Observing the Sky

Firstname Lastname

Date

1. Replace the red text at the top of this page with your name and the date.

2. As you enter your work, please make sure that your answers stay red (like this). This will make them easier to see, and thus it will be easier for us to grade them accurately. To convert black text to red, highlight it and then click on the “A” symbol in the menu bar above, to the right of the “**B**”, “*I*”, and “U” symbols. Select the red square to turn highlighted text red.

3. Delete these 3 initial instructions from this template as soon as you have followed them.

The Elongation and Illumination of the Moon

If you use the knuckle-width technique for observing the crescent moon, record your values for *r*, *d*, and α here so that your instructor can check your work.

*r* = r-value (units), *d* = d-value (units), α = α-value (units).

Table 2.3: Lunar observations

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Date | Time[[1]](#footnote-0) | ΔTime[[2]](#footnote-1) (days) | MES-1(°)[[3]](#footnote-2) | MES-2(°) | MES-3(°) | μ ± σ (°) | Illum.[[4]](#footnote-3) (%) | Phase[[5]](#footnote-4) |
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1. The nearest new moon is on this date, at this time.

2. Be sure to save a PNG-format copy of the MES versus time plot, to include here.

Place your first PNG-format image here.

3. For this plot, the units of the slope are replace this text, and the units of the *y*-intercept are replace this text.

4. It is important to be able to read and interpret the plot, and connect it back to the physical objects upon which it is based. What is the meaning of the slope and *y*-intercept, in terms of the interplay between the Sun and the Moon? (How do they translate into explaining the movement of the Moon around the Earth?)

Replace this text with your answer.

5. In a more “perfect” solar system, the Moon's orbit would be a perfect circle around the Earth, lying exactly within the plane of the ecliptic (the plane in which the planets orbited around the Sun), and all of our measurements would be free of error. The Moon would still take 29.5 days to orbit once around the Earth. In this case, what exact values of *m* and *b* would you expect to determine?

Replace this text with your answer.

6. You have plotted points covering a substantial fraction of the first half of the lunar month, and fit a straight line to them. If you took data for another two weeks, describe what a plot of all of the data would look like (over the entire month).

Replace this text with your answer.

7. Be sure to save a PNG-format copy of the illumination versus time plot, to include here.

Place your second PNG-format image here.

8. (a) Based on this plot, the illuminated fraction of the Moon 27.5 days after a new Moon is equal to the fraction replace this text days after a new Moon.

(b) On the tenth day of the lunar month, the illuminated portion of the Moon is ( more / less ) than five times that of the second day.

9. Based on this plot and your understanding of the geometry of the Sun, Earth, Moon system, what illumination values would you expect for the new, first quarter, full, and last quarter moon? Explain your answer, describing the physical positions of these three bodies and the patterns of illumination and shadow in each case.

Replace this text with your answer.

Measuring the Moon's Altitude, Finding our Latitude

1. During which season of the year is the Earth tipped over toward the position of the first quarter Moon? During which season is it tipped away from the position of the first quarter Moon?

Replace this text with your answer.

2. Explain the physical cause of the shape of the curve shown in Figure 2.7, justifying both the general form and the fact that the points do not lie exactly on the curve.

Replace this text with your answer.

3. The nearest first quarter moon culmination is on this date, at this time.

The lunar declination (*dec*) at this time is replace this text degrees, which is ( north / south ) of the Equator.

4. The three observed values for the lunar altitude are value-1, value-2, and value-3 (units).

5. The altitude of the culminating first quarter moon was mean value ± standard deviation (σ) (units).

6. The zenith distance of the culminating first quarter moon was mean value ± standard deviation (units).

7. The latitude of my observing location, location, is mean value ± standard deviation (units).

8. The tabulated latitude of my observing location is tabulated latitude.

9. By how many σ do the two latitude values differ? If the difference is more then 2σ, discuss possible sources of error in your measurements that could account for the difference.

Replace this text with your answer.

Measuring the North Star's Altitude, Finding our Latitude

1. The three measurements of the North Star altitude are value-1, value-2, and value-3 (units).

2. The altitude of the North Star was altitude ± standard deviation (units).

3. Bearing in mind that the North Star is located high in the sky above the North Pole, at what altitude would it appear if viewed from the North Pole, with a latitude of 90°?

Replace this text with your answer.

4. At what altitude would the North Star appear if viewed from the Equator, with a latitude of 0°?

Replace this text with your answer.

5. Explain the relationship between the altitude of the North Star and an observer's latitude.

Replace this text with your answer.

6. The latitude of my observing location is mean value ± standard deviation (units).

7. By how many σ do the two latitude values differ? If the difference is more then 2σ, discuss possible sources of error in your measurements that could account for the difference.

Final (post-lab) Questions

1. Fill in the following 12 blanks with the words sunrise, noon, sunset, or midnight.

The new moon rises at (roughly) time-1, culminates at time-2, and sets at time-3.

The first quarter moon rises at time-4, culminates at time-5, and sets at time-6.

The full moon rises at time-7, culminates at time-8, and sets at time-9.

The last quarter moon rises at time-10, culminates at time-11, and sets at time-12.

2. Describe one way in which you could introduce a systematic error into the measurement of your latitude, while estimating the altitude of the culminating first quarter moon.

Replace this text with your answer.

3. For an observer at a latitude of 32.3° (north of the Equator), what should a first quarter moon's altitude be at culmination on June 21? Show your work.

Replace this text with your answer.

4. If the culminating first quarter moon has a declination of -23° in the Fall (appears 23° south of the Equator), what will the approximate declination be of the last quarter moon two weeks later?

Replace this text with your answer.

Summary (300 to 500 words)

Replace this text.

Extra Credit

Replace this text.

1. Time of day to the nearest minute (such as 6:52 pm). [↑](#footnote-ref-0)
2. Time to nearest new moon phase in units of days, to nearest thousandth of a day (2.456 days). [↑](#footnote-ref-1)
3. Elongation angle formed by Sun, Earth, and Moon. Measure this angle three times in a row, and then enter the average value and standard deviation as μ ± σ. [↑](#footnote-ref-2)
4. The fractional illumination of the Moon, estimated by comparison to the pictures in Figure 2.4. [↑](#footnote-ref-3)
5. The approximate phase of the Moon (such as waxing thin crescent, or waning gibbous). [↑](#footnote-ref-4)