Q1.

$\sin 45 = \frac{\sqrt{2}}{2}$ or $\frac{1}{\sqrt{2}}$
or $\tan 45 = 1$ or $\frac{1}{1}$
or $\tan 60 = \sqrt{3}$ or $\frac{\sqrt{3}}{1}$

oe

stated or in correct place in expression or implied by multiplier of 2 or 4

B1

$\sin 45 = \frac{\sqrt{2}}{2}$ or $\frac{1}{\sqrt{2}}$
and $\tan 45 = 1$ or $\frac{1}{1}$
and $\tan 60 = \sqrt{3}$ or $\frac{\sqrt{3}}{1}$

oe

stated or in correct place in expression or implied by multiplier of 2 or 4

eg $\frac{2 \times \frac{1}{\sqrt{2}} - 1}{4 \times \frac{\sqrt{3}}{1}}$

B1

$\frac{\sqrt{2}-1}{4\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

oe rationalisation of their denominator

eg $\frac{\frac{2}{\sqrt{2}} - 1}{4\sqrt{3}} \times \frac{4\sqrt{3}}{4\sqrt{3}}$

M1

$\frac{\sqrt{6}-\sqrt{3}}{12}$

oe in the form $\frac{\sqrt{6a^2}-\sqrt{3a^2}}{12a}$ *where* A *is a positive integer*

eg $\frac{\sqrt{24}-\sqrt{12}}{24}$ *(when* $a = 2$*)*

A1

Additional Guidance

$\frac{2 \times \frac{1}{\sqrt{2}} - 1}{4\sqrt{3}}$ or $\frac{\sqrt{2}-1}{4\sqrt{3}}$ or $\frac{\sqrt{2}-1}{\sqrt{48}}$

B1B1

$\frac{\sqrt{48}(\sqrt{2}-1)}{\sqrt{48}\sqrt{48}}$ or $\frac{\sqrt{48}(\sqrt{2}-1)}{48}$

B1B1M1

$\frac{\sqrt{96}-\sqrt{48}}{48}$

B1B1M1A1

B1B1 awarded, incorrect simplification, then correct method to rationalise

B1B1M1

[4]

Q2.

$\cos 30° = \frac{\sqrt{3}}{2}$ or $\tan 60° = \sqrt{3}$

M1

$4\sqrt{3}$

A1

$\sqrt{48}$ or $k = 48$

ft value seen in the form $a\sqrt{b}$ *where* a *and* b *are integers > 1*

B1ft

[3]

Q3.

(a) $35^2 + 30^2$

M1

$\sqrt{35^2 + 30^2}$

M1dep

46(.097 …) or $5\sqrt{85}$ or $\sqrt{2125}$

A1

(b) $35^2 + 30^2 + 87^2$ or their $46^2 + 87^2$

or $2125 + 87^2$

M1

$\sqrt{35^2 + 30^2 + 87^2}$

or $\sqrt{\text{their } 46^2 + 87^2}$

or $\sqrt{2125 + 87^2}$

or $\sqrt{9694}$

M1 dep

98.(…) and No

A1

[6]

Q4.

$10^2 + 10^2$ or 200

$5^2 + 5^2$ or 50

oe

M1

$\sqrt{\text{their } 200}$

$\sqrt{\text{their } 50}$

or $10\sqrt{2}$

or $5\sqrt{2}$

or [14, 14.2]
or [7, 7.1]

oe

M1dep

$$\tan 68 = \frac{h}{\text{their } 7.1}$$

M1dep

their 7.1 × tan 68
or [17.3, 17.6]

M1dep

$\frac{1}{3} \times 10 \times 10 \times$ their [17.3, 17.6]

M1dep

[576, 587] or 590

A1

[6]

Q5.

