Grade 10 Mathematics Presentation Script

Tangents of Acute Angles

Pre-Class Preparation

Materials Checklist:

- Graph paper or printed diagrams (one per pair)
- Rulers (one per pair)
- Pencils
- Protractors (one per pair)
- Chart paper for recording key takeaways
- Markers
- Calculator (optional, for verification)
- Printed tangent tables (for extension activity)

Room Setup:

- Arrange desks for pair work
- Prepare board space for key definitions and worked examples
- Have the anchor activity diagram ready to display (projector or large poster)

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

Opening Hook (2 minutes)

[DO] Display a picture of a ladder leaning against a wall or a ramp.

[SAY] "Imagine you are a builder. You need to know the angle at which a ladder leans against a wall. How would you figure that out if you only know the height of the wall and the distance from the wall to the base of the ladder?"

[WAIT] Expected: "Use a protractor?" "Measure it?" "Calculate it somehow?"

[SAY] "Exactly! Today, we are going to discover a mathematical tool called the tangent ratio that helps us find angles when we know the sides of a right-angled triangle. This is the foundation of trigonometry, which is used in construction, navigation, and many other fields."

[ASK] "Have you ever wondered how engineers design ramps or staircases? They use tangent ratios!"

[WAIT] Expected: Students nod or show interest.

[SAY] "Let us discover this powerful tool together."

Anchor Activity Launch (3 minutes)

[DO] Distribute graph paper, rulers, and protractors to each pair.

[SAY] "Here is your challenge: You will draw a diagram with three similar triangles and discover a special relationship between the sides and the angle."

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

[SAY] "Step 1: Using your paper, ruler, and pencil, carefully draw the diagram shown on the board (Figure 2.4.1)."

[SAY] "Step 2: Measure and record the lengths of OB, BQ, OC, CR, OA, and AP using a ruler."

[SAY] "Step 3: Identify whether triangles OPA, OQB, and ORC are similar. If they are similar, compare the ratios of their corresponding sides."

[SAY] "Step 4: Calculate the following ratios: PA/OA, QB/OB, RC/OC"

[SAY] "Step 5: Observe the ratios. What do you notice about the relationship between them?"

[SAY] "Step 6: Considering the parallel lines BQ, AP and RC, examine the relationship between the vertical and horizontal distances. What do you notice about their ratios?"

[SAY] "Step 7: Use a protractor to measure the angle marked x° in the diagram."

[SAY] "Step 8: Share your observations and conclusions with your partner."

[SAY] "Work with your partner. You have 8 minutes."

Student Work Time (8 minutes)

[DO] Circulate among pairs.

[ASK] To a pair drawing the diagram: "Are you drawing the parallel lines carefully? They need to be parallel for the triangles to be similar."

[WAIT] Expected: "Yes!" or "We are not sure how to draw parallel lines."

[SAY] "Use your ruler to keep the lines straight and make sure they do not intersect."

[ASK] To another pair measuring sides: "Are you recording all six measurements?"

[WAIT] Expected: "Yes!" "We have OB, BQ, OC, CR, OA, and AP."

[SAY] "Good! Now calculate the three ratios: PA/OA, QB/OB, and RC/OC."

[ASK] "What do you notice about the three ratios?"

[WAIT] Expected: "They are the same!" "They are all equal."

[SAY] "Excellent! This is a very important discovery. The ratio is constant for a given angle."

[DO] For struggling pairs: "Let us focus on triangle OPA first. Measure PA (the vertical side) and OA (the horizontal side). Now divide PA by OA. What do you get?"

[DO] For early finishers: "What if you drew another set of parallel lines at a different angle? Would the ratio change? Try it and see."

Class Discussion (2 minutes)

[DO] Call on 2-3 pairs to share their findings.

[ASK] "What did you discover about the three ratios?"

[WAIT] Expected: "They are all the same." "They are all 1.5."

