Question number	Scheme	Marks
10 a (i)	$\overrightarrow{OP} = \overrightarrow{OA} + \frac{3}{4}\overrightarrow{AB} = \mathbf{a} + \frac{3}{4}(-\mathbf{a} + \mathbf{b})$ or $\overrightarrow{OB} + \frac{1}{4}\overrightarrow{BA} = \mathbf{b} + \frac{1}{4}(\mathbf{a} - \mathbf{b})$	M1
	$\overrightarrow{OP} = \frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$	A1
(ii)	$\overrightarrow{MN} = \overrightarrow{MO} + \frac{1}{2}\overrightarrow{OP} = -\frac{1}{2}\mathbf{a} + \frac{1}{2}\left("\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}"\right)$ or $\frac{1}{2}\overrightarrow{AO} + \frac{1}{2}\overrightarrow{OP}$	M1
	$\overrightarrow{MN} = -\frac{3}{8}\mathbf{a} + \frac{3}{8}\mathbf{b}$	A1 (4)
b	$\overrightarrow{OC} = \lambda\mathbf{b}$	B1
	$\overrightarrow{AN} = \left(\overrightarrow{AO} + \overrightarrow{ON}\right) = -\mathbf{a} + \frac{1}{2}\left("\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}"\right) = -\frac{7}{8}\mathbf{a} + \frac{3}{8}\mathbf{b}$ or $\overrightarrow{AN} = \overrightarrow{AP} + \overrightarrow{PN} =$	M1
	$\overrightarrow{OC} = \overrightarrow{OA} + \mu\overrightarrow{AN} = \mathbf{a} + \mu\left(-\mathbf{a} + \frac{1}{2}\left("\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}"\right)\right)$	M1 (A1 on ePen)
	$= \mathbf{a} - \frac{7}{8}\mu\mathbf{a} + \frac{3}{8}\mu\mathbf{b}$ *or* $\left(1 - \frac{7}{8}\mu\right)\mathbf{a} + \frac{3}{8}\mu\mathbf{b}$	A1 (M1 on ePen)
	$\therefore \lambda = \frac{3}{8}\mu$ and $0 = 1 - \frac{7}{8}\mu \Rightarrow \mu = \frac{8}{7}$ $\therefore \lambda = \frac{3}{7}$	M1 (A1 on ePen)
	$\overrightarrow{OC} = \frac{3}{7}\mathbf{b}$	A1 (6)
ALT	$\overrightarrow{AC} = -\mathbf{a} + \lambda\mathbf{b}$	B1
	$\overrightarrow{AN} = \left(\overrightarrow{AO} + \overrightarrow{ON}\right) = -\mathbf{a} + \frac{1}{2}\left("\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}"\right) = -\frac{7}{8}\mathbf{a} + \frac{3}{8}\mathbf{b}$ or $\overrightarrow{AN} = \overrightarrow{AP} + \overrightarrow{PN} =$	M1
	$\overrightarrow{AC} = \mu\overrightarrow{AN} = \mu\left(-\mathbf{a} + \frac{1}{2}\left("\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}"\right)\right)$	M1 (A1 on ePen)
	$= -\frac{7}{8}\mu\mathbf{a} + \frac{3}{8}\mu\mathbf{b}$	A1 (M1 on ePen)
	$\therefore \lambda = \frac{3}{8}\mu$ and $0 = 1 - \frac{7}{8}\mu \Rightarrow \mu = \frac{8}{7}$ $\therefore \lambda = \frac{3}{7}$	M1 (A1 on ePen)
	$\overrightarrow{OC} = \frac{3}{7}\mathbf{b}$	A1 (6)

General principles for marking part (b) – if in any doubt about allocating marks – send to review

B1 Writes a valid vector with a parameter in terms of **a** or **b** which leads to finding $\overrightarrow{OC}$

M1 M1 A1 Writes a second valid vector with a different parameter, in terms of **a** and **b**, following a distinct different route, which leads to finding $\overrightarrow{OC}$

M1 Compares components with two different parameters and arrives at a value for μ or λ

