SCIENCE FOUNDATIONS

Velocity-time graphs

Difficulty level: Intermediate

Science Foundations

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Overview of the concept

This is how you read a car's journey from a single graph, seeing when it sped up, cruised, or braked, and how far it travelled altogether. A flat line means the car held a steady speed, and a line dropping toward zero means it was braking. A driving instructor can look at a learner's graph and see exactly where they braked too hard or too late. Knowing velocity-time graphs tells you how to read speed and distance off one picture, without watching the whole drive.



Rule

Velocity-time graphs: the slope of the graph is the acceleration, and the area under the line is the displacement. A flat line means constant velocity and zero acceleration, and a line sloping down to zero means the object is slowing down, called deceleration, until it comes to rest.

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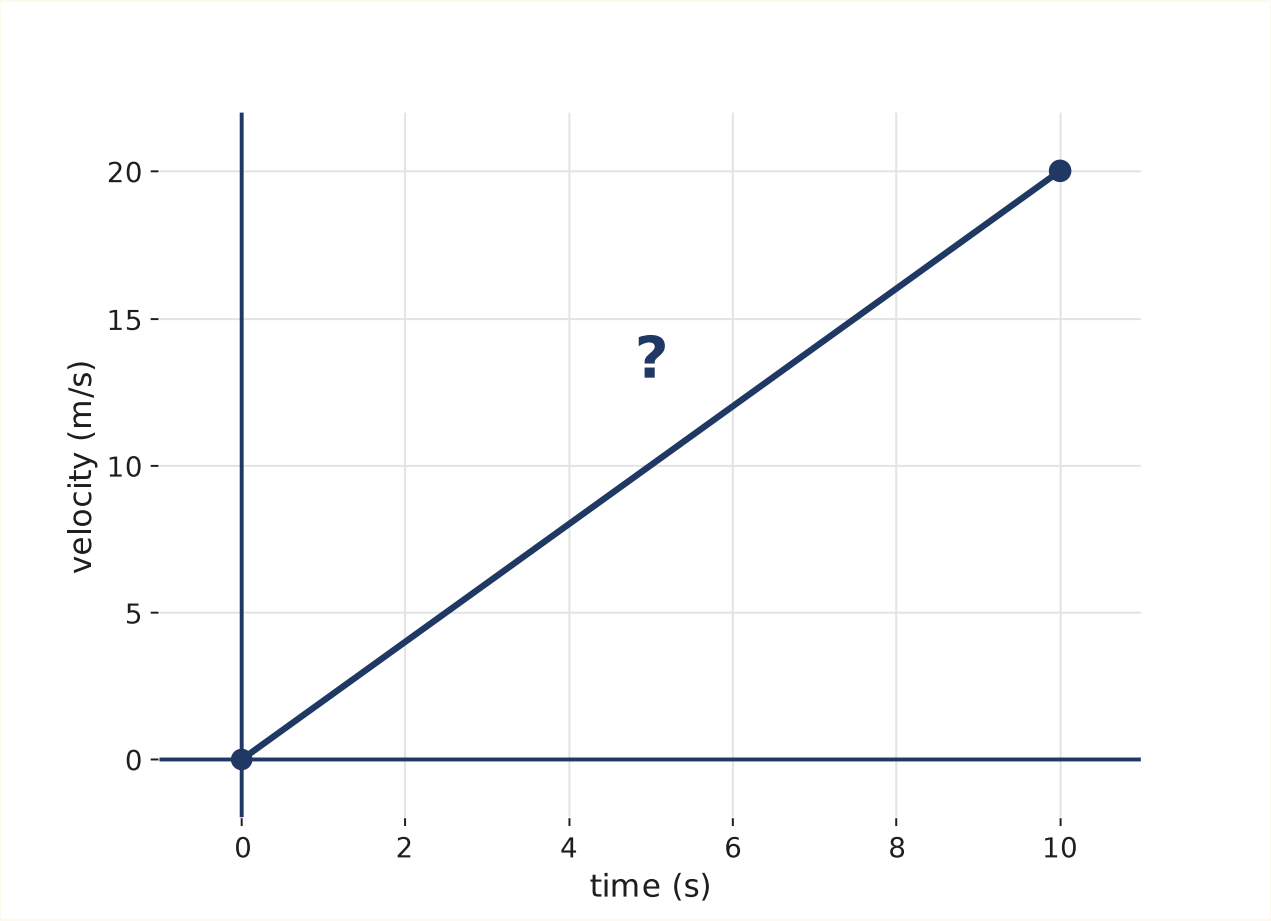
Worked examples

EXAMPLE 1

Q Read a velocity-time graph: velocity rises from 0 to 20 m/s in 10 s. Acceleration?



