inkMaths

ANSWER BOOK

# Statics of a particle

Mechanics · Year 12–13

6 questions · 20 marks

NAVY EDITION

## SECTION A · Warm-up

**A1** The resultant force is zero, which in practice means resolving in two perpendicular directions and setting each component sum to zero. Two directions give two equations, enough for two unknowns. [2]

**A2** Resolving along the slope: $T = 30 \sin 25° = 12.7$ N. Perpendicular to it: $R = 30 \cos 25° = 27.2$ N. Resolving along and across the slope keeps both unknowns apart; resolving vertically would tangle them into simultaneous equations. [3]

## SECTION B · Standard

**B1** Horizontally: $T_1 \cos 20° = T_2 \cos 70°$. Vertically: $T_1 \sin 20° + T_2 \sin 70° = 10$. Solving the pair: $T_1 = 3.42$ N and $T_2 = 9.40$ N. The steeper string carries most of the load, as the sketch suggests it should: tension follows uprightness. [5]

**B2** Resolving horizontally and vertically: $R \sin 30° = P$ and $R \cos 30° = 40$. Dividing gives $P = 40 \tan 30° = 23.1$ N, and then $R = 40/\cos 30° = 46.2$ N. The reaction exceeds the weight here: pressing horizontally into a slope squeezes the surface harder than gravity alone would. [4]

## SECTION C · Stretch

**C1** $3.42^2 + 9.40^2 = 11.7 + 88.3 = 100 = 10^2$. The angles 20° and 70° sum to 90°, so the strings are perpendicular: the weight is being split into components along two perpendicular directions, and Pythagoras reassembles it exactly. [3]

**C2** Limiting equilibrium is rest on the very point of slipping. It adds the third equation $F = \mu R$, friction at its ceiling, which is exactly what a problem with a third unknown needs. Away from the limit, friction's size is set by the balance itself and $\mu$ never enters. [3]