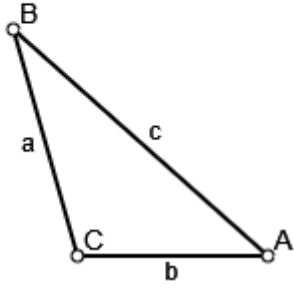
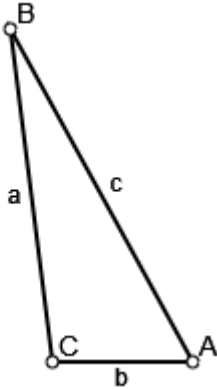
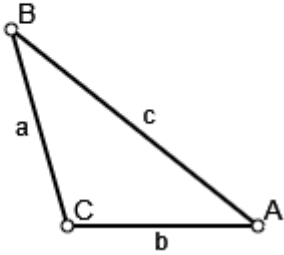
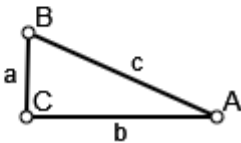
Winkelsumme	$\alpha + \beta + \gamma = 180^\circ$		
	$\alpha = 180^\circ - \beta - \gamma$	$\beta = 180^\circ - \alpha - \gamma$	$\gamma = 180^\circ - \alpha - \beta$
Umfang	$u = a + b + c$		
Flächeninhalt	$A = \frac{1}{2} a h_a$	$A = \frac{1}{2} b h_b$	$A = \frac{1}{2} c h_c$
	$A = \frac{1}{2} a b \sin \gamma$	$A = \frac{1}{2} a c \sin \beta$	$A = \frac{1}{2} b c \sin \alpha$
Höhen	$h_a = b \sin \gamma$	$h_b = a \sin \gamma$	$h_c = a \sin \beta$
	$h_a = c \sin \beta$	$h_b = c \sin \alpha$	$h_c = b \sin \alpha$
	$\frac{h_a}{h_b} = \frac{b}{a}$	$\frac{h_a}{h_c} = \frac{c}{a}$	$\frac{h_b}{h_c} = \frac{c}{b}$
Satz des Pythagoras	$a_1^2 + h_a^2 = c^2$	$a_2^2 + h_a^2 = b^2$	$h_a^2 = c^2 - a_1^2$
$a_1 + a_2 = a$ bzw. $a_1 - a_2 = a$ bzw. $a_2 - a_1 = a$	$a_1^2 = c^2 - h_a^2$	$a_2^2 = b^2 - h_a^2$	$h_a^2 = b^2 - a_2^2$

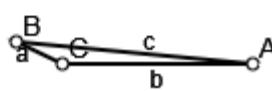
	$b_1^2 + h_b^2 = a^2$	$b_2^2 + h_b^2 = c^2$	$h_b^2 = a^2 - b_1^2$
$b_1 + b_2 = b$ bzw. $b_1 - b_2 = b$ bzw. $b_2 - b_1 = b$	$b_1^2 = a^2 - h_b^2$	$b_2^2 = c^2 - h_b^2$	$h_b^2 = c^2 - b_2^2$
	$c_1^2 + h_c^2 = b^2$	$c_2^2 + h_c^2 = a^2$	$h_c^2 = b^2 - c_1^2$
$c_1 + c_2 = c$ bzw. $c_1 - c_2 = c$ bzw. $c_2 - c_1 = c$	$c_1^2 = b^2 - h_c^2$	$c_2^2 = a^2 - h_c^2$	$h_c^2 = a^2 - c_2^2$
Trigonometrische Beziehungen (Sinus, Kosinus, Tangens)	$\sin \alpha = \frac{h_c}{b}$	$\cos \alpha = \frac{c_1}{b}$	$\tan \alpha = \frac{h_c}{c_1}$
	$\sin \alpha = \frac{h_b}{c}$	$\cos \alpha = \frac{b_2}{c}$	$\tan \alpha = \frac{h_b}{b_2}$
	$\sin \beta = \frac{h_c}{a}$	$\cos \beta = \frac{c_2}{a}$	$\tan \beta = \frac{h_c}{c_2}$
	$\sin \beta = \frac{h_a}{c}$	$\cos \beta = \frac{a_1}{c}$	$\tan \beta = \frac{h_a}{a_1}$
	$\sin \gamma = \frac{h_b}{a}$	$\cos \gamma = \frac{b_1}{a}$	$\tan \gamma = \frac{h_b}{b_1}$
	$\sin \gamma = \frac{h_a}{b}$	$\cos \gamma = \frac{a_2}{b}$	$\tan \gamma = \frac{h_a}{a_2}$
Sinussatz	$\frac{a}{\sin \alpha} = \frac{b}{\sin \beta} = \frac{c}{\sin \gamma}$		
	$a = \frac{\sin \alpha}{\sin \beta} b$	$b = \frac{\sin \beta}{\sin \gamma} c$	$c = \frac{\sin \gamma}{\sin \alpha} a$
	$\sin \alpha = \frac{a}{b} \sin \beta$	$\sin \beta = \frac{b}{c} \sin \gamma$	$\sin \gamma = \frac{c}{a} \sin \alpha$
Kosinussatz	$a^2 = b^2 + c^2 - 2bc \cos \alpha$	$\cos \alpha = \frac{b^2 + c^2 - a^2}{2bc}$	
	$b^2 = c^2 + a^2 - 2ca \cos \beta$	$\cos \beta = \frac{a^2 + c^2 - b^2}{2ac}$	
	$c^2 = a^2 + b^2 - 2ab \cos \gamma$	$\cos \gamma = \frac{a^2 + b^2 - c^2}{2ab}$	

**Aufgabe 1:** Berechne die fehlenden Größen im allgemeinen Dreieck  $\triangle ABC$  (Seiten  $a, b, c$ , Winkel  $\alpha, \beta, \gamma, A =$  Flächeninhalt,  $u =$  Umfang).

Nr.	Gegeben:	Grafik:
1	$a = 4.7 \text{ cm}, b = 2.3 \text{ cm},$ $\alpha = 87.5^\circ$	

2	$c = 5 \text{ cm}$ , $\alpha = 57.8^\circ$ , $\gamma = 100.2^\circ$	
3	$b = 9 \text{ cm}$ , $\alpha = 65.1^\circ$ , $\beta = 56.4^\circ$	
4	$a = 6.4 \text{ cm}$ , $\beta = 11.6^\circ$ , $\gamma = 144.7^\circ$	
5	$c = 6.9 \text{ cm}$ , $\alpha = 31.8^\circ$ , $\beta = 33.6^\circ$	

6	$a = 4.7 \text{ cm}$ , $b = 3.8 \text{ cm}$ , $c = 6.8 \text{ cm}$	 <p>A triangle with vertices A, B, and C. Side BC is labeled 'a', side AC is labeled 'b', and side AB is labeled 'c'.</p>
7	$a = 9.1 \text{ cm}$ , $b = 3.8 \text{ cm}$ , $\gamma = 97.3^\circ$	 <p>A triangle with vertices A, B, and C. Side BC is labeled 'a', side AC is labeled 'b', and side AB is labeled 'c'.</p>
8	$a = 7.4 \text{ cm}$ , $b = 6.9 \text{ cm}$ , $c = 11.4 \text{ cm}$	 <p>A triangle with vertices A, B, and C. Side BC is labeled 'a', side AC is labeled 'b', and side AB is labeled 'c'.</p>
9	$b = 6.1 \text{ cm}$ , $c = 6.6 \text{ cm}$ , $\alpha = 24.1^\circ$	 <p>A triangle with vertices A, B, and C. Side BC is labeled 'a', side AC is labeled 'b', and side AB is labeled 'c'.</p>

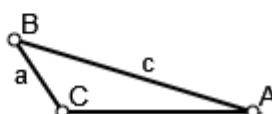
10	$a = 2.6 \text{ cm}$ , $c = 12 \text{ cm}$ , $\alpha = 5.3^\circ$	
----	--	--

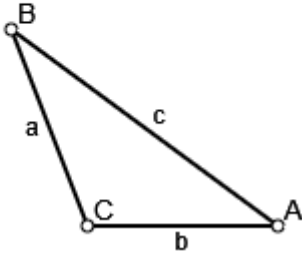
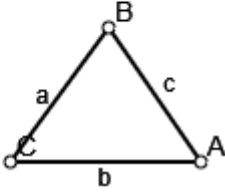
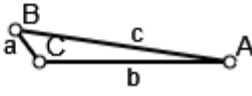
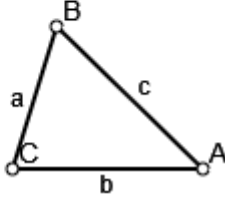
**Vorgehensweise:** Zur Ermittlung der fehlenden Größen beim allgemeinen Dreieck ist die obige Formelsammlung anzuwenden.

