



ANSWER BOOK

Modelling, quantities and units

Mechanics · Year 12–13

7 questions · 20 marks

NAVY EDITION

SECTION A · Warm-up

- A1** All the mass is treated as concentrated at a single point: size, shape and rotation are [2] ignored. Consequently every force acts at that one point, so there are no turning effects to consider and no moments to take.
- A2** Light: the cable's own weight is ignored, so the tension is the same at every point along [3] it. Inextensible: the cable cannot stretch, so the load moves exactly as the cable's top end does, with the same speed and acceleration.

SECTION B · Standard

- B1** A smooth surface or pulley exerts no friction: only a normal reaction (or, for a pulley, an [3] unchanged tension). Rough means friction acts and must enter the equations. Uniform means mass is evenly spread, so a uniform rod's weight acts at its midpoint.
- B2** Velocity m s^{-1} , acceleration m s^{-2} , force $\text{N} = \text{kg m s}^{-2}$. In the equation, ut has units $(\text{m s}^{-1})(\text{s}) = \text{m}$, and at^2 has $(\text{m s}^{-2})(\text{s}^2) = \text{m}$: every term is a length, as an equation for displacement demands. A units check like this catches rearranged formulae remembered wrongly.
- B3** Scalars: mass, speed, distance, each a bare size. Vectors: weight, velocity, [3] displacement, each carrying a direction. The pairs matter: speed is the magnitude of velocity, distance the magnitude-style companion of displacement, and mass is not weight.

SECTION C · Stretch

- C1** The model neglects air resistance, treating each object as a particle acted on by [4] weight alone, so both fall with acceleration g . For the dense, compact stone the assumption is good over a short drop; for the feather, air resistance rivals the tiny weight almost immediately, and the model's prediction fails badly. Assumptions are judged per object, not per problem.
- C2** A model trades realism for solvability: with the right assumptions the sums become [3] possible and the predictions come out close enough to use. When they stray, the modeller refines the weakest assumption, perhaps adding air resistance, and solves again: the cycle of model, compare, refine is the whole discipline.