



ANSWER BOOK

Projectile motion

Mechanics · Year 12

AQA 3.4.1.4 · CIE 2.1 · OCR A 3.1.3

9 questions · 31 marks

NAVY EDITION

SECTION A · Warm-up

- A1** Gravity acts only vertically, so it changes the vertical velocity but not the horizontal velocity. The horizontal motion is at constant velocity and the vertical motion is free fall; the two are independent and share only the time. [2]
- A2** Fall time: $t = \sqrt{2h/g} = \sqrt{(2 \times 1.2/9.81)} = 0.49$ s. Horizontal distance: $x = 3.0 \times 0.49 = 1.48$ m. [2]
- A3** The horizontal component stays constant; the vertical component changes uniformly at g , decreasing on the way up and increasing on the way down. [2]

SECTION B · Standard

- B1** (a) $t = \sqrt{(2 \times 45/9.81)} = 3.03$ s. (b) $x = 20 \times 3.03 = 60.6$ m. (c) $v_y = gt = 9.81 \times 3.03 = 29.7$ m s⁻¹. [4]
- B2** (a) $u_x = 25 \cos 30^\circ = 21.7$ m s⁻¹, $u_y = 25 \sin 30^\circ = 12.5$ m s⁻¹. (b) $T = 2u_y/g = 2.55$ s. (c) $R = u_x T = 55.2$ m. [5]
- B3** $H = u_y^2/2g = 12.5^2/(2 \times 9.81) = 7.96$ m. [3]

SECTION C · Stretch

- C1** $R = 30^2 \times \sin 80^\circ / 9.81 = 90.3$ m. The maximum range for a given speed occurs at 45°. [4]
- C2** $u_x = 13.59$ m s⁻¹, $u_y = 6.34$ m s⁻¹. Vertical: $0 = 2.0 + u_y t - \frac{1}{2}gt^2$, giving $t = 1.55$ s. Range = $u_x t = 21.1$ m. [5]
- C3** Air resistance opposes the motion, reducing both horizontal and vertical speeds. The path becomes asymmetric, steeper on the way down, the maximum height and range are reduced, and the angle for maximum range falls below 45°. [3]