Question	Scheme	Marks	AOs
6(a)	$\overrightarrow{AD} = 10\mathbf{i} + 24\mathbf{j}$ and $\overrightarrow{BC} = 50\mathbf{i} + 120\mathbf{j}$	**M1**	1.1b
	$\overrightarrow{AD} = \frac{1}{5}\overrightarrow{BC}$ therefore AD is parallel to BC *	**A1*cso**	2.2a
		(2)	
(b)	Attempt to find at least two lengths between AB, BC, CD and AD $\lvert\overrightarrow{BC}\rvert = \sqrt{50^2+120^2} = 130$, $\lvert\overrightarrow{DA}\rvert = \sqrt{10^2+24^2} = 26$	**M1**	1.1b
	$\lvert\overrightarrow{AB}\rvert = \sqrt{12^2+16^2} = 20$, $\lvert\overrightarrow{CD}\rvert = \sqrt{28^2+112^2} = 28\sqrt{17}$ (awrt 115 m)	**A1**	1.1b
	Average speed $= \dfrac{2\left(26+130+20+28\sqrt{17}\right)/1000}{5/60}$	**dM1**	3.1b
	awrt $= 6.99$ (km/h)	**A1**	3.2a
		(4)	
			(6 marks)

Notes

(a)

M1: Attempts to find both $\overrightarrow{AD} = \pm(10\mathbf{i} + 24\mathbf{j})$ and $\overrightarrow{BC} = \pm(50\mathbf{i} + 120\mathbf{j})$.

May be seen as column vectors.

Condone poor notation with column vectors e.g. $\begin{pmatrix}10\mathbf{i}\\24\mathbf{j}\end{pmatrix}$ or $\begin{matrix}10\\24\end{matrix}$ for $\begin{pmatrix}10\\24\end{pmatrix}$

This mark can be scored for at least one correct component for each vector if no method is shown.

May be implied if they go straight for ratios (gradients) e.g. $\pm\dfrac{24-0}{22-12}$, $\pm\dfrac{16-136}{0-50}$, $\pm\dfrac{0-50}{16-136}$

Some candidates use distances in an attempt to prove part (a) e.g. finding 10^2+24^2 and 50^2+120^2 in which case the M1 can be implied. Adding vectors scores M0

A1*cso: This mark requires

- correct work showing AD is parallel to BC by showing that e.g. $\overrightarrow{AD} = \pm\frac{1}{5}\overrightarrow{BC}$ or equivalent e.g. $\overrightarrow{BC} = \pm 5\overrightarrow{AD}$ or e.g. $\overrightarrow{AD} = 2(5\mathbf{i}+12\mathbf{j})$ $\overrightarrow{BC} = 10(5\mathbf{i}+12\mathbf{j})$ or e.g. $BC = \pm 5AD$ (i.e. the vector arrows are not required) or by showing the ratio/gradient of the lines through AD and BC are equal e.g. $\dfrac{24}{10} = \dfrac{120}{50}$. Condone e.g. $\dfrac{50\mathbf{i}+120\mathbf{j}}{10\mathbf{i}+24\mathbf{j}} = 5$
- a (minimal) conclusion e.g. ✓, hence shown, etc. which may be in a preamble e.g. if they are parallel then $AD = kBC$…etc. If using ratios/gradients they need to say that they are parallel.
- vectors correctly calculated but allow e.g. $\overrightarrow{AD} = -10\mathbf{i} - 24\mathbf{j}$ and allow poor column vector notation as above

Using reciprocal gradients for both is acceptable for A1 even if they call them "gradients".

Do not credit work in part (b) in part (a) unless used in part (a)

(b)

M1: Attempts to use Pythagoras to find **at least two** of the lengths of the quadrilateral.

May be implied by at least 2 correct lengths.

