



6th International Olympiad on Astronomy and Astrophysics

04 to 14 August, 2012 – Rio de Janeiro – Brazil



## Theoretical Exam - Short Questions

1. At Brazil's **National Observatory**, located at the city of Rio de Janeiro ( $22^{\circ} 54' \text{ S}$ ,  $43^{\circ} 12' \text{ W}$ ), there is a sundial above the door of the dome of the 32cm telescope, facing to the north. The dial lies on the plane East-Zenith-West and the rod is parallel to the Earth's axis. For which declinations of the sun and during what period of the year (months and seasons) the clock (i) does not work during, at least, some fraction of the day?, and (ii) does not work at all during the day?
2. Calculate the length of the sidereal day on Earth. What would be the length of the solar and sidereal days, in the current time measures (our solar hours, minutes and seconds), if the Earth would rotate in the opposite direction, but with the same rotation speed?
3. What is the time interval between two consecutive oppositions of Mars? Assume the orbit is circular.
4. What would be full Moon's visual magnitude if its albedo were equal to 1?
5. Calculate the ratio between the average densities of the Earth and the Sun, using **ONLY** the dataset below:
  - the angular diameter of the Sun, as seen from Earth
  - the gravitational acceleration on Earth's surface
  - the length of the year
  - the fact that one degree in latitude at Earth's surface corresponds to 111 km
6. Most of the energy emitted by the Sun is generated in its core via the so-called proton-proton (p-p) nuclear chain reaction, which has three different branches. The most energetic branch transforms  $2 \text{ He}^3$  into  $\text{He}^4 + 2\text{H}^1$ . Calculate the energy released (in MeV) and the fractional reduction of the mass of the particles involved in this reaction.



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## Team Problem

	$\alpha$	$\delta$	m	M
Vega	18h36m56s	+38°47'01"	0.03	0.58
Sirius	06h45m09s	-16°42'58"	-1.47	1.42
Rigel	05h14m32s	-08°12'06"	0.12	-7.84
Aldebaran	04h35m55s	+16°30'34"	0.75	-0.63