# Grade 10 Mathematics Presentation Script

## Multiplying Vectors by Scalars

### Pre-Class Preparation

**Materials Checklist:**

- Graph paper (one sheet per student)
- Rulers (one per student)
- Pencils and colored markers
- Large coordinate plane drawn on board or chart paper
- Prepared examples on chart paper

**Room Setup:**

- Draw a large coordinate plane on the board
- Prepare graph paper and rulers for distribution
- Have colored markers ready for demonstrations
- Prepare example vectors on chart paper
- Write scalar multiplication rules on the board for reference

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

**Opening Hook (2 minutes)**

[DO] Draw a vector on the board from (0,0) to (2,0).

[SAY] Imagine you are pushing a box with a certain force. What happens if you push twice as hard?

[ASK] Does the direction change or just the strength?

[WAIT] Expected: Just the strength! The direction stays the same!

[SAY] Exactly! Today we will learn how to multiply vectors by numbers called scalars.

[SAY] This is used in physics, engineering, computer graphics, and many other fields.

**Anchor Activity Launch (3 minutes)**

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

[SAY] Here is your challenge: You will discover what happens when we multiply a vector by a number.

[SAY] Here is what you will do:

[WRITE] On the board: Step 1: Draw x and y axes.

[WRITE] Step 2: Draw vector AB from A(0,2) to B(2,2).

[WRITE] Step 3: From B(2,2), draw vector to C(4,2).

[WRITE] Step 4: Find coordinates of AB and AC.

[WRITE] Step 5: How does AB relate to AC?

[SAY] Work individually first, then discuss with your neighbor.

[SAY] You have 8 minutes.

**Student Work Time (8 minutes)**

[DO] Circulate among students.

[ASK] To a student: What are the coordinates of AB?

[WAIT] Expected: (2, 0)!

[SAY] Good! What about AC?

[WAIT] Expected: (4, 0)!

[SAY] Excellent! How does AC compare to AB?

[WAIT] Expected: AC is twice as long!

[SAY] Perfect! So AC equals 2 times AB!

[DO] For struggling students: Let us measure. AB is 2 units. AC is 4 units. 4 is twice 2.

[DO] For early finishers: What if we multiply by 3? By negative 1?

**Class Discussion (2 minutes)**

[DO] Call on 2-3 students to share their findings.

[ASK] What did you discover about multiplying vectors?

[WAIT] Expected: It makes them longer! The direction stays the same!

[SAY] Excellent! This is called scalar multiplication.

[SAY] Today we will formalize this concept.

## Phase 2: Structured Instruction (10 minutes)

**Formalizing Scalar Multiplication (10 minutes)**

[SAY] Now that you have explored scalar multiplication, let us formalize what we learned.

[WRITE] On the board: Multiplying Vectors by Scalars

[SAY] Rule 1: Positive Scalar

[SAY] When we multiply a vector by a positive number, the magnitude increases but the direction stays the same.

[DO] Draw vector a on board.

[SAY] If we multiply by 2, we get 2a. It is twice as long but points the same way.

[WRITE] 2a equals a plus a

[ASK] Does everyone understand?

[WAIT] Check for nods or questions.

[SAY] Rule 2: Negative Scalar

[SAY] When we multiply a vector by a negative number, the direction reverses.

[DO] Draw vector a pointing right.

[SAY] If we multiply by negative 2, we get negative 2a. It is twice as long but points the opposite way.

[WRITE] negative 2a equals negative 2 times a

[ASK] Does everyone understand?

[WAIT] Check for understanding.

[SAY] Rule 3: Zero Scalar

[SAY] When we multiply a vector by 0, we get a zero vector with no magnitude.

[WRITE] 0 times a equals 0

[ASK] Does everyone understand?

[WAIT] Check for understanding.

**Addressing Misconceptions:**

[SAY] Let me address some common mistakes:

[SAY] Mistake 1: Multiplying by 2 adds 2 to each component. No, it multiplies each component by 2.

[SAY] Mistake 2: Negative scalar makes the vector smaller. No, it reverses direction.

[SAY] Mistake 3: Multiplying by 0 keeps the vector the same. No, it creates a zero vector.

[SAY] Mistake 4: Direction always stays the same. No, negative scalars reverse direction.

[ASK] Does everyone understand?

[WAIT] Check for understanding.

## Phase 3: Practice and Application (10 minutes)

**Worked Examples (10 minutes)**

[SAY] Let us work through examples together.

[WRITE] Example 1: Given u equals 2p plus 5q and v equals p minus 3q, find 3u plus 2v.

[SAY] 3u plus 2v equals 3(2p plus 5q) plus 2(p minus 3q)

[SAY] equals 6p plus 15q plus 2p minus 6q

[SAY] equals 8p plus 9q

[ASK] Does everyone understand?

[WAIT] Check for understanding.

[WRITE] Example 2: If a equals (3, 4), find 2a.

[SAY] 2a equals 2(3, 4) equals (6, 8)

[WRITE] Example 3: If b equals (5, negative 2), find negative 3b.

[SAY] negative 3b equals negative 3(5, negative 2) equals (negative 15, 6)

[SAY] See? The negative scalar reverses the direction!

[ASK] Any questions?

[WAIT] Address questions.

## Phase 4: Assessment (5 minutes)

**Exit Ticket**

[SAY] Before we finish, I want to check your understanding. Please complete the exit ticket individually.

[DO] Display questions on the board.

[SAY] Question 1: Simplify 5x plus 3y minus z plus 2(3x minus z) plus (8x minus 6y).

[SAY] Question 2: Simplify (a minus b) plus (c minus a) plus (b minus c).

[SAY] Question 3: Given x equals 3m minus n, express 3x in terms of m and n.

[SAY] You have 5 minutes. Show your work!

**Closing (1 minute)**

[SAY] Today we learned about multiplying vectors by scalars.

[SAY] We learned that positive scalars increase magnitude, negative scalars reverse direction, and zero creates a zero vector.

[SAY] Scalar multiplication is used in physics, engineering, and computer graphics.

[SAY] Next lesson, we will explore translating vectors.

[SAY] Great work today!

## Differentiation Notes

**For Struggling Learners:**

- Provide pre-drawn vectors.
- Use color coding for vectors.
- Provide calculation templates.
- Start with simple scalars.
- Use physical manipulatives.

**For Advanced Learners:**

- Explore 3D scalar multiplication.
- Investigate unit vectors.
- Apply to physics problems.
- Prove distributive property.
- Explore computer graphics applications.

## Post-Lesson Reflection Prompts

- Did students discover how scalar multiplication affects vectors?
- Were students able to apply scalar multiplication correctly?
- What misconceptions emerged, and how were they addressed?
- Did students understand positive vs negative scalars?
- What adjustments would improve this lesson?