[SAY] "Yes! The ratios PA/OA, QB/OB, and RC/OC are all equal. This is because the three triangles are similar."

[ASK] "What does this tell us about the relationship between the angle and the ratio?"

[WAIT] Expected: "The ratio depends on the angle." "The ratio is constant for a given angle."

[SAY] "Exactly! The ratio of vertical distance to horizontal distance is constant for a given angle. This ratio has a special name: the tangent of the angle."

[WRITE] On the board: "tan x° = 1.5"

[SAY] "We write this as tan x° equals 1.5. This means the tangent of angle x is 1.5."

Phase 2: Structured Instruction (10 minutes)

Formalizing the Tangent Ratio (5 minutes)

[SAY] "Now that you have discovered the tangent ratio through your investigation, let us formalize this concept."

[WRITE] On the board: "Key Takeaways"

[SAY] "First, the triangles OPA, OQB, and ORC are similar. This means that the ratios of their corresponding sides are equal."

[WRITE] "PA/OA = QB/OB = RC/OC = 15/10 = 1.5"

[SAY] "Second, for any line parallel to BQ, the ratio of vertical distance to horizontal distance remains the same in each triangle. In this case, the ratio is 1.5."

[SAY] "Third, this constant ratio, Vertical distance divided by Horizontal distance, is called the tangent of the angle."

[WRITE] "tan x° = Vertical distance / Horizontal distance"

[SAY] "Fourth, the tangent of an angle depends only on the size of the angle, not on the triangle size."

[ASK] "If I made the triangle bigger, would the tangent change?"

[WAIT] Expected: "No!" "The tangent stays the same."

[SAY] "Correct! The tangent is a property of the angle, not the triangle."

Formal Definition of Tangent (5 minutes)

[DO] Draw a right-angled triangle ABC on the board with angle θ at vertex B.

[SAY] "Let us look at a right-angled triangle ABC, where angle ABC equals θ."

[WRITE] Label the sides: AC (opposite), AB (adjacent), BC (hypotenuse)

[SAY] "The side AC is the vertical side, which is opposite to angle θ."

[SAY] "The side AB is the horizontal side, which is adjacent to angle θ."

[SAY] "The side BC is the hypotenuse, which is the longest side of the right-angled triangle."

[SAY] "In this case, the tangent of angle θ is defined as the ratio of the opposite side to the adjacent side."

[WRITE] On the board in a box: "tan θ = Opposite side / Adjacent side = AC / AB"

[SAY] "This is the formal definition of tangent. Remember: tangent equals opposite over adjacent."

[ASK] "Which two sides do we use for tangent?"

[WAIT] Expected: "Opposite and adjacent."

[SAY] "Correct! We never use the hypotenuse for tangent."

Addressing Misconceptions:

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

[SAY] "Mistake 1: Thinking tangent is just any ratio in a triangle. No! Tangent is specifically the ratio of the opposite side to the adjacent side in a right-angled triangle."

[SAY] "Mistake 2: Thinking the tangent changes if I make the triangle bigger. No! The tangent depends only on the angle. Similar triangles have the same tangent value."

[SAY] "Mistake 3: Using any two sides. No! You must identify which side is opposite the angle and which is adjacent. The hypotenuse is never used in the tangent ratio."

[ASK] "Does everyone understand the definition of tangent?"

[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: Find the tangent of the indicated angle using the given measurements."

[WRITE] "Given: Opposite side = 3 cm, Adjacent side = 4 cm"

[ASK] "What formula do we use to find tangent?"

[WAIT] Expected: "tan θ = Opposite / Adjacent"

[SAY] "Correct! Let us substitute the values."

[WRITE] Step by step:

tan θ = Opposite / Adjacent

tan θ = 3 cm / 4 cm

tan θ = 3/4

$\tan\theta = 0.75$

[SAY] "Therefore, $\tan\theta = 0.75$"

[ASK] "Does everyone understand this example?"

