Velocity–time graphs: gradients and direction

Student activity • observation and reasoning

YEAR 10 / LESSON 13 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

How can a velocity–time graph show both speeding up and slowing down?

Plot an original idealised journey and distinguish velocity, speed and acceleration.

Equipment

- Booklet, graph paper, ruler and calculator

Written graph activity only; no moving vehicles or live road observations are required.

Course coverage: Shared Physics / Double Award: 1.6–1.8. Velocity, acceleration and graph gradients.

Plan, model or apparatus sketch

Draw a labelled setup or force diagram; include the measured quantities.

Method and reasoning

Read the whole sequence before starting

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1. Label time in seconds on the horizontal axis and velocity in m s^{-1} on the vertical axis. Choose rightward as positive.

2. Plot the supplied practice points and join them with straight segments. Treat these as a specified model, not experimental observations.

3. Describe the first three segments: increasing positive velocity, constant positive velocity and decreasing positive velocity.

4. Calculate each segment's gradient using change in velocity divided by elapsed time. State the sign and unit of each acceleration.

5. Extend the graph with the optional reverse-motion segment, then explain why a negative velocity is not the same as negative speed.

6. Compare with a distance–time graph: explain why a horizontal line means different things on the two types of graph.

Cleanup

- Keep corrected graphs and return rulers.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Practice points: (time / s, velocity / m s^{-1}) = (0,0), (4,8), (7,8), (11,0). Optional extension: (13,−4). Acceleration is the gradient; speed is the magnitude of velocity. A negative gradient can mean slowing down while velocity is positive, or speeding up in the negative direction after velocity crosses zero.

Time interval / s	Change in v / m s^{-1}	Acceleration / m s^{-2}
0–4		
4–7		
7–11		
11–13 extension		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Find acceleration from 0 to 4 s.

2. What happens from 4 to 7 s?

3. Find acceleration from 7 to 11 s.

4. Is the object stationary throughout a horizontal velocity–time segment?

5. What does velocity −4 m s^{-1} mean?

6. When does a negative acceleration reduce speed?