INCLINED PLANE

Ramp angle, force components, and acceleration

Name: _____	Period: _____	Date: _____

INVESTIGATION QUESTION **How does ramp angle affect the acceleration of a block on a frictionless incline?**

TIME 30 minutes	SIMULATION BuildPhysics > Inclined plane	UNIT 2 Force & Translational Dynamics

Learning targets

- Resolve weight into components parallel and perpendicular to a ramp.
- Test the relationship between acceleration and sin θ.
- Determine whether mass affects frictionless incline acceleration.

Model before you measure

Keep friction off. Choose the positive direction down the ramp. Use the angle tool or the displayed surface angle to set each trial.	$F_{\parallel} = mg \sin\theta$ $F_N = mg \cos\theta$ $a = g \sin\theta$

Important: Use g = 9.8 m/s² for calculations. Reset after changing the ramp geometry so the block begins from rest on the surface.

Pre-lab prediction | 4 minutes

1. As the ramp becomes steeper, what should happen to the component of weight parallel to the ramp?

2. Predict the acceleration at θ = 30°.

3. Will a 4 kg block accelerate faster than a 1 kg block on the same frictionless ramp? Explain.

PART A Change ramp angle and measure acceleration

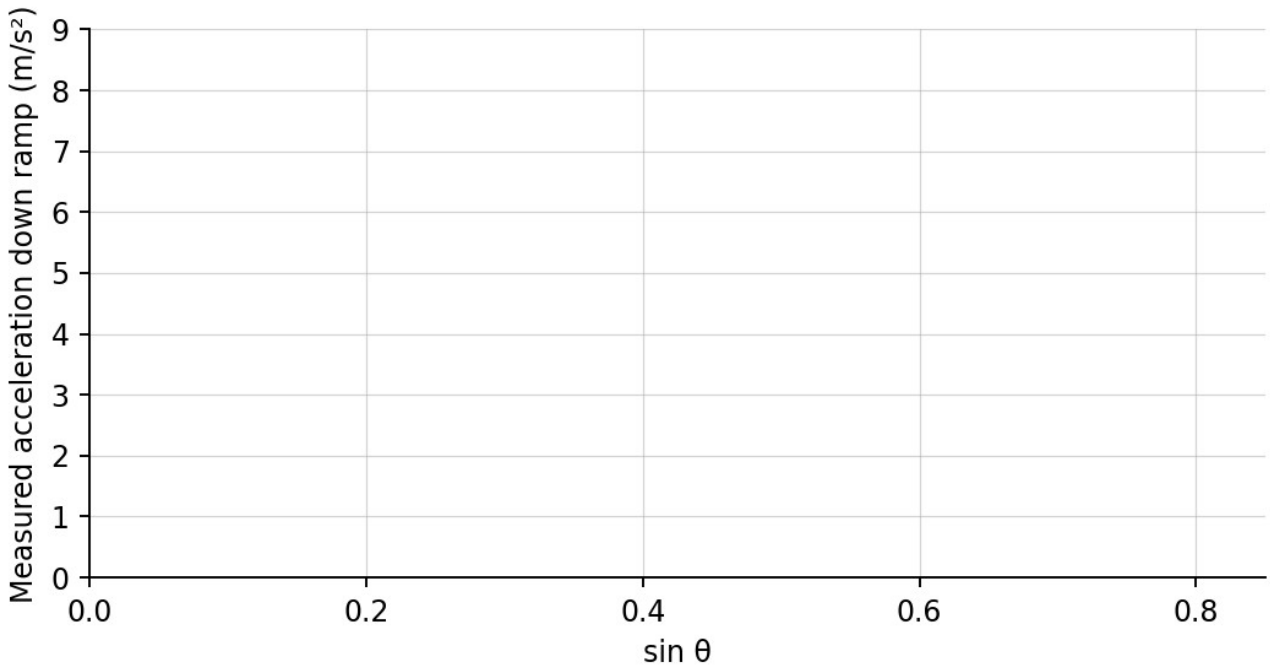
Setup | 3 minutes

- ☐ Load Inclined plane. Confirm friction is off and parallel/perpendicular force components are visible.
- ☐ Select the incline and adjust its upper endpoint until the angle matches the table.
- ☐ Select the block and display acceleration and force values. Keep mass constant.
- ☐ Reset, run for about 1 s, pause, and record the acceleration along the ramp.

Angle sequence: Use 10°, 20°, 30°, 40°, and 50°. Place the block at the same relative position before each trial.

Data table | 10 minutes

θ (deg)	sin θ	Predicted a = g sin θ (m/s²)	Measured a (m/s²)	Measured F_n (N)
10				
20				
30				
40				
50				



4. Plot measured acceleration versus sin θ. Draw a best-fit line.

PART B Change mass at a fixed angle

Mass test | 6 minutes

Fixed geometry: Set θ = 30°. Use the same starting position and keep friction off.

Mass (kg)	Measured a (m/s²)	Parallel weight component (N)	Normal force (N)
1.0			
2.0			
4.0			

Analysis | 8 minutes

5. What did the slope of the acceleration-versus-sin θ graph represent? Compare it with 9.8 m/s².

6. How did the normal force change as angle increased? Explain using components.

7. How did mass affect acceleration at 30°? How did it affect the force components?

8. Why does mass cancel when deriving a = g sin θ?

Claim-Evidence-Reasoning conclusion

Evaluate this statement: “A heavier block slides faster than a lighter block on the same frictionless incline.”

CLAIM	Accept, reject, or revise the statement.
EVIDENCE	Cite at least two measurements or graph features.
REASONING	Connect your evidence to the force model and Newton's laws.

Exit ticket

At what incline angle would a frictionless block accelerate at 4.9 m/s²? Show the relationship you use.