

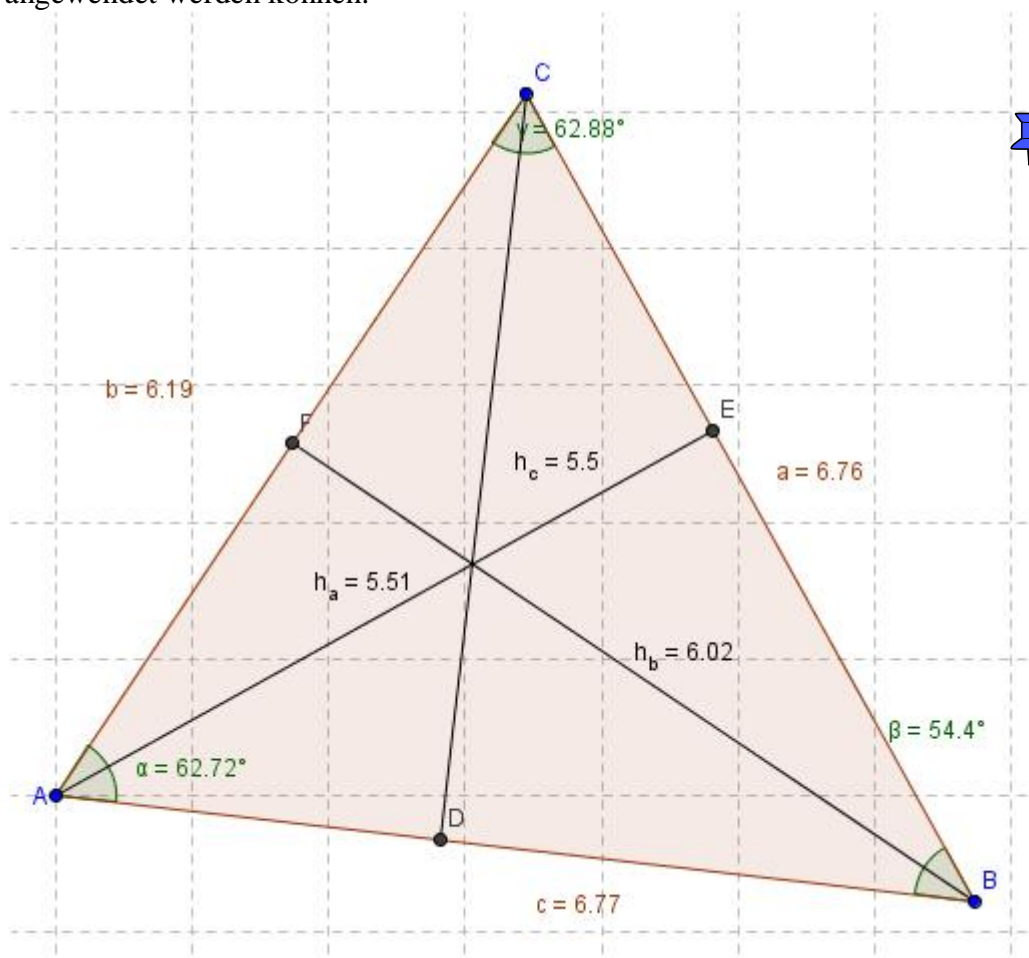
Aufgaben Sinussatz

(%i43) kill(all) /* alle Speicher löschen */;

(%o0) done

1 Herleitung Sinussatz

Abb. 1: Durch Einzeichnen der Höhen ergeben sich 6 rechtwinkelige Dreiecke, wo Winkelfunktionen angewendet werden können.



(%i1) g1:h[c]/b=sin(alpha);

$$(%o1) \frac{h_c}{b} = \sin(\alpha)$$

(%i2) g2:h[b]/c=sin(alpha);

$$(%o2) \frac{h_b}{c} = \sin(\alpha)$$

(%i3) g3:h[c]/a=sin(beta);

$$(%o3) \frac{h_c}{a} = \sin(\beta)$$

(%i4) g4:h[a]/c=sin(beta);

$$(%o4) \frac{h_a}{c} = \sin(\beta)$$

(%i5) g5:h[b]/a=sin(gamma);

$$(%o5) \frac{h_b}{a} = \sin(\gamma)$$

(%i6) g6:h[a]/b=sin(gamma);

$$(%o6) \frac{h_a}{b} = \sin(\gamma)$$

Erste Umformung

(%i7) g1:g1*b;

$$(\%o7) \quad h_c = \sin(\alpha) b$$

(%i8) g3:g3*a;

$$(\%o8) \quad h_c = a \sin(\beta)$$

(%i9) gA:second(g3)=second(g1);

$$(\%o9) \quad a \sin(\beta) = \sin(\alpha) b$$

(%i10) gA:gA/(sin(alpha)*sin(beta));

$$(\%o10) \quad \frac{a}{\sin(\alpha)} = \frac{b}{\sin(\beta)}$$

Zweite Umformung

(%i11) g2:g2*c;

