

XXIII Международная астрономическая олимпиада

XXIII International Astronomy Olympiad

Шри-Ланка, Коломбо

6-14. X. 2018

Colombo, Sri Lanka

Язык  
language

**English**

**Theoretical round. Basic criteria. For work of Jury**

**Note.** The given sketches of solutions are not full; the team leaders have to give more detailed explanations to students.  
The correct solutions in the students' papers (enough for 8 pts) may be shorter.

**Note.** Jury members should evaluate the student's solutions in essence, and not by looking on formal existence the mentioned sentences or formulae. The formal presence of the mentioned positions in the text is not necessary to give the respective points.  
Points should be done if the following steps de facto using these positions.

**Note.** Jury members should elaborate more detailed criteria, and also create criteria for other correct ways of the student's solutions.

**$\alpha$ -1. Mercury mirror.**

- 1.1. If answer about possibility is positive: max 3 pt.  
If answer about possibility is negative: max 7 pt.  
a Formulae and calculations about mirror – 3 pt.  
b Taking into account curvature of the Earth – 1 pt.  
c Conclusion about impossibility with proving – 3 pt.
- 1.2. a Artistic picture of the Bear-astronomer – 1 pt.

**$\beta$ -1. Distance to galaxy.** The redshift of this galaxy is:

- a Calculation  $z$  from the Doppler effect – 2 pt.  
b Receding speed – 1 pt. *← не в задаче.  $V = c \cdot z$  (нужно)*  
c Formulae and calculation  $H_1$  and  $H_2$  – 2 pt. *Formula pt*  
d Issue about different values of distances and calculation distances – 2 pt.  
e Correct using relativistic effects – 1 pt.

*неправильно было  
оно так поступ 1,5 pt  
прили много significant  
-0,5*

**$\alpha$ -2. Great oppositions of Mars.** On the morning of July 27, 2018, Mars.

- 2.1. a 1 pt.  
2.2. a Calculation of synodic period – 1 pt.  
b Calculation theoretical dates of the great opposition 2018 – 1 pt.  
c Calculation theoretical dates of the great opposition 2035 – 1 pt.
- 2.3. a 2 pt.  
2.4. a 2 pt.

**$\beta$ -2. Martian observations.**

- a Correct constellation – 1 pt.  
b Formulae, calculation distance from Mars for the first expedition – 1 pt.  
c Formulae, calculation distance from Mars for the second expedition – 1 pt.  
d Formulae, calculation theoretical periods of orbital stations – 1 pt.  
Solution with possibility to send orbital station – max. 4 pt.  
e Formulae, calculations and issue about impossibility to send orbital station – 3 pt.  
f Formulae, calculation diameter of Hill sphere – 1 pt.

**$\alpha\beta$ -3. Sunset at Colombo.**

- 3.1. a Zero approximation that it occurs at 18:00 – 0.5 pt.  
 b Calculation of the effects (corrections) –  $5 \times 0.5$  pt (2.5 pt in total).  
 c Correct final answer – 0.5 pt.  
 d Correct issue about the accuracy of the answer – 0.5 pt.
- 3.2. a 1.5 pt.
- 3.3. a Measurements on the map – 0.5 pt.  
 b Calculation of lowering the horizon from peak – 1 pt.  
 c The picture itself – 1 pt.

 **$\alpha\beta$ -4. Geostationary satellite.**

- 4.1. a Understanding that the satellite is seen in one point – 0.5 pt.  
 b Calculation radius of geostationary orbit – 1 pt.  
 c Picture, angles, calculations – 1 pt.  
 d Correct final answer – 0.5 pt.
- 4.2. a Understanding period of visibility at night – 1 pt.  
 b Understanding about possible eclipses by the Earth – 1 pt.  
 c Correct calculations and final answer – 0.5 pt.
- 4.3. a 2.5 pt.

**$\alpha\beta$ -5. Oort cloud.** The problem may have many approaches to be solved. For each way of solution necessary own plan how to estimate the partial solutions. Below is criteria for the author's solution.

- a Idea how the process is going – 1 pt.  
 b Calculation of the average velocities – 1 pt.  
 c Step by step formulae and calculations – 4 pt in total.  
 d Calculation average distance. Comparing with distances in Solar system – 1 pt.  
 e Calculation the total mass. Comparing with masses in Solar system – 1 pt.