Name: …… Date: ……..

Spatial Reasoning _ Sine Rule

Investigation Task: Road Safety Assessment Criterion: D and C

Key concept : Relationships, Change , Form	Related Concept : Pattern, Model and Representation	Global context: Scientific and Technical Innovation

Inquiry Question

How can understanding relationships and measurements help improve safety in shared environments?

Objective: Students to apply the Sine Rule to a real-life road safety scenario to determine unknown distances. Through this investigation, students develop problem-solving and reasoning skills by selecting appropriate strategies, performing accurate calculations, and interpreting results in context. They also learn to justify the accuracy and reasonableness of their solutions while communicating their mathematical thinking clearly.

Context: In this investigation, students act as road safety engineers who must determine distances between traffic cameras and a pedestrian crossing. Using given angle measurements and the distance between cameras, students model the situation as a triangle and apply the Sine Rule to find unknown distances. They then interpret their results in the context of road safety and monitoring.

Command Terms:

Solve	Identify	Find	Verify	Justify

ATL Skills:

Thinking Skills: Analyzing information, selecting appropriate methods, and evaluating the reasonableness of results..

Transfer Skills: Applying knowledge and skills learned in one context to new and real-life situations.

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

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Spatial Reasoning _ Sine Rule

Investigation Task: Road Safety Assessment Criterion: D and C

Context:

Two traffic safety cameras A and B are placed 60 m apart along a straight road. Both focus on the same pedestrian crossing point P on the opposite side of the road.

- Angle from Camera A to P = 48°
- Angle from Camera B to P = 67°
- Triangle formed is △ABP

a) **Identify** the known and unknown values in triangle ABP and state which trigonometric rule is suitable.

Known values
$AB = 60m$
$\angle A = 48°$
$\angle B = 67°$

unknown values
AP (distance from camera A to P)
BP (distance from camera B to P)

Sine rule, because we know two angles & one side.

b) **Find** the distance from Camera A to crossing point P using the Sine Rule.

$\angle P = 180° - (48+67°) = 65°$

Apply Sine rule:

$$\frac{AP}{\sin 67°} = \frac{60}{\sin 65°}$$

$$AP = \frac{60 \times \sin 67°}{\sin 65°}$$

$$AP \approx 60.9cm$$

Distance from Camera A $\approx$ 60.9cm

c) **Find** the distance from Camera B to crossing point P.

$$\frac{BP}{\sin 48^\circ} = \frac{60}{\sin 65^\circ}$$

$$BP = \frac{60 \times \sin 48^\circ}{\sin 65^\circ}$$

$$BP \approx 49.2\text{cm}$$

Distance from Camera B $\approx$ 49.2 cm

d) **Solve and justify the degree of accuracy:**

If angle measurements may have an error of ±1°, explain how this affects your calculated distances.

if angles have an error $\pm 1^\circ$

Let us take example

if 48° become 49°

$$BP = \frac{60 \times \sin 49^\circ}{\sin 64^\circ} \approx 50.4\text{m}$$

Difference $\approx$ 1.2m

Small angle errors cause small distant changes (about 1-2m)

Results are reasonably accurate to nearest meter.

e) **Justify whether your solution makes sense in the context of road safety.**

Are these distances reasonable for monitoring a pedestrian crossing? Explain.

Distances of 49–61 m are realistic for road camera monitoring cameras placed tens of meters away can clearly observe crossings. The values are practical and make sense for road safety planning.

Curriculum framework

Key Concepts

1. **Relationships:**

   Understanding how quantities (angles and sides) are connected. In this task, the relationship between angles and sides in a triangle helps find unknown distances.

2. **Logic:**

   Using clear reasoning and mathematical rules to reach conclusions. Students logically apply the Sine Rule to solve a real-life problem.

3. **Measure:**

   Determining lengths, distances, and angles using appropriate tools. Students measure and calculate road distances and angles for safety.

Related Concepts

1. Model:

A mathematical representation of a real-world situation. The triangle formed by cameras and crossing point is a model.

2. Generalization

Applying a rule that works in many situations. The Sine Rule works for any triangle with known angle–side data.

3. Quantity

Numerical values used in mathematics. Distances (meters) and angles (degrees) are quantities here.

Global Contexts

1. Scientific and Technical Innovation

Exploring how math improves systems and safety. Trigonometry helps design safe road monitoring systems.

2. Globalization and Sustainability

Understanding how systems impact communities. Safe road design supports sustainable and safe cities.

3. Identities and Relationships

Understanding human interaction with environments. Road safety protects pedestrians and drivers

Statements of Inquiry (SOI)

1. **SOI 1:**
   Understanding relationships and models helps improve systems that protect people in shared environments.
2. **SOI 2:**
   Using logical thinking and generalizations can support safer and more sustainable communities..
3. **SOI 3:**
   Measurement and understanding quantities influence how people safely interact in shared spaces.

GRASPS – Road Safety Investigation (Sine Rule)

G – Goal

To determine safe distances for monitoring a pedestrian crossing by calculating unknown distances using given measurements.

R – Role

You are a **road safety engineer** responsible for advising where monitoring cameras should be placed.

A – Audience

Your report is for the **local road safety committee** and school community.

S – Situation

Two safety cameras are placed along a road and focused on a pedestrian crossing. The committee needs accurate distance information to ensure the crossing is properly monitored and safe for pedestrians.

P – Product/Performance

You will create:
A labeled triangle diagram, Clear calculations, Final distance results, A short explanation of how your findings support road safety

S – Success Criteria

Your work will be successful if you: Correctly identify known and unknown values, Apply the Sine Rule correctly, Show clear working steps, Use correct units and rounding, Explain why your solution is reasonable for road safety