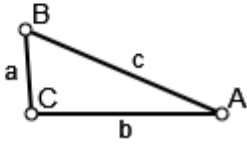
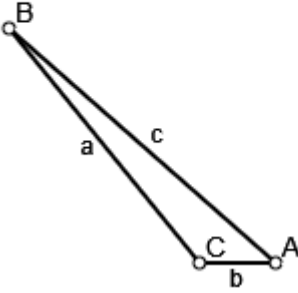
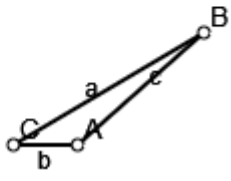
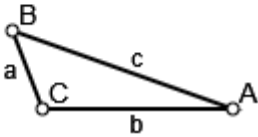
**Lösungen:**

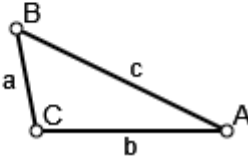
Nr.	Gegeben:	Lösungen:
1	$a = 4.7 \text{ cm}$ , $b = 2.3 \text{ cm}$ , $\alpha = 87.5^\circ$	$a = 4.7 \text{ cm}$ , $b = 2.3 \text{ cm}$ , $c = 4.2 \text{ cm}$ , $\alpha = 87.5^\circ$ , $\beta = 29.3^\circ$ , $\gamma = 63.2^\circ$ , $h_a = 2.1 \text{ cm}$ , $h_b = 4.2 \text{ cm}$ , $h_c = 2.3 \text{ cm}$ , $A = 5.4 \text{ cm}^2$ , $u = 11.2 \text{ cm}$
2	$c = 5 \text{ cm}$ , $\alpha = 57.8^\circ$ , $\gamma = 100.2^\circ$	$a = 4.3 \text{ cm}$ , $b = 1.9 \text{ cm}$ , $c = 5 \text{ cm}$ , $\alpha = 57.8^\circ$ , $\beta = 22^\circ$ , $\gamma = 100.2^\circ$ , $h_a = 1.9 \text{ cm}$ , $h_b = 4.2 \text{ cm}$ , $h_c = 1.6 \text{ cm}$ , $A = 4.1 \text{ cm}^2$ , $u = 11.2 \text{ cm}$
3	$b = 9 \text{ cm}$ , $\alpha = 65.1^\circ$ , $\beta = 56.4^\circ$	$a = 9.8 \text{ cm}$ , $b = 9 \text{ cm}$ , $c = 9.2 \text{ cm}$ , $\alpha = 65.1^\circ$ , $\beta = 56.4^\circ$ , $\gamma = 58.4^\circ$ , $h_a = 7.7 \text{ cm}$ , $h_b = 8.3 \text{ cm}$ , $h_c = 8.2 \text{ cm}$ , $A = 44.1 \text{ cm}^2$ , $u = 28 \text{ cm}$
4	$a = 6.4 \text{ cm}$ , $\beta = 11.6^\circ$ , $\gamma = 144.7^\circ$	$a = 6.4 \text{ cm}$ , $b = 3.2 \text{ cm}$ , $c = 9.2 \text{ cm}$ , $\alpha = 23.7^\circ$ , $\beta = 11.6^\circ$ , $\gamma = 144.7^\circ$ , $h_a = 1.8 \text{ cm}$ , $h_b = 3.7 \text{ cm}$ , $h_c = 1.3 \text{ cm}$ , $A = 10.2 \text{ cm}^2$ , $u = 18.8 \text{ cm}$
5	$c = 6.9 \text{ cm}$ , $\alpha = 31.8^\circ$ , $\beta = 33.6^\circ$	$a = 4 \text{ cm}$ , $b = 4.2 \text{ cm}$ , $c = 6.9 \text{ cm}$ , $\alpha = 31.8^\circ$ , $\beta = 33.6^\circ$ , $\gamma = 114.6^\circ$ , $h_a = 3.8 \text{ cm}$ , $h_b = 3.6 \text{ cm}$ , $h_c = 2.2 \text{ cm}$ , $A = 8.4 \text{ cm}^2$ , $u = 15.1 \text{ cm}$
6	$a = 4.7 \text{ cm}$ , $b = 3.8 \text{ cm}$ , $c = 6.8 \text{ cm}$	$a = 4.7 \text{ cm}$ , $b = 3.8 \text{ cm}$ , $c = 6.8 \text{ cm}$ , $\alpha = 41.7^\circ$ , $\beta = 32.5^\circ$ , $\gamma = 105.8^\circ$ , $h_a = 3.7 \text{ cm}$ , $h_b = 4.5 \text{ cm}$ , $h_c = 2.5 \text{ cm}$ , $A = 8.9 \text{ cm}^2$ , $u = 15.3 \text{ cm}$
7	$a = 9.1 \text{ cm}$ , $b = 3.8 \text{ cm}$ , $\gamma = 97.3^\circ$	$a = 9.1 \text{ cm}$ , $b = 3.8 \text{ cm}$ , $c = 10.3 \text{ cm}$ , $\alpha = 61.2^\circ$ , $\beta = 21.5^\circ$ , $\gamma = 97.3^\circ$ , $h_a = 3.8 \text{ cm}$ , $h_b = 9 \text{ cm}$ , $h_c = 3.3 \text{ cm}$ , $A = 17.3 \text{ cm}^2$ , $u = 23.2 \text{ cm}$
8	$a = 7.4 \text{ cm}$ , $b = 6.9 \text{ cm}$ , $c = 11.4 \text{ cm}$	$a = 7.4 \text{ cm}$ , $b = 6.9 \text{ cm}$ , $c = 11.4 \text{ cm}$ , $\alpha = 38.7^\circ$ , $\beta = 35.6^\circ$ , $\gamma = 105.7^\circ$ , $h_a = 6.6 \text{ cm}$ , $h_b = 7.1 \text{ cm}$ , $h_c = 4.3 \text{ cm}$ , $A = 25.5 \text{ cm}^2$ , $u = 25.7 \text{ cm}$
9	$b = 6.1 \text{ cm}$ , $c = 6.6 \text{ cm}$ , $\alpha = 24.1^\circ$	$a = 2.7 \text{ cm}$ , $b = 6.1 \text{ cm}$ , $c = 6.6 \text{ cm}$ , $\alpha = 24.1^\circ$ , $\beta = 67.5^\circ$ , $\gamma = 88.4^\circ$ , $h_a = 6.1 \text{ cm}$ , $h_b = 2.7 \text{ cm}$ , $h_c = 2.5 \text{ cm}$ , $A = 8.2 \text{ cm}^2$ , $u = 15.4 \text{ cm}$
10	$a = 2.6 \text{ cm}$ , $c = 12 \text{ cm}$ , $\alpha = 5.3^\circ$	$a = 2.6 \text{ cm}$ , $b = 9.6 \text{ cm}$ , $c = 12 \text{ cm}$ , $\alpha = 5.3^\circ$ , $\beta = 20.1^\circ$ , $\gamma = 154.6^\circ$ , $h_a = 4.1 \text{ cm}$ , $h_b = 1.1 \text{ cm}$ , $h_c = 0.9 \text{ cm}$ , $A = 12.5 \text{ cm}^2$ , $u = 24.2 \text{ cm}$

**Aufgabe 2:** Berechne die fehlenden Größen im allgemeinen Dreieck  $\Delta ABC$  (Seiten  $a$ ,  $b$ ,  $c$ , Winkel  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $A$  = Flächeninhalt,  $u$  = Umfang).

