Exercise walk-through

1.3
Momentum and moments (P)

Pearson Edexcel · International GCSE · Physics

PEARSON EDEXCEL · INTERNATIONAL GCSE · PHYSICS • EXERCISE SHEET

1.3 Momentum and moments (P)

Name: _____ Class: _____ Date: _____ **Total: 23 marks**

Objective

Build the skills to answer exam questions on **momentum and moments** :

momentum $p = mv$, conservation of momentum in collisions, force as the rate of change of momentum, safety features, Newton's third law, and moments.

You must be able to:

- calculate momentum and use conservation of momentum
- calculate force from the change in momentum and the time taken
- explain how safety features reduce the force in a collision

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- plan an experiment to test conservation of momentum

1 Key knowledge and worked examples

Momentum

idea	equation or rule
momentum	$p = m \times v$ (unit kg m/s)
conservation of momentum	total momentum before = total momentum after, if no external force acts
force and momentum	$F = (mv - mu) \div t$: force = change in momentum ÷ time
Newton's third law	when A pushes on B, B pushes back on A with an equal and opposite force
moment	force × perpendicular distance from the pivot (unit N m); balanced when clockwise moments = anticlockwise moments

Worked example 1: momentum. Find the momentum of a 0.15 kg ball moving at 20 m/s.

1. Known: $m = 0.15$ kg; $v = 20$ m/s.
2. Rule: $p = mv$.
3. Numbers: 0.15×20.

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4. Result: 3.0 **kg m/s**.

Worked example 2: force. A 60 kg person slows from 15 m/s to rest in 0.20 s. Find the force.

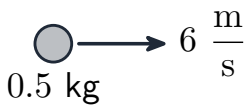
1. Known: change in momentum $60 \times 15 = 900$ kg m/s; $t = 0.20$ s.
2. Rule: $F =$ change in momentum $\div t$.
3. Numbers: $900 \div 0.20$.
4. Result: 4500 **N**.

Answer shapes: take one direction as positive; a velocity the other way is negative.

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Exercises 2.1·2.2

2.1 Calculate the momentum of a 0.5 kg ball moving at 6 m/s. [2]

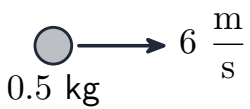


2.2 (P) State Newton's third law. [1]

Newton's third law

Exercises 2.1·2.2

2.1 Calculate the momentum of a 0.5 kg ball moving at 6 m/s. [2]



2.1 $p = 0.5 \times 6 = 3$ kg m/s.

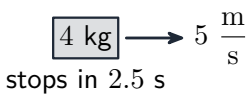
2.2 (P) State Newton's third law. [1]

Newton's third law

2.2 (P) For every action there is an equal and opposite reaction.

Exercise 2.3

2.3 A 4 kg object at 5 m/s is brought to rest in 2.5 s. Calculate the force. [3]



2.4 State the principle of moments. [1]

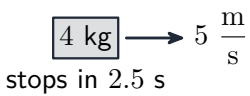
principle of moments

2.5 Through what point does the weight of a body act? [1]

weight

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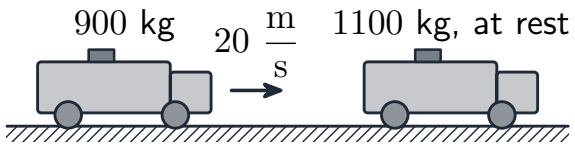
2.3 Momentum change $= 4 \times 5 = 20$ kg m/s; $F = 20/2.5 = 8$ N.

2.4 For equilibrium, the sum of clockwise moments about a point equals the sum of anticlockwise moments.

2.5 Its centre of gravity.

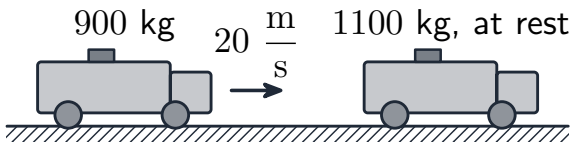
Exercise 3.1

3.1 A 900 kg car at 20 m/s collides with a stationary 1100 kg car; they move off together. Calculate their common speed and the total momentum before and after. [4]



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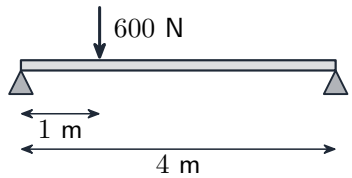
3.1 Before: $p = 900 \times 20 = 18\,000$ kg m/s. After, combined mass 2000 kg: $v = 18\,000/2000 = 9$ m/s; momentum is conserved – after $= 18\,000$ too.

Exercise 3.2

3.2 Explain, using momentum ideas, how an airbag reduces injury. [3]

airbag

3.3 A uniform 4 m beam rests on supports at its ends. A 600 N load sits 1 m from the left support. Taking moments, find the force each support exerts. [4]

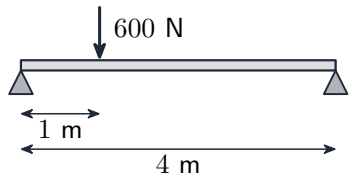


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3.2 The passenger's momentum change in the crash is fixed; the airbag slows them over a longer time; force = change in momentum ÷ time, so the force on the body is smaller.

3.3 Moments about the left support: load $600 \times 1 = 600$ N m clockwise; right support force F_N at 4 m: $4F_N = 600 \rightarrow F_N = 150$ N. Left support: $600 - 150 = 450$ N.