

# CBC Grade 10 Mathematics Lesson Plan

## Vector and Scalar Quantities

<b>Strand</b>	<b>Measurement and Geometry</b>
<b>Sub-Strand</b>	Vectors 1
<b>Specific Learning Outcome</b>	Distinguish between vector and scalar quantities in different situations and represent vectors using proper notation
<b>Key Inquiry Questions</b>	What is the difference between quantities that need direction and those that do not?
<b>Learning Resources</b>	CBC Grade 10 textbooks, paper, pencils, compass (for directions)
<b>Lesson Duration</b>	40 minutes

### Lesson Structure Overview

Phase	Activity	Duration
Phase 1	Problem-Solving and Discovery (Anchor Activity)	15 minutes
Phase 2	Structured Instruction (Key Takeaways)	10 minutes
Phase 3	Practice and Application (Worked Examples)	15 minutes
Phase 4	Assessment (Exit Ticket)	5 minutes

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

#### Anchor Activity: Emergency Map to Hospital

Work in Groups (2-3 students)

Materials:

- Paper
- Pencils
- Compass (optional, for showing directions)

Scenario:

Imagine it is a normal school day and students are playing football during games time. Suddenly, one student gets injured and needs to be taken to the nearest hospital immediately. A boda boda rider has agreed to help, but he does not know the way.

Tasks:

1. (a) Your task is to draw a clear and simple map that will guide the boda boda rider from the school to the nearest hospital. Begin by imagining that you are standing at the school gate and think carefully about the route you would take to reach the hospital. As you draw the road, show all the turns you would make, whether left, right, or straight ahead.
2. (b) Include at least three landmarks that the rider would see along the way, such as a market, a police station, a church, or a large tree. These landmarks should be placed in their correct positions to help the rider know that he is on the right path. Use arrows to show the direction the boda boda should follow and label any roads if you know their names.
3. (c) Finally, look at your map and ask yourself whether someone who has never been in the area could use it to reach the hospital without getting lost. If necessary, add a compass showing North, South, East, and West to make your directions clearer.
4. (d) Discuss: What information is essential for giving directions? Is knowing the distance enough, or do you also need to know the direction?

#### Teacher Guidance for Anchor Activity

This anchor activity introduces the concept that some quantities require both magnitude (how much) and direction (which way), while others need only magnitude. Through map-making, students discover that distance alone is insufficient for navigation—direction is equally important.

Facilitation Strategy:

- • Organize students into groups of 2-3
- • Distribute paper and pencils
- • Present the emergency scenario to create urgency and relevance
- • Guide students to think about their actual route from school to nearest hospital
- • Encourage use of arrows to show direction
- • Ask probing questions: "Is saying '5 km away' enough?" "What else do you need to know?"
- • Help students recognize that both distance AND direction are needed
- • Use student observations to introduce vector vs. scalar distinction

#### Phase 2: Structured Instruction (10 minutes)

##### Key Takeaways

After students have explored through the anchor activity, formalize their discoveries with these key concepts:

##### 1. Definition of Vector and Scalar Quantities

**Vector:** A quantity that has BOTH magnitude (size/amount) and direction.

**Scalar:** A quantity that has ONLY magnitude (size/amount), no direction.

In daily life, we measure many things using just a single number (scalars), such as temperature or mass. However, for some physical quantities, knowing "how much" is not enough—we also need to know "which way" (vectors). For example, knowing a hospital is 5 km away is not helpful unless you also know the direction to travel.

### 2. Examples of Vector and Scalar Quantities

Vector Quantities (magnitude + direction):

- Force: 50 Newtons downward
- Velocity: 60 km/h eastward
- Displacement: 10 meters north
- Acceleration: 5 m/s<sup>2</sup> upward

Scalar Quantities (magnitude only):

- Distance: 10 meters
- Temperature: 25°C
- Mass: 5 kilograms
- Speed: 60 km/h
- Time: 3 hours

### 3. Key Differences Between Vectors and Scalars

Feature	Vector Quantity	Scalar Quantity
Definition	Has both magnitude and direction	Has only magnitude
Examples	Force, Acceleration, Displacement, Velocity	Distance, Temperature, Mass, Speed, Time
Representation	Requires arrow notation or direction words	Simple number with unit

### 4. Vector Notation

Vector notation is a way of representing quantities that have both magnitude and direction in mathematics.

A vector from point A to point B can be written as:

- AB with arrow above:  $\overrightarrow{AB}$
- AB with tilde:  $\tilde{AB}$

- • Single lowercase letter: a or  $\vec{a}$

The magnitude of vector AB is written as  $|AB|$ .

We refer to A as the initial point and B as the terminal point.

### 5. Reversing Vector Direction

If the direction of a vector is reversed, we use a negative sign:

If  $\vec{AB} = a$ , then  $\vec{BA} = -a$

This means going from B to A is the opposite direction of going from A to B.

### 6. Real-Life Applications

Navigation: GPS systems use displacement vectors (distance + direction) to guide travelers.

Weather: Wind is described as a vector (speed + direction), while temperature is a scalar.

Sports: A football kick has both speed (scalar) and direction (making velocity a vector).