Nr.	Gegeben:	Grafik:
1	$b = 17.2 \text{ m}$ , $\alpha = 16.8^\circ$ , $\gamma = 124.1^\circ$	

2	$a = 8.7 \text{ dm}$ , $c = 13.7 \text{ dm}$ , $\beta = 32.5^\circ$	
3	$b = 4.9 \text{ dm}$ , $c = 4.2 \text{ dm}$ , $\beta = 70.4^\circ$	
4	$a = 2.2 \text{ mm}$ , $b = 10.4 \text{ mm}$ , $\alpha = 8.8^\circ$	
5	$b = 14.3 \text{ cm}$ , $\alpha = 44.1^\circ$ , $\beta = 62.7^\circ$	

6	$a = 8.5 \text{ mm}$ , $c = 21.4 \text{ mm}$ , $\beta = 62.3^\circ$	
7	$a = 14.4 \text{ cm}$ , $\alpha = 41.4^\circ$ , $\beta = 9.5^\circ$	
8	$a = 14.9 \text{ mm}$ , $b = 4.3 \text{ mm}$ , $\beta = 11^\circ$	
9	$b = 16.3 \text{ cm}$ , $\alpha = 19.7^\circ$ , $\gamma = 110.6^\circ$	

10	$b = 17.5 \text{ dm}, \alpha = 25.7^\circ,$ $\beta = 52.9^\circ$	
----	---	--

**Vorgehensweise:** Zur Ermittlung der fehlenden Größen beim allgemeinen Dreieck ist die obige Formelsammlung anzuwenden.

**Lösungen:**

Nr.	Gegeben:	Lösungen:
1	$b = 17.2 \text{ m}, \alpha = 16.8^\circ, \gamma = 124.1^\circ$	$a = 7.9 \text{ m}, b = 17.2 \text{ m}, c = 22.6 \text{ m}, \alpha = 16.8^\circ, \beta = 39^\circ, \gamma = 124.1^\circ, h_a = 14.2 \text{ m}, h_b = 6.5 \text{ m}, h_c = 5 \text{ m}, A = 67.9 \text{ m}^2, u = 47.7 \text{ m}$
2	$a = 8.7 \text{ dm}, c = 13.7 \text{ dm}, \beta = 32.5^\circ$	$a = 8.7 \text{ dm}, b = 7.9 \text{ dm}, c = 13.7 \text{ dm}, \alpha = 36.3^\circ, \beta = 32.5^\circ, \gamma = 111.1^\circ, h_a = 7.4 \text{ dm}, h_b = 8.1 \text{ dm}, h_c = 4.7 \text{ dm}, A = 34.4 \text{ dm}^2, u = 30.3 \text{ dm}$
3	$b = 4.9 \text{ dm}, c = 4.2 \text{ dm}, \beta = 70.4^\circ$	$a = 4.3 \text{ dm}, b = 4.9 \text{ dm}, c = 4.2 \text{ dm}, \alpha = 55.8^\circ, \beta = 70.4^\circ, \gamma = 53.8^\circ, h_a = 4 \text{ dm}, h_b = 3.5 \text{ dm}, h_c = 4.1 \text{ dm}, A = 10.5 \text{ dm}^2, u = 13.4 \text{ dm}$
4	$a = 2.2 \text{ mm}, b = 10.4 \text{ mm}, \alpha = 8.8^\circ$	$a = 2.2 \text{ mm}, b = 10.4 \text{ mm}, c = 11.8 \text{ mm}, \alpha = 8.8^\circ, \beta = 46.2^\circ, \gamma = 125^\circ, h_a = 8.5 \text{ mm}, h_b = 1.8 \text{ mm}, h_c = 1.6 \text{ mm}, A = 11.4 \text{ mm}^2, u = 24.4 \text{ mm}$
5	$b = 14.3 \text{ cm}, \alpha = 44.1^\circ, \beta = 62.7^\circ$	$a = 11.2 \text{ cm}, b = 14.3 \text{ cm}, c = 15.4 \text{ cm}, \alpha = 44.1^\circ, \beta = 62.7^\circ, \gamma = 73.2^\circ, h_a = 13.7 \text{ cm}, h_b = 10.7 \text{ cm}, h_c = 10 \text{ cm}, A = 80.1 \text{ cm}^2, u = 40.9 \text{ cm}$
6	$a = 8.5 \text{ mm}, c = 21.4 \text{ mm}, \beta = 62.3^\circ$	$a = 8.5 \text{ mm}, b = 19 \text{ mm}, c = 21.4 \text{ mm}, \alpha = 23.3^\circ, \beta = 62.3^\circ, \gamma = 94.4^\circ, h_a = 18.9 \text{ mm}, h_b = 8.5 \text{ mm}, h_c = 7.5 \text{ mm}, A = 80.8 \text{ mm}^2, u = 48.9 \text{ mm}$
7	$a = 14.4 \text{ cm}, \alpha = 41.4^\circ, \beta = 9.5^\circ$	$a = 14.4 \text{ cm}, b = 3.6 \text{ cm}, c = 16.9 \text{ cm}, \alpha = 41.4^\circ, \beta = 9.5^\circ, \gamma = 129^\circ, h_a = 2.8 \text{ cm}, h_b = 11.2 \text{ cm}, h_c = 2.4 \text{ cm}, A = 25.9 \text{ cm}^2, u = 34.9 \text{ cm}$
8	$a = 14.9 \text{ mm}, b = 4.3 \text{ mm}, \beta = 11^\circ$	$a = 14.9 \text{ mm}, b = 4.3 \text{ mm}, c = 11.4 \text{ mm}, \alpha = 138.6^\circ, \beta = 11^\circ, \gamma = 30.4^\circ, h_a = 2.2 \text{ mm}, h_b = 7.5 \text{ mm}, h_c = 2.8 \text{ mm}, A = 32 \text{ mm}^2, u = 30.6 \text{ mm}$
9	$b = 16.3 \text{ cm}, \alpha = 19.7^\circ, \gamma = 110.6^\circ$	$a = 7.2 \text{ cm}, b = 16.3 \text{ cm}, c = 20 \text{ cm}, \alpha = 19.7^\circ, \beta = 49.7^\circ, \gamma = 110.6^\circ, h_a = 15.3 \text{ cm}, h_b = 6.7 \text{ cm}, h_c = 5.5 \text{ cm}, A = 58.7 \text{ cm}^2, u = 43.5 \text{ cm}$
10	$b = 17.5 \text{ dm}, \alpha = 25.7^\circ, \beta = 52.9^\circ$	$a = 9.5 \text{ dm}, b = 17.5 \text{ dm}, c = 21.5 \text{ dm}, \alpha = 25.7^\circ, \beta = 52.9^\circ, \gamma = 101.4^\circ, h_a = 17.2 \text{ dm}, h_b = 9.3 \text{ dm}, h_c = 7.6 \text{ dm}, A = 83.1 \text{ dm}^2, u = 48.5 \text{ dm}$

**Aufgabe 3:** Berechne die fehlenden Größen im allgemeinen Dreieck  $\Delta ABC$  (Seiten  $a, b, c$ , Winkel  $\alpha, \beta, \gamma, A = \text{Flächeninhalt}, u = \text{Umfang}$ ).

