	B1	For finding the area of the segment, awrt 41 OR for finding the area of the triangle $OAB = \frac{1}{2}\times 10^2 \times \sin 1.8 = [48.692...]$ **This is not a ft mark.**
	M1	For finding the area of the logo Area = Their area of semicircle – their area of the segment. Or Area = Area of whole shape – area of sector
	A1	For the correct value of the area of the logo.

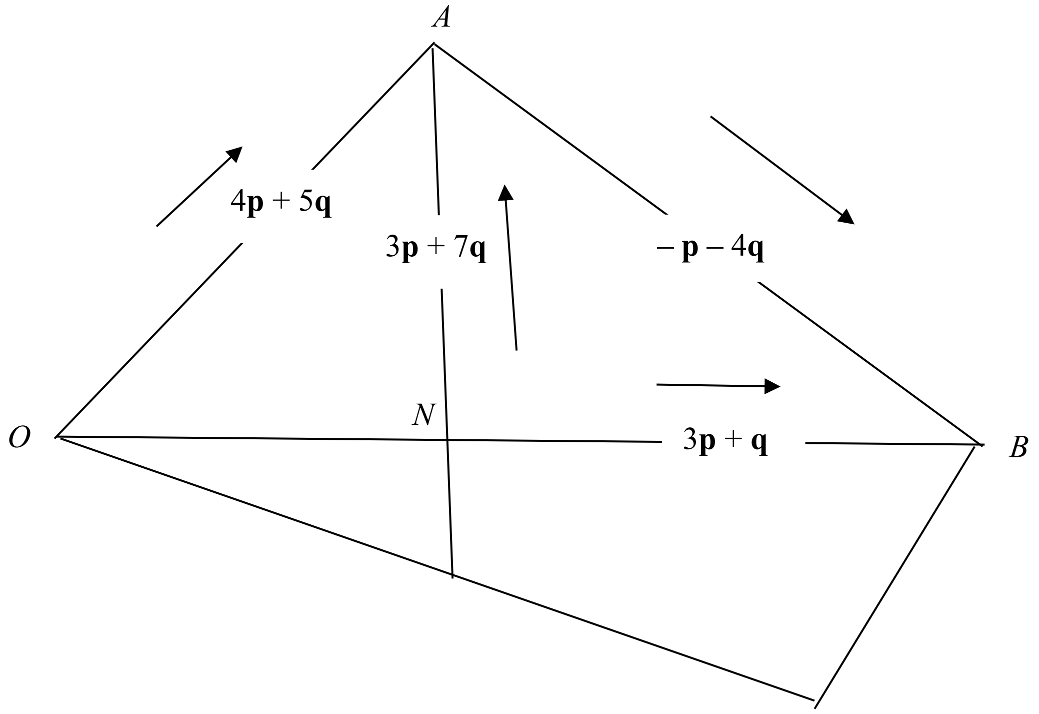
Question	Scheme	Marks
10(a)	$\alpha^3+\beta^3=(\alpha+\beta)^3-3\alpha\beta(\alpha+\beta)$	
	$\frac{115}{8}=\left(-\frac{5}{2}\right)^3-3\alpha\beta\left(-\frac{5}{2}\right)$	M1
	$\Rightarrow \alpha\beta=\dfrac{-\frac{115}{8}+\left(-\frac{5}{2}\right)^3}{3\times\left(-\frac{5}{2}\right)}$	dM1
	$\Rightarrow \alpha\beta=4$	A1 cso [3]
(b)	**Sum:** $\frac{\alpha^2+1}{\beta}+\frac{\beta^2+1}{\alpha}=\frac{\alpha^3+\beta^3+\alpha+\beta}{\alpha\beta}$	
	$\Rightarrow \frac{\alpha^2+1}{\beta}+\frac{\beta^2+1}{\alpha}=\dfrac{\frac{115}{8}+\left(-\frac{5}{2}\right)}{4}=\frac{95}{32}$	M1A1
	Product: $\frac{\alpha^2+1}{\beta}\times\frac{\beta^2+1}{\alpha}=\frac{\alpha^2\beta^2+\alpha^2+\beta^2+1}{\alpha\beta}$	M1
	$\Rightarrow \frac{\alpha^2+1}{\beta}\times\frac{\beta^2+1}{\alpha}=\frac{\alpha^2\beta^2+\left[(\alpha+\beta)^2-2\alpha\beta\right]+1}{\alpha\beta}$	M1
	$\Rightarrow \frac{\alpha^2+1}{\beta}\times\frac{\beta^2+1}{\alpha}=\dfrac{4^2+\left(-\frac{5}{2}\right)^2-2\times 4+1}{4}=\frac{61}{16}$	A1
	Equation: $x^2-\left(\frac{95}{32}\right)x+\left(\frac{61}{16}\right)=0\Rightarrow 32x^2-95x+122=0$ oe	M1A1 [7]
		Total 10 marks

<table>
<tr><th>Part</th><th>Mark</th><th>Notes</th></tr>
<tr><td rowspan="4">(a)</td><td colspan="2">Part (a) is a ‘Show that’ question. You must see sufficient work for the award of both M marks for the award of the A mark</td></tr>
<tr><td>M1</td><td>For the correct algebra and substitution of the given values into a correct expression for $\alpha^3+\beta^3$
There is more than one acceptable form of this expansion.
They must be able to substitute the given values of $\alpha+\beta$ and $\alpha^3+\beta^3$ with $\alpha\beta$ as the value to find in any version they use.
For example: $\alpha^3+\beta^3=(\alpha+\beta)\left[(\alpha+\beta)^2-3\alpha\beta\right]$</td></tr>
<tr><td>dM1</td><td>For an attempt to solve the linear equation to find a value for $\alpha\beta$
Allow one processing error for this mark.

