

KINEMATICS DAY 12: UNIT REVIEW

THE TOOLBOX

Tool	Equation	Watch out for
Average velocity	$\bar{v} = \Delta x / \Delta t$	$\neq$ average speed after a turn-around
Acceleration	$a = \Delta v / \Delta t$	sign of $a \neq$ slowing down
Kinematic equations	$v_f = v_i + at$ · $\Delta x = v_i t + \frac{1}{2}at^2$ · $v_f^2 = v_i^2 + 2a\Delta x$	constant a only; pick by missing variable
Free fall	$a = 9.8 \text{ m/s}^2$ downward, always	at the top: $v = 0$, $a \neq 0$
Components	$A_x = A \cos \theta$, $A_y = A \sin \theta$	Pythagoras only for perpendicular pieces
Projectiles	x : constant v y : free fall	time is the only shared quantity
Relative motion	$v_{AC} = v_{AB} + v_{BC}$	current/wind changes <i>where</i> , not <i>when</i>

THE GRAPH TRIO

x-t: slope = velocity. **v-t:** slope = acceleration, area = displacement — $(\text{m/s})(\text{s}) = \text{m}$. **a-t:** area = Δv — $(\text{m/s}^2)(\text{s}) = \text{m/s}$.

Going right ($x-t \rightarrow v-t \rightarrow a-t$) you take slopes; going left you take areas. The units always confirm which way you went.

The AP Physics 1 exam has exactly four free-response questions, one of each type below. You have now practiced every one of them in this unit.

FRQ Type	What it asks	You practiced it
Mathematical Routines	A multi-step calculation. Points come from symbolic setup, substitution with units, and a sensible result.	Day 5 — Stoplight Chase
Translation Between Representations	Move between words, motion diagrams, graphs, and equations for one motion — and keep them consistent.	Day 9 — One Marble, Four Pictures
Experimental Design & Analysis	Design a procedure (what you measure, with what, how many trials) and analyze data — usually by linearizing a graph.	Day 7 — Constant Acceleration Lab
Qualitative/Quantitative Translation	Connect a written argument to the math. Paragraphs are graded claim → evidence → reasoning.	Day 6 — The Top of the Flight

UNIVERSAL FRQ SCORING HABITS

- Write the symbolic equation *before* plugging in numbers
- Substitute with units and let them multiply through — wrong units are a wrong-equation alarm
- Answer the question asked (direction! sign! units!), then sanity-check the size
- In paragraphs: claim, evidence (equation or law), reasoning that connects them — complete sentences, no equations dumped without words

AP FRQ · SYNTHESIS Off the Cliff, One Last Time

A ball rolls off a 44.1 m cliff moving horizontally at 12 m/s.

(a) Find the time to land and the landing distance from the cliff base. Symbols first, then numbers with units.

(b) Find the impact speed.

(c) Sketch v_y versus t for the flight (label the final value).

(d) In a short paragraph: if the ball left the cliff at 24 m/s instead, how would the fall time and the landing distance each change? Justify using the independence of the axes.

PAPER PRACTICE

PRACTICE PROBLEMS — TEST-STYLE MIX

P1 Braking

A car at 28 m/s brakes at -7.0 m/s^2 . How far does it travel before stopping?

P2 Up and Down

A ball is thrown straight up at 24.5 m/s. Find the total flight time and the maximum height.

P3 River

A kayaker paddles 2.5 m/s straight across a 50 m river with a 1.2 m/s current. Find the crossing time and downstream drift.

P4 The Chase, Reprised

A cyclist passes a resting friend at a constant 9.0 m/s. The friend immediately accelerates from rest at 3.0 m/s^2 . How long until the friend catches up, and how far have they gone?