Nr.	Gegeben:
1	$b = 14.7 \text{ cm}, \alpha = 21.6^\circ, \beta = 113.7^\circ$
2	$a = 2.7 \text{ cm}, c = 16.6 \text{ cm}, \alpha = 9.3^\circ$
3	$a = 11.2 \text{ cm}, \beta = 59.1^\circ, \gamma = 42.4^\circ$
4	$a = 15.1 \text{ cm}, c = 9.3 \text{ cm}, \gamma = 34.8^\circ$
5	$c = 8.7 \text{ cm}, \alpha = 61.3^\circ, \gamma = 31.8^\circ$
6	$a = 14.9 \text{ cm}, \beta = 11.1^\circ, \gamma = 156.1^\circ$
7	$a = 12.7 \text{ cm}, c = 17 \text{ cm}, \beta = 10.7^\circ$
8	$b = 9.7 \text{ cm}, \alpha = 115.3^\circ, \gamma = 17.2^\circ$
9	$b = 4 \text{ cm}, \alpha = 57.3^\circ, \gamma = 103.8^\circ$
10	$a = 14 \text{ cm}, c = 13.6 \text{ cm}, \alpha = 48.8^\circ$
11	$a = 8.8 \text{ cm}, b = 15.9 \text{ cm}, c = 15.7 \text{ cm}$



12	$a = 1.6 \text{ cm}, c = 7.7 \text{ cm}, \beta = 148.3^\circ$
13	$b = 15.5 \text{ cm}, c = 9.9 \text{ cm}, \alpha = 56.5^\circ$
14	$a = 1.3 \text{ cm}, c = 11.9 \text{ cm}, \gamma = 104.9^\circ$
15	$a = 16.6 \text{ cm}, b = 1 \text{ cm}, c = 17.3 \text{ cm}$
16	$a = 17.8 \text{ cm}, b = 13.8 \text{ cm}, \gamma = 82.7^\circ$
17	$c = 9.3 \text{ cm}, \alpha = 20.5^\circ, \gamma = 31.2^\circ$
18	$b = 17.8 \text{ cm}, \alpha = 36.8^\circ, \beta = 67.8^\circ$
19	$a = 9.1 \text{ cm}, c = 15.2 \text{ cm}, \beta = 73.9^\circ$
20	$b = 14.6 \text{ cm}, \alpha = 10.9^\circ, \gamma = 147.1^\circ$

**Vorgehensweise:** Zur Ermittlung der fehlenden Größen beim allgemeinen Dreieck ist die obige Formelsammlung anzuwenden.

**Lösungen:**

Nr.	Gegeben:	Lösungen:
1	$b = 14.7 \text{ cm}, \alpha = 21.6^\circ, \beta = 113.7^\circ$	$a = 5.9 \text{ cm}, b = 14.7 \text{ cm}, c = 11.3 \text{ cm}, \alpha = 21.6^\circ, \beta = 113.7^\circ, \gamma = 44.7^\circ, h_a = 10.3 \text{ cm}, h_b = 4.2 \text{ cm}, h_c = 5.4 \text{ cm}, A = 43.4 \text{ cm}^2, u = 31.9 \text{ cm}$
2	$a = 2.7 \text{ cm}, c = 16.6 \text{ cm}, \alpha = 9.3^\circ$	$a = 2.7 \text{ cm}, b = 16.1 \text{ cm}, c = 16.6 \text{ cm}, \alpha = 9.3^\circ, \beta = 74.7^\circ, \gamma = 96^\circ, h_a = 16 \text{ cm}, h_b = 2.7 \text{ cm}, h_c = 2.6 \text{ cm}, A = 21.7 \text{ cm}^2, u = 35.4 \text{ cm}$
3	$a = 11.2 \text{ cm}, \beta = 59.1^\circ, \gamma = 42.4^\circ$	$a = 11.2 \text{ cm}, b = 9.8 \text{ cm}, c = 7.7 \text{ cm}, \alpha = 78.6^\circ, \beta = 59.1^\circ, \gamma = 42.4^\circ, h_a = 6.6 \text{ cm}, h_b = 7.5 \text{ cm}, h_c = 9.6 \text{ cm}, A = 54.9 \text{ cm}^2, u = 28.7 \text{ cm}$
4	$a = 15.1 \text{ cm}, c = 9.3 \text{ cm}, \gamma = 34.8^\circ$	$a = 15.1 \text{ cm}, b = 15.9 \text{ cm}, c = 9.3 \text{ cm}, \alpha = 67.9^\circ, \beta = 77.3^\circ, \gamma = 34.8^\circ, h_a = 9.1 \text{ cm}, h_b = 8.6 \text{ cm}, h_c = 14.7 \text{ cm}, A = 120 \text{ cm}^2, u = 40.3 \text{ cm}$
5	$c = 8.7 \text{ cm}, \alpha = 61.3^\circ, \gamma = 31.8^\circ$	$a = 14.5 \text{ cm}, b = 16.5 \text{ cm}, c = 8.7 \text{ cm}, \alpha = 61.3^\circ, \beta = 86.9^\circ, \gamma = 31.8^\circ, h_a = 8.7 \text{ cm}, h_b = 7.6 \text{ cm}, h_c = 14.5 \text{ cm}, A = 119.6 \text{ cm}^2, u = 39.7 \text{ cm}$
6	$a = 14.9 \text{ cm}, \beta = 11.1^\circ, \gamma = 156.1^\circ$	$a = 14.9 \text{ cm}, b = 12.9 \text{ cm}, c = 27.2 \text{ cm}, \alpha = 12.8^\circ, \beta = 11.1^\circ, \gamma = 156.1^\circ, h_a = 5.2 \text{ cm}, h_b = 6 \text{ cm}, h_c = 2.9 \text{ cm}, A = 96.1 \text{ cm}^2, u = 55 \text{ cm}$
7	$a = 12.7 \text{ cm}, c = 17 \text{ cm}, \beta = 10.7^\circ$	$a = 12.7 \text{ cm}, b = 5.1 \text{ cm}, c = 17 \text{ cm}, \alpha = 27.6^\circ, \beta = 10.7^\circ, \gamma = 141.7^\circ, h_a = 3.2 \text{ cm}, h_b = 7.9 \text{ cm}, h_c = 2.4 \text{ cm}, A = 32.4 \text{ cm}^2, u = 34.8 \text{ cm}$
8	$b = 9.7 \text{ cm}, \alpha = 115.3^\circ, \gamma = 17.2^\circ$	$a = 11.9 \text{ cm}, b = 9.7 \text{ cm}, c = 3.9 \text{ cm}, \alpha = 115.3^\circ, \beta = 47.5^\circ, \gamma = 17.2^\circ, h_a = 2.9 \text{ cm}, h_b = 3.5 \text{ cm}, h_c = 8.8 \text{ cm}, A = 57.7 \text{ cm}^2, u = 25.5 \text{ cm}$
9	$b = 4 \text{ cm}, \alpha = 57.3^\circ, \gamma = 103.8^\circ$	$a = 10.4 \text{ cm}, b = 4 \text{ cm}, c = 12 \text{ cm}, \alpha = 57.3^\circ, \beta = 18.9^\circ, \gamma = 103.8^\circ, h_a = 3.9 \text{ cm}, h_b = 10.1 \text{ cm}, h_c = 3.4 \text{ cm}, A = 20.8 \text{ cm}^2, u = 26.4 \text{ cm}$
10	$a = 14 \text{ cm}, c = 13.6 \text{ cm}, \alpha = 48.8^\circ$	$a = 14 \text{ cm}, b = 18.5 \text{ cm}, c = 13.6 \text{ cm}, \alpha = 48.8^\circ, \beta = 84.2^\circ, \gamma = 47^\circ, h_a = 13.5 \text{ cm}, h_b = 10.2 \text{ cm}, h_c = 13.9 \text{ cm}, A = 129.5 \text{ cm}^2, u = 46.1 \text{ cm}$
11	$a = 8.8 \text{ cm}, b = 15.9 \text{ cm}, c = 15.7 \text{ cm}$	$a = 8.8 \text{ cm}, b = 15.9 \text{ cm}, c = 15.7 \text{ cm}, \alpha = 32.3^\circ, \beta = 75.1^\circ, \gamma = 72.6^\circ, h_a = 15.2 \text{ cm}, h_b = 8.4 \text{ cm}, h_c = 8.5 \text{ cm}, A = 70 \text{ cm}^2, u = 40.4 \text{ cm}$
12	$a = 1.6 \text{ cm}, c = 7.7 \text{ cm}, \beta = 148.3^\circ$	$a = 1.6 \text{ cm}, b = 9.1 \text{ cm}, c = 7.7 \text{ cm}, \alpha = 5.3^\circ, \beta = 148.3^\circ, \gamma = 26.4^\circ, h_a = 4 \text{ cm}, h_b = 0.7 \text{ cm}, h_c = 0.8 \text{ cm}, A = 7.3 \text{ cm}^2, u = 18.4 \text{ cm}$
13	$b = 15.5 \text{ cm}, c = 9.9 \text{ cm}, \alpha = 56.5^\circ$	$a = 13 \text{ cm}, b = 15.5 \text{ cm}, c = 9.9 \text{ cm}, \alpha = 56.5^\circ, \beta = 84^\circ, \gamma = 39.4^\circ, h_a = 9.8 \text{ cm}, h_b = 8.3 \text{ cm}, h_c = 12.9 \text{ cm}, A = 100.8 \text{ cm}^2, u = 38.4 \text{ cm}$
14	$a = 1.3 \text{ cm}, c = 11.9 \text{ cm}, \gamma = 104.9^\circ$	$a = 1.3 \text{ cm}, b = 11.5 \text{ cm}, c = 11.9 \text{ cm}, \alpha = 6.1^\circ, \beta = 69.1^\circ, \gamma = 104.9^\circ, h_a = 11.1 \text{ cm}, h_b = 1.3 \text{ cm}, h_c = 1.2 \text{ cm}, A = 7.5 \text{ cm}^2, u = 24.7 \text{ cm}$
15	$a = 16.6 \text{ cm}, b = 1 \text{ cm}, c = 17.3 \text{ cm}$	$a = 16.6 \text{ cm}, b = 1 \text{ cm}, c = 17.3 \text{ cm}, \alpha = 44.4^\circ, \beta = 2.4^\circ, \gamma = 133.2^\circ, h_a = 0.7 \text{ cm}, h_b = 12.1 \text{ cm}, h_c = 0.7 \text{ cm}, A = 8.3 \text{ cm}^2, u = 34.9 \text{ cm}$
16	$a = 17.8 \text{ cm}, b = 13.8 \text{ cm}, \gamma = 82.7^\circ$	$a = 17.8 \text{ cm}, b = 13.8 \text{ cm}, c = 21.1 \text{ cm}, \alpha = 56.8^\circ, \beta = 40.5^\circ, \gamma = 82.7^\circ, h_a = 13.7 \text{ cm}, h_b = 17.7 \text{ cm}, h_c = 11.5 \text{ cm}, A = 122.8 \text{ cm}^2, u = 52.7 \text{ cm}$
17	$c = 9.3 \text{ cm}, \alpha = 20.5^\circ, \gamma = 31.2^\circ$	$a = 6.3 \text{ cm}, b = 14.1 \text{ cm}, c = 9.3 \text{ cm}, \alpha = 20.5^\circ, \beta = 128.3^\circ, \gamma = 31.2^\circ, h_a = 7.3 \text{ cm}, h_b = 3.3 \text{ cm}, h_c = 4.9 \text{ cm}, A = 44.4 \text{ cm}^2, u = 29.7 \text{ cm}$
18	$b = 17.8 \text{ cm}, \alpha = 36.8^\circ, \beta = 67.8^\circ$	$a = 11.5 \text{ cm}, b = 17.8 \text{ cm}, c = 18.6 \text{ cm}, \alpha = 36.8^\circ, \beta = 67.8^\circ, \gamma = 75.4^\circ, h_a = 17.2 \text{ cm}, h_b = 11.1 \text{ cm}, h_c = 10.7 \text{ cm}, A = 102.4 \text{ cm}^2, u = 47.9 \text{ cm}$
19	$a = 9.1 \text{ cm}, c = 15.2 \text{ cm}, \beta = 73.9^\circ$	$a = 9.1 \text{ cm}, b = 15.4 \text{ cm}, c = 15.2 \text{ cm}, \alpha = 34.6^\circ, \beta = 73.9^\circ, \gamma = 71.5^\circ, h_a = 14.6 \text{ cm}, h_b = 8.6 \text{ cm}, h_c = 8.7 \text{ cm}, A = 70.1 \text{ cm}^2, u = 39.7 \text{ cm}$
20	$b = 14.6 \text{ cm}, \alpha = 10.9^\circ, \gamma = 147.1^\circ$	$a = 7.4 \text{ cm}, b = 14.6 \text{ cm}, c = 21.2 \text{ cm}, \alpha = 10.9^\circ, \beta = 21.9^\circ, \gamma = 147.1^\circ, h_a = 7.9 \text{ cm}, h_b = 4 \text{ cm}, h_c = 2.8 \text{ cm}, A = 54 \text{ cm}^2, u = 43.2 \text{ cm}$

