



ANSWER BOOK

Newton's laws and the resultant force

Mechanics · Year 12

AQA 3.4.1.5 · CIE 3.1 · OCR A 3.2.1, 3.5.1

10 questions · 31 marks

NAVY EDITION

SECTION A · Warm-up

- A1** An object stays at rest, or continues at constant velocity, unless acted on by a resultant external force. [1]
- A2** $F = ma = 2.0 \times 3.0 = 6 \text{ N}$. [2]
- A3** The resultant force is the single force equivalent to the vector sum of all the individual forces acting on the object. [2]

SECTION B · Standard

- B1** Resultant = $12 - 4.0 = 8 \text{ N}$ to the right. $a = F/m = 8/4.0 = 2.0 \text{ m s}^{-2}$. [3]
- B2** (a) $W = mg = 70 \times 9.81 = 686.7 \text{ N}$. (b) $N - mg = ma$, so $N = m(g + a) = 70 \times (9.81 + 2.0) = 826.7 \text{ N}$. [4]
- B3** (a) $a = F/(\text{total mass}) = 10/5.0 = 2.0 \text{ m s}^{-2}$. (b) Contact force = $2.0 \times 2.0 = 4.0 \text{ N}$. [4]
- B4** The third-law pair is the book pushing down on the table with an equal and opposite force. The weight is not the pair because it is a gravitational force from the Earth acting on the book, a different type of force acting on the same object. [3]

SECTION C · Stretch

- C1** Component of weight down the slope = $mg \sin \theta$, so $a = g \sin 30^\circ = 9.81 \times 0.5 = 4.90 \text{ m s}^{-2}$. [3]
- C2** (a) For the system: $a = m_1 g / (m_1 + m_2) = 3.0 \times 9.81 / 5.0 = 5.89 \text{ m s}^{-2}$. (b) For the table mass: $T = m_2 a = 2.0 \times 5.89 = 11.8 \text{ N}$. [5]
- C3** Your weight pushes down on the ground; by the third law the ground pushes up on you with an equal and opposite normal contact force. These act on different objects and balance the forces on you, so your resultant force is zero and you stay at rest. [4]