Grade 10 Mathematics Presentation Script

Angles of Elevation

Pre-Class Preparation

Materials Checklist:

- Clinometers (one per group) - can be homemade with string, protractor, and weight
- Measuring tapes or meter sticks (one per group)
- Scientific calculators (one per group)
- Worksheets with recording tables (one per group)
- Paper and pencils
- Chart paper for recording key takeaways
- Markers

Room Setup:

- Identify suitable tall objects around the school for measurement (trees, buildings, flagpoles)
- Prepare board space for diagrams and worked examples
- Test clinometers to ensure they work properly
- Have extra materials available in case of breakage

Phase 1: Problem-Solving and Discovery (15 minutes)

Opening Hook (2 minutes)

[DO] Point to a tall building or tree visible from the classroom.

[SAY] "How tall do you think that building is? 10 meters? 20 meters? 50 meters?"

[WAIT] Expected: Various guesses.

[ASK] "How could we find out the exact height without climbing to the top with a measuring tape?"

[WAIT] Expected: "Use math!" "Measure the angle!"

[SAY] "Exactly! Today we will learn how to use angles of elevation and trigonometry to find the height of tall objects. This is the same method used by surveyors, architects, and engineers."

[SAY] "We will go outside and measure a real object using a tool called a clinometer."

Anchor Activity Launch (3 minutes)

[DO] Distribute clinometers, measuring tapes, calculators, and worksheets to each group.

[SAY] "Here is your challenge: You will use a clinometer to measure the angle of elevation from your eye level to the top of a tall object, measure the horizontal distance to the object, and use trigonometry to calculate its height."

[DO] Demonstrate how to use the clinometer.

[SAY] "Here is what you will do:"

[SAY] "Step 1: Find a tall object around the school - a tree, building, or flagpole."

[SAY] "Step 2: Measure the distance from the base of the object to your position. Record this distance."

[SAY] "Step 3: Use your clinometer to measure the angle of elevation from your eye level to the top of the object. Record the angle."

[SAY] "Step 4: Draw a right triangle representing the situation. Label the distance, the angle, and the unknown height."

[SAY] "Step 5: Decide which trigonometric ratio to use to find the height."

[SAY] "Step 6: Calculate the height using the trigonometric ratio. Show your work."

[SAY] "Step 7: Compare your result with other groups. Discuss any differences."

[SAY] "Work with your group. You have 10 minutes."

Student Work Time (8 minutes)

[DO] Take students outside and circulate among groups.

[ASK] To a group struggling with the clinometer: "Hold it at eye level and look through it to the top of the object. What angle does the string show?"

[WAIT] Expected: "35 degrees!" or similar.

[SAY] "Good! Now measure the horizontal distance from the base to where you are standing."

[ASK] To another group: "What triangle are you forming? Which side is opposite the angle?"

[WAIT] Expected: "The height!" "The vertical side!"

[SAY] "Correct! And which side is adjacent to the angle?"

[WAIT] Expected: "The horizontal distance!"

[SAY] "Excellent! So which trigonometric ratio should you use?"

[WAIT] Expected: "Tangent!" "tan = opposite / adjacent"

[SAY] "Perfect! Now calculate the height."

[DO] For struggling groups: "Let us draw the triangle together. Your eye level is here, the top is here, the base is here. What is the angle? What is the distance?"

[DO] For early finishers: "Did you remember to add your eye height to get the total height from the ground?"

Class Discussion (2 minutes)

[DO] Return to the classroom. Call on 2-3 groups to share their findings.

[ASK] "What object did you measure, and what height did you calculate?"

[WAIT] Expected: "We measured the flagpole. It is 12 meters tall."

[SAY] "Excellent! How did you calculate that?"

[WAIT] Expected: "We used tan(angle) = height / distance."

[SAY] "Perfect! Did other groups get similar results?"

[WAIT] Check for consistency or discuss differences.

[SAY] "Small differences are normal due to measurement errors. Averaging results improves accuracy."

[ASK] "What did you learn from this activity?"

[WAIT] Expected: "We can find heights without climbing!" "Trigonometry is useful!"

Phase 2: Structured Instruction (10 minutes)

Formalizing Angles of Elevation and Depression (5 minutes)

[SAY] "Now that you have explored angles of elevation in the real world, let us formalize the concepts."

[WRITE] On the board: "Key Takeaway"

[SAY] "A clinometer (or inclinometer) is a tool used to measure the angle of elevation (looking up) and the angle of depression (looking down)."

[DO] Draw a diagram on the board showing a person on the ground looking up at an object (angle of elevation) and a person on a hill looking down at an object (angle of depression).

[WRITE] "Angle of Elevation: The angle measured upward from a horizontal line to an object above."

[WRITE] "Angle of Depression: The angle measured downward from a horizontal line to an object below."

[SAY] "The dashed line is the horizontal line at eye level."

[ASK] "What is the difference between angle of elevation and angle of depression?"

[WAIT] Expected: "Elevation is looking up, depression is looking down."

[SAY] "Correct! But here is an important fact: angles of elevation and depression between the same two points are equal because they are alternate angles."

Important Notes (5 minutes)

[SAY] "Let me highlight some important points:"

[WRITE] "Important Notes"

[SAY] "1. The horizontal line is the reference line, usually at eye level."

[SAY] "2. Angles of elevation and depression between two points are equal (alternate angles)."

[SAY] "3. The tangent ratio is most commonly used: tan(angle) = opposite / adjacent."

