



XV Международная астрономическая олимпиада
XV International Astronomy Olympiad

Крым, Судак

16 – 24. X. 2010

Sudak, Crimea

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 Venus 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 19.6 vpc (19.6 venusial parsec).
 - Describe the most evident system of angular units used by astronomers of Venus.
 - Calculate the venusial diurnal parallax of the Sun and write the answer in “vau” (venusial angular units – the common angular units for astronomers of Venus).

Note: citizens of Venus have two hands (as humans), and 7 fingers at each hand.
4. **White dwarf.** The absolute stellar magnitude of a white dwarf is 14^m . Humanoids create a planet similar to the Earth by all parameters (including atmosphere and climate) rotating around this white dwarf. Calculate (estimate) the minimal possible sidereal period of the planet.
5. **International Space Station.** The graph presents the change in height of the ISS orbit depending on time. Estimate the average density of the atmosphere at heights around 340-360 km. Consider the orbit to be circular. The mass of ISS is 362 ton. Consider the cross-section of the ISS-complex to be $S = 500 \text{ m}^2$ (including the sections of the solar cell array).