1.2 Momentum safety and moments (P)

Name: _____ Class: _____ Date: _____ **Total: 18 marks**

Objective

Cover (P) momentum, safety in public transport, terminal velocity, centre of mass and moments (3.1.4–3.1.8): p = mv with conservation, F = Δp/t safety reasoning, stopping distances, parachutes and streamlining, stability and balanced moments. Original OxfordAQA Paper-2 practice.

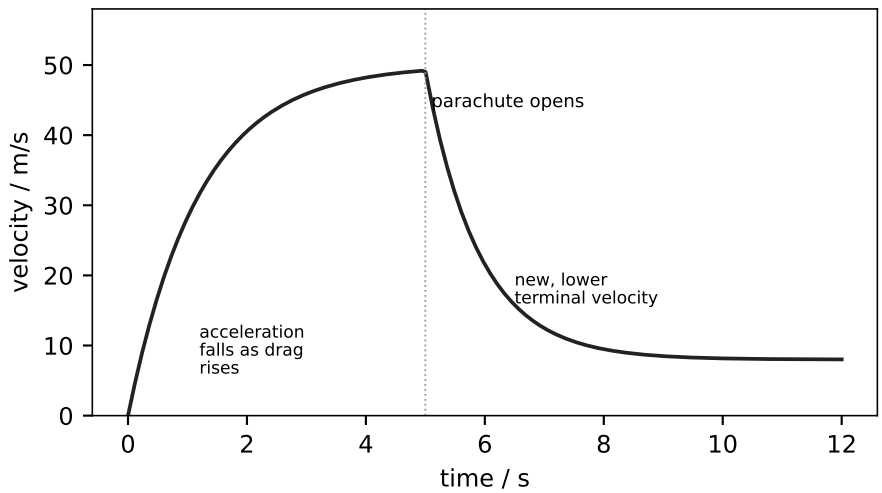
1 Key knowledge and worked examples

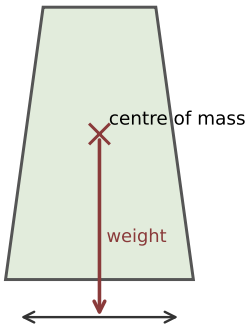
- **Momentum buys safety with time**

$$p = m \times v \qquad F = \frac{\Delta p}{t}$$

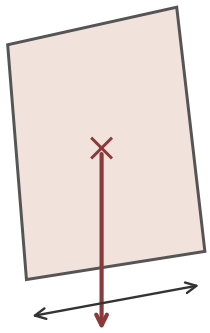
Total momentum is conserved in collisions and explosions. Every safety feature – airbag, seat belt, crumple zone, crash mat, helmet – lengthens t so F falls.

- **Terminal velocity, stability and moments**





weight line inside the base: stable



weight line outside the base: topples

$M = F \times d$ about the pivot; balance means clockwise = anticlockwise.

2 Practice

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]

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 Exam-style questions

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]

3.2 (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]

Solutions

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

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

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

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

2.5 (P) On its axis of symmetry.

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

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

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