A1 correct vector

c	(Area triangle) $OAP = \frac{3}{4}$ (Area triangle) OAB	B1
	(Area triangle) $OMN = \frac{1}{4}$ (Area triangle) $OAP = \frac{3}{16}$ (Area triangle) OAB	B1
	(Area quadrilateral) $AMNP =$ $\frac{3}{4}$ (Area triangle) $OAB - \frac{3}{16}$ (Area triangle) OAB	M1
	$= \frac{9}{16}$ (Area triangle) OAB $\quad k = \frac{9}{16}$	A1 (4)
ALT	$\frac{(\text{Area triangle})OAP}{(\text{Area triangle})\ OAB} = \frac{3}{4}$	B1
	$\left(\frac{\text{Area triangle } OMN}{\text{Area triangle } OAP} = \frac{1}{4}\right) \Rightarrow \frac{(\text{Area quadrilateral})\ MNAP}{(\text{Area triangle})\ OAP} = \frac{3}{4}$	B1
	$\frac{(\text{Area quadrilateral})MNAP}{(\text{Area triangle})\ OAP} \times \frac{(\text{Area triangle})\ OAP}{(\text{Area triangle})\ OAB} = \frac{3}{4} \times \frac{3}{4}$	M1
	$k = \frac{9}{16}$	A1 (4)
		Total 14 marks

Part	Marks	Note
(a) (i)	**M1**	For stating **or** using $\overrightarrow{OP} = \overrightarrow{OA} + \frac{3}{4}\overrightarrow{AB}$ or for $\mathbf{a} + \frac{3}{4}(-\mathbf{a} + \mathbf{b})$ or $\overrightarrow{OB} + \frac{1}{4}\overrightarrow{BA}$ or $\mathbf{b} + \frac{1}{4}(\mathbf{a} - \mathbf{b})$ (can be implied by correct vector)
	A1	For $\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$ or valid alternative form such as $\frac{\mathbf{a}+3\mathbf{b}}{4}$ or $\frac{1}{4}(\mathbf{a}+3\mathbf{b})$
(ii)	**M1**	For stating **or** using $\overrightarrow{MN} = \overrightarrow{MO} + \frac{1}{2}\overrightarrow{OP}$ or $\frac{1}{2}\overrightarrow{AO} + \frac{1}{2}\overrightarrow{OP}$ or $-\frac{1}{2}\mathbf{a} + \frac{1}{2}\left(\text{their } \overrightarrow{OP}\right)$
	A1	$-\frac{3}{8}\mathbf{a} + \frac{3}{8}\mathbf{b}$ or valid alternative form such as $\frac{-3\mathbf{a}+3\mathbf{b}}{8}$ or $\frac{1}{8}(-3\mathbf{a}+3\mathbf{b})$ (can be implied by correct vector)
(b)	**B1**	$\overrightarrow{OC} = \lambda\mathbf{b}$ or any equivalent statement involving a parameter, in terms of **b**.
	M1	A fully correct method to find $\overrightarrow{AN}$ using their $\overrightarrow{OP}$ $\overrightarrow{AN} = -\mathbf{a} + \frac{1}{2}\left("\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}"\right)$
	M1 (A1 on ePen)	**Using** $\overrightarrow{OC} = \overrightarrow{OA} + \mu\left(\text{their } \overrightarrow{AN}\right)$ in terms **a** and **b** $\overrightarrow{OC} = \overrightarrow{OA} + \mu\overrightarrow{AN} = \mathbf{a} + \mu\left(-\mathbf{a} + \frac{1}{2}\left("\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}"\right)\right)$ Simplification not required
	A1 (M1 on ePen)	$= \mathbf{a} - \frac{7}{8}\mu\mathbf{a} + \frac{3}{8}\mu\mathbf{b}$ *or* $\left(1 - \frac{7}{8}\mu\right)\mathbf{a} + \frac{3}{8}\mu\mathbf{b}$ either of these forms, ready for comparing coefficients
	M1 (A1 on ePen)	For correctly equating their components with two different parameters and attempting to solve, reaching values for μ or λ We need to see two equations here, leading to a value for one of the parameters.
	A1	$\overrightarrow{OC} = \frac{3}{7}\mathbf{b}$
ALT	**B1**	$\overrightarrow{AC} = -\mathbf{a} + \lambda\mathbf{b}$ or any equivalent statement involving a parameter, in terms of **a** and **b**.
	M1	A fully correct method to find $\overrightarrow{AN}$ using their $\overrightarrow{OP}$ $\overrightarrow{AN} = -\mathbf{a} + \frac{1}{2}\left("\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}"\right)$
	M1 (A1 on ePen)	$\overrightarrow{AC} = \mu\left(-\mathbf{a} + \frac{1}{2}\left("\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}"\right)\right)$ using their $\overrightarrow{AN}$
	A1 (M1 on ePen)	Correct vector for $\overrightarrow{AC}$
	M1 (A1 on ePen) A1	Marks allocated as main scheme
(c) BOTH SCHEMES	**B1**	Correct statement
	B1	Correct statement
	M1	Uses their statements to carry out a relevant calculation
	A1	Correct value for *k*