Draw Velocity-Time Graphs from Motion Descriptions: Slope as Acceleration

Complete worked example / separate answer key

A cart starts at rest. From 0 s to 3 s it accelerates uniformly to 6 m/s. From 3 s to 8 s it travels at constant 6 m/s. From 8 s to 10 s it slows uniformly to 2 m/s. Draw the velocity-time graph and state the acceleration for each segment.

Answer: Plot points (0,0), (3,6), (8,6), (10,2). Connect with straight segments. Segment 1 slope = (6-0)/(3-0)=2 m/s². Segment 2 slope = (6-6)/(8-3)=0 m/s². Segment 3 slope = (2-6)/(10-8)=-2 m/s². The graph rises from 0 to 6 m/s over 3 s, stays level at 6 m/s for 5 s, then falls to 2 m/s over 2 s.

Draw Velocity-Time Graphs from Motion Descriptions: Slope as Acceleration

Original tasks 1, 2, 3 / complete keys

Task 1

A cyclist moves at 4 m/s from 0 s to 5 s, then accelerates uniformly to 10 m/s from 5 s to 9 s, then stays at 10 m/s from 9 s to 12 s. Draw the velocity-time graph and give the acceleration for each segment.

Answer: Points: (0,4), (5,4), (9,10), (12,10). Segment 1 slope 0 m/s²; segment 2 slope (10-4)/(9-5)=1.5 m/s²; segment 3 slope 0 m/s².

Reason: List endpoints from the description, plot them, connect with straight lines, and compute slope as change in velocity over change in time for each segment.

Check: Recompute each slope from the plotted endpoints; confirm the graph is level from 0 to 5 s and from 9 to 12 s, and rises steadily from 4 to 10 m/s between 5 s and 9 s.

Task 2

A lift starts at 0 m/s at 0 s, speeds up uniformly to 3 m/s at 2 s, holds 3 m/s until 6 s, then slows uniformly to 0 m/s at 8 s. Draw the velocity-time graph and state each acceleration.

Answer: Points: (0,0), (2,3), (6,3), (8,0). Accelerations: (3-0)/(2-0)=1.5 m/s²; 0 m/s²; (0-3)/(8-6)=-1.5 m/s².

Reason: The lift has three constant-acceleration phases, so three straight segments. Slope of the first is positive, second zero, third negative.

Check: Check that the graph starts and ends at 0 m/s, is level between 2 s and 6 s, and that the two sloped segments have equal magnitude but opposite sign.

Task 3

A toy car moves forward at 2 m/s from 0 s to 3 s, then accelerates uniformly to 8 m/s from 3 s to 7 s, then brakes uniformly to rest at 9 s. Draw the graph and compute all accelerations.

Answer: Points: (0,2), (3,2), (7,8), (9,0). Accelerations: 0 m/s²; (8-2)/(7-3)=1.5 m/s²; (0-8)/(9-7)=-4 m/s².

Reason: Three segments: constant velocity, positive acceleration, negative acceleration. Plot endpoints and connect straight.

Check: Verify the final velocity is 0 m/s at 9 s and that the last slope is steeper than the middle slope in magnitude, matching -4 versus 1.5 m/s².

Draw Velocity-Time Graphs from Motion Descriptions: Slope as Acceleration

Original tasks 4 / complete keys

Task 4

A ball rolls forward at 5 m/s from 0 s to 2 s, slows uniformly to 0 m/s at 4 s, then continues to -3 m/s at 6 s. Draw the velocity-time graph and give the acceleration for each segment.

Answer: Points: (0,5), (2,5), (4,0), (6,-3). Accelerations: 0 m/s²; (0-5)/(4-2)=-2.5 m/s²; (-3-0)/(6-4)=-1.5 m/s².

Reason: The ball reverses direction, so velocity passes through zero at 4 s and becomes negative. Each segment is straight because acceleration is constant.

Check: Confirm the graph crosses the time axis at 4 s, the vertical axis includes negative values, and both sloped segments have negative slopes with the computed magnitudes.

Draw Velocity-Time Graphs from Motion Descriptions: Slope as Acceleration

Worked example, Task 1, Task 2, Task 3, Task 4 / Separate answer key: graphs, endpoints, slopes, checks

Answer key for all four exercises plus worked example.

Worked example: Plot points (0,0), (3,6), (8,6), (10,2). Connect with straight segments. Segment 1 slope = (6-0)/(3-0)=2 m/s². Segment 2 slope = (6-6)/(8-3)=0 m/s². Segment 3 slope = (2-6)/(10-8)=-2 m/s². The graph rises from 0 to 6 m/s over 3 s, stays level at 6 m/s for 5 s, then falls to 2 m/s over 2 s.

Exercise 1 answer: Points: (0,4), (5,4), (9,10), (12,10). Segment 1 slope 0 m/s²; segment 2 slope (10-4)/(9-5)=1.5 m/s²; segment 3 slope 0 m/s². Check: Recompute each slope from the plotted endpoints; confirm the graph is level from 0 to 5 s and from 9 to 12 s, and rises steadily from 4 to 10 m/s between 5 s and 9 s.

Exercise 2 answer: Points: (0,0), (2,3), (6,3), (8,0). Accelerations: (3-0)/(2-0)=1.5 m/s²; 0 m/s²; (0-3)/(8-6)=-1.5 m/s². Check: Check that the graph starts and ends at 0 m/s, is level between 2 s and 6 s, and that the two sloped segments have equal magnitude but opposite sign.

