Theoretical round. Basic criteria. For work of Jury

Note. The given sketches are not full; the team leaders have to give more detailed explanations to students. But 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.

α-1. Satellite of Mars.

Correct distance from Mars, $A \approx Lr/R \approx 1.1$ million.km – 1 pt.
Idea to compare this distance with the size of the Hill sphere – 1 pt.
Distance to the positions of the Lagrange points – 2 pt.
Conclusion $A > \Lambda$ – 1 pt.
Conclusion «**the situation is impossible**» – 1 pt.
A figure that is needed to accompany the solution – 2 pt.
(If wrong issue about possibility) Calculation of a hypothetical period of the satellite – 1 pt.

β-1. Dyson sphere.

Initial size of the star does not matter (period depends on the mass) – 1 pt
Period depends on the density of the modern Betelgeuse – 1 pt.
Using difference in luminosities – 2 pt.
Using irradiation law – 1 pt.
Finding the density of the modern Betelgeuse – 1 pt.
Finding orbital period – 1 pt.
Correct accuracy in the answer (not more 2 significant digits) – 1 pt.

α-2. Length of Day.

Understanding to use law of conservation of angular momentum – 1 pt.
Correct equation of conservation of angular momentum – 1 pt.
Explanation what we can neglect – 1 pt.
Correct using all necessary parameters – 1 pt.
Algebraic transformations and correct formula for $\Delta h/\Delta T$ – 2 pt.
Final result – 2 pt.

β-2. Length of Day.

Understanding to use law of conservation of angular momentum – 1 pt.
Correct equation of conservation of angular momentum – 1 pt.
Explanation what we can neglect – 1 pt.
Correct using all necessary parameters – 1 pt.
Algebraic transformations and correct formula for $\Delta h/\Delta T$ – 2 pt.
Subtraction 1.6 ms / century – 1 pt.
Final graph – 1 pt.

αβ-3. Heaven omen. Two comets.

$a = 3^{2/3} = 2.08$ au – 2 pt.
A = 2.8 au (or 2.77) P = 2a – A = 1.36 au – 1 pt.
Conclusion that comets pass near the ecliptic plane both aphelion and perihelion – 1 pt.
Comets 0.5 revolutions = Earth 1.5 revolutions – 1 pt.
Kepler's Second Law for the positions of aphelion and perihelion – 2 pt.
Formulae for the angular distances as seen from the Earth – 1 pt.
Correct result – 1 pt.

αβ-4. Heaven omen. Moon and comet.

4.1. 2 pt, including:
The comet goes from under the right side of the Moon – 2 pt.
Evening – 1 pt.

4.2. 2 pt, including:
Position of the Sun and the Moon relative to the Sun – 2 pt.
Gemini – 1 pt.

4.3. The Moon in the west or north-west and any answer based on this fact – 1 pt.

4.4. Artistic drawing – 1 pt.

4.5. 2 pt for the total full solution and dates of June 7-9, not more 1 pt for partial solution.

αβ-5. Search for asteroids.

Using distance from the Sun – 1 pt.
Using distance from the Earth – 1 pt.
Using sizes of the bodies – 1 pt.
Using sizes of albedo – 1 pt.
Formula using all the previous parameters and algebraic transformations – 2 pt.
Final result – 1 pt.
Correct accuracy in the answer (not more 1 significant digit) – 1 pt.