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Pearson Edexcel 8PH0, 9PH0

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A Level Physics • Topic 6

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Written for Pearson Edexcel AS and A Level Physics (8PH0, 9PH0).

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6.1 Impulse, momentum and collisions

MEMORISE THIS

$p = mv$ (vector, kg m s^{-1})	$\Delta p = mv - mu$
impulse = $F\Delta t = \Delta p$	area under $F-t$ graph
F = rate of change of momentum	
momentum: always conserved (no external force)	KE: only in elastic
2D: conserve x and y separately	$E_k = p^2/2m$

1 Change in momentum is a vector

A Level only

✗ Common mistake

Subtracting the speeds when an object bounces back, so the change in momentum comes out far too small.

✓ Do this instead

- Momentum $p = mv$ is a VECTOR: choose a positive direction and give every velocity a sign.
- Change in momentum $\Delta p = \text{final} - \text{initial} = mv - mu$.
- A ball hitting a wall at 12 m s^{-1} and rebounding at 8 m s^{-1} : $\Delta v = (-8) - (+12) = -20 \text{ m s}^{-1}$, not 4.
- Impulse = $F\Delta t = \Delta p$. On a force-time graph, impulse = area under the graph.
- Unit of momentum: kg m s^{-1} (or N s).

IN THE EXAM

On a bouncing-ball question, a fair proportion got the sign of the change in momentum wrong, and even more just gave the final momentum. (Jun 2016, AS P1)

Exam tip: Draw an arrow for "positive" next to every momentum question.

Examiners flagged this in: Jun 2016 AS P1, Jun 2018 AL P1, Nov 2021 AL P1, Jun 2023 AS P1

Question 1.1 Check it

[Mark scheme](#)

A ball of mass 0.15 kg hits a wall at 12 m s^{-1} and rebounds along the same line at 8.0 m s^{-1} . It is in contact with the wall for 0.040 s .

Calculate the average force exerted on the ball by the wall. (3)

force = ... N



Mark schemes

Note: all answers use $g = 9.81 \text{ N kg}^{-1}$ (9.81 m s^{-2}), the value on the Edexcel data sheet.

1 Change in momentum is a vector

Question 1.1 Check it

[Back to question](#)

Part	Answer	Marks
	$\Delta p = 0.15 \times ((-8.0) - (+12)) = -3.0 \text{ kg m s}^{-1}$ (magnitude 3.0)	1
	$F = \Delta p \div \Delta t = 3.0 \div 0.040$	1
	75 N	1
Total		3

Question 1.2 Apply it

[Back to question](#)

Part	Answer	Marks
	area = force $\times$ time (sum of $F\Delta t$), which is the impulse	1
	impulse = change in momentum (from $F = \Delta p/\Delta t$)	1
Total		2

Common wrong answers: Subtracting the speeds gives $\Delta p = 0.60 \text{ kg m s}^{-1}$ and a force of 15 N.

2 Force as rate of change of momentum

Question 2.1 Check it

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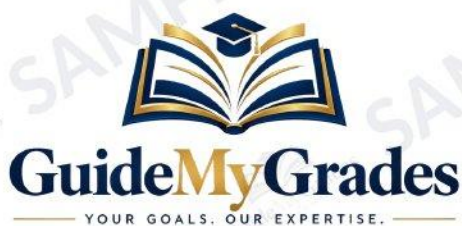
Part	Answer	Marks
	$F = \Delta p/\Delta t = 2.5 \times 12$	1
	30 N	1
Total		2

Question 2.2 Apply it

[Back to question](#)

Part	Answer	Marks
	the change in velocity of each kilogram is now 24 m s^{-1}	1
	so the rate of change of momentum, and the force, doubles to 60 N	1
Total		2

Common wrong answers: Writing "the momentum increases so the force increases" leaves out "rate of change" and does not score.



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