SCIENCE FOUNDATIONS

Scalars versus vectors

Difficulty level: Intermediate

Science Foundations

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Overview of the concept

This is how you tell the difference between saying you drove 60 kilometres an hour and saying you drove 60 kilometres an hour north, since only one of those tells a friend where you are headed. A weather report that says the wind is 40 kilometres an hour leaves out the direction, so you still do not know which way the storm is moving. A pilot filing a flight plan has to give both speed and direction, or the plan is useless. Knowing scalars versus vectors tells you when a number alone is enough and when you also need a direction.



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Rule

Scalars versus vectors: a scalar has size only, and a vector has size and direction.

Speed, distance, mass, and time are scalars, while velocity, displacement, and force are vectors.

Worked examples

EXAMPLE 1

Q **Classify: speed 20 m/s, velocity 20 m/s east.**

SOLUTION

Check speed: it gives size only, so it is a scalar.

Check velocity: it gives size and direction, so it is a vector.

Label each one.

The result is speed scalar, velocity vector.

EXAMPLE 2

Q **Classify: distance 100 m, displacement 100 m east.**

SOLUTION

Check distance: it gives total path length only, so it is a scalar.

Check displacement: it gives size and direction, so it is a vector.

Label each one.

The result is distance scalar, displacement vector.

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Practice questions

1 Classify speed 35 km/h and velocity 35 km/h south as scalar or vector.

- **A** Both are scalars
- **B** Speed is a scalar, velocity is a vector
- **C** Speed is a vector, velocity is a scalar
- **D** Both are vectors

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2 Which of these is a vector: speed, distance, velocity, or time?

- **A** Velocity
- **B** Speed
- **C** Distance
- **D** Time

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Classify distance 250 m and displacement 250 m west as scalar or vector.

A Distance is a scalar, displacement is a vector

B Distance is a vector, displacement is a scalar

C Both are scalars

D Both are vectors

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4 A car drives 60 km/h north, then 60 km/h south. Its speed is the same on both legs. Is its velocity the same on both legs?

- **A** No, because the direction is different
- **B** Yes, because the speed is the same
- **C** No, because the distance is different
- **D** Yes, because the time is the same

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5 Is force a scalar or a vector?

- **A** Vector
- **B** Scalar

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Is mass a scalar or a vector?

A Scalar

B Vector

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Which of these has size only, with no direction: velocity or mass?

A Mass

B Velocity

C Both have size only

D Neither has size only

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Two arrows of the same length point in different directions. What does a vector need that a scalar does not?

- A A direction
- B A bigger number
- C A faster speed
- D A different unit

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Is 20 m/s east a scalar or a vector?

- A Vector
- B Scalar

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Is 20 m/s a scalar or a vector?

A Scalar

B Vector

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ANSWER KEY

1. Speed is a scalar, velocity is a vector

2. Velocity

3. Distance is a scalar, displacement is a vector

4. No, because the direction is different

5. Vector

6. Scalar

7. Mass

8. A direction

9. Vector

10. Scalar

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