

Distance and displacement

AS Level

9702 AS Ch.1

Chapter 1: Kinematics

Lesson 1.2

Sections 1.2

Goal: Tell distance from displacement and scalars from vectors, and find a displacement from two perpendicular moves.

01 The big picture

Distance is the total length of the path travelled: a scalar. Displacement is the straight-line distance from the start to the finish in a stated direction: a vector.

Scalars have size only (distance, speed, time, mass, energy). Vectors have size and direction (displacement, velocity, acceleration, force), so a vector answer needs a direction.

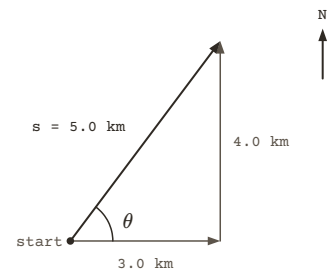
Displacement [paraphrase]

The distance moved in a particular direction from a starting point.

Scalar and vector [paraphrase]

A scalar has magnitude only; a vector has magnitude and direction.

Fig. 1 · Distance or displacement



The path (grey) is 7.0 km long; the displacement (black) is the 5.0 km straight line from start to finish.

02 Key equations

Two perpendicular moves

$$s = \sqrt{x^2 + y^2}$$

Direction

$$\tan \theta = \frac{y}{x}$$

Symbols and units

s size of the displacement m x, y perpendicular parts of the journey m θ angle from the x direction °

03 Sample problems with solutions

Sample 1 · A walk east then north

A walker goes 3.0 km east and then 4.0 km north. Calculate the distance walked and the displacement.

Step 1. Distance adds the path lengths:

$$d = 3.0 + 4.0 = 7.0 \text{ km}$$

Step 2. Displacement is the straight line from start to finish:

$$s = \sqrt{3.0^2 + 4.0^2} = 5.0 \text{ km}$$

Step 3. Direction:

$$\theta = \tan^{-1} \frac{4.0}{3.0} = 53^\circ \text{ north of east}$$

Answer: distance 7.0 km; displacement 5.0 km at 53° north of east

04 Practice problems

P1 A runner completes one lap of a 400 m track. State the distance and the displacement.

Answer: 400 m; zero

P2 Sort into scalars and vectors: mass, weight, time, velocity.

Answer: scalars: mass, time; vectors: weight, velocity

P3 A walker goes 6.0 m north and then 8.0 m west. Calculate the displacement.

Answer: 10 m at 53° west of north

P4 A car drives 5.0 km east, then 2.0 km west. State the distance and the displacement.

Answer: 7.0 km; 3.0 km east

05 Other useful information

Common mistakes

- ✗ **Wrong:** Displacement can never be zero if you moved.
- ✓ **Right:** Back at the start, the displacement is zero; the distance is not.

Exam tips

- Sketch the path; draw the displacement from start to end and give its direction.

What the syllabus asks

- 9702 topics 1 and 2: scalars and vectors; define and use displacement. Coursebook 1.2.

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