Exercise 1

Paper 1 style · No calculator

1 7 marks SL 5.1 ●○○ Routine

A ball is thrown upwards. Its height above the ground, y metres, t seconds after it is thrown, is $y(t) = 20t - 5t^2$, for $0 \leq t \leq 4$.

(a) Show that the average velocity of the ball from $t = 1$ to $t = 1 + k$ is $10 - 5k$ metres per second, for $k \neq 0$. **[3]**

(b) Hence write down the velocity of the ball when $t = 1$. **[1]**

(c) Find $y'(t)$, and hence find the time at which the ball stops rising. **[3]**

The markscheme is on the next page: try the question first. Written and verified by a practising IB mathematics teacher, produced with AI assistance; solved twice and recomputed by software. Not affiliated with or endorsed by the International Baccalaureate Organization.
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MARKSCHEME (a)

$y(1+k) = 20(1+k) - 5(1+k)^2$ **M1**

$= 15 + 10k - 5k^2$, and $y(1) = 15$ **A1**

$\dfrac{15 + 10k - 5k^2 - 15}{k} = \dfrac{10k - 5k^2}{k}$ **A1**

$= 10 - 5k$ **AG**

Total 3 marks

MARKSCHEME (b)

$10\ \text{m s}^{-1}$ **A1**

Total 1 mark

Note The limit of $10 - 5k$ as $k \to 0$.

MARKSCHEME (c)

$y'(t) = 20 - 10t$ **A1**

the ball stops rising when $y'(t) = 0$ **M1**

$t = 2$ seconds **A1**

Total 3 marks