The 1st International Olympiad on Astronomy and Astrophysics

Chiang Mai, Thailand

Experimental Competition (Data Analysis)

Monday, 3 December, 2007

Please read this first:

1. The time available is 3 hours for the experimental competition (Data analysis). There are three questions (and a set of data table).

2. Use only the pen provided.

3. Use only the front side of *writing sheets*. <u>Write only inside the boxed area.</u>

4. Begin each question on a separate sheet.

5. For each question, in addition to the *blank writing sheets*, there are the *Answer Sheets* where you *must* summarize the results you have obtained. Numerical results should be written with as many digits as are appropriate.

6. Write on the blank *writing sheets* whatever you consider is required for the solution of the question. Please use *as little text as possible*; express yourself primarily in equations, numbers, figures, and plots.

7. Fill the boxes at the top of each sheet of paper with your country code, your student code, the question number, for <u>each question</u> the consecutive number of each sheet (Page Number), and the total number of *writing sheets* used*.* If you use some blank *writing sheets* for notes that you do not wish to be marked, put a large X across the entire sheet and do not include it in your numbering.

8. Students given questions, writing sheet and answer sheets in English and national language can answer in any one sheet but must return both to the marker (examiner).

9. At the end of the exam, arrange all sheets for each problem *in the following order:*

- *Answer Sheet(s)*

- used *writing sheets* in order

- the sheets you do not wish to be marked

- unused sheets and the printed question

Place the papers inside the envelope and leave everything on your desk. You are not allowed to take *any* sheets of paper out of the room.

Some useful information for calculation

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Astronomical unit (A.U.)	149,597,870 km
Mean distance, Earth to Moon	384,399 km
Obliquity of the ecliptic	23° 26'
Earth's mean radius	6,371.0 km
Earth's mean velocity in orbit	29.783 km/s
Sidereal year	365.2564 days
Tropical year	365.2422 days
Sidereal month	27.3217 days
Synodic month	29.5306 days
Mean sidereal day	23h56m4s.091 of mean solar time
Mean solar day	24h3m56s.555 of sidereal time

Question 1   Galilean moons (4 points)

Computer simulation of the planet Jupiter and its 4 Galilean moons is shown on the screen similar to the view you may see through a small telescope. After observing the movement of the moons, please identify the names of the moons that appear at the end of the simulation. (Simulation will be played on screen during the first fifteen minutes and the last fifteen minutes of the exam)

Question 2   The Moon's age (8 points)

The 60th anniversary celebrations of King Bhumibol Adulyadej's accession to the throne of Thailand (GMT +07) were held on the 8th to the 13th June, 2006. Photographs of the Moon taken at the same hour each night are shown below:

8th June, 2006   9th June, 2006   10th June, 2006

11th June, 2006   12th June, 2006   13th June, 2006
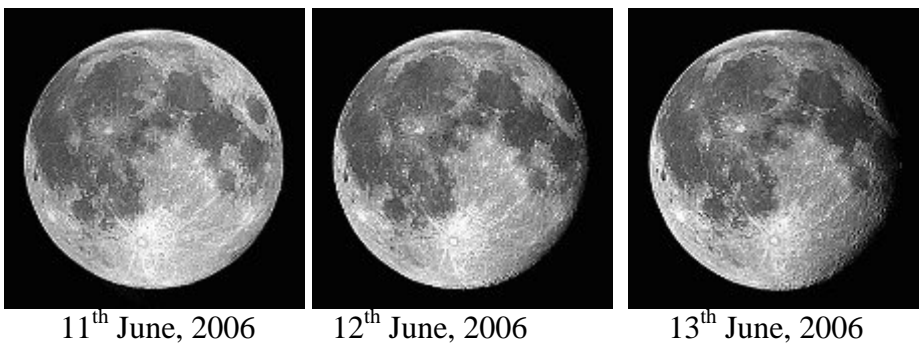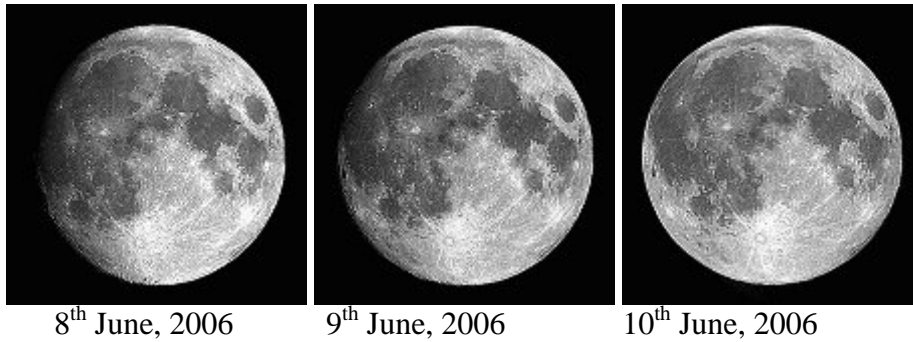
Assuming that Albert Einstein's birth was at noon on 14th March, 1879, use the data provided above to find the Moon's age (number of days after the new moon) on his birth date in Germany (GMT +01). Please show the method used for the calculation in detail. Estimate the errors in your calculation.

Question 3   Solar System objects (8 points)

A set of data containing the apparent positions of 4 Solar System objects over a period of 1 calendar year is given in Table 1. Show your method of data analysis carefully and answer the following questions.

| Location of observer | Latitude : | N 18° 47' 00.0" |
| | Longitude : | E 98° 59' 00.0" |

3.1 Put the letters A, B, C and D beside the appropriate objects on the answer sheet. **(2 points)**

3.2 During the period of observation, which object could be observed for the longest duration at night time? **(1 point)**

3.3 What was the date corresponding to the situation in 3.2? **(1 point)**

3.4 Assuming the orbits are coplanar (lie on the same plane) and circular, indicate the positions of the four objects and the Earth on the date in 3.3, in the orbit diagram provided in your answer sheet. The answer (sheet) must show one of the objects as the Sun at the centre of the Solar System. Other objects including the Earth must be specified together with the correct values of elongation on that date. **(4 points)**

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