



Theoretical round. Problems to solve

Reminding. Most of the problems are compiled in such a way that when writing solutions, minimal use of any language is required from the participant. So minimum texts are allowed in solutions of the problems (neither in the native language, nor in one of the official languages of the IAO). Pay more attention to formulas, drawings and graphs. It is permitted to write a few keywords in English (for example, “Yes”, “No”, “Assume”, “Answer”, “Average”, “Minimum”, “Maximum”, “Impossible situation”, etc.), as well as terms contained in the accompanying tables and names of objects.

1($\alpha\gamma$). Ancient observations. In the year when the Bengali calendar (*) came into operation, court astronomers measured the maximum height of the center of the Sun during the summer and winter solstices. In the first case, they received the value $h_1 = 89^\circ 27'$, in the second $h_2 = 42^\circ 11'$. Both times the Sun was south of zenith. Find:

- 1.1. at what latitude the observations were made,
- 1.2. the angle of inclination of the ecliptic to the plane of the celestial equator in the specified epoch.
- 1.3. What area has the Northern circumpolar zone (the territory inside the Arctic circle) gained (the “+” sign in the answer) or lost (the “–” sign in the answer) since then to the present?

(*) According to the Bengali calendar, the New Year begins in mid-April, the year 1432 is now, and today (November 8) is the 21st of the Seventh Month.

2($\alpha\gamma$). NGC of the Year. NGC 2025 is a small open cluster, visible as an 11^m object, located in the Mensa constellation, discovered by John Herschel on February 8, 1836. The coordinates of the center of the cluster are $05^h 32^m$, $-71^\circ 43'$, and its angular size is $2.0'$. Estimate the minimum altitude required to ascend above Dhaka in a hot air balloon to observe the whole NGC 2025. Consider that a telescope powerful enough to observe 11^m objects can be mounted on this balloon, taking into account atmospheric extinction near the horizon.