Exam: Introduction to Geodesy 15.06.2009

(Function calculator)

1. Fundamentals

- (a) What is a clothoid, and why is it being used for building railroads and motorways?
- (b) Explain the Method of Free Stationing used in detailed surveys.

2. Statistics, units

- (a) Explain random, gross and systematic errors.
- (b) Draw two different normal or gaussian density distribution curves, one depicting precise measurements and the other, imprecise measurements. Mark in both drawings the expectancy and the mean error.

3. Measurement instruments and methods

- (a) The focusing of a measurement telecope. What is *parallax*?
- (b) How can one eliminate the effects of both collimation error and trunnion axis error from horizontal angle observations?

4. First and second geodetic problems

- (a) Given a point A: $x_A = 6\,650\,000\,\text{m}$, $y_A = 480\,000\,\text{m}$. The distance to point B is $s = 2828.472\,\text{m}$ and the azimuth (direction angle) $t = 150\,\text{gon}$. Solve the first (forward) geodetic problem for points A, B.
- (b) Given is also point C with coordinates $x_C = 6\,651\,000\,\mathrm{m}$, $y_C = 479\,000\,\mathrm{m}$. Solve the second (inverse) geodetic problem for the points A, C.

5. Helmert transformation

(a) Given are points' A, B coordinates in the coordinate system (1):

$$x_A^{(1)} = 0 \text{ m}, y_A^{(1)} = 0 \text{ m}, x_B^{(1)} = 2000 \text{ m}, y_B^{(1)} = 1000 \text{ m};$$

and in the coordinate system (2):

$$x_A^{(2)} = 2000 \,\mathrm{m}; \, y_A^{(2)} = 1500 \,\mathrm{m}; \, x_B^{(2)} = 3000.1 \,\mathrm{m}; \, y_B^{(2)} = 2500.1 \,\mathrm{m}.$$

Assuming that the transformation between systems (1) and (2) is a Helmert transformation:

$$\begin{bmatrix} x^{(2)} \\ y^{(2)} \end{bmatrix} = K \begin{bmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{bmatrix} \begin{bmatrix} x^{(1)} \\ y^{(1)} \end{bmatrix} + \begin{bmatrix} \Delta x \\ \Delta y \end{bmatrix},$$

calculate its parameters K, θ , Δx and Δy .

(b) If K = 1 + m, m small, and also the angle θ small (i.e., also $m\theta \approx 0$!), how can one simplify the above formula

Points:

Question	1 ab	2 a b	3 a b	4 a b	5 a b	Total.
Points	$\begin{array}{c}5\\2&3\end{array}$	$\begin{array}{c}5\\2&3\end{array}$	$\begin{array}{c}5\\2&3\end{array}$	$\begin{array}{c}5\\2&3\end{array}$	$\begin{array}{c}5\\3&2\end{array}$	25

Points	10	13	16	19	23
Grade	1	2	3	4	5