Name: …………………………………   Date: ………………..

Spatial Reasoning _ Cosine Rule

Investigation Task: The Triangular Race Challenge   Assessment Criterion: D and C

Key concept : Relationships, Change , Form → Related Concept : Pattern, Model and Representation → Global context: Globalization and Sustainability

Inquiry Question

How can mathematics help athletes and planners choose the most efficient route in a race?

Objective: Students will able Students will Model a real-life race route using a triangle, Apply the cosine rule to determine unknown distances, Interpret results in context ,Justify whether a shortcut is realistic and beneficial

Context: In this task, students explore how trigonometry (cosine rule) can be used to model and solve real-life problems in race planning. They investigate how distances and angles determine efficient routes and evaluate whether a shortcut is practical in a competitive race setting.

Tasks:

Find → Identify → Frame a general rule → Verify → Reflect

ATL Skills:

Thinking Skills: Explaining reasoning clearly using mathematical language.

Communication Skills: Explaining mathematical thinking clearly using appropriate language and representations.

Research Skills: Interpreting given data and selecting relevant information..

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Context:

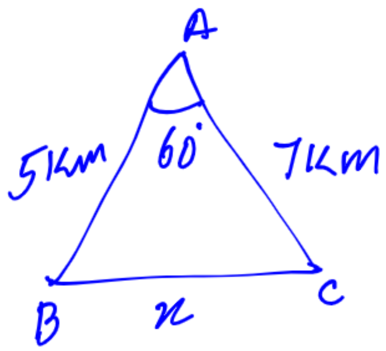
During a charity triathlon, participants must travel between three checkpoints: **A (Start), B, and C (Finish)**.

- The distance from **A to B** is **5 km**.
- The distance from **A to C** is **7 km**.
- The angle between the two paths at point A is **60°**.

However, a new rule allows elite racers to go **directly from B to C** if they know the distance.

You are part of the race planning team and must determine whether this shortcut is realistic.

i. **Sketch** triangle ABC representing the race route.



ii. Apply the **Cosine Rule** to find the direct distance from checkpoint B to C.

cosine rule

$BC^2 = AB^2 + AC^2 - 2(AB)(AC)\cos\hat{A}$

$BC^2 = 5^2 + 7^2 - 2(5)(7)\cos 60°$

$BC^2 = 25 + 49 - 70(0.5)$

$BC^2 = 39$

iii. **Calculate** the distance BC. Round your answer to **2 decimal places**.

$BC = \sqrt{39}$

$BC \approx 6.24$ Km

iv. **Explain** clearly why the Cosine Rule is the correct method to use in this situation.(Think: What information is given? Why not Pythagoras?)

Cosine rule is appropriate because
Two sides and the included angle are given
Pythagoras rule can't be used because
the triangle is not right angled.

v. The organizers claim that the shortcut saves distance and time. **Compare** the original route (A → B → C) with the shortcut (B → C).Does your answer support their claim? Does the result make sense in a real race context? **Explain** your reasoning.

Original route $A \to B \to C = 5 + 7 = 12$ Km

Short cut $B \to C = 6.24$ Km

Distance saved $12 - 6.24 = 5.76$ Km

In a race, a shorter distance saves time and energy, so elite racers would benefit from this route.

Curriculum framework

Key Concepts

1. Relationships: Understanding how distances and angles are connected in a triangle and how changing one affects others.

2. Logic: Using mathematical reasoning to select formulas and justify conclusions.

3. Model: Representing a real-life race situation as a mathematical triangle.

Related Concepts

1. Measurement: Quantifying distances and angles accurately.

2. Representation: Displaying information through diagrams, symbols, and formulas.

3. Space: Understanding the geometric arrangement of routes in a physical space**.**

Global Contexts

1. **Globalization and Sustainability**
   considering efficient routes to save time and energy in events.
2. **Scientific and Technical Innovation**
   Exploring how mathematics improves planning and efficiency.
3. **Identities and Relationships**
   how individuals (racers) make decisions to improve performance.

Statements of Inquiry (SOI)

1. **SOI 1:**
   Logical thinking and models help people design efficient routes and make better decisions.
2. **SOI 2:**
   Careful planning can reduce effort, time, and wasted energy..
3. **SOI 3:**
   Decisions based on reasoning can improve performance in competitive situations.

GRASPS Framework – Dock Alignment at a Port

G — Goal

To determine whether a direct shortcut between race checkpoints is shorter and worth including in the race.

R — Role

You are a race route planner responsible for advising organizers on the best route.

A — Audience

Race organizers and athletes who need reliable route information.

S — Situation

A race route connects three checkpoints. The organizers are considering allowing runners to take a direct shortcut but need evidence that it is beneficial.

P — Product / Performance

- A solution that includes:
- A labeled triangle diagram
- Clear calculations
- A written explanation justifying if the shortcut makes sense

S — Success Criteria

- Success will be judged by:
- Correct diagram and method
- Accurate calculations
- Clear explanation
- Logical justification in the race context
- Meeting MYP Criterion C & D expectations