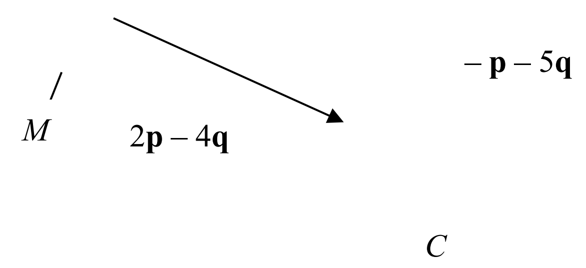
Note, this is a dependent M mark.</td></tr>
<tr><td>A1
cso</td><td>For $\alpha\beta=4$
This is a show question, you must check their algebra carefully.</td></tr>
<tr><td rowspan="7">(b)</td><td>M1</td><td>For the correct algebra and substitution of the given values to find the sum.</td></tr>
<tr><td>A1</td><td>For the correct sum $=\dfrac{95}{32}$</td></tr>
<tr><td>M1</td><td>For the correct algebra and substitution to find $\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha\beta=\left[-\dfrac{7}{4}\right]$</td></tr>
<tr><td>M1</td><td>For the correct algebra and substitution of the given values to find the product</td></tr>
<tr><td>A1</td><td>For the correct product $=\dfrac{61}{16}$</td></tr>
<tr><td>M1</td><td>For forming an equation using their sum and product correctly.
$x^2-(\text{their sum})x+(\text{their product})=(0)$
Allow missing = 0 for this mark</td></tr>
<tr><td>A1</td><td>For a correct equation with integer coefficients.
For example: $64x^2-190x+244=0$</td></tr>
</table>

Question	Scheme	Marks
11(a)	$\overrightarrow{OM} = \frac{1}{2}\overrightarrow{OC} = \mathbf{p} - 2\mathbf{q}$	B1
	$\overrightarrow{MA} = -\overrightarrow{OM} + \overrightarrow{OA}$	M1
	$\overrightarrow{MA} = -(\mathbf{p} - 2\mathbf{q}) + (4\mathbf{p} + 5\mathbf{q}) = 3\mathbf{p} + 7\mathbf{q}$	A1 [3]
(b)	$\overrightarrow{MN} = \lambda(3\mathbf{p} + 7\mathbf{q})$	M1
	$\overrightarrow{MN} = -(\mathbf{p} - 2\mathbf{q}) + \mu(3\mathbf{p} + \mathbf{q})$	M1
	$\lambda(3\mathbf{p} + 7\mathbf{q}) = -(\mathbf{p} - 2\mathbf{q}) + \mu(3\mathbf{p} + \mathbf{q})$	M1
	$\Rightarrow 3\lambda\mathbf{p} + 7\lambda\mathbf{q} = (-1 + 3\mu)\mathbf{p} + (2 + \mu)\mathbf{q}$	
	$3\lambda = -1 + 3\mu$	dM1
	$7\lambda = 2 + \mu$	A1
	$\Rightarrow 18\lambda = 7 \Rightarrow \lambda = \frac{7}{18}$	A1
	$MN : NA = 7 : 11$	[6]
		Total 9 marks

Useful sketch



PMT



Part	Mark	Notes
(a)	B1	For finding either vector $\overrightarrow{OM}=\mathbf{p}-2\mathbf{q}$ or $\overrightarrow{MO}=-\mathbf{p}+2\mathbf{q}$ This may be embedded in their working for $\overrightarrow{MA}$
	M1	For the correct vector statement $\overrightarrow{MA}=-\overrightarrow{OM}+\overrightarrow{OA}$ or $\overrightarrow{MA}=-\frac{1}{2}\overrightarrow{OC}+\overrightarrow{OA}$
	A1	For the correct simplified vector
(b)	**General principle of marking part (b)**	• First two M marks are for two vector statements for $\overrightarrow{MN}$ or $\overrightarrow{AN}$ that will allow them to be equated. Note that they can use any path that involves either of these two vectors. • The third M mark is for equating coefficients and forming a pair of simultaneous equations. • The final M mark is for solving their simultaneous equations.
	M1	For one vector for $\overrightarrow{MN}$ or $\overrightarrow{AN}$ involving a constant One example is: $\overrightarrow{AN}=K\,\overrightarrow{AM}=K(-3\mathbf{p}-7\mathbf{q})$
	M1	For a second vector for $\overrightarrow{MN}$ or $\overrightarrow{AN}$ following a different path involving a different constant. One example is: $\overrightarrow{AN}=\overrightarrow{AO}+L\,\overrightarrow{OB}=-4\mathbf{p}-5\mathbf{q}+L(3\mathbf{p}+\mathbf{q})$
	M1	For equating the two vectors and forming a pair of simultaneous linear equations, both of which must be in terms of λ and μ
	dM1	For an attempt to solve their linear equations. Allow up to one processing error. This mark is dependent on the previous M mark.
	A1	For the value of $\lambda=\frac{7}{18}$ μ is not required but the value is $\frac{13}{18}$
	A1	For the correct ratio $MN:NA=7:11$