АСТРОНОМИЧЕСКОЕ ОБЩЕСТВО

EURO–ASIAN ASTRONOMICAL SOCIETY

Round **Theo**

Group **β**

XVI Международная астрономическая олимпиада
XVI International Astronomy Olympiad

Казахстан, Алма-Ата   22 – 30. IX. 2011   Almaty, Kazakhstan

язык / language **English**

Theoretical round. Problems to solve

General note. Maybe not all problems have correct questions. Some questions (maybe the main question of the problem, maybe one of the subquestions) may make no real sense. In this case you have to write in your answer (in English or Russian): «**impossible situation – ситуация невозможна**». Of course, this answer has to be explained numerically or logically.

Data from the tables (Planetary data, stars, constants, etc.) may be used for solving every problem.

The answers «Да-Yes» or «Нет-No» has to be written in English or Russian.

1. **Solar radiation.** Find, with how many percents the mass of the Sun is diminishing per year due to its radiation.

2. **Planetarium.** Classical devices "planetaria" are arranged so that each group of stars is projected on a dome by a small optical system. Consider the planetarium of observatory "Bobek" which diameter of the hall (dome) is 2R = 10 m. On slides of the constellations projected on the dome images of 0^m stars have the size $l_0 = 0.1$ mm (foils with hole-stars of the mentioned size are often used as these "slides").
   2.1. Estimate what the parameters should be (decide yourself, which parameters are important here) of the objective of this optical system, so that the visitors sitting in the centre of the hall of the planetarium would perceive the "stars" as points (not as circles or nebulae).
   2.2. Let's suppose that all slides have been removed for replacement by more perfect ones, and all the light began to be projected on the dome. What would the total stellar magnitude of the illuminated dome be (the artificial gray sky)? Would it be possible to read a newspaper in such an illuminance?
   The answers has to include a list of the necessary parameters with formulae and numerical values.

3. **Sunrise on Mars.** The Polar Bear (whom was already met in the texts of many International Astronomy Olympiads) was tired to make astronomical observations on Earth. He made a fascinating journey to the North Pole of Mars, and decided to observe a sunrise there. Calculate how long this sunrise lasts. The solution has to include a picture with an image of the Bear on the North Pole of Mars. Necessary sizes or angular sizes should be in the picture. Assume that Mars is spherical and its orbit may be considered circular. Recollect for yourself the necessary information about the Polar Bear.

4. **Photo of Jupiter.** In the photo of Jupiter that was taken on October 19, 2009, one of the Galilean moons and its shadow on the disc of the planet can be seen. Jupiter was near the middle of Capricornus constellation when the photo was taken.
   Find the orbital distance from the moon to the surface of the planet. Determine the name of the moon. The solution should be illustrated by drawings. The name of the moon in the solution and in the drawings should be written (or duplicated) in English.

5. **Jupiter disappeared.** Let us suppose that Jupiter suddenly disappeared. The moons of Jupiter became independent bodies.
   5.1. Which former Galileo moon(s) and in what case may leave the Solar system?
   5.2. Which former Galileo moon(s) and in what case may fall into the Sun?
   The answers "which moon" and "in what case" (configurations at the moment of Jupiter disappearance) have to be given in the form of drawings, and calculations should be the base for the answers. The names of the moons in the solution and in the drawings should be written in English. Consider the orbit of Jupiter (before its disappearance) to be circular.