Grade 10 Mathematics Presentation Script

Sines and Cosines of Acute Angles

Pre-Class Preparation

Materials Checklist:

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

Room Setup:

- Arrange desks for group work (3-4 students per group)
- 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.

[SAY] "Yesterday we learned about tangent, which uses the opposite and adjacent sides. Today, we will discover two more trigonometric ratios that involve the hypotenuse."

[ASK] "What is the longest side of a right-angled triangle called?"

[WAIT] Expected: "The hypotenuse."

[SAY] "Correct! Today we will discover how the hypotenuse is used in trigonometry. These ratios are called sine and cosine, and they are used in many real-world applications like navigation, engineering, and physics."

[SAY] "Let us discover these powerful tools together."

Anchor Activity Launch (3 minutes)

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

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

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

[SAY] "Step 1: The figure shows AP, BQ, and CR perpendicular to OV and angle TOV = θ (show Figure 2.4.12 on the board)."

[SAY] "Step 2: Copy the above figure in your writing materials."

[SAY] "Step 3: Measure lengths OA, OP, AP, OQ, OB, BQ, OR, OC and CR."

[SAY] "Step 4: Fill in the following: (i) AP/OP = ____, (ii) BQ/OQ = ____, (iii) CR/OR = ____"

[SAY] "Step 5: What do you notice about the ratios of (i...iii)?"

[SAY] "Step 6: Fill also the following: (i) OA/OP = ____, (ii) OB/OQ = ____, (iii) OC/OR = ____"

[SAY] "Step 7: What do you notice about these ratios above?"

[SAY] "Step 8: Discuss your findings with other groups in your class."

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

Student Work Time (8 minutes)

[DO] Circulate among groups.

[ASK] To a group drawing the diagram: "Are you drawing the perpendicular lines carefully? They need to be perpendicular to OV."

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

[SAY] "Use your protractor to make sure the lines form 90° angles with OV."

[ASK] To another group measuring sides: "Are you recording all nine measurements?"

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

[SAY] "Good! Now calculate the first three ratios: AP/OP, BQ/OQ, and CR/OR."

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

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

[SAY] "Excellent! Now calculate the second three ratios: OA/OP, OB/OQ, and OC/OR. What do you notice?"

[WAIT] Expected: "These are also the same!"

[SAY] "Very good! You have discovered two important constant ratios."

[DO] For struggling groups: "Focus on triangle OPA first. Measure AP (the perpendicular side) and OP (the hypotenuse). Now divide AP by OP. What do you get?"

[DO] For early finishers: "Can you identify which sides are opposite the angle, which are adjacent, and which are the hypotenuse in each triangle?"

Class Discussion (2 minutes)

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

[ASK] "What did you discover about the first three ratios: AP/OP, BQ/OQ, and CR/OR?"

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

[SAY] "Yes! These ratios are all equal. This is because the three triangles are similar."

[ASK] "What about the second three ratios: OA/OP, OB/OQ, and OC/OR?"

[WAIT] Expected: "These are also all the same."

[SAY] "Exactly! You have discovered two constant ratios. The first ratio uses the opposite side and the hypotenuse. The second ratio uses the adjacent side and the hypotenuse."

[SAY] "These two ratios have special names: sine and cosine."

Phase 2: Structured Instruction (10 minutes)

Formalizing Sine and Cosine (5 minutes)

[SAY] "Now that you have discovered the sine and cosine ratios through your investigation, let us formalize these concepts."

[WRITE] On the board: "Key Takeaways"

[SAY] "First, the ratios of (3) are the same and is expressed as: AP/OP = BQ/OQ = CR/OR"

[SAY] "This constant value is obtained by taking the ratio of the side opposite to the angle θ to the hypotenuse side in each case."

[SAY] "This ratio is called the sine of angle θ, which can be written as $\sin \theta$."

[WRITE] "$\sin \theta$ = Opposite / Hypotenuse"

[SAY] "Second, the ratios of (5) are the same and is expressed as: $OA/OP = OB/OQ = OC/OR$"

[SAY] "This constant value is obtained by taking the ratio of the side adjacent to the angle θ to the hypotenuse side in each case."

[SAY] "This ratio is called the cosine of angle θ, which can be written as $\cos \theta$."

[WRITE] "$\cos \theta$ = Adjacent / Hypotenuse"

[ASK] "What is the difference between sine and cosine?"

[WAIT] Expected: "Sine uses opposite and hypotenuse. Cosine uses adjacent and hypotenuse."

[SAY] "Correct! Both use the hypotenuse, but sine uses the opposite side and cosine uses the adjacent side."

Summary of All Three Trigonometric Ratios (5 minutes)

[SAY] "Now we have learned all three trigonometric ratios. Let us summarize them."

[WRITE] On the board in a table:

Trigonometric Ratio	Formula
$\tan \theta$	Opposite / Adjacent
$\cos \theta$	Adjacent / Hypotenuse
$\sin \theta$	Opposite / Hypotenuse

[SAY] "Notice that each ratio uses two different sides of the triangle."