SOLUTION

Find the slope: rise over run, how much the velocity rises divided by how much time passes.

Rise is 20 m/s, run is 10 s.

Divide:

$20 \div 10 = 2\ \text{m/s}^2$

The result is acceleration 2 ms^2.

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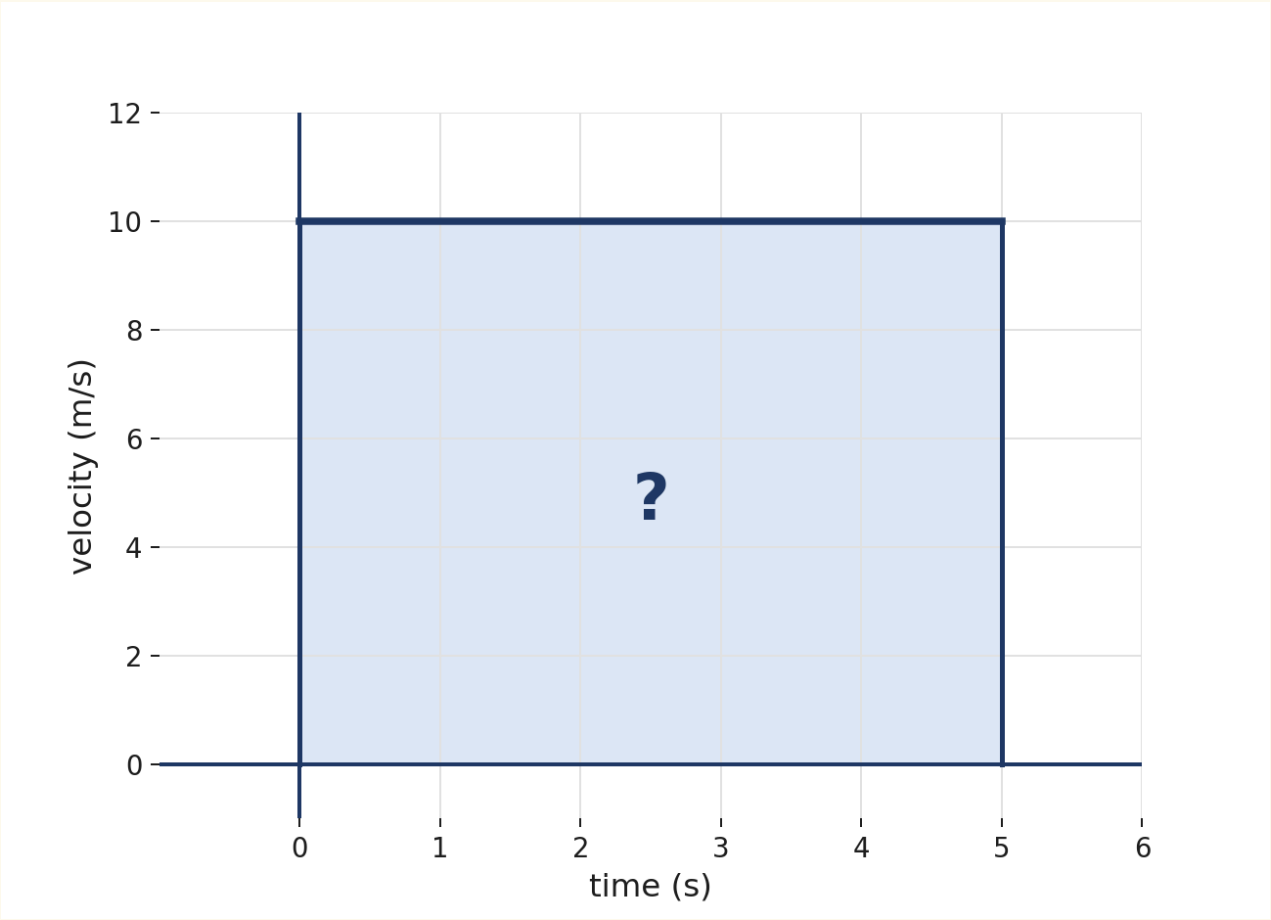
EXAMPLE 2

Q Read a velocity-time graph: constant 10 m/s for 5 s. Displacement?