$$(\%o11) \quad h_b = \sin(\alpha) c$$

(%i12) g5:g5*a;

$$(\%o12) \quad h_b = a \sin(\gamma)$$

(%i13) gB:second(g5)=second(g2);

$$(\%o13) \quad a \sin(\gamma) = \sin(\alpha) c$$

$$(\%i14) \quad gB:gB/(\sin(\alpha)*\sin(\gamma));$$

$$(\%o14) \quad \frac{a}{\sin(\alpha)} = \frac{c}{\sin(\gamma)}$$

Dritte Umformung

$$(\%i15) \quad g4:g4*c;$$

$$(\%o15) \quad h_a = \sin(\beta) c$$

$$(\%i16) \quad g6:g6*b;$$

$$(\%o16) \quad h_a = b \sin(\gamma)$$

$$(\%i17) \quad gC:\text{second}(g6)=\text{second}(g4);$$

$$(\%o17) \quad b \sin(\gamma) = \sin(\beta) c$$

$$(\%i18) \quad gC:gC/(\sin(\beta)*\sin(\gamma));$$

$$(\%o18) \quad \frac{b}{\sin(\beta)} = \frac{c}{\sin(\gamma)}$$

2 Wie viele Aufgaben gibt es?

(%i19) Seiten:{a,b,c};

```
(%o19) { a, b, c }
```

(%i20) Winkel:{alpha,beta,gamma};

```
(%o20) { alpha, beta, gamma }
```

(%i21) Seitenpaare:powerset(Seiten,2);

```
(%o21) {{ a, b }, { a, c }, { b, c } }
```

(%i22) Aufgaben:cartesian_product(Seitenpaare,Winkel);

```
(%o22) { [ { a, b }, alpha ], [ { a, b }, beta ], [ { a, b }, gamma ], [ { a, c },  
alpha ], [ { a, c }, beta ], [ { a, c }, gamma ], [ { b, c }, alpha ], [ { b, c }, beta  
], [ { b, c }, gamma ] }
```

(%i23) Aufgabe:listify(Aufgaben);

```
(%o23) [ [ { a, b }, alpha ], [ { a, b }, beta ], [ { a, b }, gamma ], [ { a, c },  
alpha ], [ { a, c }, beta ], [ { a, c }, gamma ], [ { b, c }, alpha ], [ { b, c }, beta  
], [ { b, c }, gamma ] ]
```

(%i24) n:length(Aufgabe);

```
(%o24) 9
```

3 Aufgaben

(%i25) Aufgabe[1];

(%o25) [{ a , b } , alpha]

