MR SULLY UNFOLDS PHYSICS ANSWERS

Momentum

AQA 4.5.7
Forces · Paper 2
Higher tier

Name _____ Class _____ Date _____

Every moving object has **momentum**. In a closed system, momentum is conserved in collisions and explosions.

KEY EQUATION

$$p = m v$$

p = momentum (kg m/s)
m = mass (kg)
v = velocity (m/s)
In a closed system, total momentum before = total momentum after.

WORKED EXAMPLE

A 2 kg trolley moves at 3 m/s.
p = 2 × 3 = **6 kg m/s**

Section A · Recall and calculate

Grade 5–6

1 Calculate the momentum of a 70 kg runner moving at 5 m/s. [2]

p = 70 × 5 = 350 kg m/s

2 State the law of conservation of momentum. [2]

In a closed system, the total momentum before an event

equals the total momentum after it.

3 Explain why momentum is a vector quantity. [1]

Because it depends on velocity, which has a direction.

Section B · Collisions

Grade 6–7

4 A 3 kg trolley moving at 4 m/s collides with a stationary 1 kg trolley. They stick together. Calculate their velocity after the collision. [4]

Momentum before = 3 × 4 = 12 kg m/s

Total mass after = 4 kg

v = 12 ÷ 4 = 3 m/s

5 A 0.02 kg bullet is fired at 400 m/s from a 4 kg rifle. Calculate the recoil velocity of the rifle. [3]

Momentum before = 0, so momentum after = 0

Bullet: 0.02 × 400 = 8 kg m/s forwards

Rifle: 8 ÷ 4 = 2 m/s backwards

Section C · Physics only

Grade 7+

6 A 0.15 kg ball moving at 20 m/s is caught and stopped in 0.1 s. Calculate the average force on the hand. [3]

Change in momentum = 0.15 × 20 = 3 kg m/s

F = mΔv ÷ Δt = 3 ÷ 0.1

F = 30 N

Exam-style question

AQA style

7 Cars have safety features such as crumple zones, seat belts and air bags.

a Explain how these features reduce the force on a passenger in a crash. [4]

They increase the time taken for the passenger to stop.

The change in momentum is the same,

so the rate of change of momentum is smaller,

so the force on the passenger is smaller ($F = m\Delta v \div \Delta t$).

b Give one other example of a safety feature that works in the same way. [1]

Cycle helmet / gym mats / cushioned playground surfaces

Total: _____ / 20

How confident am I?	Not yet	Nearly	Got it
I can use p = mv	☐	☐	☐
I can use conservation of momentum in collisions	☐	☐	☐
I can explain safety features using rate of change of momentum	☐	☐	☐