SOLUTION

Find the area: a rectangle

area = velocity × time.

Multiply:

10 × 5 = 50 m

Write the answer with metres.

The result is displacement 50 m.

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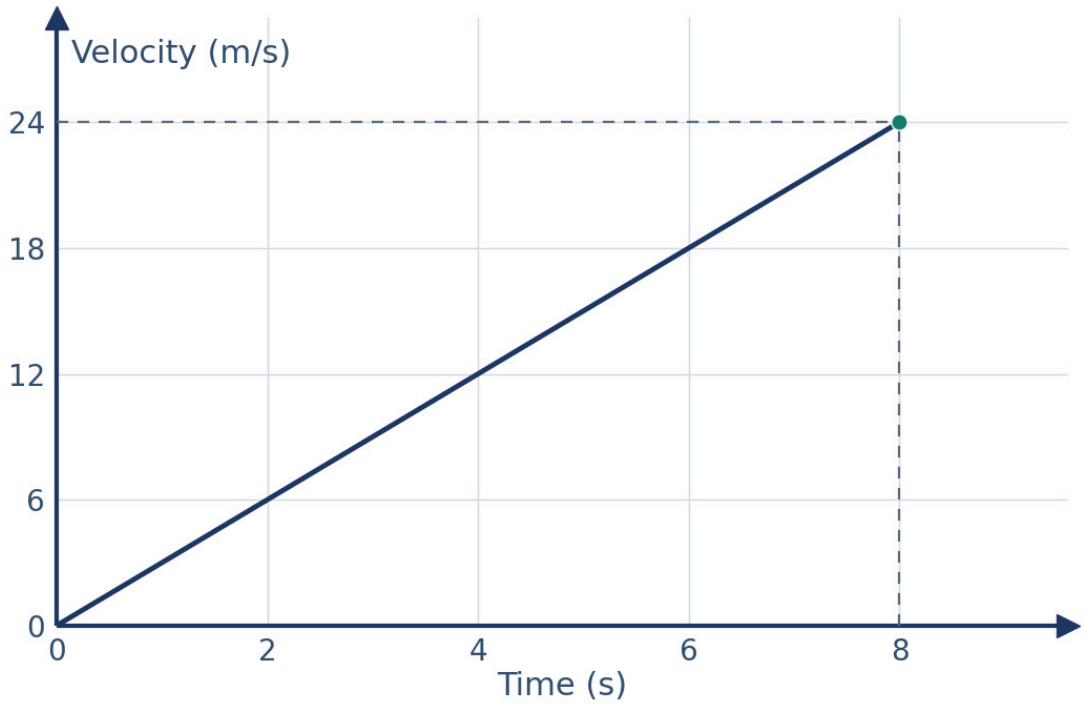
Practice questions

