Question number	Scheme	Marks
8 (a)	$BN = 10\cos 60^\circ$ $= 5$ (cm)*	M1 A1cso [2]
(b)	$FN^2 = 10^2 - 5^2 = 75$ or $FN = 10\sin 60 = 5\sqrt{3}$ or $FN = 5\tan 60$ $NE = \sqrt{12^2 + 75} = 14.7986... \approx 14.8$ (cm)	M1 M1A1 [3]
(c)	Let R be the midpoint of FN and P be the point on AD that corresponds to point N on BC. $\angle RPN = \tan^{-1}\left(\dfrac{\sqrt{75}\big/2}{12} \right) = 19.84167...^\circ \approx 19.8^\circ$	M1A1 [2]
(d)	Let the perpendicular from Y to line BC meet BC at Z $AY = \sqrt{AZ^2 + ZY^2} = \sqrt{12^2 + 6.5^2 + \left(\dfrac{\sqrt{75}}{2}\right)^2} = \sqrt{205}$ $FC = \sqrt{FN^2 + NC^2} = \sqrt{75 + 3^2} = \sqrt{84} \Rightarrow FY = \sqrt{21}$ So $EY = \sqrt{12^2 + 21} = \sqrt{165}$ $\angle AYE = \cos^{-1}\left(\dfrac{205 + 165 - 100}{2 \times \sqrt{205} \times \sqrt{165}} \right) = 42.7745...^\circ \approx 42.8^\circ$	M1A1 M1 M1 M1A1 [6]

Total 13 marks

(a)	M1	Use cosine or sine in triangle BNF, or any complete method. $BN = 10\cos 60^\circ$ or $\cos 60^\circ = \dfrac{BN}{10}$ or $\dfrac{BN}{\sin 30} = \dfrac{10}{\sin 90}$ or $BN = 10\sin 30$ or $FN = 10\sin 60 = 5\sqrt{3}$ and $BN^2 = 10^2 - (5\sqrt{3})^2$ (may use any single letter instead of BN)
	A1 cso	$BN = 5$ (cm) Correct answer from correct working. (Answer given.) Must show a calculation in the form $BN = \ldots$ e.g. $BN = 10\cos 60$
(b)	M1	Use Pythag or trig to find a numerical expression for FN or FN^2 eg $FN^2 = 10^2 - 5^2$ $(= 75)$ or $FN = 10\sin 60 \,(= 5\sqrt{3} = 8.66...)$ or $FN = 5\tan 60$
	M1	Use Pythag with their FN to find a numerical expression for NE, eg $NE = \sqrt{12^2 + (5\sqrt{3})^2} \,(= \sqrt{219})$
	A1	$NE = 14.8$ (cm) **given to 3SF**.
(c)	M1	Use tangent with their FN, eg $\tan RPN = \left(\dfrac{\frac{1}{2}\sqrt{75}}{12} \right)$ or any complete method.
	A1	19.8° **given to 1DP**.

(d)	M1	Complete method to find AY eg $AY = \sqrt{(12^2 + 6.5^2) + \left(\dfrac{\sqrt{75}}{2}\right)^2}$ $(= \sqrt{205} = 14.31...)$ (allow their FN)
	A1	$AY = \sqrt{205}$ $(= 14.31\ldots)$ (may be implied by subsequent working)
	M1	Complete method to find FY eg $FC = \sqrt{75 + 3^2}\left(= \sqrt{84}\right) \Rightarrow FY = \dfrac{1}{2}\sqrt{84}\ (= \sqrt{21})$ (allow their FN) eg $FC = \sqrt{8^2 + 10^2 - 2\times 8 \times 10 \cos 60}\left(= \sqrt{84}\right) \Rightarrow FY = \dfrac{1}{2}\sqrt{84}\ (= \sqrt{21} = 4.58...)$
	M1	Method to find EY using their FY (correct or from a correct method) eg $EY = \sqrt{12^2 + 21}\ (= \sqrt{165} = 12.84...)$
	M1	Substitute their values for AY and EY into the cosine rule used in triangle AYE. $\cos AYE = \left(\dfrac{205 + 165 - 100}{2 \times \sqrt{205} \times \sqrt{165}}\right)$ oe
	A1	$\angle AYE = 42.8°$ **given to 1DP**. Allow more than 1DP if 1DP was penalised in part (c).