Exercise 2

Paper 2 style · Graphic display calculator

2 7 marks SL 5.1 ●●○ Typical

The concentration of a drug in the blood of a patient, C milligrams per litre, t hours after it is taken, is modelled by $C(t) = 12t\,\mathrm{e}^{-0.4t}$, for $t \geq 0$.

(a) Find $C'(2)$, and interpret your answer in the context of the question. **[3]**

(b) Find the times at which the concentration is decreasing at a rate of 1 milligram per litre per hour. **[3]**

(c) Write down the value that C approaches in the long term. **[1]**

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)

use of GDC, or $C'(t) = 12\,\mathrm{e}^{-0.4t} - 4.8t\,\mathrm{e}^{-0.4t}$ **(M1)**

$C'(2) = 1.08 \;\; (1.07838\ldots)$ **A1**

two hours after it is taken, the concentration is increasing at 1.08 mg per litre per hour **R1**

Total 3 marks

MARKSCHEME (b)

$C'(t) = -1$ **(M1)**

$t = 3.27 \;\; (3.27083\ldots)$ **A1**

$t = 8.33 \;\; (8.32839\ldots)$ **A1**

Total 3 marks

Note Decreasing at a rate of 1: the rate of change is -1. $C'(t) = 1$ (which gives $t = 2.03$) earns M0.

MARKSCHEME (c)

0 **A1**

Total 1 mark

Note The drug leaves the blood: $t\,\mathrm{e}^{-0.4t} \to 0$. A table of values on the GDC confirms it.