Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
1	Makes an attempt to use Pythagoras' theorem to find $\|\mathbf{a}\|$. For example, $\sqrt{(4)^2+(-7)^2}$ seen.	M1	1.1b	4th Find the unit vector in the direction of a given vector
	$\sqrt{65}$	A1	1.1b	
	Displays the correct final answer. $\frac{1}{\sqrt{65}}(4\mathbf{i}-7\mathbf{j})$	A1	1.1b	
		(3)		
				(3 marks)

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Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
2a	States that $\overrightarrow{AB} = -\mathbf{a} + \mathbf{b}$	**M1**	2.2a	3rd Understand the condition for two vectors to be parallel
	States $\overrightarrow{PQ} = \overrightarrow{PO} + \overrightarrow{OQ}$ or $\overrightarrow{PQ} = -\frac{3}{5}\mathbf{a} + \frac{3}{5}\mathbf{b}$	**M1**	3.1a	
	States $\overrightarrow{PQ} = \frac{3}{5}(-\mathbf{a} + \mathbf{b})$ or $\overrightarrow{PQ} = \frac{3}{5}\overrightarrow{AB}$	**A1**	2.2a	
	Draws the conclusion that as $\overrightarrow{PQ}$ is a multiple of $\overrightarrow{AB}$ the two lines PQ and AB must be parallel.	**A1**	2.1	
		(4)		
2b	$PQ = \frac{3}{5} \times 10$ cm = 6 cm cao	**B1**	3.1a	3rd Understand and use position vectors
		(1)		
				(5 marks)

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Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
3a	Equates the **i** components for the equation **a** + **b** = m**c** o.e. $2p + 6 = 4m$	**B1**	2.2a	3rd Understand the condition for two vectors to be parallel
	Equates the **j** components for the their equation **a** + **b** = m**c** $-5 - 3p = -5m$	**B1**	2.2a	
	Makes an attempt to find p by eliminating m in some way. For example, $\begin{matrix} 10p + 30 = 20m \\ 20 + 12p = 20m \end{matrix}$ o.e. or $\frac{2p+6}{-5-3p} = -\frac{4}{5}$ o.e.	**M1**	1.1b	
	$p = 5$	**A1**	1.1b	
		(4)		
3b	Using their value for p from above, makes a substitution into the vectors to form **a** + **b** 10**i** – 5**j** + 6**i** – 15**j**	**M1ft**	1.1b	2nd Add, subtract and find scalar multiples of vectors by calculation
	Correctly simplifies. 16**i** – 20**j**	**A1ft**	1.1b	
		(2)		
				(6 marks)

Notes

3a
Alternatively, M1: attempt to eliminate p first. A1: $m = 4$ and $p = 5$

3b
Alternatively, M1ft: substitute their $m = 4$ into their **a** + **b** = m**c**. A1ft correct simplification.

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Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
4a	Makes an attempt to find the vector $\overrightarrow{AB}$. For example, writing $\overrightarrow{AB}=\overrightarrow{OB}-\overrightarrow{OA}$ or $\overrightarrow{AB}=10\mathbf{i}+q\mathbf{j}-(4\mathbf{i}+7\mathbf{j})$	**M1**	2.2a	3rd Understand and use position vectors
	Shows a fully simplified answer: $\overrightarrow{AB}=6\mathbf{i}+(q-7)\mathbf{j}$	**A1**	1.1b	
		(2)		
4b	Correctly interprets the meaning of $\lvert\overrightarrow{AB}\rvert=2\sqrt{13}$, by writing $(6)^2+(q-7)^2=\left(2\sqrt{13}\right)^2$ o.e.	**M1**	2.2a	4th Use vectors to solve simple geometric problems
	Correct method to solve quadratic equation in q (full working must be shown). For example, $(q-7)^2=16$ or $q^2-14q+33=0$	**M1**	1.1b	
	$q-7=\pm4$ or $(q-11)(q-3)=0$ or $q=\dfrac{14\pm\sqrt{14^2-4\times1\times33}}{2\times1}$	**M1**	1.1b	
	$q=11$	**A1**	1.1b	
	$q=3$	**A1**	1.1b	
		(5)		
				(7 marks)