[SAY] "4. Always account for eye level height when calculating total height of objects."

[SAY] "5. Draw a clear diagram to identify the right triangle and label all sides."

[ASK] "Why do we need to add eye height to our calculation?"

[WAIT] Expected: "Because we measured from our eye level, not from the ground!"

[SAY] "Exactly! The calculated height is only the height above eye level."

Addressing Misconceptions:

[SAY] "Let me address some common mistakes:"

[SAY] "Mistake 1: Measuring the angle from the object instead of from the horizontal line at your eye level."

[SAY] "Mistake 2: Forgetting to add eye height to get the total height from the ground."

[SAY] "Mistake 3: Using the wrong trigonometric ratio. Choose based on what you know and what you need."

[SAY] "Mistake 4: Thinking angle of elevation and angle of depression are always different. They are equal when measured between the same two points."

[ASK] "Does everyone understand the difference between elevation and depression?"

[WAIT] Check for nods or questions.

Phase 3: Practice and Application (10 minutes)

Worked Example 1 (3 minutes)

[SAY] "Let us work through an example together."

[WRITE] "Example 1: A person stands 20 m away from a tree. The angle of elevation from their eyes (1.6 m above the ground) to the top of the tree is 35 degrees. Find the height of the tree."

[DO] Draw a diagram on the board.

[SAY] "First, let us identify what we know and what we need to find."

[SAY] "We know: horizontal distance = 20 m, angle = 35 degrees, eye height = 1.6 m"

[SAY] "We need to find: total height of the tree"

[SAY] "Let us use the tangent ratio."

[WRITE] "tan 35 degrees = (Tree height - 1.6 m) / 20 m"

[SAY] "Solving for tree height:"

[WRITE] "Tree height = (20 × tan 35 degrees) + 1.6"

[WRITE] " = (20 × 0.7002) + 1.6"

[WRITE] " = 14 + 1.6"

[WRITE] " = 15.6 m"

[ASK] "Does everyone understand?"

[WAIT] Check for understanding.

Worked Example 2 (4 minutes)

[SAY] "Let us try another example."

[WRITE] "Example 2: A lighthouse is 50 m tall. A sailor spots the top of the lighthouse at an angle of elevation of 25 degrees. How far is the ship from the base of the lighthouse?"

[DO] Draw a diagram on the board.

[SAY] "This time, we know the height and the angle, and we need to find the distance."

[SAY] "Which trigonometric ratio should we use?"

[WAIT] Expected: "Tangent!"

[SAY] "Correct! Let us set it up."

[WRITE] "tan 25 degrees = 50 m / Base"

[SAY] "Solving for Base:"

[WRITE] "Base = 50 / tan 25 degrees"

[WRITE] " = 50 / 0.4663"

[WRITE] " = 107.2 m"

[SAY] "The ship is 107.2 meters from the base of the lighthouse."

Worked Example 3 (3 minutes)

[SAY] "Now let us look at an angle of depression problem."

[WRITE] "Example 3: A hiker stands on top of a hill that is 120 cm high and looks down at a cabin. The angle of depression to the cabin is 40 degrees. Calculate the horizontal distance from the hiker to the cabin."

[DO] Draw a diagram showing the angle of depression.

[SAY] "Notice that the angle of depression from the hiker equals the angle of elevation from the cabin to the hiker (alternate angles)."

[SAY] "We can use the tangent ratio."

[WRITE] "tan 40 degrees = 120 cm / Cabin distance"

[WRITE] "Cabin distance = 120 / tan 40 degrees"

[WRITE] " = 120 / 0.8391"

[WRITE] " = 143 cm"

[SAY] "The cabin is 143 cm away horizontally."

Phase 4: Assessment (5 minutes)

Exit Ticket

[SAY] "Before we finish, I want to check your understanding. Please complete the exit ticket individually."

[DO] Display questions on the board or distribute exit ticket.

[SAY] "You have 5 minutes to complete the four questions."

Exit Ticket Questions:

1. A ladder is leaning against a wall, forming an angle of 60 degrees with the ground. If the ladder is 10 meters long, how high does it reach on the wall? Draw a right-angled triangle to represent the situation.

2. If the angle of elevation is 30 degrees and the distance to the object is 50 m, then the height above eye level is:

3. A drone flies to a height of 80 meters above the ground. The angle of depression from the drone to a person standing on the ground is 30 degrees. Find the horizontal distance between the person and the drone projection on the ground. Sketch the problem.

4. A surveyor is standing 50 meters away from the base of a mountain. The angle of elevation to the peak of the mountain is 30 degrees. Calculate the height of the mountain above the surveyor eye level.

Answer Key:

1. Height up the wall = 8.666 m

2. The height above the eye level = 28.9 m

3. Horizontal distance = 138.6 m

4. The height above the eye level = 28.9 m

Differentiation Notes

For Struggling Learners:

- Provide pre-drawn triangles with labels.
- Use simpler angles (30, 45, 60 degrees).
- Pair with confident problem solvers.
- Provide step-by-step calculation templates.

For Advanced Learners:

- Challenge with problems involving both elevation and depression.
- Explore real-world applications: surveying, navigation, architecture.
- Investigate error analysis.

Post-Lesson Reflection Prompts

- Did students successfully use the clinometer to measure angles of elevation?
- Were students able to identify the correct trigonometric ratio?
- What misconceptions emerged, and how were they addressed?
- Did students understand the difference between elevation and depression?
- What adjustments would improve this lesson?