[SAY] "Tangent uses opposite and adjacent. Cosine uses adjacent and hypotenuse. Sine uses opposite and hypotenuse."

[SAY] "The above formulas also apply to the trigonometric ratios for α."

[ASK] "Which two ratios use the hypotenuse?"

[WAIT] Expected: "Sine and cosine."

[SAY] "Correct! Sine and cosine both use the hypotenuse."

Addressing Misconceptions:

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

[SAY] "Mistake 1: Thinking sine and cosine are the same thing. No! Sine uses opposite and hypotenuse, while cosine uses adjacent and hypotenuse."

[SAY] "Mistake 2: Using any two sides for sine or cosine. No! Sine always uses opposite and hypotenuse. Cosine always uses adjacent and hypotenuse."

[SAY] "Mistake 3: Thinking the values change if I make the triangle bigger. No! Sine and cosine depend only on the angle. Similar triangles have the same sine and cosine values."

[SAY] "Mistake 4: Thinking sine and cosine can be greater than 1. No! Since the hypotenuse is always the longest side, sine and cosine values range from 0 to 1."

[ASK] "Does everyone understand the definitions of sine and cosine?"

[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: In the figure, MN = 5 cm, NO = 12 cm and angle MNO = 90°. Calculate: a) sin θ, b) cos θ"

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

[WAIT] Expected: "The hypotenuse." "MO."

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

[WRITE] "$MO^2 = 12^2 + 5^2 = 144 + 25 = 169$"

[WRITE] "MO = 13 cm"

[SAY] "Now we can find sin θ."

[ASK] "What formula do we use for sine?"

[WAIT] Expected: "sin θ = Opposite / Hypotenuse"

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

[WRITE] "$\sin\theta = MN/MO = 5/13 = 0.3846$"

[SAY] "Now let us find $\cos\theta$."

[ASK] "What formula do we use for cosine?"

[WAIT] Expected: "$\cos\theta$ = Adjacent / Hypotenuse"

[WRITE] "$\cos\theta = NO/MO = 12/13 = 0.9231$"

[SAY] "Notice that sine and cosine are different because they use different sides."

Worked Example 2: Real-World Application (4 minutes)

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

[WRITE] "Example 2: A ladder leans against a wall, forming a 70° angle with the ground. If the ladder is 5 meters long, how high does it reach on the wall?"

[ASK] "What do we know?"

[WAIT] Expected: "The angle is 70°. The ladder is 5 meters long."

[SAY] "Correct! The ladder is the hypotenuse. We need to find the height, which is the opposite side."

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

[WAIT] Expected: "Sine!"

[SAY] "Correct! We use sine because we have the hypotenuse and we need the opposite side."

[WRITE] "$\sin 70° = \text{height}/\text{hypotenuse}$"

[WRITE] "$0.9397 = \text{height}/5$"

[WRITE] "$\text{height} = 5 \times 0.9397 = 4.6985$ m"

[SAY] "The ladder reaches 4.6985 m up the wall."

[SAY] "This is how engineers and builders use sine in real life."

Worked Example 3: Quick Practice (3 minutes)

[SAY] "Let us try one more example quickly."

[WRITE] "Example 3: In the figure given, find: a) sin α, b) cos α"

[ASK] "What is sin α?"

[WAIT] Expected: "Opposite / Hypotenuse = 3/5 = 0.6"

[SAY] "Correct!"

[ASK] "What is cos α?"

[WAIT] Expected: "Adjacent / Hypotenuse = 4/5 = 0.8"

[SAY] "Excellent! You are getting the hang of this."

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. In the figure given, find: a) sin α, b) cos α

2. A flagpole 12 meters tall casts a shadow of 8 meters on the ground. a) What is the angle of elevation of the sun? b) If the shadow increases to 10 meters, what will be the new angle of elevation?

3. An airplane takes off at an angle of 18° to the ground. After flying 500 meters, a) How high is the airplane above the ground? b) How far has it traveled horizontally from the starting point?

Answer Key:

1. a) sin α = 0.6, b) cos α = 0.8

2. a) The angle of elevation of the sun is 56.31°, b) The new angle of elevation is 50.19°

3. a) height = 154.51 m, b) horizontal distance = 475.53 m

Differentiation Notes

For Struggling Learners:

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

For Advanced Learners:

- Challenge students to find the angle when given the sine or cosine value.
- Explore the relationship: $\tan \theta = \sin \theta / \cos \theta$.
- Investigate complementary angles: $\sin \theta = \cos(90° - \theta)$.

Post-Lesson Reflection Prompts

- Did students successfully discover the two constant ratios in the anchor activity?
- Were students able to distinguish between sine and cosine?
- What misconceptions emerged during the lesson, and how were they addressed?
- Did the real-world examples help students see the relevance of sine and cosine?
- What adjustments would improve this lesson for future classes?