Fan Cart Impulse Lab

Name _____ Period _____ Date _____

How does impulse change a moving cart?

45 minutes • BuildPhysics › Experiments › Unit 4 › Fan cart impulse

Start here

Use the 2.0 kg cart starting at +1.0 m/s. Friction is off. The fan starts at 1.0 s.

Peak fan force is the strongest push. Positive pushes right and negative pushes left.

Part A Compare pushes · 14 minutes

Before running, compare trial A (peak force +4.0 N, duration 1.0 s) with trial B (peak force +2.0 N, duration 2.0 s). Will the final velocity be greater in A, greater in B, or the same in both? Explain.

1. Set Peak fan force and Pulse duration for row A, then click Run. Each run pauses at 4.0 s. Use Reset for the next row.

2. Click Open graph, then Inspect below the graphs. On the velocity–time graph, click the flat sections before and after the push. Record the readings shown below the graphs.

3. Click Area. On the net force–time graph, click just before the push starts, then just after it ends. Record the Area value below the graphs as impulse, in N·s.

The area under the curve gives impulse. Positive impulse is rightward. Negative impulse is leftward.

Pulse	Peak fan force (N)	Duration (s)	Impulse J_x (N·s)	Before v_i (m/s)	After v_f (m/s)
A	+4.0	1.0			
B	+2.0	2.0			
C	−4.0	2.0			

A1. Compare A and B. Does a larger peak fan force give a larger velocity change? Use the measured impulses and velocities to explain.

A2. About when does the cart reverse direction in trial C? Click Inspect to identify that moment on the position–time and velocity–time graphs.

Turnaround time _____ s Velocity at that time _____ m/s

Use Area to measure impulse from 1.0 s to the turnaround time. Calculate the initial momentum using $p_i = mv_i$.

Initial momentum _____ kg·m/s Impulse up to the turnaround _____ N·s

Use these values to explain why the cart stops at that moment.

Part B Design and collect

Suggested time 12 minutes

How do the size and direction of an impulse affect the cart's change in velocity?

Choose four peak fan forces between −8 and +8 N, including rightward and leftward pushes. Use the 2.0 kg cart and choose one pulse duration from 0.5 to 2.0 s for the investigation.

B1. What will you change, and what will you measure?

B2. What will you keep the same in every trial? List the values.

B3. Enter your four peak fan forces in the table. Why did you choose those values?

B4. Write a short procedure another pair could follow. Include how to change the settings and how to measure impulse and velocity change from the graphs.

Record your measurements

Record the measured impulse and velocities. You will calculate Δv_x in Part C.

Run	Peak fan force (N)	Impulse J_x (N·s)	Before v_i (m/s)	After v_f (m/s)	Δv_x (m/s)
1					
2					
3					
4					

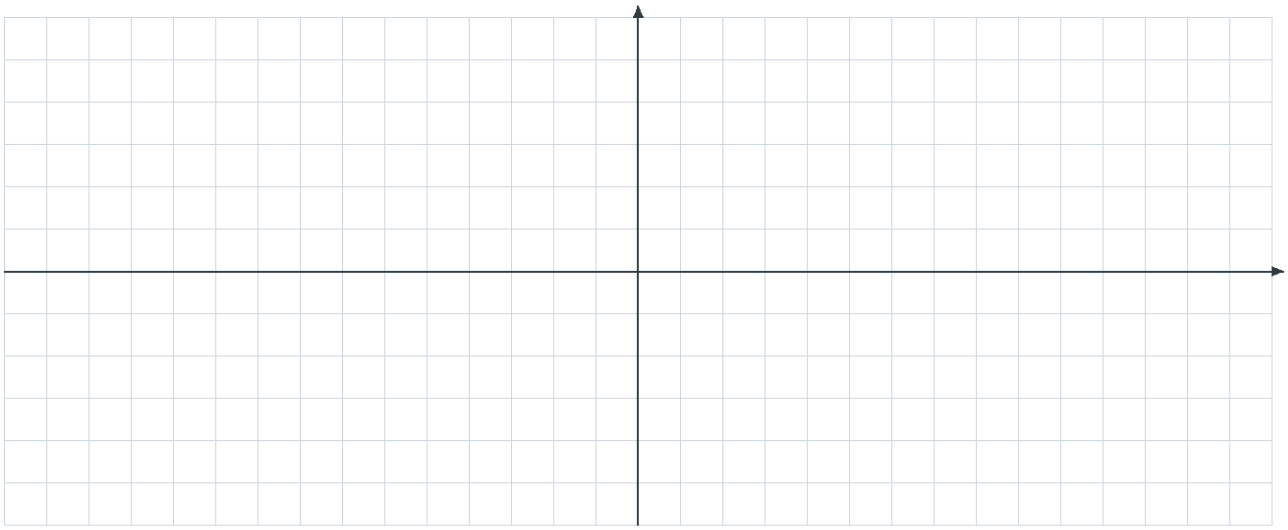
Part C Test impulse and momentum

Suggested time 11 minutes

C1. The model is $J_x = m\Delta v_x$. Choose which quantity goes on each axis so that the slope equals the cart mass. Label the axes on the grid with quantities and units.

C2. Complete the Δv_x column in your data table using $\Delta v_x = v_f - v_i$. For one run, compare the measured impulse with $m\Delta v_x$. Show both values with units.

C3. Choose useful scales, plot your four pairs of J_x and Δv_x, and draw a best-fit line.



C4. Use two widely separated points on your fitted line to calculate the slope. Show the units and report the cart mass your graph gives.

Part D Explain and predict

Suggested time 8 minutes

D1. A designer wants to stop this cart from the same initial velocity using a smaller peak force. How must the pulse duration change? Explain using the area under the curve.

D2. Use your graph to check $J_x = m\Delta v_x$.
a. How close is the mass you calculated in C4 to the cart's actual mass of 2.0 kg?

b. Does your line pass close to (0,0), where both impulse and velocity change are zero? Explain why zero impulse should leave the cart's velocity unchanged.

D3. Keep your Part B duration and choose an unused peak fan force within your tested range. Before running, predict the impulse from the triangle's area. Use your fitted line to find Δv_x, then predict $v_f = v_i + \Delta v_x$.

Show how you obtained both predictions.

Peak fan force (N)	Predicted J_x (N·s)	Predicted v_f (m/s)	Measured v_f (m/s)

Run the cart. Read the final velocity from the graph. How close was your prediction, in m/s?