

1.3 Momentum and moments (P)

Name: _____ Class: _____ Date: _____

Total: 19 marks

Objective

Cover the separate-science (P) extension (1.25P–1.33P): momentum and its conservation, force as rate of change of momentum, safety features, Newton's third law, moments, centre of gravity and beam supports. Original practice.

1 Key knowledge and worked examples

■ Momentum is conserved

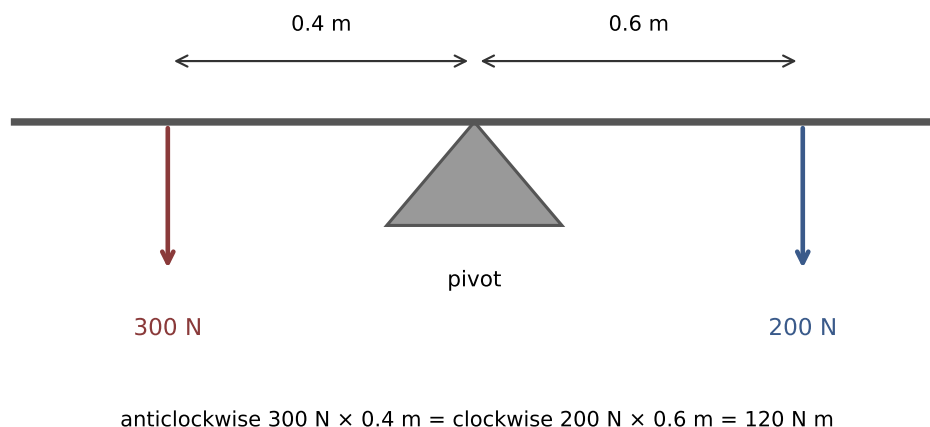
$$p = mv \quad F = \frac{mv - mu}{t}$$

In a collision the total momentum before equals the total after. **Worked check.** A 2 kg trolley at 3 m/s hits a stationary 1 kg trolley and they stick: before = $2 \times 3 = 6$; after, mass 3 kg moves at $6/3 = 2$ m/s.

■ Safety features buy time

Crumple zones, airbags and seat belts all **lengthen the collision time**; since force = change in momentum $\div$ time, the same change spread over more time means a smaller force.

■ Moments balance



Moment = force $\times$ perpendicular distance from the pivot. Equilibrium: clockwise moments = anticlockwise moments. Weight acts through the **centre of gravity**; on a beam supported at both ends, the nearer support carries more of the load.

2 Practice

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]

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]

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

3 Exam-style questions

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]

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

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]
