Question Number	Scheme	Marks
2.	$\int (x-3)^2(2x+5)\,\mathrm{d}x$	
	$(x-3)^2(2x+5)=\left(x^2-6x+9\right)(2x+5)=...$ or e.g. $(x-3)^2(2x+5)=(x-3)\left(2x^2-x-15\right)=...$	M1
	$=2x^3-7x^2-12x+45$	A1
	$\int (x-3)^2(2x+5)\,\mathrm{d}x=\frac{1}{2}x^4-\frac{7}{3}x^3-6x^2+45x+c$	M1 A1ft A1
		(5 marks)

Notes

M1: Attempts to multiply out. Look for an attempt to multiply two brackets together to form a quadratic before the result is combined with the third bracket.
Condone slips e.g. $(x-3)^2=x^2\pm 9$ and it may be left unsimplified but it must lead to an expression that could be simplified to the form ax^3+bx^2+cx+d where $a,b,c,d\neq 0$
Condone an answer appearing without an intermediate step only if it is of the form (or can be expressed in the form) $2x^3+px^2+qx\pm 45$ where $p,q\neq 0$

A1: For $2x^3-7x^2-12x+45$ but allow this unsimplified with the terms uncollected e.g. $2x^3+5x^2-12x^2-30x+18x+45$ and award this mark as soon as a correct expression is seen. Inclusion of "+ c" here scores A0 but the final mark is still available.

So $(x-3)^2(2x+5)=2x^3-7x^2-12x+45+c$ is A0 but

$\int (x-3)^2(2x+5)\,\mathrm{d}x=\int\left(2x^3-7x^2-12x+45\right)\mathrm{d}x+c$ is ok for A1

M1: For an attempt to integrate any 2 terms with **different powers** of their simplified or unsimplified expression by increasing the power of x by 1 following an attempt to expand all 3 brackets.
It is for any 2 of, $...x^3\rightarrow ...x^4$, $...x^2\rightarrow ...x^3$, $...x\rightarrow ...x^2$, $k\rightarrow kx$
Allow indices to be unprocessed e.g. $...x^3\rightarrow ...x^{3+1}$
There must have been an attempt to **expand all 3 brackets** so do not award for e.g.
$(x-3)^2=x^2-6x+9\rightarrow\frac{x^3}{3}-3x^2+9x$
or e.g. $(x-3)^2(2x+5)\rightarrow(x-3)^2\left(x^2+5x\right)$ or $(x-3)^2(2x+5)\rightarrow\frac{1}{3}(x-3)^3(2x+5)$

A1ft: For 2 **different** correctly integrated and simplified terms with **different powers** with indices processed.
Follow through on any **two different terms** with **different powers** of their simplified or unsimplified expansion.

A1: $\frac{1}{2}x^4 - \frac{7}{3}x^3 - 6x^2 + 45x + c$ or exact simplified equivalent including the + *c* all on one line.

Apply isw once a correct expression, including "+ *c*" is seen.

Condone the presence of spurious integral signs and/or d*x*'s.

Alternative attempts to integrate such as integration by parts or by substitution – send to review.

Question Number	Scheme	Marks
3(a)	$5^2 = 2^2 + 4^2 - 2\times 2\times 4\cos"\theta"$ or e.g. $(5x)^2 = (2x)^2 + (4x)^2 - 2\times 2x\times 4x\cos"\theta"$ or $\cos"\theta" = \dfrac{2^2+4^2-5^2}{2\times 2\times 4}$ or e.g. $\cos"\theta" = \dfrac{(2x)^2+(4x)^2-(5x)^2}{2\times(2x)\times(4x)}$	M1
	$\Rightarrow \theta = 108.2°$	A1
		(2)
Alternative using the cosine rule for a different angle and then the sine rule		
	e.g. $2^2 = 4^2 + 5^2 - 2\times 4\times 5\cos"A" \Rightarrow \cos"A" = \dfrac{4^2+5^2-2^2}{2\times 4\times 5}$ $\Rightarrow A = 22.33...°$ $\dfrac{2}{\sin 22.33...} = \dfrac{5}{\sin"\theta"}$	M1
	$\Rightarrow \sin"\theta" = \dfrac{5\sin 22.33...}{2} \Rightarrow \theta = 108.2°$	A1

