

High School Physics: 1D Kinematics & Motion Graph Analysis



Use the matching sheet ID when checking answers.

Part A: Kinematics Calculations. Solve each mechanical physics problem below using constant acceleration equations.

1. A high-speed train accelerates uniformly from rest ($v_0 = 0$ m/s) at a rate of 2.5 m/s^2 for 10 seconds. What is the train's final velocity v_f and total displacement Δx over this interval?

Answer: A. $v_f = 25 \text{ m/s}$; $\Delta x = 125 \text{ meters}$

Final velocity $v_f = v_0 + at = 0 + (2.5)(10) = 25 \text{ m/s}$. Displacement $\Delta x = v_0t + 0.5at^2 = 0 + 0.5(2.5)(10^2) = 0.5(2.5)(100) = 125 \text{ meters}$.

2. On a Velocity vs. Time (v-t) graph, what physical quantity is represented by the SLOPE of the line, and what is represented by the AREA under the line?

Answer: B. Slope = Acceleration; Area = Displacement (change in position)

Slope = $\Delta v / \Delta t$ = acceleration (m/s^2). The integral (area under curve) = $\int v \, dt$ = displacement Δx (meters).

3. A rock is dropped from rest off the edge of a cliff. Neglecting air resistance, what is the rock's velocity after falling freely for 3.0 seconds (taking downward $g = 9.8 \text{ m/s}^2$)?

Answer: B. 29.4 m/s downward

$v_f = v_0 + gt = 0 + (9.8 \text{ m/s}^2)(3.0 \text{ s}) = 29.4 \text{ m/s}$ downward.

Part B: Motion Graph Interpretation Matrix. Identify the motion characteristics corresponding to each graph type.

Sort these items: Horizontal flat line indicates object is stationary at rest (velocity = 0); Horizontal flat line above the axis indicates constant, unchanging velocity (zero acceleration); Non-zero constant horizontal line indicates uniform acceleration (parabolic position graph); Parabolic curve indicates changing velocity (active acceleration); Linear slope represents acceleration; crossing the horizontal axis indicates change in direction; Area under curve represents change in velocity (Δv) over the specified time interval

Position vs Time (x-t)	Velocity vs Time (v-t)	Acceleration vs Time (a-t)
Horizontal flat line indicates object is stationary at rest (velocity = 0); Parabolic curve indicates changing velocity (active acceleration)	Horizontal flat line above the axis indicates constant, unchanging velocity (zero acceleration); Linear slope represents acceleration; crossing the horizontal axis indicates change in direction	Non-zero constant horizontal line indicates uniform acceleration (parabolic position graph); Area under curve represents change in velocity (Δv) over the specified time interval