

Acceleration Velocity Time Graphs

GCSE Physics · Written to the shared content for AQA, Edexcel and OCR

Name _____ Class _____ Date _____

1. Worked example

A car speeds up from 5.0 m/s to 25 m/s in 4.0 s. Calculate its acceleration. (3 marks)

Step 1 · Write the equation

$$\text{acceleration} = \text{change in velocity} \div \text{time taken}, a = \Delta v \div t$$

Step 2 · Change in velocity

$$\Delta v = 25 - 5.0 = 20 \text{ m/s}$$

Step 3 · Calculate

$$a = 20 \div 4.0 = 5.0 \text{ m/s}^2$$

Answer: 5.0 m/s²

Check: The velocity increases by 5 m/s every second.

2. Now try one with the steps

Use the cyclist's velocity–time graph to find the acceleration in the first 4 s and the total distance travelled. (4 marks)

Step 1 · Gradient 0–4 s

Step 2 · Area 0–4 s (triangle)

Step 3 · Area 4–10 s (rectangle) and 10–14 s (triangle)

Step 4 · Total

Answer:

3. Practice

Show your working. The marks tell you how much is expected.

1. Define acceleration. [1]

2. Write the equation linking acceleration, change in velocity and time. [1]

3. A car accelerates from 5.0 m/s to 25 m/s in 4.0 s. Calculate its acceleration in m/s². [2]

4. State the unit of acceleration. [1]

5. State what the gradient of a velocity–time graph represents. [1]

6. State what the area under a velocity–time graph represents. [1]

7. A car slows from 20 m/s to rest in 5.0 s. Calculate its acceleration in m/s². [2]

8. Use the cyclist's velocity–time graph to calculate the distance travelled in the first 4 s. [2]

9. Use the cyclist's velocity–time graph to calculate the total distance travelled. [3]

10. An object starts from rest and accelerates at 3.0 m/s² over 24 m. Use $v^2 - u^2 = 2as$ to find its final velocity in m/s. [3]

11. Calculate the time for a car to go from rest to 27 m/s with an acceleration of 3.0 m/s². [2]

12. A stone is dropped from rest and falls 20 m. Calculate its speed just before it lands, ignoring air resistance. Acceleration due to gravity = 9.8 m/s^2 . Give your answer in m/s to 3 significant figures. [3]

13. A car travelling at 30 m/s stops in 45 m. Calculate its acceleration in m/s^2 . [3]

14. Explain how to estimate the distance travelled from a curved velocity–time graph. [2]

4. Before you hand it in

a = $25 \div 4$ for a car going from 5 to 25 m/s in 4 s

$$a = (\text{final} - \text{initial}) \div \text{time} = (25 - 5) \div 4 = 5 \text{ m/s}^2.$$

Reading the distance from the y-axis of a velocity–time graph

Distance is the area under the line; acceleration is the gradient.

Forgetting to square u and v in $v^2 - u^2 = 2as$

Square each velocity first, then subtract. Finally take the square root if you are finding v.

Dropping the minus sign for deceleration

A negative acceleration means slowing down; say 'deceleration of 10 m/s^2 ' or write $a = -10 \text{ m/s}^2$.