Lesson 2 The Law of Conservation of Momentum

When masses collide, or explode, total momentum before and the event is always conserved - this means that if we add up the individual values of momentum for all masses involved before the event, we will get the same answer by adding up the momentum of all masses after the event.

The law can be used in many useful applications:

- Analysing vehicle collisions to find out the speed they were travelling at
- In ballistics, to understand how much damage an explosion or a bullet might do
- In particle physics to find new particles by adding up all the particle momentum before and after an event

Before
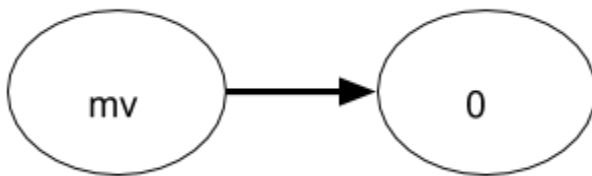
After

In this example a moving pool ball with momentum mv hits an identical, stationary one. If the moving ball stops after the collision, the stationary one must move off with velocity v because of the law of conservation of momentum. In this lesson you will practise calculations using the law.

Calculations using the law of conservation of momentum (15mins)

Go to this link and do parts B,D,E,F and G WRITING OUT ALL STEPS in your workings in your Physics notes - check the answers online - mark them correct or try again if necessary, use the Hint tabs or talk to your teacher if you don't understand where you have made mistakes:

Isaac Physics https://isaacphysics.org/questions/gcse_ch2_20_q1

More advanced calculations (20mins)

Go to the following link - watch the video (4:24) by opening Hint Tab 2 FIRST:

https://isaacphysics.org/questions/gcse_ch2_20_q2

Now try these question yourself WITHOUT opening the Hint tab - write down ALL steps in your workings in your Physics notes:

https://isaacphysics.org/questions/gcse_ch2_20_q3

https://isaacphysics.org/questions/gcse_ch2_20_q4

Practice past paper question (10mins)
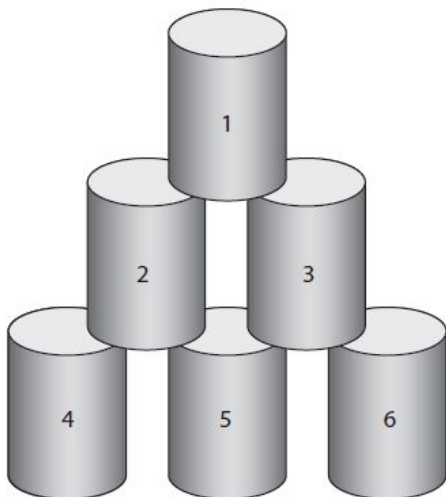
A student is playing a game with some empty tins.

(a) He throws a wet cloth of mass 0.15 kg at the tins.
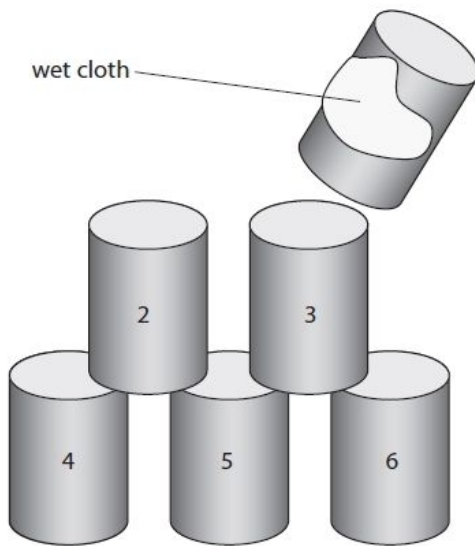
The wet cloth moves at a velocity of 6.0 m/s.

(i) State the equation linking momentum, mass and velocity. (1)

....

(ii) Calculate the momentum of the wet cloth and give the unit. (3)

Momentum = ... unit. ....

(iii) The wet cloth sticks to tin 1.

wet cloth

2   3

4   5   6

The mass of tin 1 is 0.050 kg.

The cloth and tin 1 move away together.

Calculate their velocity.

Velocity = ...m/s (2)

(b) The student throws a bigger wet cloth at the remaining tins.

wet cloth

4   5   6
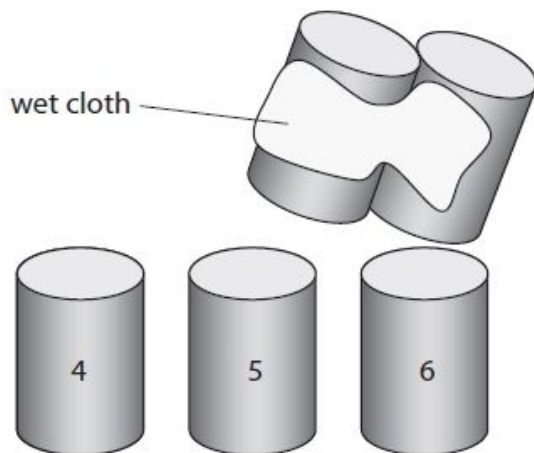
This wet cloth sticks to tins 2 and 3 and they move away together. The student concludes:

Do you agree with this conclusion? Explain why.

I threw the cloth the same way, so the velocity of tins 2 and 3 is the same as the velocity of tin 1.

(2)

....

....

....

....

....

(Total for question = 8 marks)

■ Now mark your answers, HIGHLIGHT and correct mistakes (if you just correct them, you may forget why you made them) and note anything to ask your teacher about them.

Question number		Answer	Accept	Reject	Marks
(a)	(i)	momentum = mass x velocity;			1
	(ii)	Substitution into correct equation; Calculation; e.g. momentum = 0.15 x 6 = 0.9;; Unit: kg m/s;	kg ms^{-1} Ns		3
	(iii)	0.9 = (0.15 + 0.05) x v; v = 0.9 ÷ 0.2 = 4.5 (m/s);	Ecf from 8(a) (ii) (i.e. answer for 8aii ÷ 0.2 or answer for 8aii x 5)		2
(b)		The student is wrong; Because variables are not controlled; e.g. mass of cloth different, mass of (other) tins different, cloth velocity not measured	Student is right if the mass of the second cloth is 0.3 kg;; Student is right if the momentum of the second cloth is 1.8 kg m/s;; (assuming all tins are 0.05 kg/ throws new cloth with exactly the same velocity)		2

Total 8 marks

(This question is from the Edexcel Exam Board, but is quite typical for this topic)