Abb. 2: Das Dreieck, das betrachtet wird

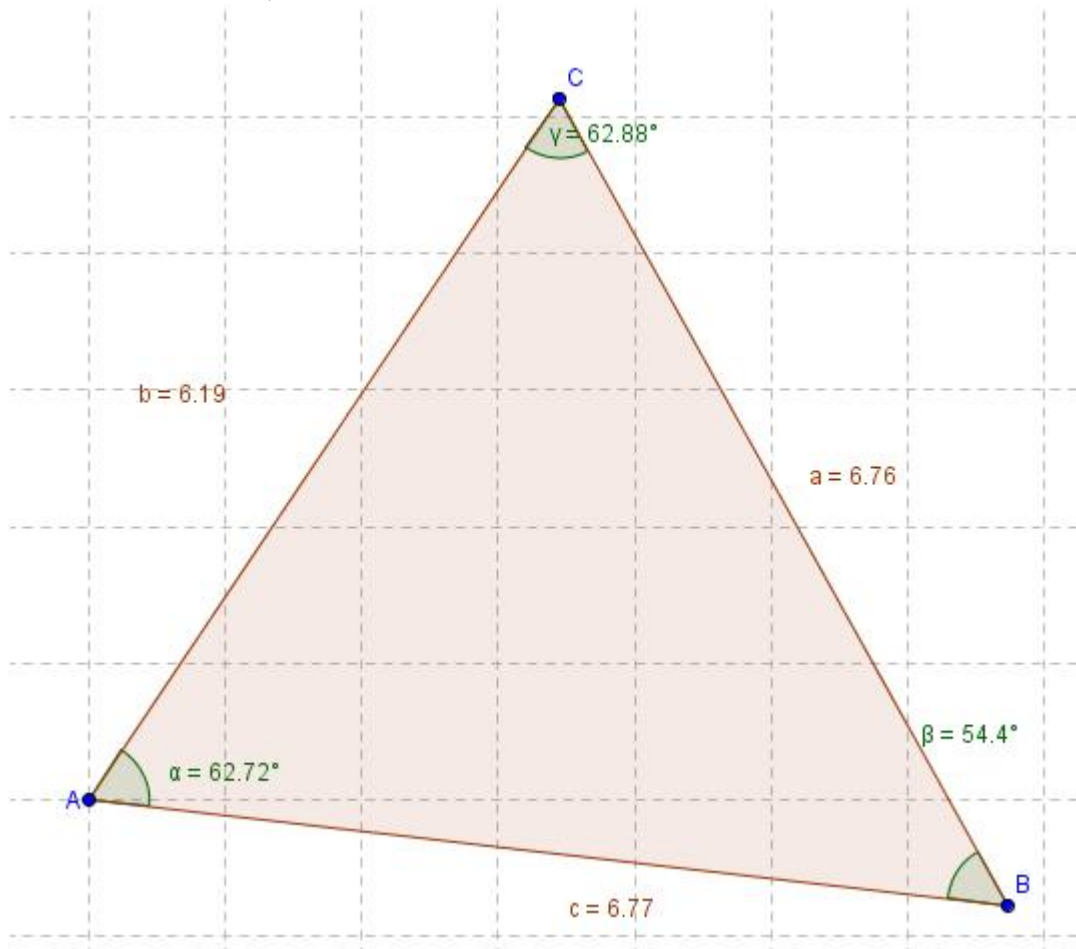


Abb. 3: Genauere Daten

- a = 6.7623513333
- b = 6.1869546269
- c = 6.7719187827
- alpha = 62.7189989265°
- beta = 54.4043976658°
- gamma = 62.8766034078°

Arbeitsblatt Sinussatz

(%i26) a:6.76;b:6.19;alpha:62.72;

(%o26) 6.76

(%o27) 6.19

(%o28) 62.72

(%i29) alphab:alpha*%pi/180,numer;

(%o29) 1.094670506850843

(%i30) g:a/sin(alphab)=b/sin(betab);

(%o30) $7.605955025867956 = \frac{6.19}{\sin(\text{betab})}$

(%i31) l:solve(g,betab),numer;

```
rat: replaced 7.605955025867956 by 19669/2586 = 7.605955143078113
rat: replaced -6.19 by -619/100 = -6.19
rat: replaced 7.605955143078113 by 19669/2586 = 7.605955143078113
rat: replaced -6.19 by -619/100 = -6.19
rat: replaced 7.733952049497293E-6 by 1/129300 = 7.733952049497293E-6
solve: using arc-trig functions to get a solution.
Some solutions will be lost.
rat: replaced 0.95072323495746 by 3878/4079 = 0.95072321647463
rat: replaced 0.95072321647463 by 3878/4079 = 0.95072321647463
rat: replaced -2.451581269919098E-4 by -1/4079 = -2.451581269919098E-4
rat: replaced -0.9507232164746 by -3878/4079 = -0.9507232164746
(%o31) [betab=0.95072321647463]
```

(%i32) betab:ev(betab,l);

(%o32) 0.95072321647463

(%i33) beta:betab*180/%pi,numer;

Arbeitsblatt Sinussatz

```
(%o33) 54.47242778909861
```

```
(%i34) gamma:180-alpha-beta;
```

```
(%o34) 62.80757221090139
```

```
(%i35) gammab:gamma*%pi/180,numer;
```

```
(%o35) 1.096198930264324
```

```
(%i36) g:a/sin(alphab)=c/sin(gammab);
```

```
(%o36) 7.605955025867956=1.124256447657487 c
```

```
(%i37) l:solve(g,c),numer;
```

```
rat: replaced 7.605955025867956 by 19669/2586 = 7.605955143078113
rat: replaced -1.12425644765749 by -1701/1513 = -1.12425644415069
rat: replaced 7.605955143078113 by 19669/2586 = 7.605955143078113
rat: replaced -1.12425644415069 by -1701/1513 = -1.12425644415069
rat: replaced -2.55583345984709E-7 by -1/3912618 = -2.55583345984709E-7
rat: replaced -6.7653204770589 by -23956/3541 = -6.76532053092347
(%o37) [c=6.765320530923468]
```

```
(%i38) c:ev(c,l);
```

```
(%o38) 6.765320530923468
```

```
(%i39) beta:floor(beta*100+0.5)/100.0;
      gamma:floor(gamma*100+0.5)/100.0;
      c:floor(c*100+0.5)/100.0;
```

```
(%o39) 54.47
```

```
(%o40) 62.81
```

```
(%o41) 6.77
```

4 Übungsteil

(%i42) `uebung:makelist(Aufgabe[i],i,2,9);`



```
(%o42) [[{a, b}, beta], [{a, b}, gamma], [{a, c}, alpha], [{a, c},  
beta], [{a, c}, gamma], [{b, c}, alpha], [{b, c}, beta], [{b, c}, gamma  
]]
```

(%i43) `transpose(uebung);`

```
(%o43) 
$$\begin{bmatrix} [a, b], beta \\ [a, b], gamma \\ [a, c], alpha \\ [a, c], beta \\ [a, c], gamma \\ [b, c], alpha \\ [b, c], beta \\ [b, c], gamma \end{bmatrix}$$

```

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