[WAIT] Check for understanding.

Worked Example 2 (4 minutes)

[SAY] "Let us try a more challenging example where we need to find the missing side first."

[WRITE] "Example 2: Find the tangent in the indicated angle."

[WRITE] "Given: Hypotenuse = 5 cm, Base = 3 cm"

[ASK] "What do we need to find first?"

[WAIT] Expected: "The perpendicular height." "The opposite side."

[SAY] "Correct! We use the Pythagorean theorem."

[WRITE] Step 1: Calculate the perpendicular height

$H^2 = b^2 + h^2$

$h^2 = H^2 - b^2 = 5^2 - 3^2 = 25 - 9 = 16$

$h = 4$ cm

[SAY] "Now we can find $\tan\theta$."

[WRITE] Step 2: Finding $\tan\theta$

Opposite side = 3 cm, Adjacent side = 4 cm

$\tan\theta = 3/4 = 0.75$

[SAY] "We can also find $\tan\alpha$."

[WRITE] Step 3: Finding $\tan\alpha$

Opposite side = 4 cm, Adjacent side = 3 cm

$\tan\alpha = 4/3 = 1.333$

[SAY] "Notice that $\tan\theta$ and $\tan\alpha$ are different because they are different angles."

Worked Example 3: Real-World Application (3 minutes)

[SAY] "Let us see how tangent is used in real life."

[WRITE] "Example 3: Flag Pole Problem"

[WRITE] "The inclination of the observer line of sight to the top of a 10 m high flag pole, positioned 15 m away, can be determined using a scale drawing."

[ASK] "What do we call the angle represented by x?"

[WAIT] Expected: "Angle of elevation."

[SAY] "Correct! The angle of elevation is the angle between the horizontal and the line of sight when looking up."

[ASK] "How do we express tan α in terms of the sides of the triangle?"

[WAIT] Expected: "tan α = Opposite / Adjacent"

[SAY] "Correct! Let us calculate it."

[WRITE] Solution:

Opposite side (height of flag pole) = 10 m

Adjacent side (distance from observer) = 15 m

$\tan \alpha = 10 / 15 = 2/3 \approx 0.667$

[SAY] "So the tangent of the angle of elevation is approximately 0.667."

[SAY] "This is how engineers and surveyors use tangent ratios in real life."

Phase 4: Assessment (5 minutes)

Exit Ticket

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

[DO] Distribute exit ticket or display questions on the board.

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

Exit Ticket Questions:

1. Define the tangent of an angle in a right-angled triangle.

2. In a right-angled triangle, the opposite side is 6 cm and the adjacent side is 8 cm. Find tan θ.

3. If tan α = 1.5, and the adjacent side is 10 cm, what is the length of the opposite side?

Answer Key:

1. The tangent of an angle θ in a right-angled triangle is the ratio of the opposite side to the adjacent side: tan θ = Opposite / Adjacent

2. tan θ = 6/8 = 3/4 = 0.75

3. tan α = Opposite / Adjacent → 1.5 = Opposite / 10 → Opposite = 1.5 × 10 = 15 cm

Differentiation Notes

For Struggling Learners:

- Provide pre-drawn diagrams with labeled sides.
- Use color-coding: opposite side in red, adjacent side in blue.
- Start with simple whole-number ratios before moving to decimals.
- Provide a tangent ratio reference card.

For Advanced Learners:

- Challenge students to find the angle when given the tangent value.
- Explore the relationship between tangent and sine/cosine.
- Investigate what happens to tangent as the angle approaches 90°.

Post-Lesson Reflection Prompts

- Did students successfully discover the constant ratio in the anchor activity?
- Were students able to identify opposite and adjacent sides correctly?
- What misconceptions emerged during the lesson, and how were they addressed?
- Did the real-world examples help students see the relevance of tangent ratios?
- What adjustments would improve this lesson for future classes?