

Exam: Geodesy and Positioning (GIS-E1010) 03.11.2016

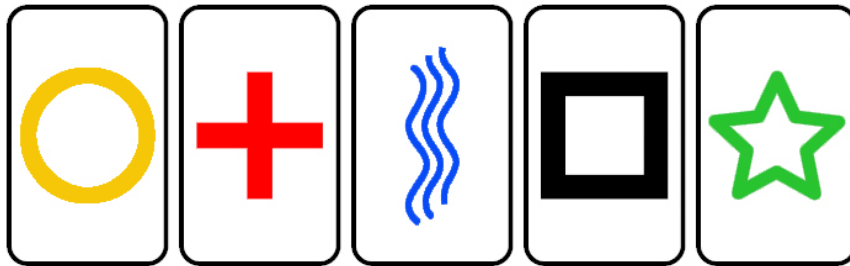
(Function calculator)

1. Fundamentals

- (a) [3p] The flattening of the Earth. How does the internal distribution of the Earth's masses affect its flattening? Newton's and Huygens' ideas and modern understanding.
- (b) [3p] Explain the concept of *height datum*, and give an example.

2. Statistics, units

- (a) [3p] A plane triangle has three angles measured, $\alpha = 62^\circ.10 \pm 0^\circ.01$, $\beta = 67^\circ.57 \pm 0^\circ.02$ and $\gamma = 50^\circ.26 \pm 0^\circ.02$.
 - i. Calculate the sum of the measured angles and its uncertainty (mean error) using *propagation of variances*. You may assume the angle measurements to be statistically independent, i.e., uncorrelated.
 - ii. *Compare* the values obtained. Conclusion?



- (b) [3p] In parapsychology, Zener cards (figure) have been used. A pack consists of 25 cards: a circle counts for 1, a cross for 2, waves for 3, a square for 4, and a star for 5. Compute the *expectancy* if a card is drawn blind from the pack.

Equation:

$$E(\underline{n}) = \sum_{i=1}^N i \cdot p(i),$$

where $p(i)$ is the probability that the card's value is i , and N is the total number of possible values.

3. Measurement instruments and methods

- (a) [2p] The *focusing* of a measurement telescope. What is *parallax*?
- (b) [2p] Explain the orbit data transmitted by the GPS satellites themselves (*broadcast ephemeris*) and so-called *precise ephemeris*. How are the latter disseminated to the users?
- (c) [2p] Explain the idea behind the GRACE mission. GRACE = Gravity Recovery And Climate Experiment.

4. Forward and inverse geodetic problems

- (a) [3p] Given a point A : $x_A = 6\,645\,000$ m, $y_A = 500\,000$ m. The distance to point B is $s = 1414.214$ m and the azimuth (direction angle) $t = 150$ gon. Solve the first (forward) geodetic problem for points A, B .
- (b) [3p] Given is also point C with coordinates $x_C = 6\,643\,000$ m, $y_C = 498\,000$ m. Solve the second (inverse) geodetic problem for the points A, C .

Grade (36 p = 100%)

$$\text{Grade} = 1 + 8 \times (\text{Exam} - 50\%) + 4 \times (\text{Exercises} - 50\%)$$

A minimum of 50% is required for both exam and exercises.