CBC Grade 10 Mathematics

Step-by-Step Presentation Script

Adding Vectors

Pre-Class Preparation

Before students arrive, ensure the following materials and setup are ready:

- Materials Needed:
- • Graph paper (one sheet per group)
- • Rulers (one per group)
- • Pencils
- • Exit tickets (one per student)
- Classroom Setup:
- • Prepare board space for diagrams and formulas
- • Display key inquiry question: "How do we combine multiple displacements to find the total resultant displacement?"
- • Have sample graph paper visible for demonstration

Lesson Overview (40 Minutes)

Phase	Duration
Phase 1: Problem-Solving and Discovery	0-15 minutes
Phase 2: Structured Instruction	15-25 minutes
Phase 3: Practice and Application	25-37 minutes
Phase 4: Assessment (Exit Ticket)	37-40 minutes

Minute-by-Minute Presentation Guide

Minutes 0-2: Introduction and Engagement

[SAY] "Good morning, class! Today we explore how to add vectors to find resultant displacement. Imagine you walk 3 blocks east, then 2 blocks north. How far are you from where you started? Vector addition helps us answer this!"

[ASK] "If you take two separate trips, how can you find your total displacement?"

[LISTEN] Expected: Add them together, combine them

[SAY] "Exactly! Today you'll discover how to add vectors both graphically (by drawing) and algebraically (using coordinates). This is essential for navigation, engineering, and physics."

[WRITE] On the board: "Adding Vectors"

[WRITE] Key inquiry question: "How do we combine multiple displacements to find the total resultant displacement?"

Minutes 2-17: Phase 1 - Anchor Activity (Discovery)

[SAY] "You will work in groups to discover how vector addition works by drawing sequential displacements on graph paper."

[DO] Organize students into groups of 2-3.

[DO] Distribute graph paper, rulers, and pencils to each group.

[SAY] "Your first task: Draw the x and y axes on your graph paper. Label them clearly."

[DO] Allow 1 minute for axis drawing (Minutes 2-3).

[SAY] "Task (b): Draw vector AB from point A at coordinates (0,0) to point B at coordinates (2,2). Use your ruler to draw a straight arrow."

[DO] Allow 2 minutes for drawing vector AB (Minutes 3-5).

[DO] Circulate to check that students draw arrows correctly from origin to (2,2).

[SAY] "Task (c): Now draw vector BC. This vector starts where AB ended - at point B(2,2) - and goes to point C at coordinates (5,2)."

[DO] Allow 2 minutes for drawing vector BC (Minutes 5-7).

[TEACHING TIP] Emphasize that the second vector starts where the first one ends - this is the "tip-to-tail" method.

[SAY] "Task (d): Count how many units you moved horizontally from the starting point A to the final point C."

[DO] Allow 2 minutes for counting (Minutes 7-9).

[DO] Circulate and ask: "How many units to the right did you move in total?"

[LISTEN] Expected: 5 units

[SAY] "Task (e): Now count how many units you moved vertically from A to C."

[DO] Allow 1 minute for counting (Minutes 9-10).

[LISTEN] Expected: 2 units

[SAY] "Task (f): Write the resultant displacement in coordinate form (x, y)."

[DO] Allow 2 minutes (Minutes 10-12).

[TEACHING TIP] Guide students to write AC = (5, 2)

[SAY] "Discuss in your groups: How does the resultant AC relate to the two vectors AB and BC?"

[DO] Allow 3 minutes for group discussion (Minutes 12-15).

[SAY] "Let's share findings. Group 1, what is the resultant displacement AC?"

[LISTEN] Expected: (5, 2)

[SAY] "Excellent! Now, AB goes from (0,0) to (2,2), so AB = (2,2). BC goes from (2,2) to (5,2), so BC = (3,0). What do you notice if we add these?"

[ASK] "What is (2,2) + (3,0)?"

[LISTEN] Expected: (5,2)

[SAY] "Perfect! You discovered that AC = AB + BC. This is vector addition! Let's formalize this concept."

Minutes 17-25: Phase 2 - Structured Instruction

[SAY] "You discovered that adding vectors means combining displacements. Let me teach you the formal rules."

[WRITE] "Sequential Vector Addition"

[SAY] "Consider a displacement from point P to Q, followed by another from Q to N. The total resultant from P to N is: PN = PQ + QN."

[WRITE] "PN = PQ + QN"

[DRAW] Simple diagram showing P→Q→N with resultant P→N

[SAY] "This is called the tip-to-tail method. We place the tail of the second vector at the tip of the first."

[WRITE] "Graphical Addition: Tip-to-Tail Method"

[SAY] "Steps: 1) Draw first vector from starting point. 2) Place tail of second vector at tip of first. 3) Resultant goes from starting tail to final tip."

[DRAW] Demonstrate with two vectors on the board

[WRITE] "Algebraic Addition: Component Method"

[SAY] "When vectors are in coordinate form, add corresponding components."

[WRITE] "If a = (x_1, y_1) and b = (x_2, y_2), then a + b = $(x_1 + x_2, y_1 + y_2)$"

[EXAMPLE] "If a = (2,3) and b = (4,-1), then a + b = (2+4, 3+(-1)) = (6,2)"

[SAY] "We can also use algebraic notation. If AD = AB + BC + CD = a + b + c, we simply write AD = a + b + c."

[WRITE] "Properties: Commutative (a + b = b + a), Associative ((a+b)+c = a+(b+c))"

[SAY] "Real-world applications: Pilots add velocity vectors to account for wind. Engineers add force vectors to calculate total load on structures."