**Aufgabe 4:** Berechne die fehlenden Größen im allgemeinen Dreieck  $\triangle ABC$  (Seiten  $a, b, c$ , Winkel  $\alpha, \beta, \gamma$ ,  $A$  = Flächeninhalt,  $u$  = Umfang).

Nr.	Gegeben:
1	$b = 2.5 \text{ m}, c = 3.4 \text{ m}, \gamma = 33.3^\circ$
2	$a = 1.1 \text{ mm}, \beta = 32.1^\circ, \gamma = 141.6^\circ$
3	$b = 7.9 \text{ cm}, c = 2.2 \text{ cm}, \gamma = 16.2^\circ$
4	$b = 2.5 \text{ dm}, c = 7.9 \text{ dm}, \gamma = 94.5^\circ$
5	$b = 8.5 \text{ m}, \alpha = 24.6^\circ, \beta = 41^\circ$
6	$b = 8.4 \text{ cm}, \alpha = 84.9^\circ, \gamma = 30.9^\circ$
7	$b = 3.2 \text{ dm}, \beta = 12.5^\circ, \gamma = 129.3^\circ$
8	$a = 1.9 \text{ m}, c = 6.1 \text{ m}, \alpha = 11.2^\circ$
9	$b = 5.8 \text{ m}, \alpha = 94.1^\circ, \gamma = 49.8^\circ$
10	$b = 1.4 \text{ mm}, \alpha = 104.5^\circ, \beta = 20.9^\circ$
11	$a = 2.8 \text{ cm}, \beta = 34.1^\circ, \gamma = 85.2^\circ$
12	$a = 1.9 \text{ mm}, b = 3.9 \text{ mm}, \beta = 51.2^\circ$
13	$a = 2.4 \text{ m}, \beta = 146.7^\circ, \gamma = 25.1^\circ$
14	$b = 5.5 \text{ m}, \alpha = 73.6^\circ, \gamma = 43.1^\circ$
15	$a = 2.6 \text{ dm}, c = 7.4 \text{ dm}, \beta = 62.2^\circ$
16	$a = 5.4 \text{ dm}, b = 1.5 \text{ dm}, \gamma = 106.5^\circ$
17	$a = 7.4 \text{ cm}, c = 9.7 \text{ cm}, \beta = 17.9^\circ$
18	$a = 3.7 \text{ dm}, b = 1.6 \text{ dm}, \gamma = 77.5^\circ$
19	$a = 7.5 \text{ m}, b = 9.3 \text{ m}, \gamma = 136.2^\circ$
20	$b = 2.9 \text{ mm}, c = 9.5 \text{ mm}, \gamma = 110.2^\circ$

**Vorgehensweise:** Zur Ermittlung der fehlenden Größen beim allgemeinen Dreieck ist die obige Formelsammlung anzuwenden.

