

Grade 10 Mathematics Lesson Plan

Relative Speeds of Objects Moving in Different Directions

Strand:	Measurement and Geometry
Sub-Strand:	Linear Motion
Specific Learning Outcome:	Determine relative speed of two moving bodies in different situations
Duration:	40 minutes
Key Inquiry Question:	How is Linear Motion applied in day-to-day life?
Learning Resources:	CBC Grade 10 textbooks, toy car, string, stopwatch, measuring tape, calculators

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

Anchor Activity: Toy Car Race Toward Each Other

Objective: Students discover that when two objects move toward each other, their relative speed is the sum of their individual speeds.

Materials needed: Toy car (pulled by string), string, stopwatch, measuring tape (10 meters), pen and paper, observers.

Steps for the activity:

1. Find a straight pathway (hallway, classroom floor, corridor, or field).
2. Measure and mark a 10-meter distance with clear starting points at opposite ends.
3. Attach string securely to the toy car.
4. Assign two participants: one student (walker) and one toy car (pulled by string).
5. Assign observers to track the race and measure times.
6. Place the student on one marked end and the toy car on the other end (opposite ends).
7. On "Go!", student walks toward the toy car, and toy car is pulled toward the student simultaneously.
8. Observers start stopwatch when both begin moving and stop when they meet.
9. Record the time it takes for them to meet.
10. Measure the distance each participant traveled before meeting.
11. Calculate individual speeds using $\text{Speed} = \text{Distance} / \text{Time}$.
12. Calculate relative speed = Speed of Toy Car + Speed of Student.
13. Compare findings with other groups.

Discussion questions:

- Who moved faster? Was the student walking faster or slower than the toy car?
- Why might one object have moved faster than the other?
- What is the relative speed? How does the speed of each participant relate to the other?
- Did they move away from each other, or did they move closer together?
- How does this differ from when they moved in the same direction?

Extension: Repeat the race with different conditions (student walks faster/slower, change race length, adjust toy car speed).

Phase 2: Structured Instruction (10 minutes)

Key Takeaways

Definition: When two objects move toward each other (in different directions), their relative speed is the sum of their individual speeds.

Formula for Different Directions: When two bodies move toward each other, their relative speed is the sum of the individual speeds.

$$\text{Relative Speed} = \text{Speed of Object 1} + \text{Speed of Object 2}$$

Why Add Speeds? When objects move toward each other, they close the gap between them faster than if only one were moving. The combined effect is captured by adding their speeds.

Time to Meet: $\text{Time} = \text{Distance} / \text{Relative Speed}$

Key Insight: Objects moving toward each other will meet faster than objects moving in the same direction.

Comparison:

- Same direction: $\text{Relative Speed} = \text{Faster Speed} - \text{Slower Speed}$
- Different directions (toward each other): $\text{Relative Speed} = \text{Speed 1} + \text{Speed 2}$

Phase 3: Practice and Application (10 minutes)

Worked Examples from Textbook

Example 2.10.12: A train left town X at 10:00 AM and traveled towards town Y at a speed of 90 km/h. A second train left town Y at 11:00 AM and traveled towards town X at 120 km/h. The distance between town X and town Y is 360 km.

Questions:

- At what time will the two trains meet?
- How far from town X will they meet?

Solution:

- Step 1: Calculate how far the first train traveled before the second train started (1 hour at 90 km/h = 90 km).
- Step 2: Remaining distance between trains when second train starts = 360 km - 90 km = 270 km.
- Step 3: Relative speed = 90 km/h + 120 km/h = 210 km/h.
- Step 4: Time to meet = 270 km / 210 km/h = 1.29 hours \approx 1 hour 17 minutes.
- Step 5: They meet at 11:00 AM + 1 hour 17 minutes = 12:17 PM.
- Step 6: Distance from town X = 90 km + (90 km/h \times 1.29 hours) = 90 km + 116 km = 206 km.

Example 2.10.13: Two cyclists start from the same point and travel in opposite directions. One cyclist rides at 20 km/h, and the other rides at 30 km/h. After 2 hours, they are 100 km apart.

Questions:

- a) How long did it take for the cyclists to be 100 km apart?
- b) How far did each cyclist travel?

Solution:

- Step 1: Relative speed = 20 km/h + 30 km/h = 50 km/h.
- Step 2: Time to be 100 km apart = 100 km / 50 km/h = 2 hours.
- Step 3: Distance traveled by first cyclist = 20 km/h \times 2 hours = 40 km.
- Step 4: Distance traveled by second cyclist = 30 km/h \times 2 hours = 60 km.
- Step 5: Total distance = 40 km + 60 km = 100 km (verified).

Phase 4: Assessment (5 minutes)

Exit Ticket

1. A motorist left Nakuru for Nairobi, a distance of 240 km, at 8:00 AM and traveled at an average speed of 90 km/h. Another motorist left Nairobi for Nakuru at 8:30 AM and traveled at 100 km/h. Find: (a) The time they met. (b) How far from Nairobi they met.
2. A cyclist is riding towards a motorcyclist on a straight road. The cyclist travels at 15 km/h and the motorcyclist at 45 km/h. If they are initially 100 meters apart, how long will it take for them to meet?
3. Two matatus start from opposite ends of a 400 km road at the same time. One travels at 60 km/h and the other at 80 km/h. When will they meet and how far from each starting point?

Differentiation Strategies

For Struggling Learners:

- Provide step-by-step calculation sheets with formulas already written.

- Use visual aids showing objects moving toward each other with arrows.
- Allow use of calculators for conversions and calculations.
- Pair with peer tutors during practice.
- Create a comparison chart: Same Direction vs Different Directions.

For Advanced Students:

- Solve problems involving three objects moving in different directions.
- Calculate meeting times with different starting times.
- Explore real-world applications: trains, aircraft, ships.
- Create their own relative speed problems for classmates to solve.
- Investigate what happens when objects start from different positions.

Extension Activity: Train Journey Investigation

Scenario: Two trains are traveling on the same track toward each other. Train A leaves Mombasa at 8:00 AM traveling at 80 km/h toward Nairobi. Train B leaves Nairobi at 9:00 AM traveling at 100 km/h toward Mombasa. The distance between Mombasa and Nairobi is 500 km.

Tasks:

14. Calculate the relative speed of the two trains.
15. Determine at what time the two trains will meet.
16. Find how far from Mombasa they will meet.
17. Create a distance-time graph showing both trains.
18. Explain what would happen if Train B left at 8:00 AM instead of 9:00 AM.