Question Number	Scheme	Mark
9(a)	$\left(\frac{k}{2}, 3\right)$	B1B1
		(2)
(b)	$-2x+k+3=\frac{1}{2}x+\frac{k+7}{2}$ **or** $2x-k+3=\frac{1}{2}x+\frac{k+7}{2}$	M1
	$x=\frac{k-1}{5}$ **or** $x=\frac{3k+1}{3}$	A1
	$-2x+k+3=\frac{1}{2}x+\frac{k+7}{2}$ **and** $2x-k+3=\frac{1}{2}x+\frac{k+7}{2}$	dM1
	M: $x=\frac{k-1}{5}$ **and** N: $x=\frac{3k+1}{3}$	A1
		(4)
(c)	y coordinate of R is $k+3$	B1
	$\frac{1}{2}\times"(k+3)"\times"\frac{(k-1)}{5}"=\frac{33}{40}\Rightarrow ...k^2\pm...k\pm...=0$	M1
	$4k^2+8k-45=0 \Rightarrow k=...\{2.5\} \Rightarrow \frac{1}{2}\times("2.5+3")\times\left(\frac{3\times2.5+1}{3}\right)=\frac{187}{24}$	dM1A1
		(4)
		(10 marks)

Mark all parts together.

(a) **Note: May be seen on their diagram if they have drawn one.**

B1: One coordinate correct. Allow e.g. $x=0.5k$ or $y=3$

B1: Both coordinates correct. Allow e.g. $x=\frac{1}{2}k$, $y=3$

If they write their answer as a vector $\begin{pmatrix}\frac{1}{2}k\\3\end{pmatrix}$ then score B1B0

(b) **Ignore any attempt to find *y* coordinates in this part.**

M1: Attempts to form an equation with modulus brackets removed.

They must deal with the modulus brackets correctly (so $|2x-k|$ must be replaced with either $2x-k$ or $-2x+k$ o.e.) but condone a slip e.g. in multiplying by 2 when they first set up the equation.

So allow e.g. $|2x-k|+3=\frac{1}{2}x+\frac{k+7}{2} \rightarrow 2|2x-k|+3=x+k+7 \rightarrow 4x-2k+3=x+k+7$

or e.g. $|2x-k|+3=\frac{1}{2}x+\frac{k+7}{2} \rightarrow |2x-k|+6=x+k+7 \rightarrow -(2x-k)+6=x+k+7$

A1: $x=\frac{k-1}{5}$ or $x=\frac{3k+1}{3}$ o.e. Do not be concerned by labelling.

Ignore incorrect simplification after a correct expression for x in terms of k is seen.

dM1: Attempts to form both equations with modulus brackets removed.
It is dependent on the previous method mark.
They must deal with the modulus brackets correctly (so $|2x-k|$ must be replaced with each of $2x-k$ and $-2x+k$ o.e. in their equations) but condone a slip as above e.g. in multiplying by 2 when they first set up the equations.

A1: x coordinate of M is $x=\frac{k-1}{5}$ o.e. **and** x coordinate of N is $x=\frac{3k+1}{3}$ o.e.
There is no need to specify which is M or N but withhold this mark if they have been incorrectly paired.
Ignore incorrect simplification after a correct expression for x in terms of k is seen.
If there are other x coordinates given that are clearly answers for part (b) then score final A0.

(c)

B1: y coordinate of R is $k+3$ May be seen elsewhere in their work, but it must clearly be R if being scored in part (a) or (b) (so e.g. $(0, k+3)$ or R: $k+3$ is acceptable but not $\left(\frac{k}{2}, k+3\right)$
If they have $(k+3, 0)$ but go on to use $k+3$ as their y coordinate, then allow recovery.

M1: Uses the formula for the area of a triangle using their R and their M, sets equal to $\frac{33}{40}$ and rearranges to achieve a 3TQ equation in k. All terms do not need to be on the same side.
Condone slips e.g. in expanding their brackets.

dM1: Attempts to solve the 3TQ in k using the usual rules, including by calculator, and uses their value of $k>1$ in the formula for the area of the triangle using their R and their N to find a value. If they have two values for $k>1$ then allow them to use either.