**Lösungen:**

Nr.	Gegeben:	Lösungen:
1	$b = 2.5 \text{ m}, c = 3.4 \text{ m}, \gamma = 33.3^\circ$	$a = 5.2 \text{ m}, b = 2.5 \text{ m}, c = 3.4 \text{ m}, \alpha = 122.9^\circ, \beta = 23.8^\circ, \gamma = 33.3^\circ, h_a = 1.4 \text{ m}, h_b = 2.9 \text{ m}, h_c = 2.1 \text{ m}, A = 6.5 \text{ m}^2, u = 11.1 \text{ m}$
2	$a = 1.1 \text{ mm}, \beta = 32.1^\circ, \gamma = 141.6^\circ$	$a = 1.1 \text{ mm}, b = 5.3 \text{ mm}, c = 6.2 \text{ mm}, \alpha = 6.3^\circ, \beta = 32.1^\circ, \gamma = 141.6^\circ, h_a = 3.3 \text{ mm}, h_b = 0.7 \text{ mm}, h_c = 0.6 \text{ mm}, A = 2.9 \text{ mm}^2, u = 12.6 \text{ mm}$
3	$b = 7.9 \text{ cm}, c = 2.2 \text{ cm}, \gamma = 16.2^\circ$	$a = 7.6 \text{ cm}, b = 7.9 \text{ cm}, c = 2.2 \text{ cm}, \alpha = 74.2^\circ, \beta = 89.7^\circ, \gamma = 16.2^\circ, h_a = 2.2 \text{ cm}, h_b = 2.1 \text{ cm}, h_c = 7.6 \text{ cm}, A = 30 \text{ cm}^2, u = 17.7 \text{ cm}$
4	$b = 2.5 \text{ dm}, c = 7.9 \text{ dm}, \gamma = 94.5^\circ$	$a = 7.3 \text{ dm}, b = 2.5 \text{ dm}, c = 7.9 \text{ dm}, \alpha = 67.1^\circ, \beta = 18.4^\circ, \gamma = 94.5^\circ, h_a = 2.5 \text{ dm}, h_b = 7.3 \text{ dm}, h_c = 2.3 \text{ dm}, A = 9.1 \text{ dm}^2, u = 17.7 \text{ dm}$
5	$b = 8.5 \text{ m}, \alpha = 24.6^\circ, \beta = 41^\circ$	$a = 5.4 \text{ m}, b = 8.5 \text{ m}, c = 11.8 \text{ m}, \alpha = 24.6^\circ, \beta = 41^\circ, \gamma = 114.3^\circ, h_a = 7.7 \text{ m}, h_b = 4.9 \text{ m}, h_c = 3.5 \text{ m}, A = 23 \text{ m}^2, u = 25.7 \text{ m}$
6	$b = 8.4 \text{ cm}, \alpha = 84.9^\circ, \gamma = 30.9^\circ$	$a = 9.3 \text{ cm}, b = 8.4 \text{ cm}, c = 4.8 \text{ cm}, \alpha = 84.9^\circ, \beta = 64.1^\circ, \gamma = 30.9^\circ, h_a = 4.3 \text{ cm}, h_b = 4.8 \text{ cm}, h_c = 8.4 \text{ cm}, A = 39.1 \text{ cm}^2, u = 22.5 \text{ cm}$
7	$b = 3.2 \text{ dm}, \beta = 12.5^\circ, \gamma = 129.3^\circ$	$a = 9.1 \text{ dm}, b = 3.2 \text{ dm}, c = 11.4 \text{ dm}, \alpha = 38.1^\circ, \beta = 12.5^\circ, \gamma = 129.3^\circ, h_a = 2.5 \text{ dm}, h_b = 7 \text{ dm}, h_c = 2 \text{ dm}, A = 14.6 \text{ dm}^2, u = 23.7 \text{ dm}$
8	$a = 1.9 \text{ m}, c = 6.1 \text{ m}, \alpha = 11.2^\circ$	$a = 1.9 \text{ m}, b = 4.5 \text{ m}, c = 6.1 \text{ m}, \alpha = 11.2^\circ, \beta = 27.5^\circ, \gamma = 141.3^\circ, h_a = 2.8 \text{ m}, h_b = 1.2 \text{ m}, h_c = 0.9 \text{ m}, A = 4.3 \text{ m}^2, u = 12.5 \text{ m}$
9	$b = 5.8 \text{ m}, \alpha = 94.1^\circ, \gamma = 49.8^\circ$	$a = 9.8 \text{ m}, b = 5.8 \text{ m}, c = 7.5 \text{ m}, \alpha = 94.1^\circ, \beta = 36.2^\circ, \gamma = 49.8^\circ, h_a = 4.4 \text{ m}, h_b = 7.5 \text{ m}, h_c = 5.8 \text{ m}, A = 28.4 \text{ m}^2, u = 23.1 \text{ m}$
10	$b = 1.4 \text{ mm}, \alpha = 104.5^\circ, \beta = 20.9^\circ$	$a = 3.8 \text{ mm}, b = 1.4 \text{ mm}, c = 3.2 \text{ mm}, \alpha = 104.5^\circ, \beta = 20.9^\circ, \gamma = 54.6^\circ, h_a = 1.1 \text{ mm}, h_b = 3.1 \text{ mm}, h_c = 1.4 \text{ mm}, A = 2.7 \text{ mm}^2, u = 8.4 \text{ mm}$
11	$a = 2.8 \text{ cm}, \beta = 34.1^\circ, \gamma = 85.2^\circ$	$a = 2.8 \text{ cm}, b = 1.8 \text{ cm}, c = 3.2 \text{ cm}, \alpha = 60.7^\circ, \beta = 34.1^\circ, \gamma = 85.2^\circ, h_a = 1.8 \text{ cm}, h_b = 2.8 \text{ cm}, h_c = 1.6 \text{ cm}, A = 2.5 \text{ cm}^2, u = 7.8 \text{ cm}$
12	$a = 1.9 \text{ mm}, b = 3.9 \text{ mm}, \beta = 51.2^\circ$	$a = 1.9 \text{ mm}, b = 3.9 \text{ mm}, c = 4.8 \text{ mm}, \alpha = 22.3^\circ, \beta = 51.2^\circ, \gamma = 106.5^\circ, h_a = 3.7 \text{ mm}, h_b = 1.8 \text{ mm}, h_c = 1.5 \text{ mm}, A = 3.7 \text{ mm}^2, u = 10.6 \text{ mm}$
13	$a = 2.4 \text{ m}, \beta = 146.7^\circ, \gamma = 25.1^\circ$	$a = 2.4 \text{ m}, b = 9.3 \text{ m}, c = 7.2 \text{ m}, \alpha = 8.1^\circ, \beta = 146.7^\circ, \gamma = 25.1^\circ, h_a = 4 \text{ m}, h_b = 1 \text{ m}, h_c = 1.3 \text{ m}, A = 11.2 \text{ m}^2, u = 18.9 \text{ m}$

