АСТРОНОМИЧЕСКОЕ ОБЩЕСТВО		EURO–ASIAN ASTRONOMICAL SOCIETY		Round	**Theo**

XV Международная астрономическая олимпиада
XV International Astronomy Olympiad

Крым, Судак   16 – 24. X. 2010   Sudak, Crimea

Group α

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 have 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 table of planetary data may be used for solving every problem.

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

1. **Circumpolar stars.** Usually we consider that there are about 6000 stars in the whole sky which are visible to the naked eye. The refraction near the horizon is 35'. Find, how many more stars visible to the naked eye become circumpolar (which means that they never set) due to refraction:

    1.1 for observer on the North Pole at zero height position (like Polar Bear in a position with its eyes at zero height).

    1.2 for observer on the Equator at zero height position (like Giraffe with the eyes lowered to zero level).

    In your solution include a picture with an image of the Bear on the ices of North Pole and the Giraffe on the Equator, and necessary dimensions and/or angular dimensions used.

2. **Observation of a star.** A star is observed from the Earth. It is found that its magnitude is $m_1 = 2^m.74$ when observed at Zenith and $m_2 = 2^m.85$ when observed at 45° above the horizon. What would the apparent magnitude m_0 of the star be if observed from above the atmosphere (from a satellite, for example)?

3. **Parallax.** Like humans, astronomers of Mercury use the same method for definitions of parallaxes and of parsec but measure them in different (their own) units. For example, the distance to Sirius equals to 1.406 мерс (1.406 mercurial parsec).
    - Describe the most evident system of angular units used by astronomers of Mercury.
    - Calculate the mercurial diurnal parallax of the Sun and write the answer in "meau" (mercurial angular units – the common angular units for astronomers of Mercury).

4. **Climate.** There is a reference to climate in Crimea according to observations during 934 months between 1821 and 1991 on the web-site of the XV IAO. The average temperatures in Simferopol in January and July are equal to –0.4° C and +21.2° C respectively according to that data. Imagine a planet whose axis of rotation is perpendicular to the planets' ecliptic. Estimate, what the eccentricity of the planets' orbit should be in order to give climatic seasons identical to the ones in Crimea.

5. **Cosmonaut.** Imagine a small space station with a total mass of M = 50 ton placed far away from any celestial body. A cosmonaut with a total mass (with ammunitions) of m = 100 kg appears L = 80 m away from the station without any fuel. Calculate (estimate) the time τ after which the cosmonaut reaches the station due to gravitational attraction. Consider the initial velocity of the cosmonaut to be zero.