Newton's Second Law

BuildPhysics Guided Investigation

Name: _____	Period: _____	Date: _____

Investigation question: How do net force and mass determine an object's acceleration?

Learning goals: Collect controlled data, identify direct and inverse relationships, and use graph slopes to interpret Newton's second law.

30 minutes

4 min setup
9 min Part A
9 min Part B
8 min analysis

1. Open and verify the preset

☐ Open BuildPhysics and load Unit 2 -> Newton's Second Law.

☐ Select the block. Confirm the starting mass is 2.0 kg and the horizontal applied force is 6.0 N.

☐ Keep friction off. Keep the block on the horizontal surface and begin each trial from rest.

☐ Open Analyze -> Graph. Display net force x, acceleration x, and velocity x.

☐ For every trial: change only the listed variable, press Reset, run briefly, pause, and record the constant acceleration.

Measurement tip: Use the flat value on the acceleration graph or the selected-object acceleration readout. Record at least two significant figures.

2. Predict before collecting data

1. If the net force doubles while mass remains constant, what should happen to acceleration? Explain.

_____

2. If the mass doubles while net force remains constant, what should happen to acceleration? Explain.

_____

3. Identify the independent variable, dependent variable, and two controlled variables for Part A.

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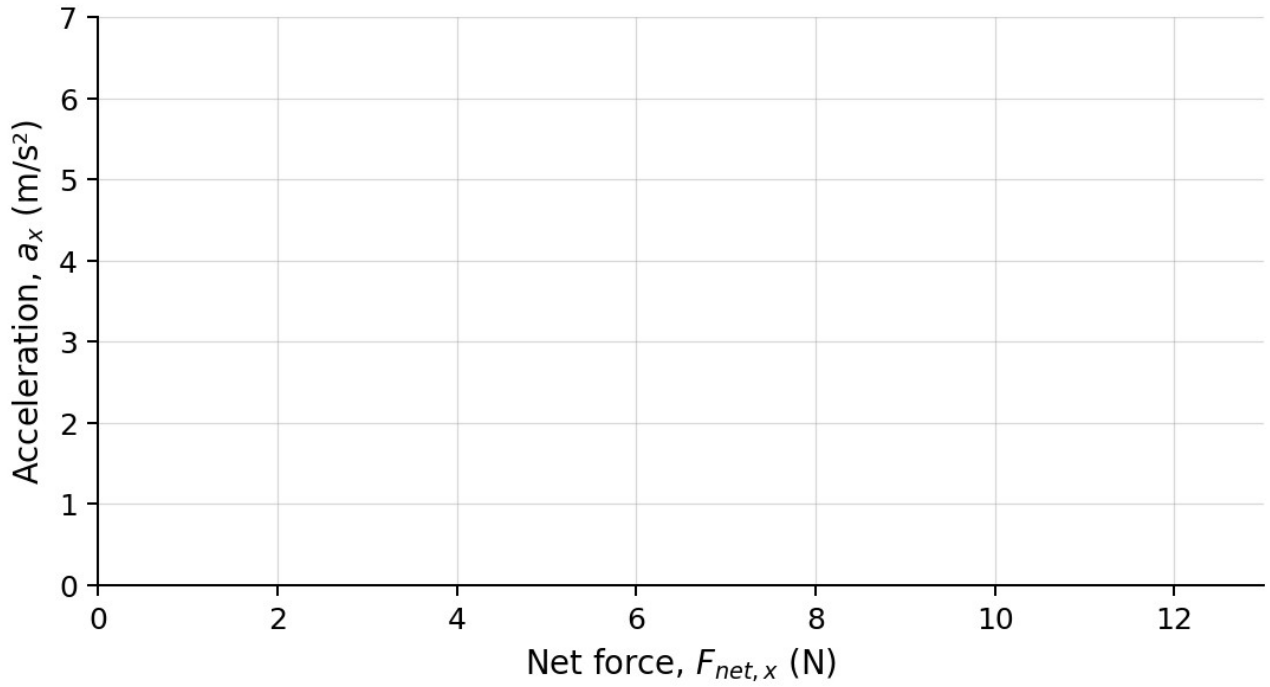
Part A - How does acceleration depend on net force?

Keep mass constant at 2.0 kg. Change only the horizontal applied force. Reset before each trial.

Trial	Mass m (kg)	Net force Fnet,x (N)	Predicted a Fnet/m (m/s²)	Measured ax (m/s²)
1	2.0	3.0		
2	2.0	6.0		
3	2.0	9.0		
4	2.0	12.0		



4. Plot measured acceleration versus net force. Draw a best-fit line.

5. Calculate the slope of your best-fit line, including units.

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6. What physical quantity does the slope represent? Compare it with the value expected from the constant mass.

