Question number	Scheme	Marks
8 (a)	$\overrightarrow{OB} = \overrightarrow{OA} + \overrightarrow{AB} = \mathbf{a} + \mathbf{b}$	B1 [1]
(b)	$\overrightarrow{OC} = 2\mathbf{b}$ $\overrightarrow{BC} = \overrightarrow{BO} + \overrightarrow{OC} = -(\mathbf{a} + \mathbf{b}) + 2\mathbf{b} = \mathbf{b} - \mathbf{a}$	B1 M1A1 [3]
(c)	$\overrightarrow{OM} = \overrightarrow{OB} + \overrightarrow{BM} = \mathbf{a} + \mathbf{b} + \frac{2}{3}(\mathbf{b} - \mathbf{a}) = \frac{\mathbf{a}}{3} + \frac{5\mathbf{b}}{3}$ or $\frac{1}{3}(\mathbf{a} + 5\mathbf{b})$	M1A1ft [2]
(d)	$\overrightarrow{OY} = \mu\left(\frac{\mathbf{a}}{3} + \frac{5\mathbf{b}}{3}\right) = \frac{\mu\mathbf{a}}{3} + \frac{5\mu\mathbf{b}}{3}$ $\overrightarrow{OY} = \overrightarrow{OA} + \overrightarrow{AY} = \boldsymbol{a} + \lambda\boldsymbol{b}$ $\Rightarrow \frac{\mu}{3} = 1$ and $\frac{5\mu}{3} = \lambda$ Solves simultaneous equations by any method $\mu = 3,\ \lambda = 5$ $AB : BY = 1 : 4$ **ALT** $\overrightarrow{BY} = \lambda\overrightarrow{AB} = \lambda\mathbf{b}$ $\overrightarrow{BY} = \overrightarrow{BO} + \overrightarrow{OY} = \overrightarrow{BO} + \mu\overrightarrow{OM} = -(\boldsymbol{a} + \mathbf{b}) + \mu\left(\frac{1}{3}\mathbf{a} + \frac{5}{3}\boldsymbol{b}\right)$ $= \left(-1 + \frac{1}{3}\mu\right)\mathbf{a} + \left(-1 + \frac{5}{3}\mu\right)\mathbf{b}$ $\Rightarrow -1 + \frac{1}{3}\mu = 0$ and $\lambda = -1 + \frac{5}{3}\mu$ $\mu = 3, \lambda = 4$ $AB : BY = 1 : 4$	M1 M1 M1 M1 A1 [5] [M1 M1 M1 M1 A1]
(e)	$10 = \frac{1}{2}ab\sin 60^\circ \Rightarrow ab = \frac{40}{\sqrt{3}} \Rightarrow a = \frac{40}{b\sqrt{3}}$ $\text{Area} = \frac{1}{2}a \times 5b\sin 120^\circ = \frac{1}{2} \times \frac{40}{b\sqrt{3}} \times 5b\sin 120^\circ$ $\text{Area} = 50$ **ALT** $\frac{\text{Area } OAY}{\text{Area } OAB} = \frac{\frac{1}{2} \times h \times 5}{\frac{1}{2} \times h \times 1} = \frac{5}{1}$ $\text{Area } OAY = 5 \times \text{Area } OAB$ $\text{Area } OAB = 10$ $\text{Area} = 50$	M1A1 dM1 A1 [4] [M1 A1 dM1 A1]
		Total 15 marks

Part	Mark	Notes
(a)	B1	For a correct expression for $\overrightarrow{OB}$ in terms of **a** and **b**
(b)	B1	For a correct expression for $\overrightarrow{OC}$
	M1	For a correct vector statement for $\overrightarrow{BC}$: $\overrightarrow{BC} = \overrightarrow{BO} + \overrightarrow{OC}$ This mark can be implied by a correct (unsimplified) vector using their $\overrightarrow{OB}$. Vector statement must be suitable for substitution to find $\overrightarrow{BC}$
	A1	For the correct simplified $\overrightarrow{BC}$ in terms of a single **a** and **b** only. $\overrightarrow{BC} = \mathbf{b} - \mathbf{a}$ If answer $\overrightarrow{BC} = \mathbf{b} - \mathbf{a}$ seen without wrong working then award B1M1A1.
