Grade 10 Mathematics Lesson Plan

Acceleration

Strand:	**Measurement and Geometry**
Sub-Strand:	Linear Motion
Specific Learning Outcome:	Explain the terms distance, displacement, speed, velocity and acceleration in real-life situations; Determine velocity and acceleration in different situations
Duration:	40 minutes
Key Inquiry Question:	How is Vectors 1 applied in day-to-day life?
Learning Resources:	CBC Grade 10 textbooks, calculators, stopwatches, measuring tape, toy cars

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

Anchor Activity: Exploring Velocity and Acceleration

Objective: Students work in groups to define velocity and acceleration, calculate average velocity, and explore the concept of positive and negative acceleration through practical problems.

Work in groups to complete the following tasks:

Task 1: Define the following terms in your own words

- Velocity - What does it mean when we say an object has velocity?
- Acceleration - How is acceleration different from velocity?

Task 2: A car travels 200 meters in 10 seconds. What is its average velocity?

Calculate and show your working. Discuss: What information do we need to find velocity?

Task 3: A car accelerates from 75 km/h to 90 km/h in 10 seconds.

Find its acceleration. What does this tell us about how the car is moving?

Task 4: A vehicle moving at 25 m/s applies brakes and comes to a stop in 5 seconds.

- What is the acceleration of the vehicle?
- Is the acceleration positive or negative? Why?
- What does negative acceleration mean in real life?

Discussion prompts for teachers:

- How did you calculate velocity? What formula did you use?
- What is the difference between speed and velocity?
- When the car is speeding up, what happens to acceleration?
- When the car is slowing down (braking), is acceleration positive or negative?
- Can you think of real-life examples of positive and negative acceleration?

Phase 2: Structured Instruction (10 minutes)

Key Takeaways

1. Velocity

Definition: Velocity is speed in a specified direction OR the rate of change of displacement with time.

Symbol: v (velocity), s (speed)

Formula: v = d/t (where d = distance, t = time)

For constant velocity: s = vt (where s = displacement)

2. Acceleration

Definition: The rate of change of velocity with time.

SI Unit: m/s^2 (meters per second squared)

Formula:

> ***Acceleration = Change in velocity / Time Taken***
>
> ***$a = \Delta v/\Delta t$***

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3. Negative Acceleration

Negative acceleration is called **deceleration** or **retardation**. It occurs when an object is slowing down.

4. Three Equations of Motion (for constant acceleration)

Equation 1: Final velocity = Initial velocity + (acceleration × time)

> ***$v = u + at$***

Where: v = final velocity, u = initial velocity, a = acceleration, t = time

Equation 2: Displacement = (initial velocity × time) + (½ × acceleration × $time^2$)

> ***$s = ut + \frac{1}{2}at^2$***

Where: s = displacement

Equation 3: Final velocity^2 = Initial velocity^2 + (2 × acceleration × displacement)

$$v^2 = u^2 + 2as$$

Phase 3: Practice and Application (15 minutes)

Worked Examples from Textbook

Example 2.10.18: A car starts from rest and accelerates at 2 m/s^2 for 5 seconds. Find its final velocity.

Solution:

- Given: u = 0 (starts from rest), a = 2 m/s^2, t = 5 seconds
- Use equation: v = u + at
- v = 0 + (2 × 5) = 10 m/s
- Final velocity is 10 m/s

Example 2.10.19: A rocket accelerates from rest to 250 m/s in 10 seconds. Calculate the rocket's acceleration.

Solution:

- Given: Initial velocity u = 0 m/s, Final velocity v = 250 m/s, Time t = 10 seconds
- Use formula: a = (v - u) / t
- a = (250 - 0) / 10 = 250 / 10 = 25 m/s^2
- The rocket's acceleration is 25 m/s^2

Example 2.10.20: An object decelerates from 20 m/s to 5 m/s in 3 seconds. What is its acceleration?

Solution:

- Given: Initial velocity u = 20 m/s, Final velocity v = 5 m/s, Time t = 3 seconds
- Use formula: a = (v - u) / t
- a = (5 - 20) / 3 = -15 / 3 = -5 m/s^2
- The object's acceleration is -5 m/s^2
- The negative sign indicates deceleration (slowing down)

Phase 4: Assessment (5 minutes)

Exit Ticket

1. A car's velocity changes from 10 m/s to 30 m/s in 4 seconds. Find its acceleration.

2. A car moves with 8 m/s^2 acceleration for 5 seconds, reaching 40 m/s. Find its initial velocity.

3. A cyclist's speed increases from 5 m/s to 17 m/s over a period of 6 seconds. What is the cyclist's average acceleration?

Differentiation Strategies

For Struggling Learners:

- Provide formula sheets with all three equations of motion clearly displayed.
- Use visual aids showing objects speeding up (positive acceleration) and slowing down (negative acceleration).
- Allow use of calculators for all calculations.
- Break down multi-step problems into smaller, manageable steps.
- Pair with peer tutors during practice.
- Create a table comparing velocity vs acceleration concepts.

For Advanced Students:

- Solve problems involving all three equations of motion.
- Calculate displacement when given acceleration and time.
- Explore real-world applications: rocket launches, car safety (braking distances).
- Create their own acceleration problems for classmates to solve.
- Investigate how acceleration relates to force (preview of Newton's laws).
- Analyze velocity-time graphs to determine acceleration.

Extension Activity: Rocket Launch Investigation

Scenario: A rocket is launched from rest and accelerates uniformly at 15 m/s^2 for 8 seconds. After 8 seconds, the engines shut off and the rocket continues upward with its final velocity.

Tasks:

1. Calculate the final velocity of the rocket after 8 seconds.
2. Calculate the displacement (height) of the rocket after 8 seconds.
3. If the rocket continues upward with constant velocity after the engines shut off, how high will it be after a total of 12 seconds?
4. Create a velocity-time graph showing the rocket's motion for the first 12 seconds.
5. Explain what would happen if the acceleration were doubled to 30 m/s^2.