SCIENCE FOUNDATIONS

Speed versus velocity

Difficulty level: Intermediate

Science Foundations

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Overview of the concept

This is how you tell the difference between how fast your speedometer reads on a winding road and your actual progress toward home, since turning alone changes your velocity even at steady speed. A driver on a winding road can hold 60 kilometres an hour on the speedometer while their progress toward home speeds up and slows down with every bend. A runner on a circular track returns to the start with no overall velocity, even though they ran fast the whole way. Knowing speed versus velocity tells you when how fast is enough, and when direction changes the answer.



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Rule

Speed versus velocity: speed = $\frac{\text{distance}}{\text{time}}$, and velocity = $\frac{\text{displacement}}{\text{time}}$.

Displacement is the straight-line distance from your starting point to your finishing point, with direction. Speed has size only, while velocity has size and direction, so turning at constant speed changes velocity but not speed.

Worked examples

EXAMPLE 1

Q **A car travels 120 km in 2 hours. Average speed?**

SOLUTION

Write the rule:

speed = distance ÷ time.

Substitute:

speed = 120 ÷ 2 = 60 km/h

Write the answer with km/h.

The result is 60 km/h.

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EXAMPLE 2

Q A car goes 120 km east in 2 hours, then returns. Average velocity for the round trip?

SOLUTION

Find displacement: start to finish is zero for a round trip.

Divide displacement by total time:
velocity = 0 ÷ total time = 0 km/h

State the average velocity.

The result is 0 km/h.

Practice questions

1 A car travels 150 km in 3 hours. What is its average speed?

- **A** 50 km/h
- **B** 150 km/h
- **C** 3 km/h
- **D** 75 km/h

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2 A car travels 120 km in 2 hours, then 90 km in 1 hour. What is its average speed for the whole trip?

- **A** 70 km/h
- **B** 105 km/h
- **C** 210 km/h
- **D** 60 km/h

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3 A car goes 90 km east in 1.5 hours, then returns to its starting point in 1.5 hours. What is its average velocity for the whole round trip?

- **A** 0 km/h
- **B** 60 km/h
- **C** 30 km/h
- **D** 90 km/h

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4 A runner goes 400 m around a track and finishes where she started, in 80 s. What is her average speed?

- **A** 5 m/s
- **B** 0 m/s
- **C** 400 m/s
- **D** 80 m/s

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5 What is the formula for speed?

- **A** Distance divided by time
- **B** Time divided by distance
- **C** Distance times time
- **D** Displacement divided by time

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What is the formula for velocity?

A Displacement divided by time

B Distance divided by time

C Displacement times time

D Time divided by displacement

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A car at constant speed turns a corner. Does its velocity change?

A Yes

B No

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8

A car at constant speed turns a corner. Does its speed change?

A No

B Yes

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A displacement of 100 m east in 10 s gives what velocity?

A 10 m/s east

B 100 m/s east

C 1 m/s east

D 10 m/s west

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Which needs direction: speed or velocity?

A Velocity

B Speed

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ANSWER KEY

1. 50 km/h

2. 70 km/h

3. 0 km/h

4. 5 m/s

5. Distance divided by time

6. Displacement divided by time

7. Yes

8. No

9. 10 m/s east

10. Velocity

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