Grade 10 Mathematics Lesson Plan

Trigonometry Using Tables and Calculators

Strand:	**Measurement and Geometry**
Sub-Strand:	Determining Trigonometric Ratios Using a Calculator
Specific Learning Outcome:	Determine the trigonometric ratios of acute angles from mathematical tables and calculators
Duration:	40 minutes
Key Inquiry Questions:	What is trigonometry? How do we use trigonometry in real-life situations?
Learning Resources:	CBC Grade 10 textbooks, scientific calculators, worksheets with tables

Lesson Structure Overview

Phase	Duration	Focus
Problem-Solving and Discovery	15 minutes	Anchor activity: Exploring trigonometric ratios using calculators
Structured Instruction	10 minutes	Formalizing calculator usage and degree mode
Practice and Application	10 minutes	Worked examples and guided practice
Assessment	5 minutes	Exit ticket to check understanding

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

Anchor Activity: Exploring Trigonometric Ratios Using Calculators

Students work in pairs to use scientific calculators to find sine, cosine, and tangent values for various angles, record them in a table, and observe patterns in how these values change as angles increase.

Materials Required:

- Scientific calculators or any other calculator having sin, cos and tan buttons
- Protractor and ruler (for optional verification with a drawn triangle)
- Worksheet with a table

Instructions for Students:

1. Turn on your scientific calculator.
2. Ensure your calculator is set to degree mode (not radians).
3. For each given angle (0°, 25°, 30°, 45°, 60°, 75°, 90°), do the following: Press the sin button followed by the angle, then note the value. Press the cos button followed by the angle, then note the value. Press the tan button followed by the angle, then note the value.
4. Record all values in the table below. Use a calculator to find the sine, cosine, and tangent of the given angles, and fill in the table.
5. Observe and Answer: Observe the values of sin in your table. Do they increase or decrease? Compare the cosine values for different angles. Why does tan 90° display a syntax error?
6. Discuss your work with other learners.

Recording Table for Student Observations:

Angle (°)	sin	cos	tan
0°	___	___	___
25°	___	___	___
30°	___	___	___
45°	___	___	___
60°	___	___	___
75°	___	___	___
90°	___	___	___

Teacher Role During Discovery:

- Circulate among pairs, ensuring students have set their calculators to degree mode (DEG).
- Ask probing questions: "What do you notice about the sine values as the angle increases?" "What about the cosine values?" "Why do you think tan 90° gives an error?"
- For struggling pairs: "Let us start with 30°. Press the sin button, then 30, then equals. What do you get? Now try cos 30°."
- For early finishers: "Can you find any patterns between sine and cosine values? Look at sin 30° and cos 60°. What do you notice?"
- Guide students to articulate: "Sine values increase from 0 to 1 as angles go from 0° to 90°. Cosine values decrease from 1 to 0. Tangent values increase rapidly and are undefined at 90°."
- Identify 2-3 pairs with clear observations to share with the class.

Discovery Table: Linking Observations to Mathematical Significance

Student Observation	Mathematical Significance
Sine values increase from 0 to 1 as angles increase from 0° to 90°	$\sin 0° = 0$, $\sin 90° = 1$; sine is an increasing function
Cosine values decrease from 1 to 0 as angles increase from 0° to 90°	$\cos 0° = 1$, $\cos 90° = 0$; cosine is a decreasing function
Tangent values increase rapidly and tan 90° gives an error	$\tan 90°$ is undefined because it involves division by zero
sin 30° = cos 60° and sin 60° = cos 30°	Complementary angles: $\sin \theta = \cos(90° - \theta)$
Calculators give the same values for the same angles	Trigonometric ratios are constant for a given angle

Phase 2: Structured Instruction (10 minutes)

Connecting Student Discoveries to Formal Concepts

After students have completed the anchor activity and shared their findings, the teacher formalizes the process of using calculators to find trigonometric ratios.

Key Takeaways:

When given an acute angle, a calculator can be used to determine these ratios accurately.

How to Determine Trigonometric Ratios Using a Calculator:

7. Ensure the calculator is in degree mode. Press the "MODE" button and select "DEG" (if using a scientific calculator).
8. Enter the angle value. For example, to find sin 30°, type: Press sin → Press 30 → Press =. The calculator should display 0.5 or some calculator will display 1/2.