[TEACHING TIP] Use arrows and colors to distinguish different vectors on the board

Minutes 25-37: Phase 3 - Practice and Application

[SAY] "Now let's apply these concepts to solve problems."

[EXAMPLE] Example 1: Algebraic Notation

[WRITE] "Find vector AD where AB = a, BC = b, CD = c"

[SAY] "We follow the path from A to D: AD = AB + BC + CD"

[WRITE] "AD = a + b + c"

[SAY] "Simple! We just add the vectors along the path."

[EXAMPLE] Example 2: Coordinate Form

[WRITE] "Given a = (2,3) and b = (4,-1), find a + b"

[SAY] "Add x-components: 2 + 4 = 6. Add y-components: 3 + (-1) = 2."

[WRITE] "a + b = (6, 2)"

[DRAW] Quick sketch showing both vectors and resultant

[EXAMPLE] Example 3: Square Problem

[WRITE] "PQNM is a square. PQ = a, PM = b. Find PN and MQ."

[SAY] "PN is the diagonal. We go from P to Q to N: PN = PQ + QN = a + b"

[WRITE] "PN = a + b"

[SAY] "For MQ, we go from M to N to Q: MQ = MN + NQ = a + (-b) = a - b"

[WRITE] "MQ = a - b"

[EXAMPLE] Example 4: Complex Expression

[WRITE] "Given u = 2p + 5q and v = p - 3q, find 3u + 2v"

[SAY] "Substitute: 3u + 2v = 3(2p + 5q) + 2(p - 3q)"

[WRITE] "= 6p + 15q + 2p - 6q"

[SAY] "Combine like terms: p terms together, q terms together."

[WRITE] "= 8p + 9q"

[SAY] "Now try these problems individually:"

[WRITE] "Practice Problems:"

1. 1. Pentagon ABCDE: AB = m, BC = n, CD = k. Find AC and AD.
2. 2. Given a = (3,5) and b = (2,-3), find a + b.
3. 3. Simplify: 5x + 3y - z + 2(3x - z) + (8x - 6y)

[DO] Give students 7 minutes (minutes 30-37) for individual practice.

[DO] Circulate to check understanding and provide support.

[TEACHING TIP] Remind students: Tip-to-tail for graphical, add components for algebraic, combine like terms for expressions

Minutes 37-40: Phase 4 - Assessment (Exit Ticket)

[SAY] "Excellent work today! To check your understanding, complete this exit ticket individually."

[DO] Distribute exit tickets.

[SAY] "You have 3 minutes. Show all your work."

[WRITE] Display exit ticket questions:

Question 1: Draw vectors a = (3,1) and b = (2,4) on graph paper. Add them graphically using tip-to-tail method and state the resultant.

Question 2: In triangle ABC, AB = p and BC = q. Express AC in terms of p and q.

Question 3: Given x = 3m - n and y = n + 4m, express 3x in terms of m and n.

[DO] Students work silently (minutes 37-40).

[DO] Collect exit tickets.

[SAY] "Great work today! You now know how to add vectors both graphically and algebraically. Remember: tip-to-tail for drawing, add components for coordinates, combine like terms for expressions. Vector addition is essential for navigation, engineering, and physics. Tomorrow we'll explore multiplying vectors by scalars!"

Teaching Tips and Strategies

Emphasis Points:

- • Tip-to-tail method: second vector starts where first ends
- • Resultant goes from starting tail to final tip
- • Component addition: add x's together, y's together
- • Algebraic addition: combine like terms
- • Vector addition is commutative and associative

Differentiation in Action:

- • For struggling learners: Use color coding, provide pre-drawn axes, start with horizontal/vertical vectors
- • For advanced learners: Introduce vector subtraction, 3D vectors, parallelogram law
- • Use physical arrows or string to demonstrate
- • Connect graphical and algebraic methods

Common Student Errors:

- • Placing vectors tail-to-tail instead of tip-to-tail
- • Drawing resultant incorrectly (not from start to finish)
- • Adding x to y components (mixing components)
- • Forgetting to distribute scalars before combining terms
- • Not combining like terms in algebraic expressions

Engagement Strategies:

- • Use hands-on graphing activity
- • Connect to navigation and engineering
- • Use colored arrows for visual clarity
- • Reference real-world applications (pilots, architects)

Assessment Guidance

Exit Ticket Evaluation Criteria:

- • Correct graphical representation using tip-to-tail method
- • Accurate component addition for coordinate vectors
- • Proper algebraic notation for vector expressions
- • Clear diagrams with labeled vectors and resultant
- • Correct simplification of algebraic expressions

Mastery Indicators:

- • Student can add vectors graphically using tip-to-tail method
- • Student can add vectors algebraically by adding components
- • Student can express resultant vectors in terms of given vectors
- • Student understands connection between graphical and algebraic methods

Follow-Up for Students Who Struggle:

- • Provide additional practice with pre-drawn axes
- • Use color-coded step-by-step templates
- • Create visual reference cards showing tip-to-tail method
- • Schedule small group intervention for hands-on practice

Post-Lesson Reflection Questions

After teaching this lesson, reflect on:

- • Did students successfully add vectors both graphically and algebraically?
- • Were students able to use the tip-to-tail method correctly?
- • What misconceptions emerged about vector direction and magnitude?
- • How engaged were students with the graphical anchor activity?
- • Did students understand the connection between graphical and algebraic methods?
- • What percentage demonstrated mastery on the exit ticket?
- • What adjustments would improve this lesson?