Question Number	Scheme	Marks
6.(a)	Attempts to find the gradient of $3x-4y+20=0 \Rightarrow y=\dfrac{3}{4}x+5$	M1
	Equation l_2 is $y-0="\dfrac{3}{4}"(x-8) \Rightarrow 3x-4y-24=0$ oe	M1, A1
		(3)
(b)	$P=\left(-\dfrac{20}{3},0\right), Q=(0,5)$	B1
	Area $PQRS=PR\times OQ=\left(8+"\dfrac{20}{3}"\right)\times"5"=\dfrac{220}{3}$	M1, A1
		(3)
(c)	$\overrightarrow{QR}=\begin{pmatrix}8\\-5\end{pmatrix} \Rightarrow S=\left(-\dfrac{20}{3}+8,0-5\right)=\left(\dfrac{4}{3},-5\right)$	M1, A1
		(2) **(8 marks)**
Alt(c)	Solve their $y="\dfrac{3}{4}x-6"$ with their $"y=-\dfrac{5}{8}\left(x+\dfrac{20}{3}\right)"$	
	$\dfrac{3}{4}x-6=-\dfrac{5}{8}\left(x+\dfrac{20}{3}\right) \Rightarrow \dfrac{11}{8}x=\dfrac{11}{6} \Rightarrow x=...$	M1
	$S=\left(\dfrac{4}{3},-5\right)$	A1
		(2)

If you see any unusual approaches which may involve vectors and matrices then please send to review if you are unsure how to mark.

(a)

M1 For an attempt to find the gradient of $3x-4y+20=0$
Look for an attempt to rearrange $3x-4y+20=0$ and make y the subject.
Expect to see $\pm 4y=...$ **followed by** $y=...$ **or equivalent** if they do not achieve the correct value.

M1 For using the same gradient as their gradient of l_1 with $R(8,0)$ to form a linear equation.
If they use $y=mx+c$ they must proceed as far as $c=...$ starting from a correct equation with their gradient of l_1 and the coordinates correctly substituted in.
Some candidates may set $3x-4y+c=0$ and substitute $(8,0)$ to find c which is M1M1.

A1 $3x-4y-24=0$ or any integer multiple. All terms must be on one side of an equation $=0$.
Correct equation implies full marks and it must be seen in (a) to score the A mark. (They may make errors in the manipulation of l_1 which is condoned).

Mark parts (b) and (c) together.

(b)

B1 $P=\left(-\frac{20}{3},0\right), Q=(0,5)$. This may be implied by subsequent calculations or seen on a diagram

M1 A full attempt to find the area of parallelogram $PQRS = PR\times OQ=\left(8+"\frac{20}{3}"\right)\times"5"$ using their P and their Q and proceeding to find a value for the area. Condone attempts which appear to be calculating parallelogram $PQSR$.

Candidates may use the "Shoelace" algorithm i.e. $2\times\frac{1}{2}\begin{vmatrix} 8 & 0 \\ 0 & 5 \\ -\frac{20}{3} & 0 \\ 8 & 0 \end{vmatrix}=2\times\frac{1}{2}\times\left(8\times5--\frac{20}{3}\times5\right)$

Candidates may attempt to find the area of the parallelogram using the determinant

eg $\frac{20}{3}\underline{i}+5\underline{j}$ and $8\underline{i}-5\underline{j}$ Area $=\left|\det\begin{bmatrix}\frac{20}{3} & 5\\ 8 & -5\end{bmatrix}\right|=\left|\frac{20}{3}\times-5-8\times5\right|=\left|-\frac{220}{3}\right|\Rightarrow$ Area $=\frac{220}{3}$

A1 $\frac{220}{3}$ oe (condone awrt 73.3)

(SC Sign slip on the coordinate *Q* to give $P=\left(-\frac{20}{3},0\right), Q=(0,-5)\Rightarrow$ Area of parallelogram = $\frac{220}{3}$ scores 011)

Some candidates who do part c) and form parallelogram *PQSR* to find $S=\left(\frac{44}{3},5\right)$ may then attempt b) and proceed to the correct answer. This can still score M1 A1 in (b)

(c)

M1 A full attempt to find both the coordinates of *S*. Examples include:

