Exercise 3

Paper 2 style · Graphic display calculator

3 6 marks AHL 3.14 · 3.15 ●●○ Typical

A drone flies in a straight line. At time t hours its position vector, in kilometres, is $\mathbf{r} = \begin{pmatrix} 3 \\ -2 \\ 0.5 \end{pmatrix} + t\begin{pmatrix} -1 \\ 2 \\ 0.25 \end{pmatrix}$. A mast has its top at $T(-2, 6, 2)$.

(a) Find the speed of the drone. **[2]**

(b) Find the value of t when the drone is closest to T. **[2]**

(c) Find the shortest distance between the drone and T. **[2]**

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)

$\sqrt{1^2 + 2^2 + 0.25^2}$ **M1**

2.25 km h^{-1} **A1**

Total 2 marks

MARKSCHEME (b)

$\overrightarrow{TP} = \begin{pmatrix} 5 - t \\ 2t - 8 \\ 0.25t - 1.5 \end{pmatrix}$, $\overrightarrow{TP} \cdot \begin{pmatrix} -1 \\ 2 \\ 0.25 \end{pmatrix} = 5.0625t - 21.375 = 0$ **M1**

$t = 4.22 \ \left(\frac{38}{9}\right)$ **A1**

Total 2 marks

Note Or minimise the distance on the GDC.

MARKSCHEME (c)

$\left|\overrightarrow{TP}\right|$ at $t = \frac{38}{9}$ **M1**

1 km **A1**

Total 2 marks