



GCSE CONSERVATION OF MOMENTUM

Momentum, like energy, is always conserved. In a closed system, the total sum of momentum before an event, like a collision, always equals the total sum of momentum after the event.

$$p_{\text{before}} = p_{\text{after}}$$

1. Write down the equation for the momentum of an object.
2. Complete the equation showing the relationship of two colliding objects with masses m_1 and m_2 , initial velocities u_1 and u_2 and final velocities v_1 and v_2 .

$$p_{1,\text{before}} + p_{2,\text{before}} = p_{1,\text{after}} + p_{2,\text{after}}$$

$$m_1 \underline{\quad} + \underline{\quad} u_2 = \underline{\quad} \underline{\quad} + m_2 v_2$$

3. Write down the units of **m**, **u**, **v** and **p**.
4. Calculate the total sum of momentum of:
 - a. A 2.0 kg mass and a 7.0 kg mass both travelling at 4.0 m/s in the same direction
 - b. A 0.20 kg mass travelling at 120 m/s and an 80 kg mass travelling at 0.80 m/s in the same direction
 - c. A 4.0 kg mass and a 3.0 kg mass both travelling at 8.0 m/s but in opposite directions
 - d. A 5.0 kg mass travelling at 12 m/s travelling in one direction and a 20 kg mass travelling at 3.0 m/s in the opposite direction



5. Two clowns are playing rugby. One clown has a mass of 70 kg and is travelling at 4.0 m/s. He collides with the other clown which has a mass of 100 kg and is at rest.
- a. Calculate the total momentum of the two clowns

After the impact, the two clowns move off together.

- b. Calculate the velocity of the two clowns



Later in the game, the two clowns collide again. This time the 100 kg clown travels at 5.0 m/s and collides with the 70kg clown who is at rest. After the collision the 100 kg clown stays at rest.

- c. Calculate the velocity of the 70 kg clown

6. Mary is surfing in Devon. She has a mass of 59 kg (including her board) and catches a wave which causes her to travel at a velocity of 5.5 m/s.
- a. Calculate Mary's momentum

A dolphin swims alongside Mary as they both travel at 6.8 m/s. The total momentum of the dolphin and Mary is 1140 kgm/s.

- b. Calculate the dolphin's mass

Mary catches a different wave. This wave propels her at 7.6m/s but the dolphin swims directly at her at 5.1 m/s. The dolphin jumps out of the water and collides with Mary (luckily both are unhurt).

- c. Calculate the resulting velocity of both the dolphin and Mary