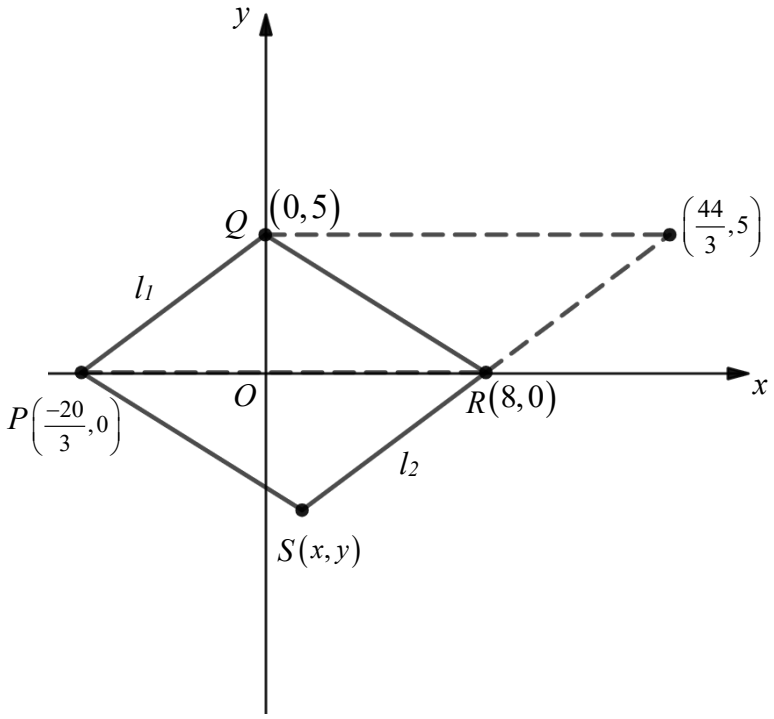
- $\overrightarrow{OP}+\overrightarrow{QR}$ or equivalent using a vector approach.
- An attempt to solve their $y=\frac{3}{4}x-6$ with their $y=-\frac{5}{8}\left(x+\frac{20}{3}\right)$
- An attempt to equate the length *RS* with *PQ* (or *PS* with *RQ*) to produce an equation that is solved simultaneously with l_2 or with each other (see next page)
- $y_S=-5$ from rotational symmetry consideration and proceeds to finding x
- It is also acceptable to score full marks following a sketch. Send to review if you find any which you think are credit-worthy.

In all cases they should proceed to find the coordinates of *S* but condone arithmetical slips in their working. If in doubt send to review.

A1 $\left(\frac{4}{3},-5\right)$. Allow alternatives eg $x=\ldots, y=\ldots$ Condone (awrt 1.33,5)

SC: For those students who find $S=\left(\frac{44}{3},5\right)$ score SC 10

Additional guidance: some examples of methods for (c) using the lengths between points



1. Equating *RS*: $(8,0)$ to (x,y) with *PQ*: $\left(\frac{-20}{3},0\right)$ to $(0,5)$ and solving simultaneously with l_2

Look for $(x-8)^2+y^2=\frac{625}{9}$ and $3x-4y-24=0$ proceeding to $x=\frac{4}{3},\ y=-5$

2. Equating *PS*: $\left(\frac{-20}{3},0\right)$ to (x,y) with *RQ*: $(8,0)$ to $(0,5)$ and solving simultaneously with l_2

Look for $(x--\frac{20}{3})^2+y^2=89$ and $3x-4y-24=0$ proceeding to $x=\frac{4}{3},\ y=-5$

3. Equating *RS*: $(8,0)$ to (x,y) with *PQ*: $\left(\frac{-20}{3},0\right)$ to $(0,5)$ and equating *PS*: $\left(\frac{-20}{3},0\right)$ to (x,y) with *RQ*: $(8,0)$ to $(0,5)$ and solving simultaneously

Look for $(x-8)^2+y^2=\frac{625}{9}$ and $(x--\frac{20}{3})^2+y^2=89$ which proceeds to

$9x^2-144x+9y^2-49=0$ and $9x^2+120x+9y^2-401=0 \Rightarrow 264x=352 \Rightarrow x=\frac{4}{3},\ y=-5$

Question Number	Scheme	Marks
7. (a)(i)	$P=(90°,3)$	M1, A1
(ii)	$Q=(540°,0)$	B1 **(3)**
(b)	$(270°,4)$	M1, A1 **(2)** **(5 marks)**

Note we condone the absence of the degree symbol in this question.

(a)(i)

M1 For one value in the coordinate pair of $(90°,3)$. Condone lack of brackets and do not be concerned with *x* or *y* correctly paired for this mark eg condone (…,90˚) or (3,…) Allow in radians.

A1 For both of $(90°,3)$. Allow $x=90,\ y=3$

(a)(ii)

B1 $Q=(540°,0)$ Allow $x=540,\ y=0$

(b)

M1 For one value in the coordinate pair of $(270°,4)$. Condone lack of brackets and do not be concerned with *x* or *y* correctly paired for this mark eg condone (…,270˚) or (4,…). Allow in radians.

A1 For both of $(270°,4)$. Allow $x=270,\ y=4$

For answers missing the brackets or radians(or both) in all parts then penalise the first time the A or B mark is due

FYI (a)(i) $\left(\frac{\pi}{2},3\right)$ (a)(ii) $Q=(3\pi,0)$, (b) $\left(\frac{3\pi}{2},4\right)$ would score M1 A0(first error) B1 M1 A1

For all correct values the wrong way round $(3,90°),(0,540°)(4,270°)$ **SC M1A0B0M1A1**