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Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
5a	States or implies that $\overrightarrow{BC} = 13\mathbf{i} - 8\mathbf{j}$ o.e.	**M1**	2.2a	4th Use vectors to solve simple geometric problems
	Recognises that the cosine rule is needed to solve for $\angle BAC$ by stating $a^2 = b^2 + c^2 - 2bc \times \cos A$	**M1**	3.1a	
	Makes correct substitutions into the cosine rule. $\left(\sqrt{233}\right)^2 = \left(\sqrt{45}\right)^2 + \left(\sqrt{104}\right)^2 - 2\left(\sqrt{45}\right)\left(\sqrt{104}\right) \times \cos A$ o.e.	**M1**	1.1b	
	$\cos A = -\frac{7}{\sqrt{130}}$ or awrt −0.614 (seen or implied by correct answer).	**M1**	1.1b	
	A = 127.9° cao	**A1**	1.1b	
		(5)		
5b	States formula for the area of a triangle. Area $= \frac{1}{2}ab\sin C$	**M1**	3.1a	4th Use vectors to solve simple geometric problems
	Makes correct substitutions using their values from above. Area $= \frac{1}{2}\left(\sqrt{45}\right)\left(\sqrt{104}\right)\sin 127.9...^\circ$	**M1ft**	1.1b	
	Area = 27 (units^2)	**A1ft**	1.1b	
		(3)		
				(8 marks)

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Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
6a	States that $\tan\theta = \pm\frac{2}{3}$ or $\theta = \tan^{-1}\pm\frac{2}{3}$ (if θ shown on diagram sign must be consistent with this).	**M1**	1.1b	2nd Find the direction of a vector using tan
	Finds −33.7° (must be negative).	**A1**	1.1b	
		(2)		
6b	Makes an attempt to use the formula **F** = m**a**	**M1**	3.1a	4th Understand the link that vectors have with mechanics
	Finds p = 10 Note: $8 + p = 6\times3 \Rightarrow p = 10$	**A1**	2.2a	
	Finds $q = -2$ Note: $-10 + q = 6\times-2 \Rightarrow q = -2$	**A1**	2.2a	
		(3)		
6c	Attempt to find **R** (either $6(3\mathbf{i} - 2\mathbf{j})$ or $8\mathbf{i} - 10\mathbf{j} + '10'\mathbf{i} + '-2'\mathbf{j}$).	**M1**	3.1a	2nd Use the magnitude and direction of a vector to find its components
	Makes an attempt to find the magnitude of their resultant force. For example, $\lvert R\rvert = \sqrt{'18'^2 + '12'^2}\left(=\sqrt{468}\right)$	**M1**	1.1b	
	Presents a fully simplified exact final answer. $\lvert R\rvert = 6\sqrt{13}$	**A1**	1.1b	
		(3)		
				(8 marks)

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Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
7a	Shows how to move from *M* to *N* using vectors. $\overrightarrow{MN} = \overrightarrow{MB} + \overrightarrow{BC} + \overrightarrow{CN} = \frac{4}{5}\mathbf{b} + \mathbf{a} - \frac{1}{5}\mathbf{b}$ or $\overrightarrow{MN} = \overrightarrow{MO} + \overrightarrow{OA} + \overrightarrow{AN} = -\frac{1}{5}\mathbf{b} + \mathbf{a} + \frac{4}{5}\mathbf{b}$	**M1**	1.1b	3rd Understand and use position vectors
	$\overrightarrow{MN} = \mathbf{a} + \frac{3}{5}\mathbf{b}$	**A1**	1.1b	
		(2)		
7b	Shows how to move from *S* to *T* using vectors. $\overrightarrow{ST} = \overrightarrow{SB} + \overrightarrow{BO} + \overrightarrow{OT} = -\frac{1}{5}\mathbf{a} - \mathbf{b} + \frac{4}{5}\mathbf{a}$ or $\overrightarrow{ST} = \overrightarrow{SC} + \overrightarrow{CA} + \overrightarrow{AT} = \frac{4}{5}\mathbf{a} - \mathbf{b} - \frac{1}{5}\mathbf{a}$	**M1**	1.1b	3rd Understand and use position vectors
	$\overrightarrow{ST} = \frac{3}{5}\mathbf{a} - \mathbf{b}$	**A1**	1.1b	
		(2)		