For reference $\pm\overrightarrow{AB} = \pm(-12\mathbf{i}+16\mathbf{j})$, $\pm\overrightarrow{BC} = \pm(50\mathbf{i}+120\mathbf{j})$, $\pm\overrightarrow{CD} = \pm(-28\mathbf{i}-112\mathbf{j})$, $\pm\overrightarrow{DA} = \pm(10\mathbf{i}+24\mathbf{j})$

Allow ft if using their vectors from part (a) provided subtraction was used. Do not be concerned about the signs of individual components but must be using subtraction (but condone $\pm\overrightarrow{AB} = \pm(12\mathbf{i}+16\mathbf{j})$) to find the vectors and then squaring and adding components and then taking the square root.

A1: At least 2 lengths correct: If units are given they must be correct.

$\left|\overrightarrow{AB}\right| = \sqrt{12^2 + 16^2} = 20,$ $\qquad \left|\overrightarrow{CD}\right| = \sqrt{28^2 + 112^2} = 28\sqrt{17}$ (allow awrt 115 m)

$\left|\overrightarrow{BC}\right| = 10\sqrt{5^2 + 12^2} = 130,$ $\qquad \left|\overrightarrow{DA}\right| = 2\sqrt{5^2 + 12^2} = 26$

Allow if they are working in km e.g. $\left|\overrightarrow{AB}\right| = 0.02$ etc.

M1A1 is implied by a total distance of awrt 291 (m) or possibly a multiple of this if they are doubling (awrt 583) or e.g. multiplying by 24 (awrt 6990) etc.

dM1: For an attempt at an average speed ignoring any attempt to get the correct units.
They must have attempted all 4 lengths for this mark.
There must be some indication that they have divided by 5 but this may be implied.
Allow this mark if they calculate the average speed for 2 laps or 1 lap e.g.
$\frac{"291"\times 2}{5}$, $\frac{"291"}{5}$, $"291"\times 12$, $\quad "291"\times 2\times 12$ or e.g. if they divide by 2.5 or multiply by 24.

A1: awrt 6.99 (km/h). or anything which truncates to 6.99 e.g. 6.995. Units are **not** required but if they are given they must be correct. Isw once a correct answer is seen.

An exact answer is acceptable for the final A1 in (b): $4.224 + 0.672\sqrt{17}$

Special Case:

Some candidates are misinterpreting/misreading the position vector for B as $16\mathbf{i}$ rather than $16\mathbf{j}$
This is usually implied by their vectors/ratios e.g.

$$\overrightarrow{AD} = \pm(10\mathbf{i} + 24\mathbf{j}) \quad \text{and} \quad \overrightarrow{BC} = \pm(34\mathbf{i} + 136\mathbf{j})$$

or e.g.

$$\pm\frac{24-0}{22-12},\ \pm\frac{50-16}{136-0}$$

For part (a), the maximum possible score is **M1A0** with the conditions for the M mark as described in the main scheme.

For part (b) the maximum possible score is **M1A1M1A0** as follows:

M1: Attempts to use Pythagoras to find **at least two** of the lengths of the quadrilateral as defined in the main scheme.

For reference $\pm\overrightarrow{AB} = \pm 4\mathbf{i},\ \pm\overrightarrow{BC} = \pm(34\mathbf{i} + 136\mathbf{j}),\ \pm\overrightarrow{CD} = \pm(-28\mathbf{i} - 112\mathbf{j}),\ \pm\overrightarrow{DA} = \pm(10\mathbf{i} + 24\mathbf{j})$

A1: Correct lengths for AD and CD. If units are given they must be correct.
This may **not** be scored for correct ft lengths for AB or BC
So requires both:

$$\left|\overrightarrow{CD}\right| = \sqrt{28^2 + 112^2} = 28\sqrt{17} \text{ (allow awrt 115 m)}$$

$$\left|\overrightarrow{DA}\right| = \sqrt{10^2 + 24^2} = 26$$

dM1: As above for an attempt at an average speed ignoring any attempt to get the correct units.

A0: Not available

If the position vector for B is not misinterpreted/misread in part (b) then full marks are available.