Student Name :

Grade : IGCSE yr -1

Finding the Height of a Tower Using Trigonometry

Objective:

Students will construct a **DIY clinometer**, use it to measure angles of elevation, and apply trigonometry concepts (tangent ratios and scale factors) to determine the height of a chosen tall object (e.g., a tower, building, or tree).

Materials Required:

- Protractor
- Straw
- String
- Small weight (washer or paperclip)
- Measuring tape
- Calculator
- Notebook for recording data







Instructions for Students:

Step 1: Construct a DIY Clinometer

- 1. Tape a **protractor** onto a flat surface.
- Attach a straw along the straight edge of the protractor (this serves as the sighting tube).
- 3. Tie a **string** through the protractor's center hole and attach a **small weight** at the end of the string.
- 4. Your clinometer is now ready! The string will indicate the angle when you look through the straw.

Step 2: Choose an Object to Measure

- 1. Select a tall object such as a school building, tree, tower, or flagpole.
- Identify a measuring point at a known horizontal distance from the object (e.g., 10m, 15m, or 20m).

Step 3: Measure the Angle of Elevation

- 1. Stand at your chosen distance from the base of the object.
- 2. Use the **clinometer** to look at the top of the object.
- 3. Record the **angle of elevation** displayed on the protractor.



Step 4: Apply Trigonometry to Find the Height

1. Use the tangent formula:

 $tan(\theta)$ =height of object-eye level heightdistance from object\tan(\theta) =

\frac{\text{height of object} - \text{eye level height}}{\text{distance from object}}

• Solve for the height of the object:

Height=(tan angle)×(distance from object)+eye level height\text{Height} =

\text{(tan angle)} \times \text{(distance from object)} + \text{eye level height}

- 2. Measure your eye level height and add it to the calculated value.
- 3. Convert results if needed using scale factors to compare real-world measurements.

Step 5: Document Findings and Real-World Applications

• Draw a diagram showing your setup and calculations.



| Criteria Clinometer | Excellent (5 pts) Well-built, functions accurately, and | Good (4 pts) Functions well | Satisfactory (3 pts) Basic construction, | Needs Improvement (2 pts) Poorly built, |
|-------------------------------------|---|--|---|---|
| Construction | includes all materials. | but may have minor flaws. | but accuracy issues present. | missing key materials. |
| Measurement & Data Collection | Precise angle readings, correct application of measurements. | Mostly accurate, slight measurement errors. | Some errors in angle reading and distances. | Major errors, incomplete data. |
| Mathematical Calculations | All calculations correct, clear use of trigonometry. | Minor calculation errors but correct method. | Some mistakes in trigonometry application. | Incorrect calculations, missing work. |
| Real-World Connection | Insightful applications to real- world contexts. | Good connection to real-life uses. | Basic mention of applications. | No real-world connection made. |
| Presentation & Documentation | Well-organized, clearly explained, and neatly presented. | Mostly clear, minor missing details. | Lacks organization, some steps missing. | Poorly documented, incomplete explanation. |



Total Score: / 25

Extension Activity:

- **Compare different heights** by measuring multiple objects and analyzing how varying angles impact results.
- Collaborate with peers to validate accuracy.
- Apply scale factors to estimate distances in large maps and city planning.

Reflection Questions:

- How does changing the measuring distance affect accuracy?
- What are the real-world limitations of using a clinometer?
- In which professions would this method be useful?