Grade 10 Mathematics Lesson Plan

Relative Speeds of Objects Moving in the Same Direction

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 Experiment

Objective: Students discover the concept of relative speed by racing a toy car against a walking student.

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 and finishing lines.
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 both participants at the starting line.
7. On "Go!", student walks and toy car is pulled simultaneously in the same direction at constant speeds.
8. Observers start stopwatch when both begin moving and stop when either reaches the finish line.
9. Record times for both the student (T_1) and the toy car (T_2).
10. Calculate individual speeds using Speed = Distance / Time.
11. Calculate relative speed = Speed of Toy Car - Speed of Student.
12. 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?

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: Relative speed is how fast one object is moving compared to another object.

Formula for Same Direction: When two bodies move in the same direction at different speeds, their relative speed is the difference between the individual speeds.

$$\textit{Relative Speed = Speed of Faster Object - Speed of Slower Object}$$

Converting Units: To convert km/h to m/s, multiply by 1000/3600 (or divide by 3.6).

Time to Overtake: Time = Distance / Relative Speed

Key Insight: The faster object will eventually overtake the slower one when moving in the same direction.

Phase 3: Practice and Application (10 minutes)

Worked Examples from Textbook

Example 2.10.8: A cyclist is riding at 12 km/h, and a motorcycle is moving at 20 km/h on the same road in the same direction. If the cyclist starts 100 meters ahead of the motorcycle, how long will it take for the motorcycle to overtake the cyclist?

Solution:

- Relative speed = 20 km/h - 12 km/h = 8 km/h
- Convert to m/s: 8 × (1000/3600) = 2.22 m/s
- Time = Distance / Relative Speed = 100m / 2.22 m/s ≈ 45 seconds

Example 2.10.9: A car travels at 60 km/h, and a truck travels at 45 km/h in the same direction. If the car starts 150 meters behind the truck, how long will it take for the car to overtake the truck?

Solution:

- Relative speed = 60 km/h - 45 km/h = 15 km/h
- Convert to m/s: 15 × (1000/3600) = 4.17 m/s
- Time = 150m / 4.17 m/s ≈ 36 seconds

Phase 4: Assessment (5 minutes)

Exit Ticket

1. A cyclist is riding at 18 km/h, and a motorcycle is traveling at 30 km/h on the same road. If the cyclist starts 200 meters ahead, how long will it take for the motorcycle to overtake the cyclist? (Answer: 60 seconds)

2. A toy car is pulled at 5 m/s, while a person walks at 2 m/s along the same path. If the toy car starts 15 meters ahead, how much time will it take for the person to catch up? (Answer: 5 seconds)

3. Two cyclists are riding along the same road. Cyclist A travels at 12 km/h and Cyclist B travels at 15 km/h. If Cyclist B starts 100 meters behind Cyclist A, how long will it take for Cyclist B to overtake Cyclist A? (Answer: 120 seconds)

4. A person walks at 1.5 m/s, and a dog runs at 3 m/s. If the dog starts 10 meters behind the person, how long will it take the dog to catch up? (Answer: 6.67 seconds)

Differentiation Strategies

For Struggling Learners:

- Provide step-by-step calculation sheets with formulas already written.
- Use visual aids showing objects moving in the same direction.
- Allow use of calculators for conversions.
- Pair with peer tutors during practice.

For Advanced Students:

- Solve problems involving three objects moving in the same direction.
- Calculate relative speeds with changing speeds (acceleration).
- Explore real-world applications: highway traffic, race cars, trains.
- Create their own relative speed problems for classmates to solve.

Extension Activity: Highway Traffic Simulation

Scenario: Two cars are traveling on a highway. Car A is traveling at 80 km/h, and Car B is traveling at 100 km/h. Car B is 500 meters behind Car A.

Tasks:

13. Calculate the relative speed of Car B with respect to Car A.
14. Determine how long it will take for Car B to overtake Car A.
15. If the highway is 10 km long, where will Car B overtake Car A?
16. Create a distance-time graph showing both cars.