

Subtracting vectors

AS Level

9702 AS Ch.1

Chapter 1: Kinematics

Lesson 1.7

Sections 1.7

Goal: Find a change in velocity, $\Delta v = v_2 - v_1$, by adding the reverse of the first vector.

— velocity — acceleration

01 The big picture

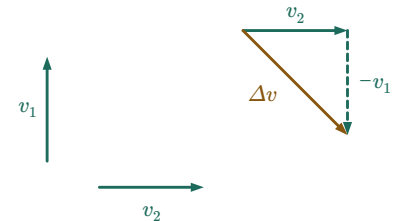
To subtract a vector, add its reverse: $\vec{a} - \vec{b} = \vec{a} + (-\vec{b})$, where $-\vec{b}$ has the same size as $\vec{b}$ but points the opposite way.

The most common use is a change in velocity: $\Delta \vec{v} = \vec{v}_2 - \vec{v}_1$ (final minus initial). Even at constant speed, a change of direction gives a non-zero Δv .

Change in velocity [paraphrase]

Final velocity minus initial velocity, found as a vector.

Fig. 1 · $\Delta \vec{v} = \vec{v}_2 - \vec{v}_1 = \vec{v}_2 + (-\vec{v}_1)$



Draw v_2 , then add the reverse of v_1 at its tip. Δv runs from the start of v_2 to the end of $-v_1$.

02 Key equations

Subtracting a vector

$$\vec{a} - \vec{b} = \vec{a} + (-\vec{b})$$

Change in velocity

$$\Delta \vec{v} = \vec{v}_2 - \vec{v}_1$$

Symbols and units

$\vec{v}_1, \vec{v}_2$ initial and final velocity m s^{-1} $\Delta \vec{v}$ change in velocity m s^{-1}

03 Sample problems with solutions

Sample 1 · A car turning a corner

A car travelling north at 20 m s^{-1} turns and travels east at 20 m s^{-1} . Find its change in velocity.

Step 1. Add the reverse of v_1 (20 m s^{-1} south) to v_2 (20 m s^{-1} east): the two are perpendicular.

$$|\Delta v| = \sqrt{20^2 + 20^2} = 28.3 \text{ m s}^{-1}$$

Step 2. Direction: equal east and south parts, so 45° between them.

Answer: 28 m s^{-1} towards the south-east (45° south of east)

04 Practice problems

P1 A ball moving right at 6.0 m s^{-1} rebounds moving left at 4.0 m s^{-1} . Find the change in velocity.

Answer: 10 m s^{-1} to the left

P2 A velocity changes from 3.0 m s^{-1} east to 4.0 m s^{-1} north. Find Δv .

Answer: 5.0 m s^{-1} at 53° north of west

P3 Find $A - B$ for $A = 7.0 \text{ N}$ east and $B = 2.0 \text{ N}$ east.

Answer: 5.0 N east

P4 A velocity changes from 10 m s^{-1} north to 10 m s^{-1} south. Find Δv .

Answer: 20 m s^{-1} south

05 Other useful information

Common mistakes

- ✗ **Wrong:** Subtract the speeds: $20 - 20 = 0$, so no change.
- ✓ **Right:** The direction changed, so Δv is not zero.
- ✗ **Wrong:** Work out $v_1 - v_2$.
- ✓ **Right:** $\Delta v = \text{final} - \text{initial}: v_2 - v_1$.

Exam tips

- In one dimension, give each velocity a sign (+ one way, - the other) and subtract the numbers.

What the syllabus asks

- 9702 topic 1: add and subtract coplanar vectors. Coursebook 1.7.

Explore: [Practice questions for this lesson](#)