(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. $\frac{\sqrt{231}}{16}$

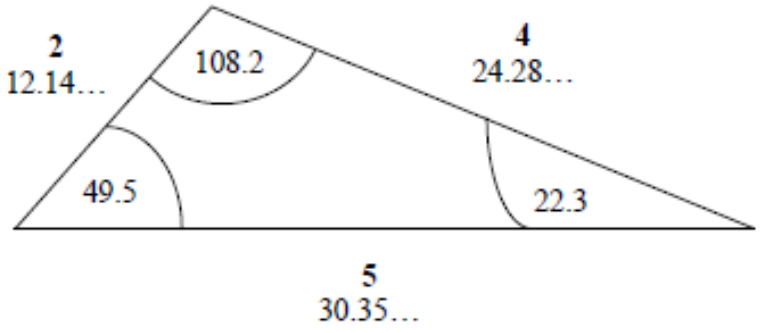
You do not need to be concerned about the order of operations as long as it involves taking the square root to find "x".

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



Question Number	Scheme	Marks
4(i)	**Examples:** lhs: $3^{2p-5}=3^{2p}\times3^{-5}$ or $\dfrac{3^{2p}}{3^5}$ or $\dfrac{3^{2p}}{243}$ or $3^{2p}=\left(3^{p}\right)^2$ or $9^{\frac{1}{2}(2p-5)}$ or $9^{p-\frac{5}{2}}$ rhs: $\dfrac{1}{9}=\dfrac{1}{3^2}$ or 9^{-1}, $\sqrt{27}=3\sqrt{3}$ or $3^{\frac{3}{2}}$, $\dfrac{1}{9}\sqrt{27}=\dfrac{\sqrt{3}}{3}$	M1
	Examples:	**d**M1 A1
	$3^{2p-5}=\dfrac{1}{9}\sqrt{27}\Rightarrow 3^{2p-5}=3^{-0.5}\Rightarrow 2p-5=-0.5\Rightarrow p=2.25$	
	$3^{2p-5}=\dfrac{1}{9}\sqrt{27}\Rightarrow \dfrac{3^{2p}}{3^5}=3^{-0.5}\Rightarrow 3^{2p}=3^{4.5}\Rightarrow 2p=4.5\Rightarrow p=2.25$	
	$3^{2p-5}=\dfrac{1}{9}\sqrt{27}\Rightarrow 3^{2p}\times3^{-5}=\dfrac{1}{9}\sqrt{27}\Rightarrow 9^{p}=81\sqrt{3}\Rightarrow p=2.25$	
	$3^{2p-5}=\dfrac{1}{9}\sqrt{27}\Rightarrow 3^{2p-5}=\dfrac{1}{3}\sqrt{3}\Rightarrow 3\times3^{2p-5}=\sqrt{3}\Rightarrow 3^{2p-4}=3^{0.5}$ $\Rightarrow 2p-4=0.5\Rightarrow p=2.25$	
	$3^{2p-5}=\dfrac{1}{9}\sqrt{27}\Rightarrow 9^{p-\frac{5}{2}}=9^{-1}\times9^{\frac{3}{4}}\Rightarrow p-\dfrac{5}{2}=-\dfrac{1}{4}\Rightarrow p=2.25$	
		(3)

(i) Notes

This part of the question can be solved in many different ways.

If you are unsure if a particular approach deserves credit, seek advice from your TL

M1: This is effectively a B mark and is for using a correct law of indices on the lhs or rhs of the equation. This may be seen in isolation i.e. not necessarily within the equation.
See scheme for some examples.

dM1: Reaches a value for p condoning arithmetic slips but with no incorrect index work e.g.
$\dfrac{1}{9}\times3^{\frac{3}{2}}=\left(\dfrac{1}{3}\right)^{\frac{3}{2}}$ or e.g. $3\times3^{\frac{1}{2}}=9^{\frac{1}{2}}$.
See main scheme for examples of acceptable work.
See also supplementary document for some example responses with marks.
Depends on the first method mark.

A1: Fully correct work leading to $p=2.25$ o.e. e.g. $\dfrac{9}{4}$, $2\dfrac{1}{4}$ following award of both Method marks.

Correct answer with no working scores no marks in (i)

(ii)	$x^2+1=\dfrac{36}{x^2-4}\Rightarrow\left(x^2+1\right)\left(x^2-4\right)=36\Rightarrow x^4-4x^2+x^2-4=36$	M1
	$\Rightarrow x^4-3x^2-40=0$ or e.g. $\Rightarrow x^4-3x^2=40$	A1
	$\left(x^2-8\right)\left(x^2+5\right)=0\Rightarrow x^2=...$	**d**M1
	$x=\pm2\sqrt{2}$	A1
		(4)
		(7 marks)

Notes

M1: Attempts to cross multiply and expand to obtain a polynomial equation in x or another variable if a substitution is used e.g. $y=x^2\Rightarrow y+1=\dfrac{36}{y-4}\Rightarrow\left(y+1\right)\left(y-4\right)=36\Rightarrow y^2-4y+y-4=36$

A1: Correct 3 term quadratic equation in x^2. The terms do not have to all be on the same side but must be collected so e.g. $x^4-3x^2=40$ is acceptable.
If the terms are all one side, the "= 0" may be implied by their attempt to solve.
May also be implied by a substitution e.g.
$y=x^2\Rightarrow y+1=\dfrac{36}{y-4}\Rightarrow\left(y+1\right)\left(y-4\right)=36\Rightarrow y^2-4y+y-4=36\Rightarrow y^2-3y=40$

dM1: Attempts to solve 3TQ in x^2 by any **non-calculator** means leading to values for x^2
This may be implied by substitution e.g. $y=x^2\Rightarrow y^2-3y-40=0\Rightarrow\left(y-8\right)\left(y+5\right)=0\Rightarrow y=...$
This may also be implied by their values for x e.g. $\left(x^2-8\right)\left(x^2+5\right)=0\Rightarrow x=\pm2\sqrt{2}$
Note that e.g. $x^4-3x^2-40=0\Rightarrow\left(x-8\right)\left(x+5\right)=0\Rightarrow x=8,-5$ scores dM0
but $x^4-3x^2-40=0\Rightarrow\left(x-8\right)\left(x+5\right)=0\Rightarrow x^2=8,-5$ scores dM1 by implication.

A1: $x=\pm2\sqrt{2}$ o.e. e.g. $\pm\sqrt{8}$ and no other values. Do **not** allow decimal values.
Do not isw if they obtain e.g. $x=\pm\sqrt{8}$ and then $x=\pm4$ score A0
Similarly if they obtain $x=\pm2\sqrt{2}$ and then declare e.g. therefore $x=2\sqrt{2}$ score A0
Must clearly be identified as values of x not any other variable e.g. y or t.