1 Use the velocity-time graph. What is the acceleration?



A 3 m/s²

B 2 m/s²

C 24 m/s²

D 8 m/s²

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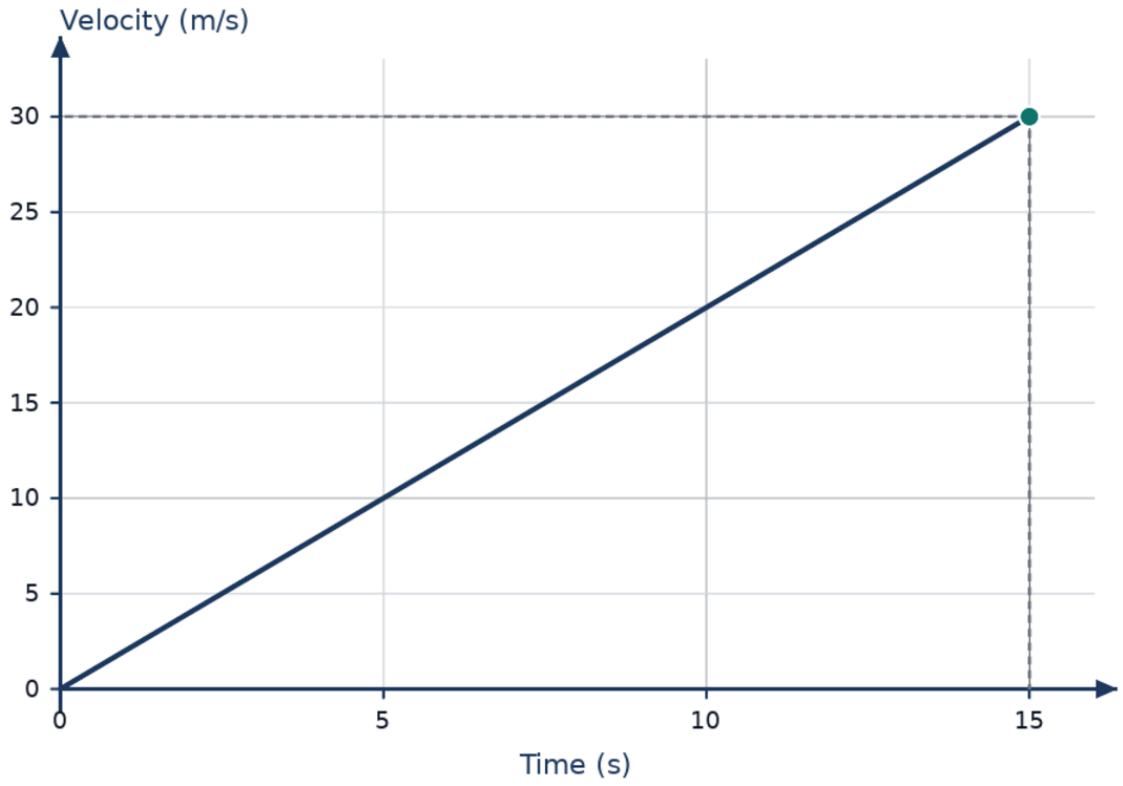
2 Use the velocity-time graph. What is the velocity at 10 s?



A 20 m/s

B 30 m/s

C 10 m/s

D 15 m/s

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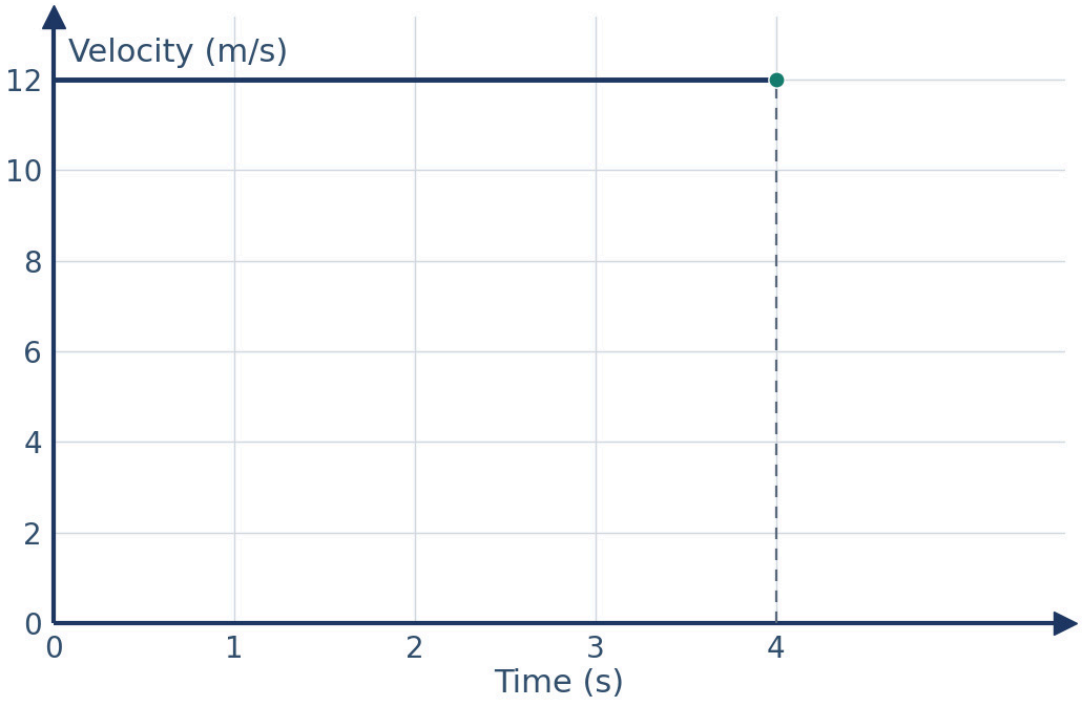
3 Use the velocity-time graph. What is the displacement?



