

Momentum Conservation

GCSE Physics · Written to the shared content for AQA, Edexcel and OCR

Name _____ Class _____ Date _____

1. Worked example

Calculate the momentum of a 0.20 kg ball travelling at 15 m/s. (2 marks)

Step 1 · Write the equation

$$\text{momentum} = \text{mass} \times \text{velocity}, p = m v$$

Step 2 · Substitute and calculate

$$p = 0.20 \times 15 = 3.0 \text{ kg m/s}$$

Answer: 3.0 kg m/s

Check: Momentum is a vector: it has the same direction velocity.

2. Now try one with the steps

Trolley A (2.0 kg) moving at 3.0 m/s hits stationary trolley B (1.0 kg). They stick together. Calculate their velocity after the collision. (3 marks)

Step 1 · Momentum before

Step 2 · Conservation

Step 3 · Velocity after

Answer:

3. Practice

Show your working. The marks tell you how much is expected.

1. Write the equation for momentum and give its unit. [2]

2. Calculate the momentum of a 0.20 kg ball moving at 15 m/s, in kg m/s. [2]

3. A 1500 kg car has a momentum of 30 000 kg m/s. Calculate its velocity in m/s. [2]

4. State the principle of conservation of momentum. [2]

5. A 2.0 kg trolley at 3.0 m/s hits a stationary 1.0 kg trolley and they stick together. Calculate their velocity afterwards, in m/s. [3]

6. Two skaters at rest push apart. A 40 kg skater moves off at 3.0 m/s. Calculate the speed of the 60 kg skater, in m/s. [3]

7. Explain why the total momentum of two objects that push apart from rest is zero afterwards. [2]

8. A 1000 kg car moving east at 10 m/s collides head-on with an 800 kg car moving west at 5.0 m/s. They lock together. Calculate their velocity after the collision, in m/s east, to 2 significant figures. [4]

9. A 0.010 kg bullet leaves a 4.0 kg rifle at 400 m/s. Calculate the recoil speed of the rifle, in m/s. [3]

10. A 0.15 kg ball is hit from rest to 30 m/s. The bat is in contact for 0.010 s. Calculate the average force on the ball. [3]

11. A 1200 kg car at 15 m/s is brought to rest in 1.5 s by crumple zones. Calculate the average force. [3]

12. Explain how an airbag reduces the risk of injury in a crash. [3]

13. Explain why cycle helmets contain a layer of crushable foam. [2]

14. Explain why gymnasts land on thick, soft mats rather than a hard floor. [2]

4. Before you hand it in

Adding momenta of objects moving in opposite directions

Choose a positive direction. Objects moving the other way have negative momentum.

"After a collision, momentum is lost"

Momentum is always conserved in a closed system. Kinetic energy may be transferred to other stores; momentum is not.

Dividing by only one mass after objects stick together

$v = \text{total momentum} \div (m_1 + m_2)$.

"Airbags reduce the change in momentum."

Airbags increase the time over which momentum changes, so the force is smaller.