14	$b = 5.5 \text{ m}, \alpha = 73.6^\circ, \gamma = 43.1^\circ$	$a = 5.9 \text{ m}, b = 5.5 \text{ m}, c = 4.2 \text{ m}, \alpha = 73.6^\circ, \beta = 63.4^\circ, \gamma = 43.1^\circ, h_a = 3.8 \text{ m}, h_b = 4 \text{ m}, h_c = 5.3 \text{ m}, A = 16.2 \text{ m}^2, u = 15.6 \text{ m}$
15	$a = 2.6 \text{ dm}, c = 7.4 \text{ dm}, \beta = 62.2^\circ$	$a = 2.6 \text{ dm}, b = 6.6 \text{ dm}, c = 7.4 \text{ dm}, \alpha = 20.4^\circ, \beta = 62.2^\circ, \gamma = 97.4^\circ, h_a = 6.5 \text{ dm}, h_b = 2.6 \text{ dm}, h_c = 2.3 \text{ dm}, A = 8.6 \text{ dm}^2, u = 16.6 \text{ dm}$
16	$a = 5.4 \text{ dm}, b = 1.5 \text{ dm}, \gamma = 106.5^\circ$	$a = 5.4 \text{ dm}, b = 1.5 \text{ dm}, c = 6 \text{ dm}, \alpha = 59.7^\circ, \beta = 13.9^\circ, \gamma = 106.5^\circ, h_a = 1.4 \text{ dm}, h_b = 5.2 \text{ dm}, h_c = 1.3 \text{ dm}, A = 4.1 \text{ dm}^2, u = 12.9 \text{ dm}$
17	$a = 7.4 \text{ cm}, c = 9.7 \text{ cm}, \beta = 17.9^\circ$	$a = 7.4 \text{ cm}, b = 3.5 \text{ cm}, c = 9.7 \text{ cm}, \alpha = 40.6^\circ, \beta = 17.9^\circ, \gamma = 121.5^\circ, h_a = 3 \text{ cm}, h_b = 6.3 \text{ cm}, h_c = 2.3 \text{ cm}, A = 13 \text{ cm}^2, u = 20.6 \text{ cm}$
18	$a = 3.7 \text{ dm}, b = 1.6 \text{ dm}, \gamma = 77.5^\circ$	$a = 3.7 \text{ dm}, b = 1.6 \text{ dm}, c = 3.7 \text{ dm}, \alpha = 77.5^\circ, \beta = 25^\circ, \gamma = 77.5^\circ, h_a = 1.6 \text{ dm}, h_b = 3.6 \text{ dm}, h_c = 1.6 \text{ dm}, A = 3 \text{ dm}^2, u = 9 \text{ dm}$
19	$a = 7.5 \text{ m}, b = 9.3 \text{ m}, \gamma = 136.2^\circ$	$a = 7.5 \text{ m}, b = 9.3 \text{ m}, c = 15.6 \text{ m}, \alpha = 19.5^\circ, \beta = 24.4^\circ, \gamma = 136.2^\circ, h_a = 6.4 \text{ m}, h_b = 5.2 \text{ m}, h_c = 3.1 \text{ m}, A = 34.9 \text{ m}^2, u = 32.4 \text{ m}$
20	$b = 2.9 \text{ mm}, c = 9.5 \text{ mm}, \gamma = 110.2^\circ$	$a = 8.1 \text{ mm}, b = 2.9 \text{ mm}, c = 9.5 \text{ mm}, \alpha = 53.1^\circ, \beta = 16.6^\circ, \gamma = 110.2^\circ, h_a = 2.7 \text{ mm}, h_b = 7.6 \text{ mm}, h_c = 2.3 \text{ mm}, A = 11.7 \text{ mm}^2, u = 20.5 \text{ mm}$

**Aufgabe 5:** Berechne die fehlenden Größen im allgemeinen Dreieck  $\Delta ABC$  (Seiten  $a, b, c$ , Winkel  $\alpha, \beta, \gamma$ ,  $A$  = Flächeninhalt,  $u$  = Umfang).

Nr.	Gegeben:
1	$b = 11.4 \text{ cm}, c = 36.8 \text{ cm}, \gamma = 107.7^\circ$
2	$a = 5.9 \text{ cm}, c = 20.6 \text{ cm}, \beta = 128.4^\circ$
3	$a = 49.2 \text{ mm}, b = 22.8 \text{ mm}, \alpha = 87.3^\circ$
4	$b = 48.8 \text{ mm}, \beta = 72^\circ, \gamma = 97.4^\circ$
5	$a = 31.3 \text{ dm}, b = 28.7 \text{ dm}, \gamma = 71.2^\circ$
6	$a = 44.2 \text{ cm}, b = 20.5 \text{ cm}, \beta = 21.7^\circ$
7	$a = 21.2 \text{ mm}, b = 28.7 \text{ mm}, \beta = 44.7^\circ$
8	$a = 10.4 \text{ m}, b = 32 \text{ m}, \alpha = 18.5^\circ$
9	$a = 20.9 \text{ m}, \alpha = 53.1^\circ, \gamma = 101.5^\circ$
10	$b = 48.4 \text{ cm}, c = 54.5 \text{ cm}, \alpha = 21.6^\circ$
11	$c = 10.2 \text{ mm}, \alpha = 81.8^\circ, \beta = 58.4^\circ$
12	$b = 19 \text{ dm}, \beta = 36.4^\circ, \gamma = 72.4^\circ$
13	$c = 15.4 \text{ mm}, \alpha = 25.3^\circ, \beta = 79^\circ$
14	$a = 7.3 \text{ cm}, \alpha = 10.3^\circ, \gamma = 128.9^\circ$
15	$c = 33.2 \text{ m}, \alpha = 24.6^\circ, \gamma = 46.3^\circ$
16	$b = 30.5 \text{ mm}, \alpha = 27.9^\circ, \beta = 31.8^\circ$
17	$b = 36.2 \text{ mm}, c = 20.7 \text{ mm}, \gamma = 18.9^\circ$
18	$a = 29.7 \text{ cm}, b = 14.6 \text{ cm}, c = 18.6 \text{ cm}$
19	$b = 44.7 \text{ mm}, c = 35.2 \text{ mm}, \beta = 110.7^\circ$
20	$a = 20.9 \text{ m}, b = 47.4 \text{ m}, c = 50.7 \text{ m}$

**Vorgehensweise:** Zur Ermittlung der fehlenden Größen beim allgemeinen Dreieck ist die obige Formelsammlung anzuwenden.

**Lösungen:**

Nr.	Gegeben:	Lösungen:
1	$b = 11.4 \text{ cm}, c = 36.8 \text{ cm}, \gamma = 107.7^\circ$	$a = 31.7 \text{ cm}, b = 11.4 \text{ cm}, c = 36.8 \text{ cm}, \alpha = 55.2^\circ, \beta = 17.2^\circ, \gamma = 107.7^\circ, h_a = 10.9 \text{ cm}, h_b = 30.2 \text{ cm}, h_c = 9.4 \text{ cm}, A = 180.7 \text{ cm}^2, u = 79.9 \text{ cm}$
2	$a = 5.9 \text{ cm}, c = 20.6 \text{ cm}, \beta = 128.4^\circ$	$a = 5.9 \text{ cm}, b = 24.7 \text{ cm}, c = 20.6 \text{ cm}, \alpha = 10.8^\circ, \beta = 128.4^\circ, \gamma = 40.8^\circ, h_a = 16.1 \text{ cm}, h_b = 3.9 \text{ cm}, h_c = 4.6 \text{ cm}, A = 72.9 \text{ cm}^2, u = 51.2 \text{ cm}$
3	$a = 49.2 \text{ mm}, b = 22.8 \text{ mm}, \alpha = 87.3^\circ$	$a = 49.2 \text{ mm}, b = 22.8 \text{ mm}, c = 44.7 \text{ mm}, \alpha = 87.3^\circ, \beta = 27.6^\circ, \gamma = 65.2^\circ, h_a = 20.7 \text{ mm}, h_b = 44.6 \text{ mm}, h_c = 22.8 \text{ mm}, A = 560.9 \text{ mm}^2, u = 116.7 \text{ mm}$
4	$b = 48.8 \text{ mm}, \beta = 72^\circ, \gamma = 97.4^\circ$	$a = 9.5 \text{ mm}, b = 48.8 \text{ mm}, c = 50.9 \text{ mm}, \alpha = 10.7^\circ, \beta = 72^\circ, \gamma = 97.4^\circ, h_a = 48.4 \text{ mm}, h_b = 9.4 \text{ mm}, h_c = 9 \text{ mm}, A = 231.8 \text{ mm}^2, u = 109.2 \text{ mm}$

