In this experiment, we're going to investigate conservation of momentum in an elastic collision.

For this you will need: a track, two trolleys fitted with card masks – these measure five centimetres, two light gates - these are attached to a timer and power supply, a digital balance, and some extra masses.

We will be carrying out a number of collisions so draw up a table to record the results. This should have headings for mass in kilograms, velocity in metres per second and momentum in kilogram metres per second.

Add columns for: M1: Mass of the red trolley. M2: Mass of the blue trolley. U1: Initial velocity of the red trolley before the collision. U2: Initial velocity of the blue trolley.

V1: the final velocity of the red trolley. V2: Final velocity of the blue trolley. m1u1 plus m2u2: The calculated initial momentum. m1v1 plus m2v2: The calculated final momentum.

Let's begin the experiment. Connect the timer and set it up to measure the velocities of the trolleys before and after the collisions. Set the mask size to five centimetres.

Next set up the light gates. Set up light gate A so that it measures the velocity of trolley A just before the collision. Set up light gate B so that it measures the velocity of the blue trolleys after the collision.

Measure in kilograms to three significant figures, the mass of the red trolley with no extra mass and record in a table. In this case, the mass of the red trolley is 0.309 kilograms.

Measure the mass of the blue trolley with no extra mass and record it in the table. The blue trolley has a mass of 0.303 kilograms.

Position both trolleys on the track and press 'go' on the timer. Collide the red trolley into the blue trolley on the track.

Record the initial velocity of the red trolley: 0.632 metres per second. And the final velocity of both vehicles. Red cart final velocity: zero. Blue cart final velocity: 0.632 metres per second.

Repeat the experiment with one extra mass on the red trolley: 0.802 kilograms. The blue trolley remains the same.

Record the initial velocity of the red trolley and the final velocity of both vehicles. Red cart initial velocity: 0.278 metres per second. Blue cart initial velocity: zero.

Blue cart final velocity: 0.234 metres per second. Red cart final velocity: 0.229 metres per second.

Now for Run three: Repeat the collision with two extra masses on the red trolley. The red trolley's mass is: 1.296 kilograms. The blue trolley remains the same.

Record the initial velocity of the red trolley and the final velocity of both vehicles. Red cart initial velocity: 0.429 metres per second. Blue trolley initial velocity: zero.

Blue cart final velocity: 0.707 metres per second. Red cart final velocity: 0.262 metres per second.

Next Run four. This time, the red trolley has no extra mass and the blue trolley has one extra mass. Note the mass of the blue trolley: 0.796 kilograms.

Record your results. As the red trolley changed direction its final velocity has a negative value. Red cart initial velocity: 0.600 metres per second. Blue trolley initial velocity: zero.

Blue trolley final velocity: 0.616 metres per second. Red cart final velocity: -0.290 metres per second.

And finally, Run five: Again, the red trolley has no extra mass and the blue trolley has two extra masses. Note the mass of the blue trolley: 1.290 kilograms.

Record your results. Again, the red trolley has negative velocity. Red cart initial velocity is: 0.599 metres per second. Blue cart initial velocity: zero.

Blue trolley final velocity is: 0.362 metres per second. And red trolley final velocity: -0.226 metres per second.

You can then calculate the total initial momentum. This is equal to the momentum of the red trolley as the blue trolley was stationary before the collision.

Calculate the final momentum by adding together the momentum of the red trolley and the blue trolley after the collision.

The results show that the total momentum before the collision and after the collision are approximately equal.

This confirms the law of conservation of momentum which states that the total momentum before a collision is equal to the total momentum after the collision, in the absence of external forces.

You can also calculate the kinetic energy before and after the collision. Use the equation, Ek equals half mv squared, where Ek is the kinetic energy, m is the mass and v is the velocity. Work this out for each trolley separately,

You should see that the kinetic energy before each collision is approximately the same as the kinetic energy after the collision.

For elastic collisions, Momentum is conserved and Kinetic energy is conserved.