VIII Международная астрономическая олимпиада
VIII International Astronomy Olympiad
VIII:e Internationella Astronomiolympiaden

Швеция, Стокгольм 2 – 8. 10. 2003 Stockholm, Sweden

Задачи теоретического тура **Theoretical round. Problems to solve**

язык / language	English

Group B

1. Today is the 46th anniversary of the start of the "cosmic era". History changed on October 4, 1957, when the world's first artificial satellite, ***Sputnik I***, was successfully launched. It was about the size of a basketball, a sphere of 580 mm in diameter with a mass of 83.6 kg and a 2 mm thick surface of highly polished aluminium alloy. The Russian word "sputnik" means "companion" ("satellite" in the astronomical sense). Sputnik I had an elliptical orbit – at perigee, just after launch, it was 227 km from the Earth's surface, and 945 km at apogee. It remained in orbit until January 4, 1958.

   Estimate (with necessary figures and calculations), whether was it possible to observe the satellite with the naked eye.

2. Estimate with order-of-magnitude accuracy how many degrees it would be possible to raise temperature of water in a normal swimming pool ($50 \times 20 \times 2$ m) if one was able to collect all energy which "stellar" astronomers used untill to obtaining knowledge about the structure of the Universe, observing at night on optical telescopes. The heat capacity of water is 4200 J/(kg·K). The Total Solar Irradiation Constant is equal to 1.37 kW/m^2. List in a table all the parameters and assumptions you have used in your solution.

3. The White Bear from the previous International Astronomy Olympiad is still sitting at the North Pole. But this year a follower has appeared – a Penguin sitting at South Pole. Recently, after the ending of polar night, the Penguin observed the sunrise. What did the Bear observe at this time? Draw what the White Bear saw at the moment when the Penguin observed exactly half of the solar disk on the horizon. Assume that the Earth is spherical. The answer should be explained by drawing a figure with an image of the Bear on North Pole; necessary sizes or angular sizes should be in the picture. Recollect for yourself the necessary information about the animals.

4. The Great Opposition of Mars took place this year on August 28 at $17^h\,56^m$ UT. The next Great Opposition of Mars will take place in summer 2018. Somebody did not understand and, instead, imagined that 2018 will be the year not for the next Great Opposition but simply next opposition. Find parameters of the orbit of such a hypothetical planet, «Mars-2», and estimate its magnitude visible from Earth during the mean opposition. Consider the orbit of «Mars-2» to be circular and its physical characteristics the same as for Mars.

5. Every day an astronomer makes observations at the same moment of the Local Sidereal Time, and always notices the Sun just on the mathematical horizon. Where and when the observations are carried out? Your answer must contain both explanations and explicit figures (possible coordinates, etc.)

6. Even the ancient Greeks knew that the size of the Earth is small compared to the distances to the stars. For example, in one myth it is told that the god Hephaestus once carelessly dropped his anvil on the Earth. It took nine whole days before the anvil hit the earth. Estimate "the height of the sky" according to the representations of the ancient Greeks and compare it to the distances of objects known to you.

Data from the “Table of planetary data” may be used for solving of every problem.