

How momentum is conserved in collisions

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Lab answers

These model answers use the sample results in the table. Your own data will differ a little, so compare the method, the percentage retained and the reasoning about errors rather than the exact numbers.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS2-2, HS-PS2-3

Question 1 Speeds in run 1

Run 1: before $u = 0.50 \div 0.40 = \mathbf{1.25 \text{ m/s}}$; after $v = 0.50 \div 0.84 = \mathbf{0.60 \text{ m/s}}$.

Run 3: $u = 0.50 \div 0.45 = \mathbf{1.11 \text{ m/s}}$; $v = 0.50 \div 1.40 = \mathbf{0.36 \text{ m/s}}$.

Question 2 Momentum before and after

Before = mass A $\times$ u. After = (mass A + mass B) $\times$ v.

- Run 1: before 0.625 kg m/s, after 0.595 kg m/s
- Run 2: before 0.455 kg m/s, after 0.439 kg m/s
- Run 3: before 0.556 kg m/s, after 0.536 kg m/s
- Run 4: before 1.111 kg m/s, after 1.071 kg m/s

Totals are within a few per cent of each other in every run.

Question 3 Percentage retained

After $\div$ before $\times 100$:

- Run 1: 95.2 %
- Run 2: 96.5 %
- Run 3: 96.4 %
- Run 4: 96.4 %

Mean = **96.1 %**.

Question 4 Conclusion

About 96 % of the momentum is found after the collision, and the shortfall is smaller than the timing uncertainty, so the results **support conservation of momentum**.

Question 5 Why less than 100 %

Friction between wheels and runway removes momentum while the trolleys move, and the timing is read after the collision when the pair has already slowed. Both effects make the measured speed after the collision **slightly too small**.

Question 6 Timing uncertainty

Run 1 before: $0.02 \div 0.40 \times 100 = 5.0 \%$. Run 1 after: $0.02 \div 0.84 \times 100 = 2.4 \%$.

Question 7 Improving the lab

Tilt the runway slightly so gravity cancels friction, and **use light gates or a longer timed section** to reduce the percentage timing uncertainty. Repeat each run three times and average.