Exam: Introduction to Geodesy 12.01.2007

(Also qualifies as Fundamental Geodesy I)

(Function calculator)

1. **Fundamentals**

   (a) What is a clothoid, and why is it being used for building railroads and motorways?

   (b) Describe the scientific controversy that the French Academy's grade measurement expeditions to Lapland and Peru attempted to settle, and how they did it.

   (c) What is a geodesic?

2. **Statistics, units**

   (a) Convert the angle $46°35'30''$ to gon and radians.

   (b) The German V2 rocket weapon had the following impact probabilities: Big city, 100 victims, 1%; small city or village, 10 victims, 10%; and countryside, no victims, 89%. What was the *expectancy* of the number of victims of one rocket?
   Equation:
   $$E(\underline{n}) = \sum_{i=0}^{100} i \cdot p(i),$$
   where $p(i)$ is the probability that the number of victims is i.

3. **Measurement instruments and methods**

   (a) The focusing of a measurement telecope. What is *parallax*?

   (b) Explain the self-levelling (automatic) level (drawing!)

4. **First and second geodetic problems**

   (a) Given a point A: $x_A = 6\,650\,000\,\mathrm{m}$, $y_A = 480\,000\,\mathrm{m}$. The distance to point B is $s = 2828.472\,\mathrm{m}$ and the azimuth (direction angle) $t = 50\,\mathrm{gon}$. Solve the first (forward) geodetic problem for points A, B.

   (b) Given is also point C with coordinates $x_C = 6\,649\,000\,\mathrm{m}$, $y_C = 479\,000\,\mathrm{m}$. 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):
   $$x_A^{(1)} = 0\,\mathrm{m},\ y_A^{(1)} = 0\,\mathrm{m}, x_B^{(1)} = 2000\,\mathrm{m}, y_B^{(1)} = 1000\,\mathrm{m};$$
   and in the coordinate system (2):
   $$x_A^{(2)} = 3500\,\mathrm{m};\ y_A^{(2)} = 1500\,\mathrm{m};\ x_B^{(2)} = 5500.02\,\mathrm{m};\ y_B^{(2)} = 2500.01\,\mathrm{m}.$$
   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) Write the following transformation's

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

inverse transformation (fill in the question marks):

$$\begin{bmatrix} x^{(1)} \\ y^{(1)} \end{bmatrix} = ? \begin{bmatrix} ? & ? \\ ? & ? \end{bmatrix} \begin{bmatrix} x^{(2)} \\ y^{(2)} \end{bmatrix}.$$

Does this always succeed?

Points:

Question	1 a b c	2 a b	3 a b	4 a b	5 a b	Total.
Points	5 2 2 1	5 2 3	5 2 3	5 2 3	5 2 3	25

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