### Scaffolding Strategies

Address common misconceptions revealed during the anchor activity:

- • Clarify that direction words (north, east, left, right) indicate vector quantities
- • Emphasize that scalars are complete with just a number and unit
- • Show that speed (scalar) becomes velocity (vector) when direction is added
- • Demonstrate that distance (scalar) becomes displacement (vector) with direction
- • Use consistent notation throughout (arrows, tildes, or bold letters)

### Phase 3: Practice and Application (15 minutes)

#### Worked Examples

#### Example 1: Identifying Vector vs. Scalar

Classify each quantity as vector or scalar:

5. (a) A car travels 80 km/h

6. (b) A car travels 80 km/h northward
7. (c) The room temperature is 22°C
8. (d) A force of 100 N pulls the box eastward

Solution:

9. (a) Scalar - speed has only magnitude
10. (b) Vector - velocity has magnitude and direction (northward)
11. (c) Scalar - temperature has only magnitude
12. (d) Vector - force has magnitude and direction (eastward)

**Example 2: Vector Notation**

A student walks from point M (center of field) 30 meters directly North to a flag at point N.

- (a) Write the vector representing this movement using arrow notation.
- (b) If this vector is assigned the letter b, write it using tilde notation.

Solution:

- (a)  $\overrightarrow{MN}$
- (b)  $\tilde{b}$

**Example 3: Reversing Direction**

If vector  $\overrightarrow{PQ} = c$  represents walking from P to Q, how do we represent walking from Q back to P?

Solution:

$$\overrightarrow{QP} = -c$$

Explanation: Reversing direction means using the negative of the original vector.

**Example 4: Real-World Application**

A pilot needs to fly from Nairobi to Mombasa. Which information represents vectors and which represents scalars?

13. (a) Distance: 480 km

14. (b) Displacement: 480 km southeast
15. (c) Flight time: 1 hour
16. (d) Wind velocity: 40 km/h from the west

Solution:

17. (a) Scalar - distance has no direction
18. (b) Vector - displacement includes direction (southeast)
19. (c) Scalar - time has no direction
20. (d) Vector - velocity includes direction (from the west)

#### Individual Practice (Students work independently)

Provide students with similar problems to solve:

21. 1. Classify as vector or scalar: (a) 50 kg, (b) 20 m/s downward, (c) 15°C, (d) 5 km east
22. 2. Write vector notation for movement from point A to point B using: (a) arrow notation, (b) tilde notation
23. 3. If  $\vec{AB} = d$ , what is  $\vec{BA}$ ?
24. 4. Give three examples each of vectors and scalars from everyday life.

#### Phase 4: Assessment - Exit Ticket (5 minutes)

Students complete individually to demonstrate understanding:

Question 1: Explain the difference between a vector quantity and a scalar quantity. Give one example of each.

Question 2: Classify each as vector or scalar:

- (a) A runner completes 400 meters
- (b) A runner moves 400 meters northward
- (c) The mass of the ball is 2 kg

Question 3: A student walks from library (L) to cafeteria (C). Write this movement in vector notation using arrow notation.

#### Exit Ticket Answer Key

Question 1:

A vector quantity has both magnitude and direction, while a scalar quantity has only magnitude.

Example vector: Velocity (60 km/h eastward)

Example scalar: Temperature (25°C)

Question 2:

- (a) Scalar - distance has no direction
- (b) Vector - displacement has direction (northward)
- (c) Scalar - mass has no direction

Question 3:

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## Differentiation Strategies

### For Struggling Learners:

- • Use color coding: blue for scalars, red for vectors
- • Provide memory aid: "Vectors have direction words (north, east, up, down)"
- • Create visual chart with examples of each type
- • Use physical demonstrations (walking in directions)
- • Provide sentence frames: " \_\_\_\_ is a vector because it has \_\_\_\_ and \_\_\_\_"

### For Advanced Learners:

- • Explore vector addition and subtraction conceptually
- • Investigate why some quantities are vectors (fundamental physics)
- • Research applications in engineering and navigation
- • Introduce three-dimensional vectors
- • Explore magnitude calculation preview

## Extension Activity

### Vector and Scalar Hunt

Objective: Identify vectors and scalars in everyday situations.

Activity Description:

25. 1. Walk around the school compound for 10 minutes.
26. 2. Record 10 physical quantities you observe or can measure.
27. 3. Classify each as vector or scalar.
28. 4. For vectors, identify both the magnitude and direction.
29. 5. Create a poster showing your findings with drawings.
30. 6. Present to the class explaining your classifications.

### Direction-Giving Challenge

Students can:

- • Work in pairs: one gives directions using only scalars (distances), the other using vectors (distances + directions)
- • Compare which method is more effective for navigation
- • Write a reflection on why direction matters

### Post-Lesson Reflection for Teachers

- • Did students successfully distinguish between vectors and scalars?
- • Were students able to identify direction as the key difference?
- • What misconceptions emerged about magnitude and direction?
- • How engaged were students with the map-making activity?
- • Did students understand vector notation?
- • What adjustments are needed for future lessons on this topic?