CONSTANT SPEED

Position, velocity, and the slope of an x–t graph

Name: _____	Period: _____	Date: _____

INVESTIGATION QUESTION **How does position change when an object moves with constant velocity?**

TIME 30 minutes	SIMULATION BuildPhysics > Constant speed	UNIT 1 Kinematics

Learning targets

- Collect position-time data for several constant velocities.
- Use the slope of an x–t graph to determine horizontal velocity.
- Explain why the acceleration is zero even while the object is moving.

Model before you measure

Choose +x to the right. Keep the surface frictionless and begin each trial from the same starting position.	**Constant-velocity model** $\Delta x = v_x \Delta t$ slope of x–t = v_x $a_x = 0$

Important: A steeper x–t line means a greater magnitude of velocity. A negative slope means motion in the −x direction.

Pre-lab prediction | 4 minutes

1. Sketch or describe the shape of an x–t graph for constant positive velocity.

_____

2. What should happen to the graph slope if the velocity doubles?

_____

3. Describe the v_x–t and a_x–t graphs for constant-speed motion.

_____

PART A Measure position and graph slope

Setup | 3 minutes

□ Load Constant speed. Select the Constant-speed block.

□ Open Data → Graph and display x, v_x, and a_x. Keep only x visible while finding each slope.

□ Use the velocity controls to set the listed v_x. Reset before every trial and start at the same x-position.

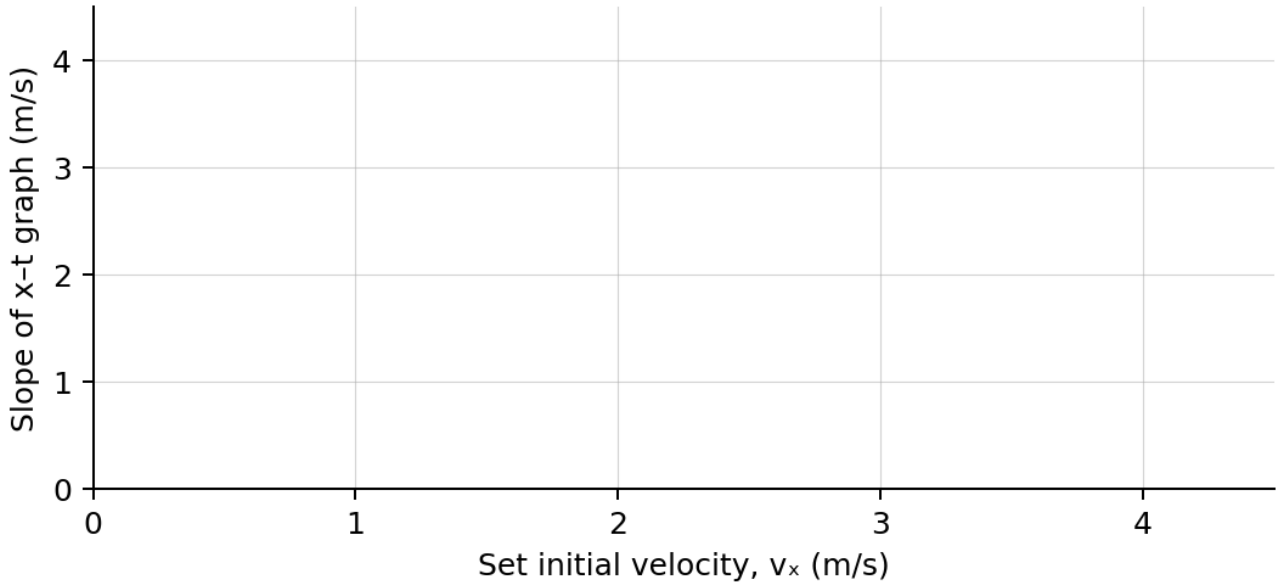
□ Run each trial for 3.0 s, then pause and record the position values.

Consistent trials: Reset → set v_x → Run → pause at 3.0 s → record. Keep gravity, surface, and starting position unchanged.

Data table | 10 minutes

Trial	Set v_x (m/s)	x at 0 s (m)	x at 1 s (m)	x at 2 s (m)	x at 3 s (m)	Graph slope (m/s)
1	1.0					
2	2.0					
3	3.0					
4	4.0					

Slope calculation: slope = Δx/Δt = _____



4. Plot graph slope versus the set initial velocity. Draw a best-fit line.

PART B Reverse direction and analyze

Direction test | 5 minutes

Set v_x (m/s)	x at 0 s (m)	x at 2.0 s (m)	Δx (m)	x–t slope (m/s)	a_x (m/s²)
−2.0					

5. How did the sign of the slope identify the direction of motion?

Analysis | 8 minutes

6. Compare each measured graph slope with the velocity you set. How close were they?

7. What does the y-intercept of an x–t graph represent physically?

8. Why can an object have nonzero velocity while its acceleration is zero?

9. Predict the displacement of a block moving at −3.5 m/s for 4.0 s.

Claim-Evidence-Reasoning conclusion

Evaluate this statement: “An object must have a net change in speed in order to change its position.”

CLAIM	Accept, reject, or revise the statement.
EVIDENCE	Cite at least two measurements or graph features.
REASONING	Connect your evidence to the kinematics model.

Exit ticket

A block’s x–t graph has a constant slope of +2.4 m/s. State its velocity and acceleration.