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7c	Finds $\overrightarrow{OD}$ travelling via M. $\overrightarrow{OD}=\overrightarrow{OM}+\overrightarrow{MD}=\frac{1}{5}\mathbf{b}+\lambda\left(\mathbf{a}+\frac{3}{5}\mathbf{b}\right)$	**M1***	3.1a	4th Use vectors to solve simple geometric problems
	Finds $\overrightarrow{OD}$ travelling via T. $\overrightarrow{OD}=\overrightarrow{OT}+\overrightarrow{TD}=\frac{4}{5}\mathbf{a}+\mu\left(-\frac{3}{5}\mathbf{a}+\mathbf{b}\right)$	**M1***	3.1a	
	Recognises that any two ways of travelling from O to D must be equal and equates $\overrightarrow{OD}$ via M with $\overrightarrow{OD}$ via T. $\frac{1}{5}\mathbf{b}+\lambda\left(\mathbf{a}+\frac{3}{5}\mathbf{b}\right)=\frac{4}{5}\mathbf{a}+\mu\left(-\frac{3}{5}\mathbf{a}+\mathbf{b}\right)$ Or $\lambda\mathbf{a}+\left(\frac{1}{5}+\frac{3}{5}\lambda\right)\mathbf{b}=\left(\frac{4}{5}-\frac{3}{5}\mu\right)\mathbf{a}+\mu\mathbf{b}$	**M1***	2.2a	
	Equates the **a** parts: $\lambda=\frac{4}{5}-\frac{3}{5}\mu$ or $5\lambda=4-3\mu$ or $3\mu+5\lambda=4$	**M1***	2.2a	
	Equates the **b** parts: $\frac{1}{5}+\frac{3}{5}\lambda=\mu$ or $1+3\lambda=5\mu$ or $5\mu-3\lambda=1$	**M1***	2.2a	
	Makes an attempt to solve the pair of simultaneous equations by multiplying. For example, $15\mu+25\lambda=20$ and $15\mu-9\lambda=3$ or $9\mu+15\lambda=12$ and $25\mu-15\lambda=5$	**M1**	1.1b	
	Solves to find $\lambda=\frac{1}{2}$ and $\mu=\frac{1}{2}$	**A1**	1.1b	
	Either: explains, making reference to an expression for $\overrightarrow{OD}$ or, for example, $\overrightarrow{MD}$ that $\lambda=\frac{1}{2}$ implies that D is the midpoint of MN or finds $\overrightarrow{MD}=\overrightarrow{DN}$ or $\overrightarrow{MD}=\frac{1}{2}\overrightarrow{MN}$ o.e. and therefore MN is bisected by ST.	**B1**	3.2	
	Uses argument (as above) for bisection of ST using $\mu=\frac{1}{2}$	**B1**	3.2	

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		(9)		
(13 marks)				

Notes

7c

Equating, for example, $\overrightarrow{OD}$ via M with $\overrightarrow{OD}$ via N, will lead to a pair of simultaneous equations that has infinitely many solutions. In this case, providing all work is correct, award one of the first two method marks, together with the 3rd, 4th, 5th and 6th method marks, for a maximum of 5 out of 9.

Alternative Method

(M1) Finds $\overrightarrow{OD}$ travelling via N.

$$\overrightarrow{OD} = \overrightarrow{OA} + \overrightarrow{AN} + \overrightarrow{ND} = \mathbf{a} + \frac{4}{5}\mathbf{b} + \lambda\left(-\mathbf{a} - \frac{3}{5}\mathbf{b}\right)$$

(M1) Finds $\overrightarrow{OD}$ travelling via S.

$$\overrightarrow{OD} = \overrightarrow{OB} + \overrightarrow{BS} + \overrightarrow{SD} = \mathbf{b} + \frac{1}{5}\mathbf{a} + \mu\left(\frac{3}{5}\mathbf{a} - \mathbf{b}\right)$$

(M1) Equates $\overrightarrow{OD}$ via N with $\overrightarrow{OD}$ via S.

$$\mathbf{a} + \frac{4}{5}\mathbf{b} + \lambda\left(-\mathbf{a} - \frac{3}{5}\mathbf{b}\right) = \mathbf{b} + \frac{1}{5}\mathbf{a} + \mu\left(\frac{3}{5}\mathbf{a} - \mathbf{b}\right)$$

(M1) Equates the **a** parts:

$$1 - \lambda = \frac{1}{5} + \frac{3}{5}\mu \text{ or } 5 - 5\lambda = 1 + 3\mu \text{ or } 3\mu + 5\lambda = 4$$

(M1) Equates the **b** parts:

$$\frac{4}{5} - \frac{3}{5}\lambda = 1 - \mu \text{ or } 4 - 3\lambda = 5 - 5\mu \text{ or } 5\mu - 3\lambda = 1$$

Proceeds as above.

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