

7th Indian National Astronomy Olympiad

May 1 to 20, 2005

Theory Test 3

2453508.58333 JD

Duration 4 hrs

Seniors

1. Binary Stars: (20 marks)

HP2110psc is a binary in Scutum. The two members are moving in elliptical orbit around each other with the orbit making nearly (but not exactly) 90° with the plane of sky.

- If the ratios of their redshifts as observed along the minor axis is 0.6, calculate the eccentricity of the orbit. The difference in the magnitudes is $0^m.5$ and they are observed to be of the same spectral class. The mass luminosity relation is $L \propto m^{3.5}$.
- The maximum angular separation of the two members is observed as $0''.34$. If the orbit were in the plane of sky estimate the aperture and focal length of the telescope (to be mounted on Astrosat) which will resolve it at all times. CCD mounted at the prime focus of this telescope has a 3000 dpi (dots per inch) resolution.

2. Mining on Miranda: (50 marks)

Scientists at ISRO find evidences for the presence of platinum, ruthenium and gadolinium on Miranda – one of the satellites of Uranus. You are sent to Miranda as a part of a team to set up a mining station. In the leisure time you continue your hobby of astronomy. You observe that Uranus – the mother planet rises every 2.0×10^6 s and from the same point on horizon. The orbit of the Uranus is observed to be making 90° with its equator. The sun's apparent magnitude is $-21^m.4$ while you recall that it was $-27^m.8$ from earth.

- You also observe that the solar eclipse can take place only in certain seasons. Calculate after how much time the season of eclipses repeats.
- Calculate the maximum duration for which Jupiter will occult the sun. Jupiter is seen to have $14''$ diameter. Plot its path on the sun's disk.
- What will the Jupiter's maximum elongation from Sun?
- Draw the celestial sphere. Show the diurnal motion of Sun on the celestial sphere during summer and spring from the northern hemisphere of Uranus.
- Vernal equinox for Uranus points in the direction of Denebola (to be more specific, $\beta = 1^\circ$, $\lambda = 168^\circ$ as defined from the earth's coordinates). Calculate the distance (in Uranus light years) of 1 parsec for Uranus. Hence show the parallactic ellipse for Denebola on the celestial sphere in spring and summer. Recall that Denebola is $2^m.1$ star 36 earth light years away from the sun.

3. The return of Pingu and Tingu: (30 marks)

Pingu and Tingu, bored of their cosmic adventures, decide to return to the earth. But their journey back is not free of misadventures. Being away from earth for so long, they know nothing about it and its neighbourhood.

- They land on earth, but they have no idea where they are. They observe the moon rising at the same sidereal time on two consecutive days. Where could they be?
- They decide to travel and explore the earth. They reach a place where the moon is visible continuously for 48 hours. What is the minimum latitude of such a place?
- They travel some more and observe a total solar eclipse. From the local astronomers they find out that it is 22nd July 2009 and that $\phi=30^\circ\text{N}$, $\lambda=113^\circ\text{E}$ and their watches (which were still showing UT) read 1:25. Calculate the geocentric right ascension and declination of the moon.