A 48 m

B 12 m

C 4 m

D 96 m

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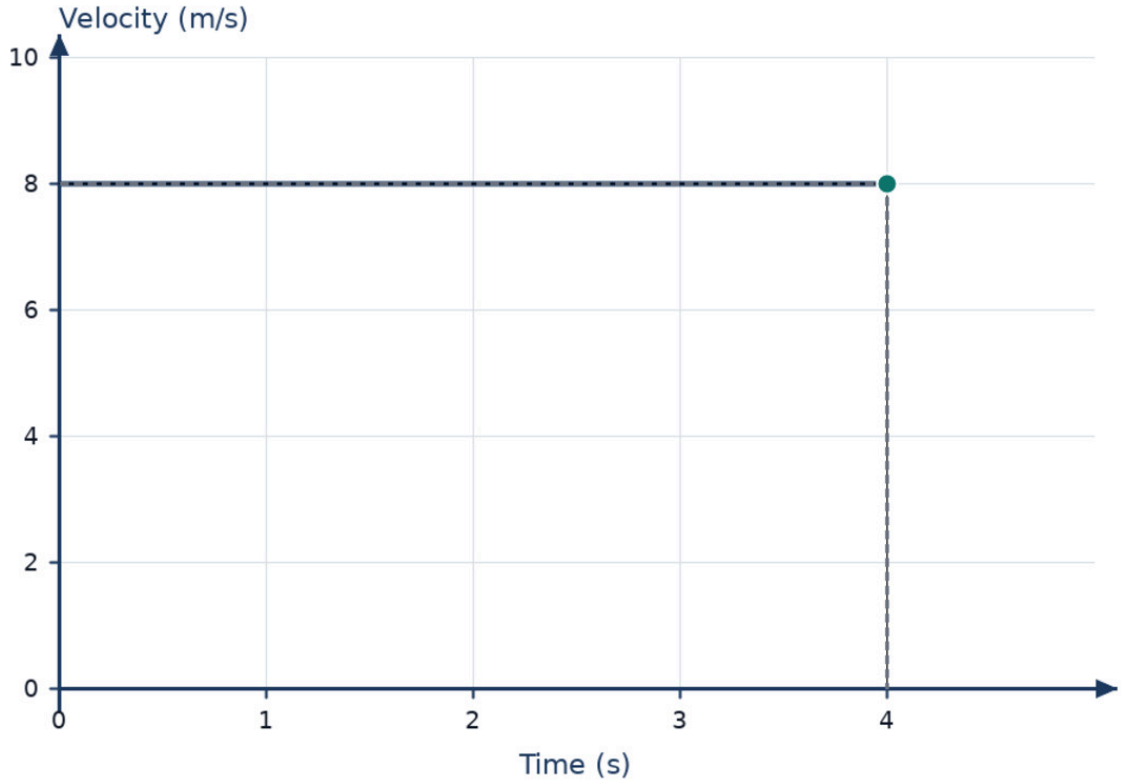
4 Use the velocity-time graph. For how many seconds does the object travel at 8 m/s?



A 4 s

B 8 s

C 2 s

D 12 s

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5

What does the slope of a velocity-time graph show?