(a) Notes

Note that some candidates may use equivalent correct ratios

e.g. $1:2:\frac{5}{2}$ **or** $x:2x:\frac{5}{2}x$ **or** $\frac{2}{11}:\frac{4}{11}:\frac{5}{11}$ **or** $\frac{2}{11}x:\frac{4}{11}x:\frac{5}{11}x$

M1: Attempts to use the cosine rule with the sides 2, 4 and 5 or e.g. $2x$, $4x$ and $5x$ or e.g. x, $2x$ and $2.5x$ **in the correct positions for the largest angle**.

Condone missing brackets e.g. $2x^2$ rather than $(2x)^2$ as long as the intention is clear.

If they start with a rearranged rule, the values or expressions must be in the correct positions.

A1: $\theta =$ awrt $108.2°$ (Degrees symbol not required)

Allow missing brackets to be recovered e.g. $\cos"\theta°" = \dfrac{2x^2+4x^2-5x^2}{2\times 2x\times 4x} \Rightarrow \theta = 108.2°$

Note that attempts to find any of the other angles, correct or incorrect, can be ignored if the largest angle is found correctly.

Alternative:

M1: Attempts to use the cosine rule with the sides 2, 4 and 5 or e.g. $2x$, $4x$ and $5x$ in the correct positions for their angle and then attempts to use the sine rule with their angle and the largest angle in the correct positions.

Note that they may also find the other smaller angle using the sine rule (or cosine rule) and then subtract the 2 smaller angles from 180°

A1: $\theta =$ awrt $108.2°$ (Degrees symbol not required)

Note that this method is likely to lead to the acute angle (71.79…°) and scores A0

Allow missing brackets to be recovered as above.

(b)	$A=\frac{1}{2}ab\sin C \Rightarrow 140=\frac{1}{2}2x\times 4x\sin"108.2°"$ or e.g. $A=\frac{1}{2}ab\sin C \Rightarrow 140=\frac{1}{2}2a\times\frac{5}{2}a\sin"22.33...°"$	B1ft
	$x^2=\frac{280}{8\sin("108.2°")}=36.8...\Rightarrow x=...$	M1
	Shortest side $=2\times\sqrt{36.8...}=12.1$ (cm)	A1
		(3)
		(5 marks)

(b) Notes

B1ft: Sets up a correct area equation in one variable e.g. x. using $A=\frac{1}{2}ab\sin C$ with A = 140 and with the sides and angle in the correct positions. Follow through on their $108.2°$ and they must have a value i.e. not just "C".

It is for e.g. $140=\frac{1}{2}\times 2x\times 4x\sin"108.2°"$ or with some letter other than "x" but note that $140=\frac{1}{2}\times x\times 2x\sin"108.2°"\Rightarrow x=...$ is also acceptable as the correct ratio is being used and leads directly to the length of the shortest side.

or if they didn't find the largest angle in part (a), it is for setting up the correct corresponding equation for their angle.

M1: Full use of $A=...x^2\sin C$ with A = 140 leading to a value for x (or any other letter) that involves taking the **square root** of their variable.

Note some candidates may use the exact value for $\sin C$ e.g. $\frac{\sqrt{231}}{16}$

You do not need to be concerned about the order of operations as long as it involves taking the square root to find "x".

Condone errors in sides and/or angles used.

A1: awrt 12.1 (cm). Units are not required but if they are given they must be correct.

Q3 values for reference

NB scale factor $"x"=\sqrt{\frac{80\sqrt{231}}{33}}=\sqrt{36.845...}=6.0700...$

