Practical 1: Surveying and geodesy. Dimensions and units. Angular calculations. Using a scientific calculator for surveying calculations

Accessories to be used:

1 scientific calculator for each student

Contents:

Introduction: Surveying and Geodesy. The contents of Surveying I. and II.

- Horizontal and vertical positioning.
- Observation processing: calculations and mapping
- Setting out.

Dimensions and unit, conversions: angle, length, area.

Calculations with angles.

The application of scientific calculators for surveying calculations: angular inputs (degree, minute, second), simple trigonometric calculations. Using the memory of the calculator.

Working exercises:

Exercise 1:

Angular units (° ’ ” - DMS, float DMS, gradian, radian) and their conversions

1° = 60’ = 60 x 60” = 3600”

35° 42’ 15” = 35-42-15 = 128 535”

35° 42’ 15” = 35.704 167°

45.351 947° = 45° 21’ 07” = 45-21-07

1 rad = 57.295 780° = 3 437.7468’ = 206 264.8” ≈ $2 \cdot 10^5$”

1” = 0.000 004 8 rad

5” = 0.000 0242 rad

10° 32’ 43” = 10-32-43 = 0.184 050 rad

1 grad (gradian) = 1^g = 0.9°

1° = 1,111 111^g

16-43-55 = 16.731 944° =18.591 05^g

385.139 57^g = 346.625 613° = 346-37-32

Exercise 2:

Length (km, m, cm, mm, fathom) and their conversions

1 km = 1 000 m

0.001 km = 1 m

1 m = 100 cm = 1 000 mm

0.01 m = 1 cm = 10 mm

0.1 cm = 1 mm

10.324 51 km = 10 324.51 m = 10 km 324 m 51 cm

1 fathom (fth) = 1.896 483 84 m

1 m = 0.527 291 6 fth

53.14 fth = 100.78 m

12 928.56 m = 6 817.12 fth

Exercise 3:

Area (ha - hectare, m² – square meter, Hungarian acre, fth² square fathom) and their conversions

1 ha = 10 000 m^2 = 100 m x 100 m

0.0001 ha = 1 m^2

534 352 m^2 = 53.4352 ha = 53 ha 4352 m^2

135 ha 4510 m^2 = 135.4510 ha = 1 354 510 m^2

1 fth^2 = 3.596 650 955 m^2

1 m^2 = 0.278 036 432 fth^2

200 fth^2 = 719.330 191 1 m^2 ≈ 719 m^2

1000 m^2 = 278.036 432 fth^2 ≈ 278 fth^2

1 Hungarian acre (ac) = 1600 fth^2

1 fth^2 = 0.000 625 ac

10 324 ac = 16 518 400 fth^2

5 415 fth^2 = 3.384 ac

1 ac = 5 754.64 m^2 = 0.575 464 ha

10 324 ac = 5 941.0903 ha = 59 410 903 m^2

32 ac 1500 fth^2 = 52 700 fth^2 = 189 544 m^2 = 18 ha 9 544 m2 = 18.954 4 ha

1 ha = 2 780.4 fth^2 = 1,737 75 ac = 1 ac 1 180.4 fth^2

Exercise 4:

Adding angles:

$\gamma = \alpha + \beta$ when $\gamma > 360°$ then 360° must be subtracted!

α = 214-21-54
$+\beta$ = 135-44-12
γ = 350-06-06

α = 314-24-41
$+\beta$ = 222-11-42
γ = **536-36-23 (-360°) = 176-36-23**

α = 180-00-01
$+\beta$ = 180-00-00
γ = **360-00-01 (-360°) = 0-00-01**

α = 145-25-45
$+\beta$ = 122-57-54
γ = **268-23-39**

Exercise 5:

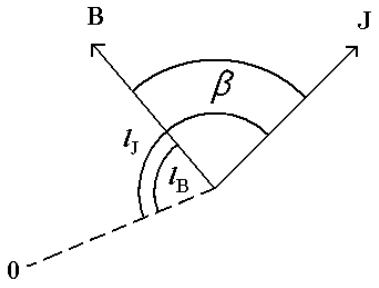
Computation of deflection angles (subtracting angles):

$\beta = l_J - l_B$ When $\beta<0°$ (negative), 360° must be added to the result.

l_J = 214-21-54
$-l_B$ = 135-44-12
β = **78-37-42**

l_J = 0-00-00 **(+360°)**
$-l_B$ = 184-54-11
β = **175-05-49**

l_J = 331-43-18 **(+360°)**
$-l_B$ = 331-43-19
β = **359-59-59**



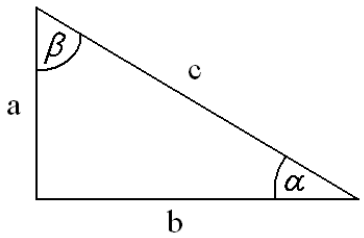
l_J = 98-22-32

$-l_B$ = 211-55-49

β = **-(113-33-17)+360°=246-26-43**

Exercise 6:

Simple trigonometric calculations:



c = 43.58 m

α= 22-45-34

$b = c \cos \alpha$ = 43.58 cos 22-45-34 = **40.19 m**

c = 43.58 m

α= 22-45-34

$a = c \sin \alpha$ = 43,58 sin 22-45-34 = **16.86 m**

a = 16.86 m

b = 40.19 m

$c = \sqrt{(a^2 + b^2)} = \sqrt{(16{,}86^2 + 40{,}19^2)}$ = **43.58 m**

β = arccos (a/c) = arccos (16.86/43.58) = **67-14-23**

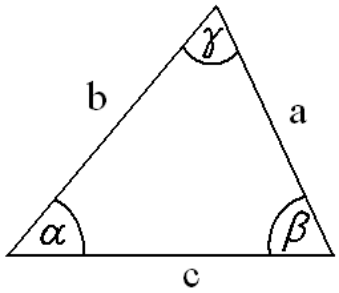
β = arctan (b/a) = arctan (40.19/16.86) = **67-14-30**

$\beta = 180° - (90° + 22\text{-}45\text{-}34)$ = **67-14-26**

Why do the three calculated β values differ from each other?

Exercise 7:

Trigonometric calculations (law of sines and cosines):



α = 40-05-49

β = 67-14-16

$\gamma = 180° - (\alpha + \beta) = 180° - (40\text{-}05\text{-}49 + 67\text{-}14\text{-}16)$ = **72-39-55**

c = 19.17 m

$a = c \sin \alpha / \sin \gamma$ = 19.17 sin 40-05-49 / sin 72-39-55 = **12.93 m**

$b = c \sin \beta / \sin \gamma$ = 19.17 sin 67-14-16 / sin 72-39-55 = **18.52 m**

$a = \sqrt{(c^2 + b^2 - 2\ c\ b \cos\ \alpha)} =$
$= \sqrt{(19.17^2 + 18.52^2 - 2 \times 19.17 \times 18{,}52 \times \cos 40\text{-}05\text{-}49)}$ = **12.93 m**

$b = \sqrt{(c^2 + a^2 - 2\ c\ a \cos\ \beta)} =$
$= \sqrt{(19.17^2 + 12.93^2 - 2 \times 19.17 \times 12.93 \times \cos 67\text{-}14\text{-}16)}$ = **18.52 m**