Important Notes:

- Always check that your calculator is in degree mode (DEG), not radian mode (RAD).
- Round your answers to the required number of decimal places (usually 4 decimal places).
- $\tan 90°$ is undefined because it would require division by zero.
- Complementary angles have a special relationship: $\sin \theta = \cos(90° - \theta)$.

Scaffolding Strategies to Address Misconceptions:

- Misconception: "My calculator is giving different answers." → Clarification: "Check if your calculator is in degree mode (DEG), not radian mode (RAD)."
- Misconception: "tan 90° should have a value." → Clarification: "No, tan 90° is undefined because it involves dividing by zero. The calculator shows an error."
- Misconception: "I can just memorize all the values." → Clarification: "You do not need to memorize all values. Learn how to use the calculator efficiently."
- Misconception: "Sine and cosine can be greater than 1." → Clarification: "No, sine and cosine values always range from 0 to 1 for acute angles."

Phase 3: Practice and Application (10 minutes)

Worked Examples:

Example 1: Finding Trigonometric Ratios for 40° (Textbook Example 2.4.29)

Use calculator to find the following (write your answer to 4 decimal places):

sin 40°, cos 40°, tan 40°

Solution:

Ensure the calculator is in degree mode

1. sin 40°

   Press sin → Press 40 → Press =

   sin 40° = 0.6428

2. cos 40°

   Press cos → Press 40 → Press =

   cos 40° = 0.7660

3. tan 40°

   Press tan → Press 40 → Press =

   tan 40° = 0.8391

Example 2: Finding Trigonometric Ratios for 25° (Textbook Example 2.4.30)

Find sin 25°, cos 25°, tan 25° using calculator.

Solution:

sin 25°

Press sin → Press 25 → Press =

sin 25° = 0.4226

cos 25°

Press cos → Press 25 → Press =

cos 25° = 0.9063

tan 25°

Press tan → Press 25 → Press =

tan 25° = 0.4663

Phase 4: Assessment (5 minutes)

Exit Ticket:

Students complete the following questions individually using their calculators.

Use a calculator to determine the following trigonometric ratios:

1. Find sin 35°, cos 35°, tan 35°

2. Find sin 50°, cos 50°, tan 50°

3. Find sin 15°, cos 15°, tan 15°

4. Find sin 75°, cos 75°, tan 75°

Answer Key:

1. sin 35° = 0.574, cos 35° = 0.8192, tan 35° = 0.7002

2. sin 50° = 0.7660, cos 50° = 0.6428, tan 50° = 1.1918

3. sin 15° = 0.2588, cos 15° = 0.9659, tan 15° = 0.2679

4. sin 75° = 0.9659, cos 75° = 0.2588, tan 75° = 3.7321

Differentiation Strategies

For Struggling Learners:

- Provide step-by-step calculator instruction cards with button sequences.
- Use calculators with larger displays for better visibility.
- Start with special angles (30°, 45°, 60°) before moving to other angles.
- Pair struggling students with confident calculator users.

For On-Level Learners:

- Encourage students to verify their calculator results using trigonometric tables.
- Ask students to explain why certain patterns emerge (e.g., complementary angles).
- Provide mixed practice with different angles.

For Advanced Learners:

- Challenge students to find angles when given trigonometric ratios (inverse functions).
- Explore the relationship between degrees and radians.
- Investigate trigonometric identities using calculator verification.
- Apply calculator skills to solve real-world problems involving angles and distances.

Extension Activity

Verifying Complementary Angle Relationships

Students work in pairs to explore the relationship between sine and cosine of complementary angles.

Materials: Scientific calculators, worksheet

Tasks:

9. Use your calculator to find sin 20° and cos 70°. What do you notice?
10. Use your calculator to find sin 35° and cos 55°. What do you notice?
11. Use your calculator to find sin 40° and cos 50°. What do you notice?
12. Complete the statement: sin θ = cos(___)
13. Explain why this relationship makes sense using what you know about right-angled triangles.
14. Discuss your findings with other learners.

Key Takeaway:

Students should discover that $\sin \theta = \cos(90° - \theta)$. This is called the complementary angle relationship.

Teacher Reflection Prompts

- Did students successfully set their calculators to degree mode?
- Were students able to observe the patterns in sine, cosine, and tangent values?
- What misconceptions emerged during the lesson, and how were they addressed?
- Did students understand why tan 90° is undefined?
- What adjustments would improve this lesson for future classes?