6 In this question lengths are in centimetres and time, t, is in seconds.

A particle P is moving in a straight line with a speed of 26 in the direction of the vector $\begin{pmatrix} 5 \\ -12 \end{pmatrix}$.

(a) Find the velocity vector of P. [2]

When $t = 0$, P passes through a point A which has position vector $\begin{pmatrix} 3 \\ 6 \end{pmatrix}$.

(b) Write down the position vector of P at time t. [2]

At the same time that P passes through A, a particle Q passes through a point B.

The position vector of Q at time t is given by $\begin{pmatrix} 8t-5 \\ 2-25t \end{pmatrix}$.

The distance between P and Q at time t is d.

(c) Show that $d^2 = mt^2 + nt + r$, where m, n and r are integers to be found. [3]

(d) Hence show that P and Q do **not** collide. [1]

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7 **(a)** Given that $y = x\cos 2x$, find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$. [2]

(b) Hence find $\int x\sin 2x \, \mathrm{d}x$. [4]