



ANSWER BOOK

Moments and equilibrium

Mechanics · Year 12

AQA 3.4.1.2 · CIE 4.1, 4.2 · OCR A 3.2.3

10 questions · 30 marks

NAVY EDITION

SECTION A · Warm-up

- A1** Moment = force $\times$ perpendicular distance from the pivot to the line of action of the force. Unit: newton metre (N m). [2]
- A2** Moment = $15 \times 0.40 = 6.0$ N m. [2]
- A3** For a body in equilibrium, the sum of the clockwise moments about any point equals the sum of the anticlockwise moments about that point. [2]

SECTION B · Standard

- B1** $2.0 \times 0.20 = 4.0 \times d$, so $d = 0.10$ m to the right of the pivot. [3]
- B2** $300 \times 1.2 = 450 \times d$, so $d = 0.80$ m. [3]
- B3** Taking moments about A: $R_B \times 4.0 = 120 \times 2.0 + 200 \times 1.0$, so $R_B = 110$ N. Vertically: $R_A = (120 + 200) - 110 = 210$ N. [2]
- B4** This is a couple. Its moment (torque) = one force $\times$ the separation = $8.0 \times 0.25 = 2.0$ N m. [3]

SECTION C · Stretch

- C1** Moments about the hinge: $T \times 2.0 = 40 \times 1.0$, so $T = 20$ N. Vertically: hinge force = $40 - 20 = 20$ N upwards. [2]
- C2** Moments about the pivot: $2.0 \times 0.40 = W \times (0.65 - 0.40)$, so $W = 0.80 / 0.25 = 3.2$ N. [4]
- C3** The moment of the applied force equals force $\times$ perpendicular distance from the hinge. Placing the handle far from the hinge maximises that distance, so a smaller force produces the moment needed to open the door. [2]