A Acceleration

B Displacement

C Velocity

D Time

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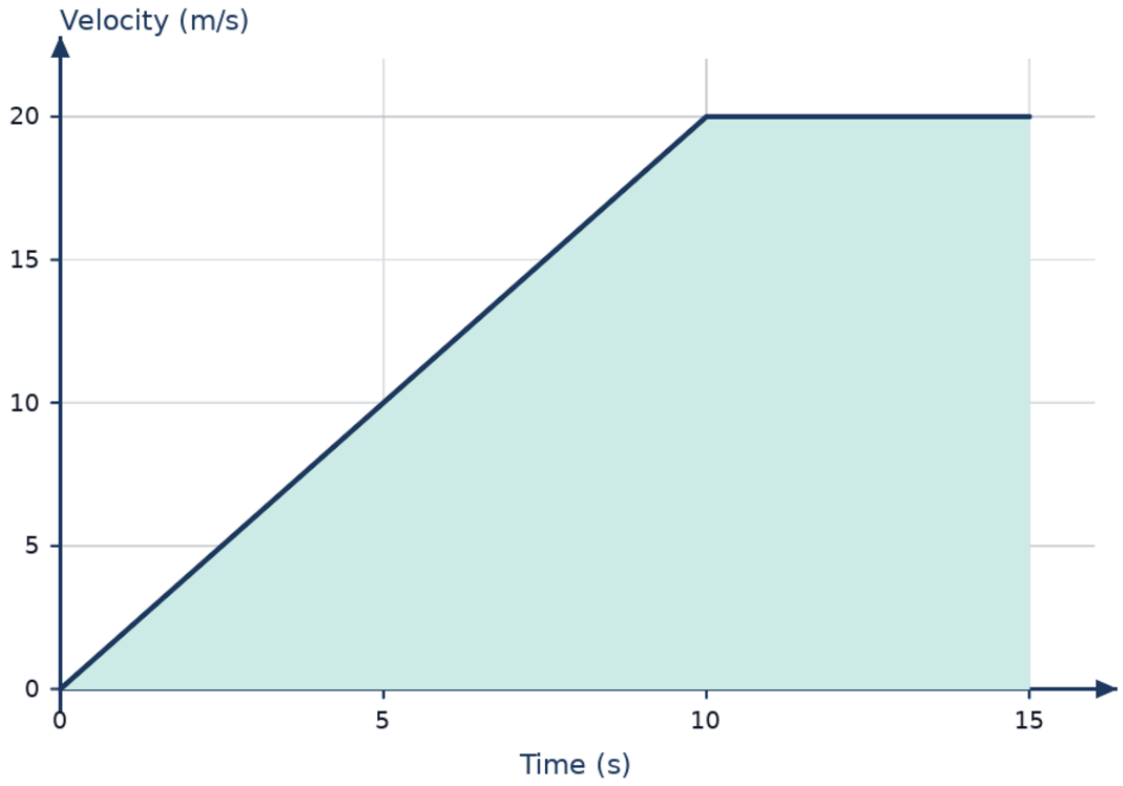
6 What does the area under a velocity-time graph show?



A Displacement

B Acceleration

C Velocity

D Time

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7 A velocity-time graph is flat. What does that mean?

- **A** Constant velocity, zero acceleration
- **B** Constant acceleration, zero velocity
- **C** Increasing velocity, constant acceleration
- **D** Decreasing velocity, zero acceleration

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8 A velocity-time graph slopes down. What does that mean?

- **A** Deceleration
- **B** Acceleration
- **C** Constant velocity
- **D** Displacement

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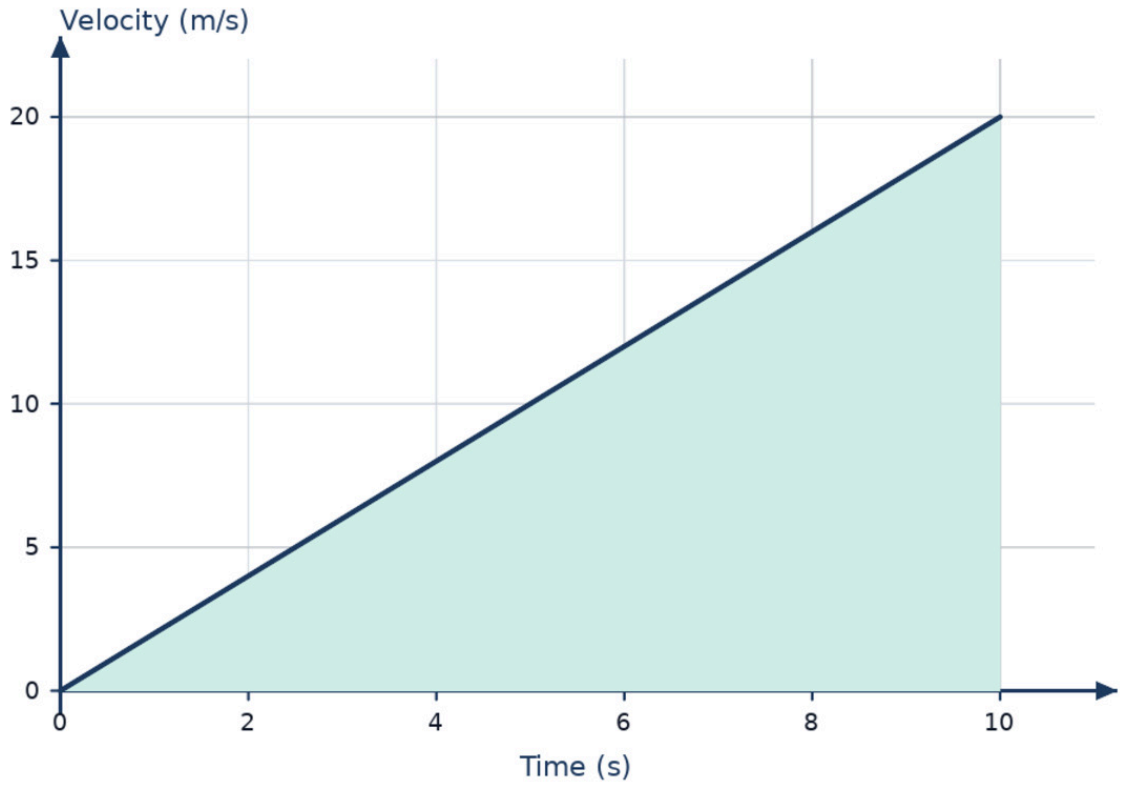
9

