Acceleration

How are force, mass and acceleration related?

In this practical you will:

- time how long it takes for a toy car or trolley of constant mass to move a distance when different forces are applied to it
- time how long it takes for a toy car or trolley to move a distance if the force applied is constant but the mass of the toy car or trolley is varied
- calculate the acceleration of the toy car or trolley in each case.

Activity 1: Measuring the effect of force on acceleration at constant mass

Apparatus

- a toy car (or trolley)
- a metre ruler
- pencil, chalk or masking tape to mark the intervals
- a bench pulley
- string
- a small weight stack
- a stopwatch
- Blu-tac.

Method

1. Use the ruler to measure intervals on the bench and draw straight lines or place tape across the bench at these intervals.
2. Attach the bench pulley to the end of the bench.
3. Tie a length of string to the toy car or trolley. Pass the string over the pulley and attach the weight stack to the other end of the string.
4. Make sure the string is horizontal and is in line with the toy car or trolley.
5. Hold the toy car or trolley at the start point.
6. Attach the full weight stack (1.0 N) to the end of the string.
7. Release the toy car or trolley at the same time as you start the stopwatch, press the stop watch (lap mode) at each measured interval on the bench and for the final time at 100 cm.
8. Record the results in the table.
9. Repeat steps 5–8 for decreasing weights on the stack for example, 0.8 N, 0.6 N, 0.4 N, 0.2 N.

Distance travelled in cm	1.0 N	0.8 N	0.6 N	0.4 N	0.2 N
	Time in s	Time in s	Time in s	Time in s	Time in s
20					
40					
60					
80					
100					

Activity 2: Measuring the effect of mass on acceleration with a constant force

Apparatus

The same apparatus as you used in activity 1.

Method

1. Setup the bench, pulley, weight stack and car as in steps 1-5 of activity 1.
2. Use your results from activity 1 to select a weight for the weight stack that will just accelerate the car along the bench.
3. Put a 200g mass on the car.
4. Hold the car at the start point.
5. Attach your chosen weight stack to the end of the string.
6. Release the car at the same time as you start the stopwatch, press the stopwatch (lap mode) at each measured interval on the bench and for the final time at 100 cm.
7. Record the results in the table outline below.
8. Repeat steps 5–8 for increasing more masses on the car.

	Change in mass of the toy car				
Distance travelled in cm					
20					
40					
60					
80					
100					

Conclusion

a) Write a sentence to state the relationship that you have seen in both activities. Do the results of your activities reflect Newton's Second Law?
b) Identify and classify the sources of error in this investigation.
c) How could you change the method or the apparatus used to improve the accuracy and reproducibility of your results?