

XXI Международная астрономическая олимпиада
XXI International Astronomy Olympiad

България, Пампорово-Смолян 5 - 13. X. 2016 Pamporovo-Smolyan, Bulgaria

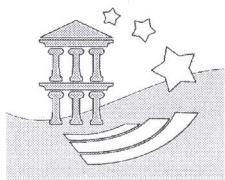
Group **α**

ЯЗЫК
language **English**

Evaluation criteria for problem No 1
of jury member Shumeiko Aleksandr (KG)
country

<u>No</u>	Abbreviation (if used in table)	Explanations of gradating sub-points	N of points
1		Correct distance from Mars, $A = L^2/R = 1,1$ million km	1
2		Idea to compare this distance with the size of the Hill sphere	1
3		Distance to the positions of the Lagrange points	2
4		Conclusion $A > \Lambda$	1
5		Conclusion "the situation is impossible"	1
6		A figure that is needed to accompany the solution	2
7	if wrong	(IF wrong issue about pos- sibility) Calculation of a hypothe- tical period of the satellite	1
		Equivalent correct parts of other ways of solution	8
		Extra conclusions or correct additions (add. to 8 pt)	

Jury member signature Perl

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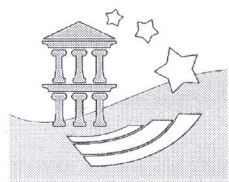
Group

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languageEnglish

Evaluation criteria for problem № 2
 of jury member Romualdas Lazauskas (Lithuania)
 country

<u>№</u>	Abbreviation (if used in table)	Explanations of gradating sub-points	N of points
1	L, J	Angular momentum $L = \text{const}$ Formula of moment of inertia	1
2	Exp	Explanation of the process, measurements in graph	2
3	Concl	Conclusion from explanation: period decrease, $\Delta h = -$	1
4	Calc	Correct calculations	2
5	Negl	Mentioned what can neglect	1
6	Result	Correct final result	1
		Equivalent correct parts of other ways of solution	8
		Extra conclusions or correct additions (add. to 8 pt)	

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5 - 13. X. 2016

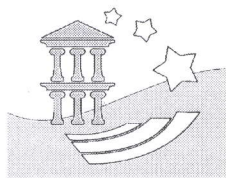
Pamporovo-Smolyan, Bulgaria

ЯЗЫК
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Evaluation criteria for problem № 2
of jury member Andrew Simon (Ukraine)
country

<u>№</u>	Abbreviation (if used in table)	Explanations of gradating sub-points	N of points
1		Correct estimation of δt from graph	1
2		Described nature of the phenomenon	2
3		Using angular momentum	1
4		Make conclusions about sign of δh	1
5		Using correct values for calculations	1
6		Correct formula	1
7		Correct answer	1
		Equivalent correct parts of other ways of solution	8
		Extra conclusions or correct additions (add. to 8 pt)	

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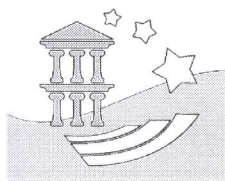
ЯЗЫК
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Evaluation criteria for problem No 3
of jury member Stoian Lucian (ROMANIA)
country

No	Abbreviation (if used in table)	Explanations of gradating sub-points	N of points
1.		- paths of comets are one the same ellipse - movements of comets obey the laws Kepler - at aphelion comets can not be seen because of limited resolution of the eye	1p.
		$a = \sqrt[3]{T^2} \quad 0,4p. \quad a = 2,08 \text{ AU} \quad 0,2p$ $A = a_{\text{ceres}} = 2,8 \text{ AU} \text{ (or. } 2,7 \text{ AU)} - \text{distance Sun - comets at aphelion}$	
		$P = 2a - A - \text{distance Sun - comets at perihelion, } 0,4p$ $P = 1,36 \text{ AU} - 0,2p$	
		$V_A \cdot A = V_P \cdot P \quad 0,4p \text{ (Kepler's second law)}$ $L_A \cdot A = L_P \cdot P \quad 0,4p$	
2.		$\alpha = \frac{L_A}{A - 1 \text{ AU}} \quad 0,4p \quad \text{angular distance as seen from Earth at aphelion}$	4p
		$\beta = \frac{L_P}{1 - 1 \text{ AU}} \quad 0,4p \quad \text{--- perihelion}$	
		$\beta = \alpha \cdot \frac{A}{P} \cdot \frac{A - 1 \text{ AU}}{P - 1 \text{ AU}} \quad 0,4p.$	
		$\alpha < \delta \quad 0,2p \quad \delta \approx 1' \div 2' \text{ angular resolution for human eye } 0,2p.$	
3.		$\beta = \alpha \cdot \frac{A}{P} \cdot \frac{A - 1 \text{ AU}}{P - 1 \text{ AU}} \approx 10,3' \approx 10' - 2p.$	2p.
4		For correct picture. 1p. Observation: And if it missing figure is given but all algebraic calculations are correct	1p
		Equivalent correct parts of other ways of solution	8
		Extra conclusions or correct additions (add. to 8 pt)	

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Evaluation criteria for problem № 3