The velocity-time graph forms a triangle under the line. What is the displacement?



A 100 m

B 200 m

C 10 m

D 50 m

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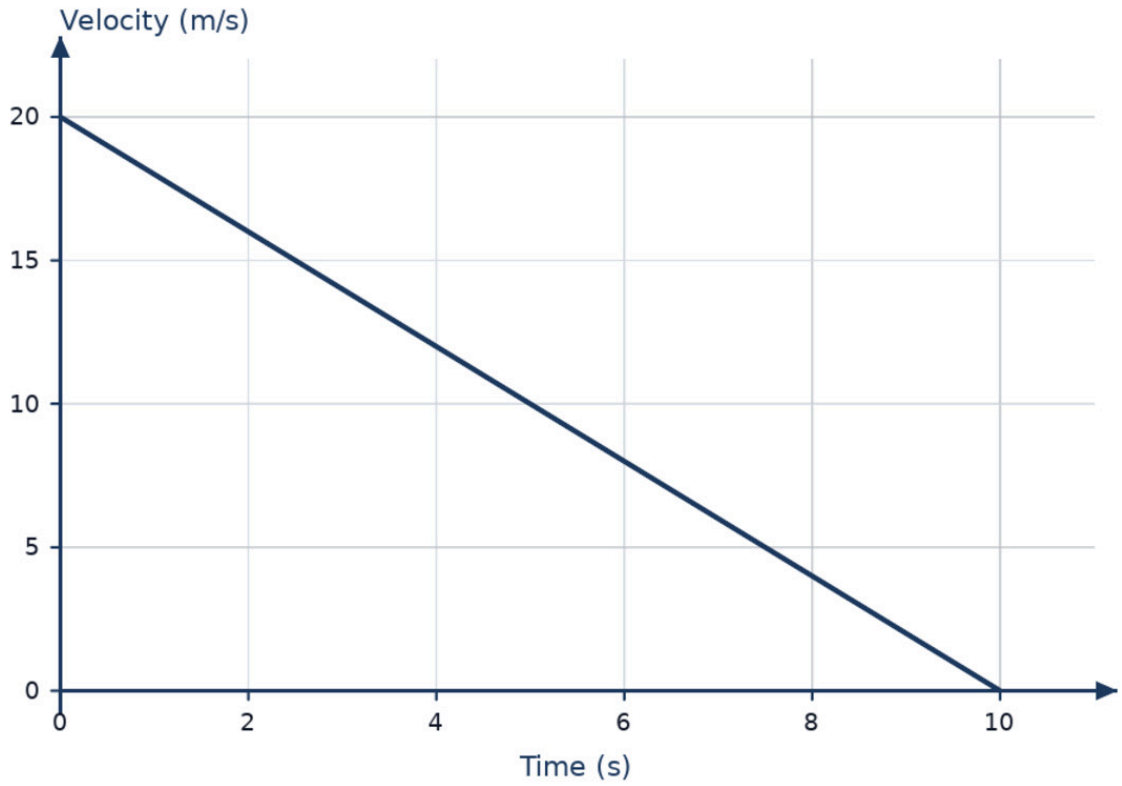
10 **The velocity-time graph slopes down. What is the acceleration?**



- **A** -2 m/s²
- **B** 2 m/s²
- **C** -20 m/s²
- **D** 0 m/s²

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ANSWER KEY

1. 3 $\frac{m}{s^2}$

2. 20 m/s

3. 48 m

4. 4 s

5. Acceleration

6. Displacement

7. Constant velocity, zero acceleration

8. Deceleration

9. 100 m

10. -2 m/s^2

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