A1: $\frac{187}{24}$ or exact equivalent e.g. $7\frac{19}{24}$ or $7.791\dot{6}$ but not 7.79166…

Note: There are no marks scored for those that set up an equation e.g.

$$\frac{\text{Area}(ORN)}{\text{Area}(ORM)}=\frac{\frac{1}{2}OR\left("k+\frac{1}{3}"\right)}{\frac{1}{2}OR\left("\frac{k-1}{5}"\right)} \text{ or } \text{Area}(ORN)=\frac{\left("k+\frac{1}{3}"\right)}{\left("\frac{k-1}{5}"\right)}\times\frac{33}{40}$$

without some attempt to set up an equation which can be used to find a value of k.

Note: Any attempts via integration that appear to be worthy of credit should be sent to review.

Question Number	Scheme		Mark
10(a)	**Left to right** $\cot x - \operatorname{cosec} 2x \equiv \frac{\cos x}{\sin x} - \frac{1}{\sin 2x}$ $\equiv \frac{2\cos^2 x}{2\sin x\cos x} - \frac{1}{\sin 2x} \equiv \frac{2\cos^2 x - 1}{2\sin x\cos x}$ $\equiv \frac{\cos 2x}{\sin 2x}$ $\equiv \cot 2x$ *	**Right to left** $\cot 2x \equiv \frac{\cos 2x}{\sin 2x}$ $\equiv \frac{\cos 2x}{2\sin x\cos x}$ $\equiv \frac{2\cos^2 x}{2\sin x\cos x} - \frac{1}{2\sin x\cos x}$ $\equiv \frac{\cos x}{\sin x} - \frac{1}{\sin 2x} \equiv \cot x - \operatorname{cosec} 2x$ *	M1 M1 M1 A1*
			(4)
(b)	$13 + \cot(2\theta + 30°) = \operatorname{cosec}^2(2\theta + 30°)$ $13 + \cot(2\theta + 30°) = 1 + \cot^2(2\theta + 30°) \Rightarrow \cot^2(2\theta + 30°) - \cot(2\theta + 30°) - 12 = 0$ $\{\cot(2\theta + 30°) =\}\ \ 4$ **and** -3 $\tan(2\theta + 30°) = \frac{1}{4} \Rightarrow 2\theta + 30° = 180° + \tan^{-1}\left(\frac{1}{4}\right) \Rightarrow \theta = \ldots$ **or** $\tan(2\theta + 30°) = -\frac{1}{3} \Rightarrow 2\theta + 30° = 180° + \tan^{-1}\left(-\frac{1}{3}\right) \Rightarrow \theta = \ldots$ $= \text{awrt } 65.8°,\ \text{awrt } 82.0°$		B1 M1 A1 dM1 A1
			(5)
			(9 marks)

(a)

M1: Uses one of $\cot x = \frac{\cos x}{\sin x}$ or $\operatorname{cosec} 2x = \frac{1}{\sin 2x}$ (or $\cot 2x = \frac{\cos 2x}{\sin 2x}$ if working right to left).
The arguments must be correct (may be recovered if missing).

M1: Attempts to use $\sin 2x = 2\sin x\cos x$ (**and** proceeds to a single fraction if working left to right).

M1: Attempts to use $\pm\cos 2x = \pm 2\cos^2 x \pm 1$ (**and** splits the fraction if working right to left).
Alternatively, replaces $\pm 1 = \pm\sin^2 x \pm \cos^2 x$ and divides through by $\pm\cos^2 x$ to create an expression in terms of $\tan x$ only:

$$\frac{2\cos^2 x - 1}{2\sin x\cos x} = \frac{2\cos^2 x - \sin^2 x - \cos^2 x}{2\sin x\cos x} = \frac{2 - \tan^2 x - 1}{2\tan x} \left\{= \frac{1 - \tan^2 x}{2\tan x} = \cot 2x\right\}$$

A1*: Achieves the given answer with no errors. Penalise poor notation e.g. missing arguments or $\cos x^2$ in this mark. Condone the use of = in place of ≡ throughout.
The given answer should be stated at some stage, which may be implied through their working as in the main scheme, or it may be explicitly stated at the start or end of their work. Note e.g. "LHS =" on its own is not sufficient for this mark.
Condone $\frac{\cos 2x}{2\sin x\cos x} = \cot 2x$ at the final step (they have already used $\sin 2x = 2\sin x\cos x$)
They may work from both sides in an attempt to find an expression that is equivalent to both