Homi Bhabha Centre for Science Education

Tata Institute of Fundamental Research

7th Indian National Astronomy Olympiad

May 1 to 20, 2005

Theory Test 2

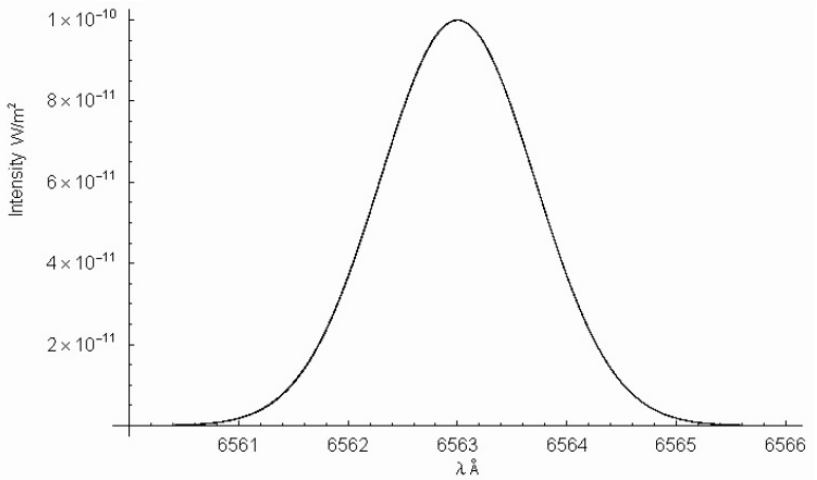
May 12, 2005: 9:30 IST Duration 3^h

Note: All questions carry equal marks

Seniors

1. Estimate the duration for which Jupiter is in retrograde motion. At the start of this period, Jupiter was seen in the 'Gateway of Heavens'. Where will it be at the end of this period?

	δ	α
Castor	32°	$7^h\ 35^m$
Pollux	28°	$7^h\ 45^m$
Procyon	6°	$7^h\ 40^m$
Gomeisa	8°	$7^h\ 25^m$



2. The adjacent figure shows the intensity profile of a cluster (something) for H_α line (6563Å as observed in the laboratory). The spectral analyses of individual stars in the cluster suggest that all stars belong to the main sequence and are 10 times brighter than the sun. Discuss the nature of this cluster if it is at the distance of 1kpc. Is the cluster closed?

3. Pingu and Tingu now have moved from the White Dwarf Xaerox to a pulsar ModiXaerox. Pulsars are thought to be rapidly rotating neutron stars. ModiXaerox has a radius of about 10km, a mass of about one solar mass, and revolves at a rate of 30 times per second. While moving around the pulsar in the circular orbit with the period of 40^d they push each other so that Pingu goes into the eccentric orbit and goes to the nearest distance of ModiXaerox without being pulled apart. Assume that his body mass is uniformly distributed along his height (2m tall), his feet point toward the pulsar, and dismemberment begins when the force that each half of his body exerts on the other exceeds ten times his body weight on the Earth. What is the period of revolution in a circular orbit about the pulsar at this minimum distance? With what orbit Tingu must be moving around the pulsar.

4. Algol is an eclipsing binary in Perseus with apparent magnitude V=2.10 and colour (B-V) = -0.05. If the ratios of the luminosities of the two components of the binary

are 2.1 in V and 2.8 in B, find the apparent V and B magnitudes and B-V colours of each component.

5. Find out the mass of the double star Alpha Centauri for which parallax is 0.75'', period is 79 years and observed semi-major axis subtends 17.6''. If the minimum separation between them is 4.2'', find the limit on the individual masses.
6. Tiger Thyangarajan from Vishakhapattanam showed me a beautiful photograph of a crescent Moon he had from the seashore, looking towards the waters of the Bay of Bengal. I was fascinated looking at it, because I also had taken a photo of the Moon around the same season of the year from Mumbai, which showed the Arabian Sea. The crescents in both the pictures not only have similar phases but were identical in size. Estimate the shortest periods possible when these photographs might have been taken. Give what all differences these two photos might have.