

Exercise walk-through

1.2

Momentum safety and moments (P)

OxfordAQA · International GCSE · Physics

1. Forces and their effects

Forces and their effects

Every push, pull and hold in the world is a force — and OxfordAQA's first topic organises them: contact and non-contact interactions, scalars against vectors, Newton's three laws, vehicle safety, and the P-extension ideas of momentum, terminal velocity, centre of mass and moments

OxfordAQA International GCSE Physics 9203, topic 3.1 (Version 5.1, exams 2018 onwards)

5. (P) Centre of mass and moments

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The centre of mass is where an object's mass may be thought concentrated; a freely suspended object rests with it below the suspension point, and a symmetrical object's centre of mass lies on the axis of symmetry

Find it for an irregular lamina by suspending it from two points and drawing plumb lines

Exercises 2.1·2.3

2.1 (P) Calculate the momentum of a 0.4 kg ball at 15 m/s. [2]

2.2 (P) State the conservation of momentum in a closed system. [1]

2.3 Name two factors that increase a driver's reaction time. [2]

Exercises 2.1·2.3

2.1 (P) Calculate the momentum of a 0.4 kg ball at 15 m/s. [2]

2.1 (P) $p = 0.4 \times 15 = 6 \text{ kg m/s}$.

2.2 (P) State the conservation of momentum in a closed system. [1]

2.2 (P) Total momentum before an interaction equals total momentum after it.

2.3 Name two factors that increase a driver's reaction time. [2]

2.3 Tiredness, distractions, drugs, alcohol (any two).

Exercises 2.4·3.1

2.4 (P) State two design features that reduce drag on a vehicle. [2]

2.5 (P) Where does a symmetrical object's centre of mass lie? [1]

3.1 (P) A 60 kg rider falls from a bike at 8 m/s and stops in 0.05 s without a helmet, or 0.20 s with one. Calculate the decelerating force in each case. [4]

Exercises 2.4·3.1

2.4 (P) State two design features that reduce drag on a vehicle. [2]

2.4 (P) Streamlined (teardrop) shape; smooth surfaces.

2.5 (P) Where does a symmetrical object's centre of mass lie? [1]

2.5 (P) On its axis of symmetry.

3.1 (P) A 60 kg rider falls from a bike at 8 m/s and stops in 0.05 s without a helmet, or 0.20 s with one. Calculate the decelerating force in each case. [4]

3.1 (P) Momentum change $\Delta p = 60 \times 8 = 480 \text{ kg m/s}$. Without: $F = 480/0.05 = 9600 \text{ N}$; with helmet: $F = 480/0.20 = 2400 \text{ N}$ – four times smaller.

Exercises 3.2·3.3

3.2 (P) A 4 kg trolley at 3 m/s collides with a stationary 2 kg trolley; they move off together. Calculate their common velocity. [3]

3.3 (P) A see-saw balances with a 300 N child 1.6 m from the pivot. Calculate the distance of a 400 N child on the other side. [3]

Exercises 3.2·3.3

3.2 (P) A 4 kg trolley at 3 m/s collides with a stationary 2 kg trolley; they move off together. Calculate their common velocity. [3]

3.2 (P) Before: $4 \times 3 = 12 \text{ kg m/s}$; after: $(4 + 2)v = 12$; $v = 2 \text{ m/s}$.

3.3 (P) A see-saw balances with a 300 N child 1.6 m from the pivot. Calculate the distance of a 400 N child on the other side. [3]

3.3 (P) Anticlockwise $= 300 \times 1.6 = 480 \text{ N m}$; clockwise $400 \times d = 480$; $d = 1.2 \text{ m}$.