



ANSWER BOOK

Estimation and orders of magnitude

Measurements · Year 12

AQA 3.1.3 · CIE 1.1 · OCR A 2.1.1

10 questions · 30 marks

NAVY EDITION

SECTION A · Warm-up

- A1** The order of magnitude is the size of a quantity to the nearest power of ten, obtained [2]
by rounding it to the closest value of 10^n .
- A2** (a) About 0.1 kg, so 10^{-1} kg. (b) About 30 m s⁻¹, so 10^1 m s⁻¹. [2]
- A3** (a) 10^7 (4.5 rounds up to 10). (b) 10^{-4} . [2]

SECTION B · Standard

- B1** Beats $\approx 70 \times 60 \times 24 \times 365 \times 80 \approx 2.9 \times 10^9$, which is of order 10^9 beats. [3]
- B2** 1 m = 100 cm, so the number = $100^3 = 1 \times 10^6$ cubes (order 10^6). [3]
- B3** KE = $\frac{1}{2}mv^2 \approx \frac{1}{2} \times 70 \times 5^2 \approx 875$ J, which is of order 10^3 J. [4]
- B4** Ratio $\approx (6 \times 10^{24})/60 = 1 \times 10^{23}$, so of order 10^{23} . [3]

SECTION C · Stretch

- C1** Breaths $\approx 15 \times 60 \times 24 = 21600 \approx 2 \times 10^4$, of order 10^4 breaths. [4]
- C2** $Q = mc\Delta\theta \approx 0.25 \times 4200 \times 80 \approx 84000$ J, which is of order 10^5 J. [4]
- C3** They give a quick check on whether a detailed answer is reasonable, catching errors of many powers of ten. They also let you judge whether something is feasible, or compare the sizes of quantities, without needing precise data or a full calculation.