CONSTANT ACCELERATION

Position, velocity, and equal-time changes

Name: _____	Period: _____	Date: _____

INVESTIGATION QUESTION **How do position and velocity change during motion with constant acceleration?**

TIME	SIMULATION	UNIT 1
30 minutes	BuildPhysics > Constant acceleration	Kinematics

Learning targets

- Use x–t, v_x–t, and a_x–t data to identify constant acceleration.
- Relate the slope of a v_x–t graph to acceleration.
- Test the relationships $v_x = v_{x0} + a_x t$ and $\Delta x = v_{x0} t + \frac{1}{2} a_x t^2$.

Model before you measure

Choose +x to the right. Begin each trial from rest at the same position.	**Constant-acceleration model** $v_x = v_{x0} + a_x t$ $\Delta x = v_{x0} t + \frac{1}{2} a_x t^2$

Use for this lab: $g = 9.8\ m/s^2$. Gravity is balanced by the surface, so the measured horizontal acceleration is controlled separately.

Pre-lab prediction | 4 minutes

1. Describe the expected shapes of the x–t, v_x–t, and a_x–t graphs.

_____

_____

2. During equal time intervals, should the changes in velocity be equal? Explain.

_____

PART A One detailed constant-acceleration trial

Setup | 3 minutes

☐ Load Constant acceleration. Select the Constant-acceleration block.

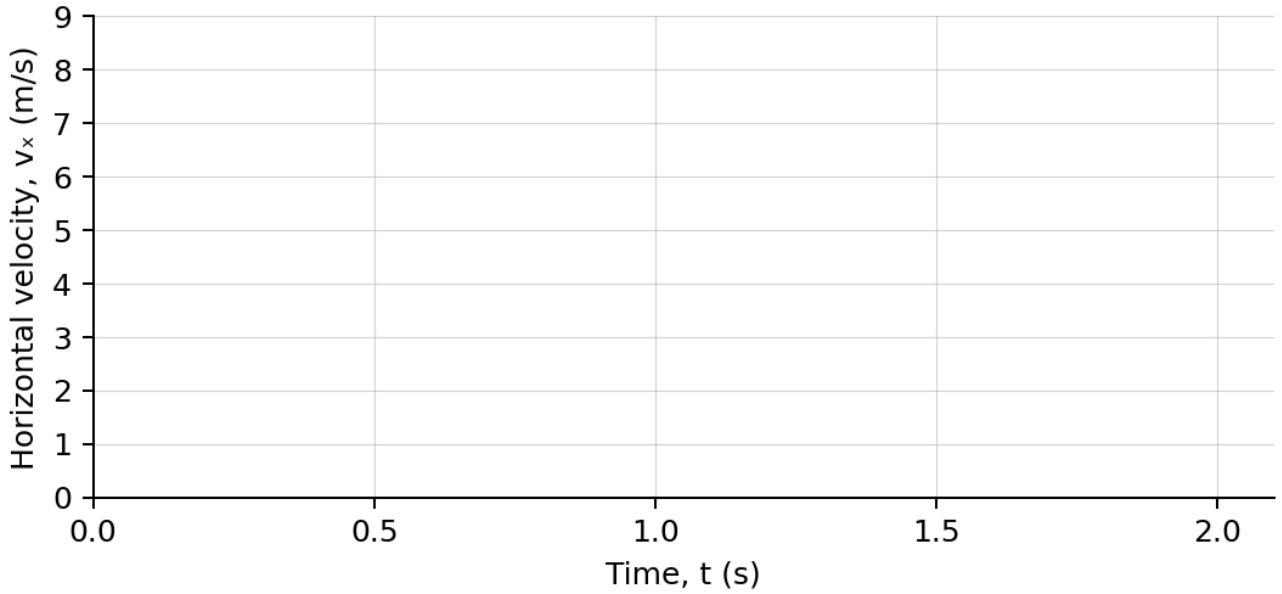
☐ Open Analyze → Graph and display x, v_x, and a_x.

☐ Use Set acceleration or the object controls to set a_x = +2.0 m/s² and v_{x0} = 0.

☐ Reset, run for 2.0 s, and use the graph cursor to record the data below.

Time-series data | 8 minutes

t (s)	x (m)	v_x (m/s)	a_x (m/s²)	Δv_x during next 0.5 s	Δx during next 0.5 s
0.0					
0.5					
1.0					
1.5					
2.0					



3. Plot v_x versus t and draw a best-fit line. Calculate its slope.

4. Compare the slope with the acceleration shown by BuildPhysics.

PART B Change acceleration and test the model

Controlled trials | 8 minutes

Keep v_{x0} = 0 and t = 2.0 s. Change only a_x. Reset before each trial.

Trial	Set a_x (m/s^2)	Measured v_x at 2.0 s	Measured Δx at 2.0 s	$\Delta v_x/\Delta t$ (m/s^2)	$2\Delta x/t^2$ (m/s^2)
1	1.0				
2	2.0				
3	3.0				
4	4.0				

Analysis | 7 minutes

5. What stayed constant in the v_x–t data, and what changed when a_x increased?

6. Compare $\Delta v_x/\Delta t$ and $2\Delta x/t^2$ with the acceleration you set. What pattern do you observe?

7. Why does an x–t graph curve upward even though acceleration is constant?

8. At a_x = 3.0 m/s^2, predict v_x and Δx after 3.0 s from rest.

Claim-Evidence-Reasoning conclusion

Evaluate this statement: “Constant acceleration means an object travels equal distances during equal time intervals.”

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 v_x–t graph is a straight line with slope −1.5 m/s^2. Describe the object’s acceleration and how its velocity changes each second.