Exercise walk-through

4.5
Momentum and impulse

Pearson Edexcel · International A-Level · Further Mathematics

Check yourself

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State modelling assumptions and their consequences; vector velocities, positions, bearings; multi-phase suvat and motion graphs; paired equations over a pulley with the 2T pulley force; impulse on one body and momentum conservation with rebounds; μR moving versus capped at rest; equilibrium by two resolutions; moments about successive tilting pivots.

Exercises 2.1·2.3

2.1 A ball of mass 0.5 kg hits a wall perpendicular to it at 6 $\mathrm{m\,s^{-1}}$ and rebounds at 4 $\mathrm{m\,s^{-1}}$. Find the magnitude of the impulse the wall exerts on the ball. [3]

2.2 A 2 kg particle moving at 5 $\mathrm{m\,s^{-1}}$ collides with a 3 kg particle at rest and they move off together. (a) Find their common speed. (b) Find the impulse on the 3 kg particle. [4]

2.3 A ball of mass 0.4 kg is dropped and hits the floor at 5 $\mathrm{m\,s^{-1}}$, rebounding at 3 $\mathrm{m\,s^{-1}}$. Find the impulse exerted by the floor. [4]

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2.1 Reversal: $I = 0.5(6+4) = 5$ N s.

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2.2 (a) $2(5) = (5)v$, so $v = 2$ $\mathrm{m\,s^{-1}}$. (b) Impulse on the 3 kg: $3(2-0) = 6$ N s.

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2.3 Reversal: $I = 0.4(5+3) = 3.2$ N s.

Exercises 2.4·3.1

2.4 A 1 kg particle moving right at 4 $\mathrm{m\,s^{-1}}$ collides with a 2 kg particle moving left at 1 $\mathrm{m\,s^{-1}}$. After the collision the 1 kg particle moves left at 0.5 $\mathrm{m\,s^{-1}}$. Find the velocity of the 2 kg particle. [4]

3.1 *(Edexcel IAL WME01 June 2025 Q1.)* Two particles P and Q move in the same direction along the same straight line on a smooth horizontal surface. The mass of P is km and the mass of Q is $3m$. They collide directly. Immediately before the collision, the speed of P is $5u$ and the speed of Q is $2u$. Immediately after, the speed of P is $2u$ with direction unchanged, and the speed of Q is v. The impulse exerted on Q by P has magnitude $4.5mu$. (a) Find v in terms of u. (b) Find k. [6]

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2.4 Right positive: $1(4) + 2(-1) = 1(-0.5) + 2v$, so $2 = -0.5 + 2v$ and $v = 1.25\ \mathrm{m\,s^{-1}}$ to the right.

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3.1 (a) Impulse-momentum on Q: $3m(v - 2u) = 4.5mu$, so $v - 2u = 1.5u$ and $v = 3.5u$. (b) The impulse on P is equal in magnitude and opposite in effect (it slows P): $km(5u - 2u) = 4.5mu$, so $3k = 4.5$ and $k = 1.5$.

Exercise 3.2

3.2 *(Edexcel IAL WME01 June 2025 Q8d, condensed.)* A ball of mass 1.5 kg falls and hits the ground with speed $3.13\ \mathrm{m\,s^{-1}}$, rebounding with speed $0.4\ \mathrm{m\,s^{-1}}$. Find the magnitude of the impulse it receives. [4]

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3.2 $I = 1.5(3.13 + 0.4) = 5.3$ N s (5.30).

Local review guidance: impulse-momentum applied to ONE named body; momentum conserved with all velocities signed consistently; reversals handled as sums of speeds in magnitude-form or clean sign algebra. This is authored classroom guidance.