(c)	M1	For a correct vector statement for $\overrightarrow{OM}$: $\overrightarrow{OM} = \overrightarrow{OB} + \frac{2}{3}\overrightarrow{BC}$ This mark can be implied by a correct (unsimplified) vector using their $\overrightarrow{OB}$ and their $\overrightarrow{BC}$.
	A1ft	For the correct simplified using their $\overrightarrow{OM}$ in terms of a single **a** and **b** only. $\overrightarrow{OM} = \frac{\boldsymbol{a}}{3} + \frac{5\boldsymbol{b}}{3}$ or $\frac{1}{3}(\boldsymbol{a} + 5\boldsymbol{b})$
(d)	M1 M1	M1 for one correct statement of route for $\overrightarrow{OY}$ M1 for second correct statement of route for $\overrightarrow{OY}$ $\overrightarrow{OY} = \mu\overrightarrow{OM}$ (or any other variable in place of μ) $\overrightarrow{OY} = \left(\overrightarrow{OA} + \overrightarrow{AY}\right) = \mathbf{a} + \lambda\mathbf{b}$ (or any other variable in place of λ, provided this is different to their μ). Allow use of their vectors from earlier parts of the question.
	M1	For equating their coefficients of **a** and **b** to obtain two equations. Mark intent – one must be correct, condone slips in second.
	M1	Solving their simultaneous equations by any method. Only the value for their λ is required for this mark.
	A1	For $AB: BY = 1: 4$
ALT – use of $\overrightarrow{BY}$ route, use also for $\overrightarrow{AY}$ route		
	M1 M1	M1 for one correct statement of route for $\overrightarrow{BY}$ M1 for second correct statement of route for $\overrightarrow{BY}$ $\overrightarrow{BY} = \lambda\overrightarrow{AB} = \lambda\mathbf{b}$ (or any other variable in place of λ) $\overrightarrow{BY} = \overrightarrow{BO} + \overrightarrow{OY} = \overrightarrow{BO} + \mu\overrightarrow{OM} = -(\boldsymbol{a} + \mathbf{b}) + \mu\left(\frac{1}{3}\mathbf{a} + \frac{5}{3}\boldsymbol{b}\right)$ $= \left(-1 + \frac{1}{3}\mu\right)\mathbf{a} + \left(-1 + \frac{5}{3}\mu\right)\mathbf{b}$ (or any other variable in place of μ provided this is different to their λ). Allow use of their vectors from earlier parts of the question.
	M1	For equating their coefficients of **a** and **b** to obtain two equations. Mark intent – one must be correct, condone slips in second.
	M1	Solving their simultaneous equations by any method. Only the value for their λ is required for this mark.
	A1	For $AB: BY = 1: 4$

(e)	**M1**	For use of the **correct** formula for area of a triangle with 60° and correct value of sin 60° $10 = \frac{1}{2}ab\sin 60° = ab \times \frac{\sqrt{3}}{4}$
	A1	For correct expression for ab or a $ab = \frac{40}{\sqrt{3}}$ or $a = \frac{40}{b\sqrt{3}}$
	dM1	For use of the **correct** formula for area of a triangle with 120° and attempt to substitute for ab or a. $\text{Area} = \frac{1}{2}a \times '5'b\sin 120° = \frac{1}{2} \times '\frac{40}{b\sqrt{3}}' \times '5'b\sin 120°$ or $\text{Area} = \frac{1}{2}a \times '5'b\sin 120° = \frac{1}{2} \times ab \times '5'\sin 120° = \frac{1}{2} \times '\frac{40}{\sqrt{3}}' \times '5'\sin 120°$ Dependent on the first M awarded. Allow use of their λ from part (d).
	A1	For the correct area $\text{Area} = 50$
ALT – use of ratios of areas		
	M1	For use of their ratio $AB : BY$ to write an equation linking area OAY and area OAB $\frac{\text{Area } OAY}{\text{Area } OAB} = \frac{\frac{1}{2}\times h \times (1+'4')}{\frac{1}{2}\times h \times 1} = \frac{'5'}{1}$
	A1	For correct relationship between area OAY and area OAB
	dM1	For a correct method to find the area of OAB Dependent on first M mark being awarded.
	A1	For the correct area $\text{Area} = 50$