InkPhysics

ANSWER BOOK

Motion graphs and the SUVAT equations

Mechanics · Year 12

AQA 3.4.1.3 · CIE 2.1 · OCR A 3.1.1, 3.1.2

10 questions · 31 marks

NAVY EDITION

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SECTION A · Warm-up

A1 Average velocity is total displacement divided by total time. Instantaneous velocity is the rate of change of displacement at one instant, that is the gradient of the displacement–time graph at that point. [2]

A2 $v = u + at = 0 + 2.0 \times 6.0 = 12$ m s^{-1}. [2]

A3 The gradient represents acceleration; the area between the line and the time axis represents displacement. [2]

SECTION B · Standard

B1 (a) $v = u + at = 8.0 + 1.5 \times 4.0 = 14$ m s^{-1}. (b) $s = ut + \tfrac{1}{2}at^2 = 8.0 \times 4.0 + \tfrac{1}{2} \times 1.5 \times 4.0^2 = 44$ m. [4]

B2 (a) $v^2 = u^2 + 2as$ gives $a = -(20^2)/(2 \times 40) = -5.0$ m s^{-2} (a deceleration of 5.0 m s^{-2}). (b) $t = v/|a| = 20/5 = 4.0$ s. [4]

B3 Distance $= \tfrac{1}{2} \times 5.0 \times 15 + 15 \times 10 = 187.5$ m. [3]

B4 $v = gt = 9.81 \times 2.0 = 19.62$ m s^{-1}. $s = \tfrac{1}{2}gt^2 = \tfrac{1}{2} \times 9.81 \times 2.0^2 = 19.62$ m. [3]

SECTION C · Stretch

C1 (a) $v = u + at = 0 + 0.50 \times 20 = 10$ m s^{-1}. (b) $s = \tfrac{1}{2}at^2 = \tfrac{1}{2} \times 0.50 \times 20^2 = 100$ m. [4]

C2 (a) At the top $v = 0$, so $h = u^2/2g = 15^2/(2 \times 9.81) = 11.47$ m. (b) $t = u/g = 15/9.81 = 1.53$ s. [4]

C3 The acceleration is the gradient of the line (change in velocity divided by change in time). The displacement is the area of the trapezium between the line and the time axis, which equals $\tfrac{1}{2}(u + v)t$. [3]