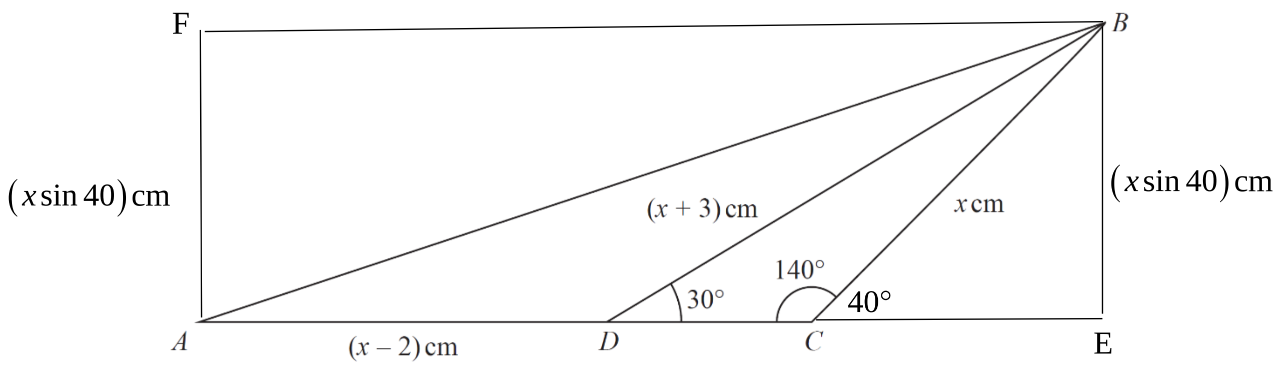
Question	Scheme	Marks	AOs
4(a)	$\dfrac{x}{\sin 30°}=\dfrac{x+3}{\sin 140°}$	M1	1.1b
	$2x\sin 140-x=3$	dM1	3.1a
	$x=10.5$ *	A1*	1.1b
		(3)	
(b)	$AB^2=8.5^2+13.5^2-2\times8.5\times13.5\times\cos"150"$ $\Rightarrow AB=...$	M1	3.1a
	$AB=$ awrt 21.3 (cm)	A1	1.1b
		(2)	
			(5 marks)

Notes



(a) Do not allow verification attempts using $x=10.5$ by substituting into formulae

M1: Recognises the need to apply the sine rule and attempts to use it with the sides in the correct positions to form an equation in *x*. Alternatively, uses trigonometric ratios twice to form an equation in *x*

e.g. $BE=x\sin 40°\Rightarrow \sin 30°=\dfrac{x\sin 40°}{x+3}$ or e.g. $AF=x\sin 40°\Rightarrow \cos 60°=\dfrac{x\sin 40°}{x+3}$

May also see an attempt at Pythagoras' Theorem:

$BD^2=BE^2+DE^2\Rightarrow (x+3)^2=\left((x+3)\cos 30°\right)^2+(x\sin 40°)^2$

dM1: Attempts to rearrange the equation by collecting terms in *x* on one side of the equation and non *x* terms on the other. It is dependent on the previous method mark. Condone sign slips only in their rearrangement but allow miscopying/arithmetical slips when rounding. Do not allow this mark to be scored for proceeding directly to a numerical value for *x*.
In the attempt using Pythagoras' Theorem, look for an attempt to multiply out and rearrange to form a three-term quadratic.

A1*: Achieves 10.5 with sufficient working shown. Condone invisible brackets to be recovered. **They must have achieved either a correct expression for *x*** or $x(2\sin 140°-1)=3$ o.e. before stating 10.5 or better. It is acceptable to use rounded decimals for trigonometric values provided they are correct to at least 3sf. e.g. $\sin 140°=0.64278...$

e.g. $2x=\dfrac{x+3}{\sin 140°}\Rightarrow x=\dfrac{1.5}{\sin 40°-0.5}=10.5$ scores M1dM1A1* (allow 0.5 in their initial equation for sin30 and allow interchanging of equivalent angles such as sin140 and sin40) e.g. $x\sin 140 = (x+3)\sin 30° \Rightarrow x = \dfrac{3\sin 30°}{0.643 - \sin 30°} = 10.5$ scores M1dM1A1*

e.g. $\dfrac{x}{\sin 30°} = \dfrac{x+3}{\sin 140°} \Rightarrow x\sin 140° = (x+3)\sin 30° \Rightarrow x = 10.505....$ is M1dM0A0* (insufficient working shown as they do not reach an expression for x or $x(2\sin 140° - 1) = 3$ o.e.)

In the method using Pythagoras' Theorem usual rules apply for solving a quadratic but it cannot be awarded for proceeding to the answer via a calculator (e.g. must see use of the quadratic formula or completing the square).

(b)

M1: Applies the cosine rule correctly using $150°$ (or $180° - 30°$ seen if incorrect) for angle *ADB* with the correct numerical lengths by attempting to substitute in $x = 10.5$ or better and proceeds to obtain a value for *AB*. Look for other methods such as finding lengths *DC* and *CE* followed by using trigonometry or Pythagoras' Theorem on triangle *ABE*. (see below)

A1: awrt 21.3 (cm) Units not required but if they are given they must be correct.
(Using full calculator display 21.29959497/using $x = 10.5$ gives 21.28…)

Alt (b)

Note that there are various longer methods to finding *AB*. General principles of marking alternative methods:

M1: A complete attempt to find a value for *AB*, but condone slips. The angles and lengths in formulae should be in the correct positions, but allow slips when rearranging or calculating values.

e.g. $BE = 6.75...,\ AE = 8.5 + 3.648... + 8.047... = 20.... \Rightarrow AB = \sqrt{6.75...^2 + 20...^2} = ...$

A1: awrt 21.3 (cm) Units not required but if they are given they must be correct.
(Using full calculator display 21.29959497/using $x = 10.5$ gives 21.28…)