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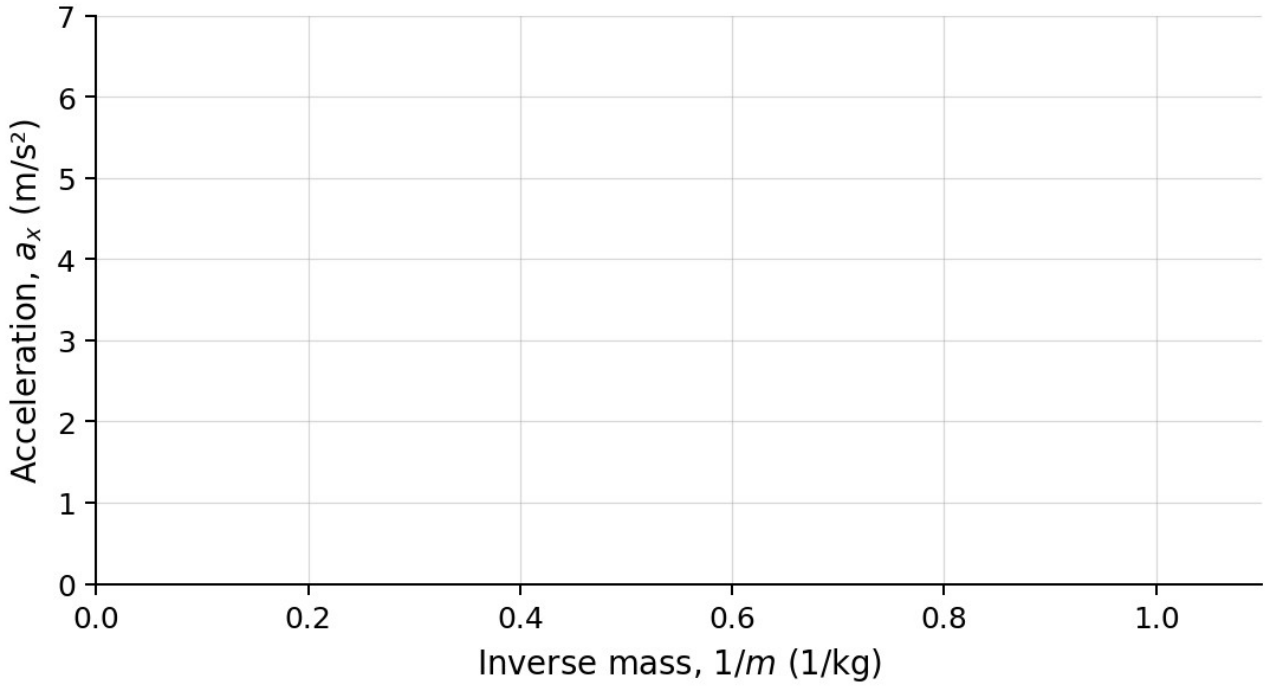
Part B - How does acceleration depend on mass?

Keep net force constant at 6.0 N. Change only the block's mass. Reset before each trial.

Trial	Net force Fnet,x (N)	Mass m (kg)	1/m (1/kg)	Predicted a Fnet/m (m/s²)	Measured ax (m/s²)
1	6.0	1.0			
2	6.0	2.0			
3	6.0	3.0			
4	6.0	4.0			



7. Plot measured acceleration versus 1/m. Draw a best-fit line.

8. Calculate the slope of this graph, including units.

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9. What physical quantity does the slope represent? Compare it with the constant force used in Part B.

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_____

3. Analysis and conclusion

10. State the mathematical relationship between acceleration and net force when mass is constant.

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11. State the mathematical relationship between acceleration and mass when net force is constant.

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12. Why is acceleration versus mass curved, while acceleration versus 1/m is linear?

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13. A 5.0 kg block experiences a net force of 15 N. Predict its acceleration. Then test your prediction in BuildPhysics and record the measured value.

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Claim	Write one sentence that answers the investigation question.
Evidence	Use at least two numerical results or graph slopes.
Reasoning	Connect your evidence to Fnet = ma and the patterns in both investigations.
One source of uncertainty	Describe one measurement or setup choice that could affect your results.

4. Exit ticket

14. Without running another trial, predict the acceleration of a 2.5 kg block under a 10 N net force. Show your reasoning.

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Confidence: 1 2 3 4 5 (circle one)