Israel Open Astronomy Olympiad 2025

Junior and Senior age group problems

Stellarium problem (30 p.)

During a Solar eclipse, the Moon occults the Sun, that is, is positioned between the Sun and the observer. In the same way, the Moon may also occult a planet. For example, in the evening of January 04, 2025, an occultation of Saturn by Moon occurred.

Similarly to the Solar eclipse, the planetary occultation by the Moon is also visible just from a small fraction of the surface of the Earth.

A Set up the observer position in Netanya and the time to January 04, 2025, 21:00. The angular diameter of the Moon is 30'. Determine the distance from Saturn to the nearest point of the Moon's disk. You may use the ruler to measure the distances on the screen.

Answer: The angular distance from Saturn to the nearest edge of the Moon disk is []'. (5 p.)

Solution:

The sky map view should look the following way. As I have measured on my screen, the diameter of the Moon disk was equal to 10.0 cm, but the distance from Saturn was equal to 5.1 cm. Taking linear proportion, when 10.0 cm corresponds to 30', then 5.1 cm corresponds to 15'. The allowed distance range is 12' – 18'.



B What is the numerical value of the phase of the Moon at this moment? The phase $\Phi = d/D$ is defined as illuminated diameter fraction of the Moon disk (e.g., 0.33). Read value from the Stellarium or determine yourself.

Answer: Moon phase at this moment is []. (5 p.)

Solution: The Moon information page will tell that the phase is 25% (must be entered to the answer sheet as 0.25).

Manually measuring the illuminated fraction from screen, the illuminated part equals 2.44 cm, whereas the diameter equals 10.0 cm. The phase thus equals 0.244.

The allowed variation range is from 0.20 to 0.30.



C Determine the time of closest approach between the center of the Moon disk and the Saturn as seen from Netanya. How large is this distance from the **center** of the Moon disk to Saturn (express in angular minutes, ')?

Answer: The time of closest approach on January 04, 2025, is []h []m (3 p.). The smallest angular distance between Saturn and the **center** of the Moon disk is []'. (3 p.)

Solution: By fixing

Stellarium view on Saturn, stopping the time and manually changing it by one minute, the time of closest approach is found to be about 20:34. Allowed error equals five minutes.

The minimum distance to the edge of the disk in the same scale as above equals 4.1 cm, that is, by proportion, 12.3'. The distance to the center is thus 12.3' + 15' = 27.3'. Allowed range is 25' to 30'.



D Was Saturn occulted on January 04, as seen from Netanya [yes/no]?

Answer: Select one: [Yes]/[No] (1 p.)

Solution: No, as the distance above is larger than the Moon angular radius.

E If not, specify the reason. If yes, how long was the duration of the occultation as seen from Netanya (in minutes)? Specify 0 if the event did not occur.

Answer: Select one: [Occultation was observable] / [Moon's disk did not touch Saturn / Occultation occurred when Moon and Saturn were below the horizon / Occultation occurred during daytime] (1 p.)

The occultation duration, as seen from Netanya, was [] minutes. (4 p., if relevant)

Solution: The correct reason is "Moon disk did not touch Saturn". Event duration should be indicated as 0 minutes. The total number of points is 1 p.

F Was this occultation seen from Greenwich, London? [yes/no]

Answer: Select one: [Yes]/[No] (1 p.)

Solution: Change the observer position to Greenwich, keeping the time to be 20:34. Find Moon and see that Saturn was just recently became visible after the occultation. So yes, it was seen from there.

Note that this is still Israeli time.



G If not, specify the reason. If yes, how long was the duration of the occultation as seen from Greenwich (in minutes)? Specify 0 if the event did not occur.

Answer: Select one: [Occultation was observable] / [Moon's disk did not touch Saturn / Occultation occurred when Moon and Saturn were below the horizon / Occultation occurred during daytime] (1 p.)

The occultation duration, as seen from Greenwich, was [] minutes. (4 p., if relevant)

Solution: As determined previously, occultation did occur. Modifying the observation time and zooming in to Saturn, we determine that the occultation started at $19^{h}20^{m}20^{s}$ and finished at $20^{h}29^{m}35^{s}$. Neglecting seconds, the duration of the occultation was $1^{h}9^{m} = 69$ minutes. Allowed variation is 67 - 71 minutes. Total number of points here is 5 p.

H Every month, Moon passes near Saturn on the sky. Check whether the Saturn occultation of the Moon may be observed from Netanya:

a) In February 2025

Answer: [Yes] / [No, Moon's disk did not touch Saturn] / [No, occultation occurred when Moon and Saturn were below the horizon] / [No, occultation occurred during daytime] (2 p.)

Solution: On February 01, 2025, the closest approach of Saturn and Moon occurred at 05:26, but both objects were below the horizon. On February 28, 2025, the next closest approach occurred, but again both objects were below the horizon, as seen from Netanya.

b) In April 2025

Answer: [Yes] / [No, Moon's disk did not touch Saturn] / [No, occultation occurred when Moon and Saturn were below the horizon] / [No, occultation occurred during daytime] (2 p.)

Solution: On April 25, 2025, the closest approach of Saturn and Moon occurred at 04:55 during the night and above the horizon, but the occultation did not occur as the Moon's disk did not touch Saturn.

c) In August 2024

Answer: [Yes] / [No, Moon's disk did not touch Saturn] / [No, occultation occurred when Moon and Saturn were below the horizon] / [No, occultation occurred during daytime] (2 p.)

Solution: On August 21, 2024, the closest approach of Saturn and Moon occurred at 07:16 during the night and above the horizon, but the occultation did not occur as the Moon's disk did

not touch Saturn. The distance as seen from Netanya was just about 3', and already in Cyprus the occultation was observable.