PROJECTILE-MOTION INDEPENDENCE

Comparing dropped and horizontally launched objects

Name: _____	Period: _____	Date: _____

INVESTIGATION QUESTION **Does horizontal velocity change the time required to fall from a given height?**

TIME 30 minutes	SIMULATION BuildPhysics > Projectile-motion independence	UNIT 1 Kinematics

Learning targets

- Compare the vertical position and velocity of two objects with different horizontal velocities.
- Test whether horizontal launch speed affects fall time.
- Relate horizontal range to horizontal speed and common flight time.

Model before you measure

Both objects begin at the same height with $v_{yo} = 0$. One object is dropped; the other has a horizontal velocity.	**Vertical model for both objects** $\Delta y = -\frac{1}{2}gt^2$ $v_y = -gt$ $g = 9.8\ m/s^2$

Key comparison: At the same time, compare y, v_y, and a_y—not the total speed or horizontal position.

Pre-lab prediction | 4 minutes

1. Which ball should reach the ground first? Explain your reasoning.

_____

2. At t = 1.0 s, predict whether the balls have the same y and v_y.

_____

3. What should happen to the launched ball's range if v_x doubles?

_____

PART A Compare vertical motion

Setup | 3 minutes

□ Load Projectile-motion independence. Keep the dropped ball at $v_x = 0$ and the launched ball at $v_x = 6.0$ m/s.

□ Open graph data. For each ball, display y and v_y.

□ Reset and run both objects together. Pause at each listed time and record the values.

□ Continue until both objects first contact the landing ground.

Synchronized data | 8 minutes

t (s)	Dropped y (m)	Launched y (m)	Dropped v_y (m/s)	Launched v_y (m/s)
0.25				
0.50				
0.75				
1.00				

Object	Initial v_x (m/s)	Landing time (s)	Horizontal range (m)	v_y before landing (m/s)
Dropped ball	0.0			
Launched ball	6.0			

4. Use your measurements to state whether the vertical motions matched.

_____

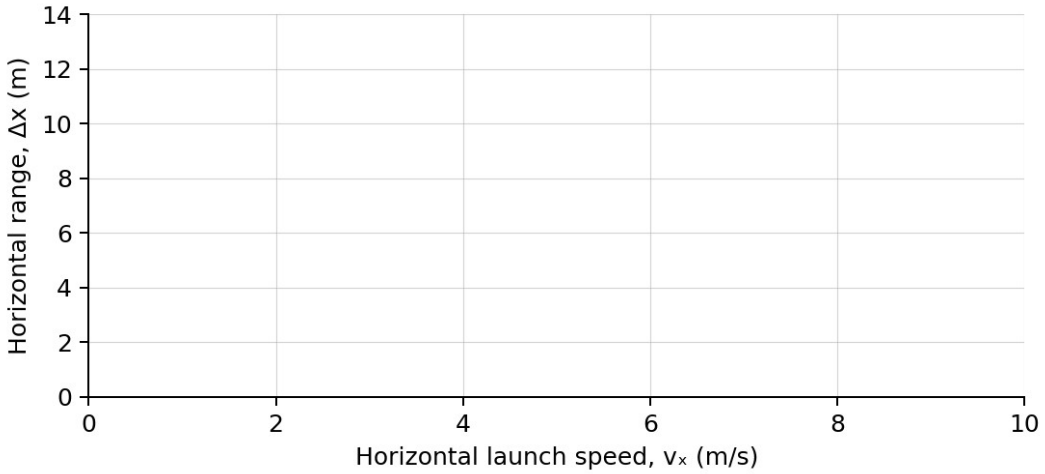
_____

PART B Change horizontal speed

Controlled trials | 8 minutes

Keep the starting height and $v_{y0} = 0$ unchanged. Change only the launched ball's v_x.

Trial	Launched v_x (m/s)	Dropped landing time (s)	Launched landing time (s)	Launched range (m)
1	3.0			
2	6.0			
3	9.0			



5. Plot range versus v_x. What does the slope represent physically?

Analysis | 6 minutes

6. Why does changing v_x change range but not landing time?

7. How can two objects have the same v_y but different total speeds?

8. Use $\Delta y = -\frac{1}{2}gt^2$ and $g = 9.8\ m/s^2$ to explain why both objects have the same fall time.

Claim-Evidence-Reasoning conclusion

Evaluate this statement: "A horizontally launched object stays in the air longer than an object dropped from the same height."

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

Two balls leave the same height with identical v_{y0} but different v_x. Which vertical quantities must be identical at every shared time?