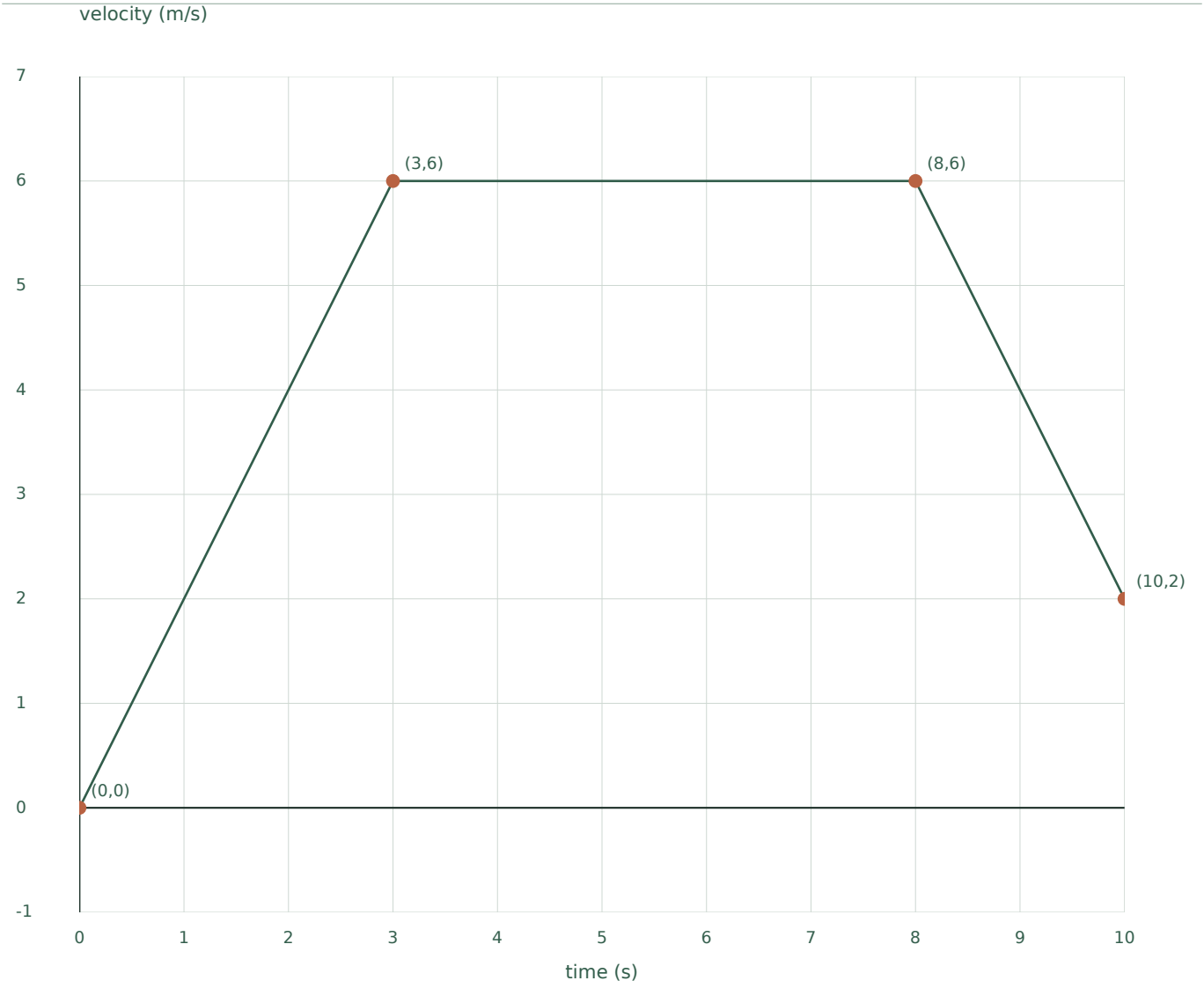
Exercise 3 answer: Points: (0,2), (3,2), (7,8), (9,0). Accelerations: 0 m/s²; (8-2)/(7-3)=1.5 m/s²; (0-8)/(9-7)=-4 m/s². Check: Verify the final velocity is 0 m/s at 9 s and that the last slope is steeper than the middle slope in magnitude, matching -4 versus 1.5 m/s².

Exercise 4 answer: Points: (0,5), (2,5), (4,0), (6,-3). Accelerations: 0 m/s²; (0-5)/(4-2)=-2.5 m/s²; (-3-0)/(6-4)=-1.5 m/s². Check: Confirm the graph crosses the time axis at 4 s, the vertical axis includes negative values, and both sloped segments have negative slopes with the computed magnitudes.

Rubric: Axes are labelled velocity (m/s) vertical and time (s) horizontal, with a stated scale. Every stated time-velocity endpoint is plotted correctly, including zero and negative values if present. Segments are straight where acceleration is constant and horizontal where velocity is constant. Each segment's slope is computed and labelled with correct units m/s². Graph is clear enough to check without guessing; alternative scales and handwriting styles are acceptable if the

Draw Velocity-Time Graphs from Motion Descriptions: Slope as Acceleration

Worked example / Worked example: segmented velocity-time graph



Segment slopes: 2 m/s², 0 m/s², -2 m/s².

Draw Velocity-Time Graphs from Motion Descriptions: Slope as Acceleration

Source rubric / reflection

- [ ] Axes are labelled velocity (m/s) vertical and time (s) horizontal, with a stated scale.
- [ ] Every stated time-velocity endpoint is plotted correctly, including zero and negative values if present.
- [ ] Segments are straight where acceleration is constant and horizontal where velocity is constant.
- [ ] Each segment's slope is computed and labelled with correct units m/s^2.
- [ ] Graph is clear enough to check without guessing; alternative scales and handwriting styles are acceptable if labels are unambiguous.

Reflection: What did you check, what did you change, and what will you try next?