# Lab Report: The Telescope and the Microscope

## Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## DATA TABLE PROCEDURE A: The Astronomical Telescope: Looking at a Far Away Object

|  |  |  |  |
| --- | --- | --- | --- |
| ***Summary of Positions:*** | | | |
| ***Visual Description of the First Image:*** | |  | Orientation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Magnification: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Type: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| ***Summary of Distances:*** |  | | |
| *Visual Estimate of the Total Magnification:* | | | |
| ***Theoretical Total Magnification:*** | | | |

**DATA TABLE PROCEDURE B: The Astronomical Telescope: Looking at a Nearby Object**

|  |  |  |  |
| --- | --- | --- | --- |
| ***Summary of Positions:*** | | | |
| ***Visual Description of the First Image:*** | |  | Orientation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Magnification: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Type: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| ***Summary of Distances:*** |  | | |
| *Visual Estimate of the Total Magnification:* | | | |
| ***Theoretical Total Magnification:*** | | | |

**DATA TABLE PROCEDURE C: The Galilean Telescope: Using a Negative Eyepiece**

|  |  |  |  |
| --- | --- | --- | --- |
| ***Summary of Positions:*** | | | |
| ***Visual Description of the First Image:*** | |  | Orientation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Magnification: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Type: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| ***Summary of Distances:*** |  | | |
| *Visual Estimate of the Total Magnification:* | | | |
| ***Theoretical Total Magnification:*** | | | |

## DATA TABLE PROCEDURE D: The Compound Microscope: Looking at a Nearby but Very Small Object

|  |  |  |  |
| --- | --- | --- | --- |
| ***Summary of Positions:*** | | | |
| ***Visual Description of the First Image:*** | |  | Orientation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Magnification: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Type: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| ***Summary of Distances:*** |  | | |
| ***Total Magnification:*** | | | |
| ***What is the message?*** | | | |

### QUESTIONS for PROCEDURES A, B and C: Telescopes

1. It should have been immediately obvious that when you look through the astronomical telescope (procedures A and B) the image is upside down. Discuss: Is this a big problem when making astronomical observations?
2. In contrast: What is the orientation of the final image in the Galilean telescope?
3. Is the final image from a telescope real or virtual? How can you tell?
4. How good were your visual estimates of the total magnification of the telescopes, as compared to the theoretically expected values? Discuss what makes the visual estimates hard to measure in each case.
5. According to Eq. 3, the total magnification of a two-lens system is . Go to Procedure A: use the theoretical magnification and the calculated value for , to calculate what must have been the magnification of the first image, . Does the value of matches your visual observations? Discuss.
6. Use your calculation of  (question 4) and Eq. 2 to determine the distance from the objective to the object,  (the one we assumed was infinite). Discuss: does the calculated distance seem realistic, given the actual object you were looking at? Why yes or why not? Was it reasonable, then, to assume that ?
7. In general, which type of telescope would require a longer tube-length, an astronomical telescope or a Galilean telescope? Why?

### QUESTIONS for PROCEDURE D: The Compound Microscope

1. Is the final image of the microscope upright or upside down?
2. Is the final image of the microscope real or virtual? How can you tell?

**RAY DIAGRAMS**

Use the grids provided in the next pages to trace principal ray diagrams for Procedures B, C and D.

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| --- | --- | --- | --- | --- | --- |
|  | **PROCEDURE C: The Galilean Telescope: Using a Negative Eyepiece** |  | | | **PROCEDURE B: The Astronomical Telescope: Looking at a Nearby Object** |
|  | | | **PROCEDURE D: The Compound Microscope** |

GRID PATTERN

Copy and attach to the Viewing Screen

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