

# 1.1 Motion graphs and acceleration

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 10 marks

**KEY WORDS** velocity • acceleration

## Objective

Motion graphs and acceleration. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

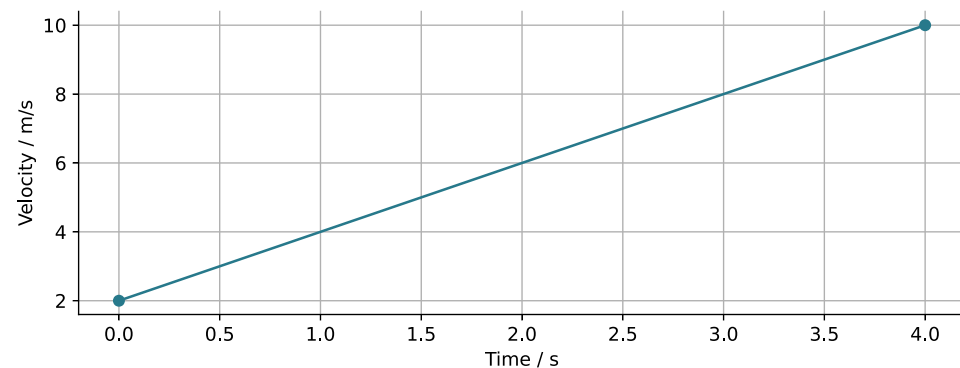
## 1 Key knowledge and worked examples

### ■ What would explain this observation?

- A speedometer gives a reading at one moment. A journey average can hide stops and rapid changes in speed.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

### ■ Build the model

- Displacement includes direction; distance counts total path length. **Velocity** is change in displacement per time. **Acceleration** is change in velocity per time.
- velocity: Rate of change of displacement; acceleration: Rate of change of velocity.



### ■ Choose evidence that can test it

- The gradient of a displacement-time graph is velocity. The area under a velocity-time graph gives displacement. A constant-acceleration formula is valid only when its assumption is justified.
- Choose a positive direction and state it. Use a light gate or video with a known scale and frame interval for repeatable motion measurements. Avoid assuming hand timing is exact over very short intervals.

### ■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: velocity rises uniformly from 2 to 10 metres per second in 4 s.  $a = (v-u)/t$ .  
 $a = (10-2)/4 = 2$  metres per second squared. Displacement is trapezium area:  $s = (u+v)t/2 = (2+10) \times 4/2 = 24$  m.

### Example:

Velocity changes from 3 to 15 metres per second in 6 s. Find acceleration. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

### ■ Check the conclusion and its limits

- Negative velocity indicates direction under the chosen sign convention; it does not necessarily mean slowing down.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

### Warn:

A negative velocity always means the object is slowing down. This claim is false: Negative velocity indicates direction under the chosen sign convention; it does not necessarily mean slowing down.

### Key:

Motion graphs and acceleration: The gradient of a displacement-time graph is velocity. The area under a velocity-time graph gives displacement. A constant-acceleration formula is valid only when its assumption is justified.

## 2 Practice

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**2.1** What does area under a velocity-time graph represent? Choose one answer.

- **A** Displacement
- **B** Acceleration
- **C** Mass

[1]

**2.2** Velocity changes from 3 to 15 metres per second in 6 s. Find acceleration. Show the relation, substitution and units.

[2]

**2.3** Decide whether this claim is true and justify: A negative velocity always means the object is slowing down.

[2]

**2.4** Rate of change of displacement: write the technical term.

[1]

## 3 Exam-style questions

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**3.1** Velocity falls uniformly from  $+6$  to  $-2$  m/s in 4 s. Find acceleration, displacement and distance. Explain why the last two differ.

[4]