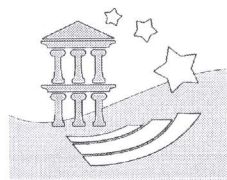
of jury member Mikhail Kuznetsov (ML)

country

No	Abbreviation (if used in table)	Explanations of gradating sub-points	N of points
1	III -d Kepler's Law	a) $T^2/a^3 = 1 \Rightarrow a = 2.08 \approx 2,1 \text{ a.u.} \rightarrow 1 \text{ pt}$ b) $T = \frac{2\pi a}{v}$; $v = \sqrt{\frac{GM}{a}} \rightarrow 0,5 \text{ pt}$ c) wrong formulae or not used III -d law $\rightarrow 0 \text{ pt}$	
2	q - Peri- gelson	a) $q = a(1-e) = 2a - Q$ with right calcul. $\rightarrow 1 \text{ pt}$ b) If some calculation mistake $\rightarrow 0,5 \text{ pt}$ c) wrong formulae or now answer $\rightarrow 0 \text{ pt}$	
3	Q - Aphe- lion	a) $Q \in [2,5 - 3,5 \text{ a.u.}] \rightarrow 0,5 \text{ pt}$ b) $Q \notin [2,5 - 3,5 \text{ a.u.}] \rightarrow 0 \text{ pt}$	
4	Opposition on perigelson	a) calculate synodic period or conclude that from 1,5 year in comet will be in opposition $\rightarrow 1 \text{ pt}$	
		b) Use q because it is the min $\rightarrow 0,5 \text{ pt}$ c) distance or without assumptions $\rightarrow 0 \text{ pt}$ d) no use q $\rightarrow 0 \text{ pt}$	
5	II -d Kepler's Law	a) correct use $\rightarrow 2 \text{ pt}$ b) use with mistake $\rightarrow 1 \text{ pt}$ c) conclude Δ between comet must change $\rightarrow 0,5 \text{ pt}$ d) Δ between comets in q and Q not change $\rightarrow 0 \text{ pt}$	
6	Naked eye	a) $\angle \in [1', 2'] \rightarrow 0,5 \text{ pt}$ b) $\angle \notin [1', 2'] \rightarrow 0 \text{ pt}$	
7	Angular distance	a) $\beta_Q = \frac{L}{Q-1 \text{ a.u.}}$; $\beta_g = \frac{L}{g-1 \text{ a.u.}}$; $\frac{\beta_Q}{\beta_g} = \frac{g-1}{Q-1} \rightarrow 1 \text{ pt}$ b) $\angle [\text{rad}] = \frac{P}{L} = \arctan(\frac{P}{L}) \rightarrow 0,5 \text{ pt}$ c) no correct or now formulae $\rightarrow 0 \text{ pt}$	
8	Final arswer	a) $\beta_g \approx 10,3'$ or a hother correct with $Q \in [2,5; 3,5 \text{ a.u.}] \rightarrow 1 \text{ pt}$ b) $\beta_g > \text{naked eye limit}$ $\rightarrow 0,5 \text{ pt}$ c) $\beta_g < \text{naked eye limit}$ $\rightarrow 0 \text{ pt}$	
		Equivalent correct parts of other ways of solution	
		Extra conclusions or correct additions (add. to 8 pt)	

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Kuznetsov



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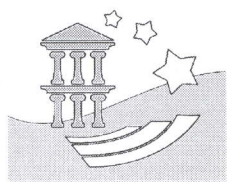
ЯЗЫК
language

English

Evaluation criteria for problem № 4
of jury member V. MAGNIBEDA (RU)
country

<u>No</u>	Abbreviation (if used in table)	Explanations of gradating sub-points	N of points
1		Evening - 1 pt The comet goes from the right side of Moon - 1 pt	2
2		The constellations : Gemini , Cancer	1
3		The Moon in the north-west - 1 Greek army saw the event - 1	2
4		Artistic drawing with correct position of the Moon + comet	1
5		Full solution and dates of June 7-9 - 2 pt partial solution - 1 pt	2
		Equivalent correct parts of other ways of solution	8
		Extra conclusions or correct additions (add. to 8 pt)	

Jury member signature V. Magnibeda

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of jury member

5

Bulgaria

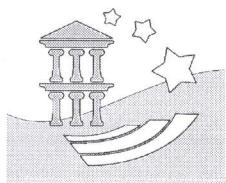
(CM)
country

No	Abbreviation (if used in table)	Explanations of gradating sub-points	N of points
1		Using the distance of the Sun	1
2		Using the distance of the earth	1
3		Using the sizes of the objects	1
4		Thinking about the albedo of the objects	1
5		The right formula	2
6		Final result from the data used	1
7		Correct accuracy in the answer	1
		Using wrong distance of main belt and Kuiper belt will get part of point No.1	
		Only thinking about the relationship of distance and size will get part of point No.5	
		Thinking about the resolution of the telescope will get part of point No.5	
		Equivalent correct parts of other ways of solution	8
		Extra conclusions or correct additions (add. to 8 pt)	

8

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Bulgaria



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Evaluation criteria for problem № 5
of jury member VALENTINI GAETANO (IT)
country

<u>No</u>	Abbreviation (if used in table)	Explanations of gradating sub-points	N of points
		USING THE DISTANCE FROM THE SUN (0.5 FOR EACH DISTANCE)	1
		USING THE DISTANCE FROM THE EARTH (0.5 FOR EACH DISTANCE)	1
		USING THE RATIO OF SIZE BODY	1
		USING THE ALBEDO EFFECT ON L (0.5 IF USE ONLY ONE GOOD VALUE)	1
		USING FORMULA $\left\{ \begin{array}{l} \text{RATIO OF PARAMETER} \\ \text{ANGULAR RESOLUTION OF TELES.} \end{array} \right.$	2
		RESULT	1
		ACCURACY (1 digit)	1
		Equivalent correct parts of other ways of solution	8
		Extra conclusions or correct additions (add. to 8 pt)	8

Jury member signature