5	$a = 31.3 \text{ dm}, b = 28.7 \text{ dm}, \gamma = 71.2^\circ$	$a = 31.3 \text{ dm}, b = 28.7 \text{ dm}, c = 35 \text{ dm}, \alpha = 57.9^\circ, \beta = 50.9^\circ, \gamma = 71.2^\circ, h_a = 27.2 \text{ dm}, h_b = 29.6 \text{ dm}, h_c = 24.3 \text{ dm}, A = 449.2 \text{ dm}^2, u = 95 \text{ dm}$
6	$a = 44.2 \text{ cm}, b = 20.5 \text{ cm}, \beta = 21.7^\circ$	$a = 44.2 \text{ cm}, b = 20.5 \text{ cm}, c = 28.7 \text{ cm}, \alpha = 127.1^\circ, \beta = 21.7^\circ, \gamma = 31.2^\circ, h_a = 10.6 \text{ cm}, h_b = 22.9 \text{ cm}, h_c = 16.4 \text{ cm}, A = 453.1 \text{ cm}^2, u = 93.4 \text{ cm}$
7	$a = 21.2 \text{ mm}, b = 28.7 \text{ mm}, \beta = 44.7^\circ$	$a = 21.2 \text{ mm}, b = 28.7 \text{ mm}, c = 39.6 \text{ mm}, \alpha = 31.3^\circ, \beta = 44.7^\circ, \gamma = 104^\circ, h_a = 27.8 \text{ mm}, h_b = 20.6 \text{ mm}, h_c = 14.9 \text{ mm}, A = 304.2 \text{ mm}^2, u = 89.5 \text{ mm}$
8	$a = 10.4 \text{ m}, b = 32 \text{ m}, \alpha = 18.5^\circ$	$a = 10.4 \text{ m}, b = 32 \text{ m}, c = 32.5 \text{ m}, \alpha = 18.5^\circ, \beta = 78^\circ, \gamma = 83.5^\circ, h_a = 31.8 \text{ m}, h_b = 10.3 \text{ m}, h_c = 10.2 \text{ m}, A = 166.4 \text{ m}^2, u = 74.9 \text{ m}$
9	$a = 20.9 \text{ m}, \alpha = 53.1^\circ, \gamma = 101.5^\circ$	$a = 20.9 \text{ m}, b = 11.2 \text{ m}, c = 25.6 \text{ m}, \alpha = 53.1^\circ, \beta = 25.4^\circ, \gamma = 101.5^\circ, h_a = 11 \text{ m}, h_b = 20.5 \text{ m}, h_c = 9 \text{ m}, A = 117 \text{ m}^2, u = 57.7 \text{ m}$
10	$b = 48.4 \text{ cm}, c = 54.5 \text{ cm}, \alpha = 21.6^\circ$	$a = 20.2 \text{ cm}, b = 48.4 \text{ cm}, c = 54.5 \text{ cm}, \alpha = 21.6^\circ, \beta = 61.9^\circ, \gamma = 96.4^\circ, h_a = 48.1 \text{ cm}, h_b = 20.1 \text{ cm}, h_c = 17.8 \text{ cm}, A = 488.8 \text{ cm}^2, u = 123.1 \text{ cm}$
11	$c = 10.2 \text{ mm}, \alpha = 81.8^\circ, \beta = 58.4^\circ$	$a = 15.8 \text{ mm}, b = 13.6 \text{ mm}, c = 10.2 \text{ mm}, \alpha = 81.8^\circ, \beta = 58.4^\circ, \gamma = 39.7^\circ, h_a = 8.7 \text{ mm}, h_b = 10.1 \text{ mm}, h_c = 13.5 \text{ mm}, A = 107.4 \text{ mm}^2, u = 39.6 \text{ mm}$
12	$b = 19 \text{ dm}, \beta = 36.4^\circ, \gamma = 72.4^\circ$	$a = 30.3 \text{ dm}, b = 19 \text{ dm}, c = 30.5 \text{ dm}, \alpha = 71.2^\circ, \beta = 36.4^\circ, \gamma = 72.4^\circ, h_a = 18.1 \text{ dm}, h_b = 28.9 \text{ dm}, h_c = 18 \text{ dm}, A = 287.9 \text{ dm}^2, u = 79.8 \text{ dm}$
13	$c = 15.4 \text{ mm}, \alpha = 25.3^\circ, \beta = 79^\circ$	$a = 6.8 \text{ mm}, b = 15.6 \text{ mm}, c = 15.4 \text{ mm}, \alpha = 25.3^\circ, \beta = 79^\circ, \gamma = 75.7^\circ, h_a = 15.1 \text{ mm}, h_b = 6.6 \text{ mm}, h_c = 6.7 \text{ mm}, A = 53 \text{ mm}^2, u = 37.8 \text{ mm}$
14	$a = 7.3 \text{ cm}, \alpha = 10.3^\circ, \gamma = 128.9^\circ$	$a = 7.3 \text{ cm}, b = 26.6 \text{ cm}, c = 31.7 \text{ cm}, \alpha = 10.3^\circ, \beta = 40.7^\circ, \gamma = 128.9^\circ, h_a = 20.7 \text{ cm}, h_b = 5.7 \text{ cm}, h_c = 4.8 \text{ cm}, A = 97.1 \text{ cm}^2, u = 65.6 \text{ cm}$
15	$c = 33.2 \text{ m}, \alpha = 24.6^\circ, \gamma = 46.3^\circ$	$a = 19.1 \text{ m}, b = 43.4 \text{ m}, c = 33.2 \text{ m}, \alpha = 24.6^\circ, \beta = 109.2^\circ, \gamma = 46.3^\circ, h_a = 31.4 \text{ m}, h_b = 13.8 \text{ m}, h_c = 18 \text{ m}, A = 414.5 \text{ m}^2, u = 95.7 \text{ m}$
16	$b = 30.5 \text{ mm}, \alpha = 27.9^\circ, \beta = 31.8^\circ$	$a = 27.1 \text{ mm}, b = 30.5 \text{ mm}, c = 50 \text{ mm}, \alpha = 27.9^\circ, \beta = 31.8^\circ, \gamma = 120.4^\circ, h_a = 26.3 \text{ mm}, h_b = 23.4 \text{ mm}, h_c = 14.3 \text{ mm}, A = 413.3 \text{ mm}^2, u = 107.6 \text{ mm}$
17	$b = 36.2 \text{ mm}, c = 20.7 \text{ mm}, \gamma = 18.9^\circ$	$a = 17.2 \text{ mm}, b = 36.2 \text{ mm}, c = 20.7 \text{ mm}, \alpha = 15.7^\circ, \beta = 145.4^\circ, \gamma = 18.9^\circ, h_a = 11.8 \text{ mm}, h_b = 5.6 \text{ mm}, h_c = 9.8 \text{ mm}, A = 311.3 \text{ mm}^2, u = 74.1 \text{ mm}$
18	$a = 29.7 \text{ cm}, b = 14.6 \text{ cm}, c = 18.6 \text{ cm}$	$a = 29.7 \text{ cm}, b = 14.6 \text{ cm}, c = 18.6 \text{ cm}, \alpha = 126.5^\circ, \beta = 23.3^\circ, \gamma = 30.2^\circ, h_a = 7.4 \text{ cm}, h_b = 15 \text{ cm}, h_c = 11.7 \text{ cm}, A = 216.8 \text{ cm}^2, u = 62.9 \text{ cm}$
19	$b = 44.7 \text{ mm}, c = 35.2 \text{ mm}, \beta = 110.7^\circ$	$a = 17.8 \text{ mm}, b = 44.7 \text{ mm}, c = 35.2 \text{ mm}, \alpha = 21.9^\circ, \beta = 110.7^\circ, \gamma = 47.5^\circ, h_a = 32.9 \text{ mm}, h_b = 13.1 \text{ mm}, h_c = 16.7 \text{ mm}, A = 397.8 \text{ mm}^2, u = 97.7 \text{ mm}$
20	$a = 20.9 \text{ m}, b = 47.4 \text{ m}, c = 50.7 \text{ m}$	$a = 20.9 \text{ m}, b = 47.4 \text{ m}, c = 50.7 \text{ m}, \alpha = 24.3^\circ, \beta = 69^\circ, \gamma = 86.7^\circ, h_a = 47.3 \text{ m}, h_b = 20.9 \text{ m}, h_c = 19.5 \text{ m}, A = 495.3 \text{ m}^2, u = 119 \text{ m}$

www.michael-buhlmann.de / 01.2019 / Mathematik-Aufgabenpool: Trigonometrie III / Aufgaben 726-730