Momentum and Collisions: Why Speed Matters

KS4 PHYSICS Ages 11-14 ⏰ 3 min read

What is Momentum?

Momentum is a way of measuring how much force and movement an object has. It depends on two things: how heavy the object is (its **mass**) and how fast it's moving (its **velocity**). The heavier and faster something is, the more momentum it has.

We calculate momentum using a simple formula: **momentum = mass × velocity**. This is why a light tennis ball moving slowly has almost no momentum, but a heavy truck moving at the same speed has huge momentum.

Think of it like this: imagine pushing a shopping trolley versus a car. Even if both move at the same speed, the car is much harder to stop because it has more momentum.

How Does Momentum Affect Collisions?

When two objects collide, their momentum plays a crucial role in what happens. **The Law of Conservation of Momentum** tells us that the total momentum before a collision equals the total momentum after it. Momentum doesn't disappear—it just gets transferred from one object to another.

Imagine a bowling ball hitting pins. The ball transfers its momentum to the pins, sending them flying. A faster or heavier ball creates a bigger collision because it has more momentum to give away. This is why heavy vehicles cause more damage in crashes than light ones—they're carrying far more momentum.

Think of it like passing energy in a game of tag. When you run fast and tag someone, you're passing your movement energy to them, just like momentum passes between colliding objects.

Real-World Examples

In car crashes, momentum explains why **speed matters so much**. A car travelling at **50 mph** has four times the momentum of one travelling at **25 mph** (because velocity

is squared in the energy equation). This is why safety features like airbags and seatbelts are so important—they help spread the force of momentum over a longer time, reducing injury.

Sports also show momentum in action. A **cricket ball** bowled very fast has massive momentum despite being small and light. A **sumo wrestler** running slowly might have similar momentum because they're so heavy. This is why momentum, not just speed or weight alone, determines the impact.

Understanding momentum helps us design safer cars, predict what happens in collisions, and explain why some crashes are more dangerous than others.