Marked example 2

Paper 2 style · Graphic display calculator

2 6 marks SL 5.1 · 5.6 ●○○ Routine

A cup of tea is left to cool in a room. The temperature of the tea, in °C, t minutes after it is poured, is modelled by

$$T(t) = 21 + 64\,\mathrm{e}^{-0.085t}, \qquad t \geq 0.$$

(a) Write down the temperature of the tea when it is poured. [1]

(b) Find $T'(10)$. [2]

(c) Interpret your answer to part (b) in the context of the question. [1]

(d) Find the time at which the temperature of the tea is decreasing at a rate of 1 °C per minute. [2]

MARKSCHEME (a)

85 °C — A1

Total 1 mark

MARKSCHEME (b)

attempt to differentiate, or use of GDC — (M1)

$T'(10) = -2.33 \;\; (-2.32513\ldots)$ — A1

Total 2 marks

MARKSCHEME (c)

10 minutes after it is poured, the temperature of the tea is decreasing at about 2.33 °C per minute — R1

Total 1 mark

Note Both the idea of decreasing and a rate in °C per minute are needed. FT from their answer to (b).

MARKSCHEME (d)

$T'(t) = -1$ OR $5.44\,\mathrm{e}^{-0.085t} = 1$ — (M1)

$t = 19.9$ minutes $\;(19.9268\ldots)$ — A1

Total 2 marks

Note Award M1 for $T'(t) = 1$ only if followed by a correct interpretation of the sign.

ON THE CALCULATOR

NumWorks (b) Calculation: Toolbox → Calculus → Derivative, type $21 + 64e^{-0.085x}$, then the value 10 → -2.325137.
(d) With $T'(t) = -5.44\,e^{-0.085t}$: Functions: $f(x) = -5.44e^{-0.085x}$, $g(x) = -1$; Graph → Calculate → Find → Intersection → $x = 19.92681$.

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