(a) **Alternative method 1**

$17^2 - (16 \div 2)^2$ or $17^2 - 8^2$ or $289 - 64$

Correct use of Pythagoras' theorem

eg $8^2 + 15^2 = 17^2$ *or* $64 + 225 = 289$

M1

$\sqrt{17^2 - (16 \div 2)^2} (= 15)$ or $\sqrt{17^2 - 8^2} (= 15)$ or $\sqrt{289 - 64} (= 15)$

Correct use of Pythagoras' theorem using a square root

A1

Alternative method 2

$\sin E = \frac{8}{17}$ or $\cos A = \frac{8}{17}$ or $E = 28.(\ldots)$ or $A = 61.9(\ldots)$ or 62

and

$\cos 28.(...) = \frac{EM}{17}$ or $\tan 28.(...) = \frac{8}{EM}$ or $\sin 61.9(...) = \frac{EM}{17}$ or $\tan 61.9(...) = \frac{EM}{8}$

M1

17 cos 28.(…) or 8 ÷ tan 28.(…) or 17 sin 61.9(…) or 8 tan 61.9(…)

A1

Additional Guidance

8, 15, 17 on their own

M0A0

$EM^2 = 289 - 64 = 225$, $EM = 15$

M1A0

(b) **Alternative method 1**

$30^2 + (16 \div 2)^2$ or $30^2 + 8^2$ or 964

oe

M1

$\sqrt{\text{their } 964}$ or $2\sqrt{241}$ or [31, 31.1]

oe

CM

M1dep

$\tan x = \frac{15}{\text{their } [31, 31.1]}$

oe eg $90 - \tan^{-1}\frac{\text{their } [31, 31.1]}{15}$

Dep on M1 M1

M1dep

[25.7, 26]

A1

Alternative method 2

$30^2 + 17^2$ or 1189

oe

M1

$\sqrt{\text{their } 1189}$ or [34.4, 34.5]

oe CE

M1dep

$\sin x = \frac{15}{\text{their}[34.4, 34.5]}$

oe eg $90 - \cos^{-1}\frac{15}{\text{their } [34.4, 34.5]}$

or $\frac{\sin x}{15} = \frac{\sin 90}{\text{their } [34.4, 34.5]}$

Dep on M1 M1

M1dep

[25.7, 26]

A1

Alternative method 3

$30^2 + (16 \div 2)^2$ or 964 or $30^2 + 17^2$ or 1189

oe

M1

$\sqrt{\text{their } 964}$ or $2\sqrt{241}$ or [31, 31.1] or $\sqrt{\text{their } 1189}$ or [34.4, 34.5]

oe CM

CE

M1dep

$$\cos x = \frac{\text{their [31, 31.1]}}{\text{their [34.4, 34.5]}}$$

oe eg $90 - \sin^{-1} \dfrac{\textit{their [31, 31.1]}}{\textit{their [34.4, 34.5]}}$

Dep on M1 M1

M1dep

[25.7, 26]

A1

Alternative method 4

$17^2 - (16 \div 2)^2$ or 225 or $30^2 + (16 \div 2)^2$ or 964 or $30^2 + 17^2$ or 1189

oe EM^2

CM^2

CE^2

M1

$$\cos x = \frac{\text{their } 964 + \text{their } 1189 - \text{their } 225}{2 \times \sqrt{\text{their } 964} \times \sqrt{\text{their } 1189}}$$

oe

M1dep

$$\cos^{-1} \frac{\text{their } 964 + \text{their } 1189 - \text{their } 225}{2 \times \sqrt{\text{their } 964} \times \sqrt{\text{their } 1189}}$$

oe

Dep on M1 M1

M1dep

[25.7, 26]

A1

[6]

Q6.

Alternative method 1

$\sqrt{14^2 + 8^2}$ or $\sqrt{260}$

or $2\sqrt{65}$ or [16.1, 16.125]

AC

M1

$\tan(x) = \frac{7}{\text{their } AC}$

oe

M1dep

[23.4667, 23.5]

A1

Alternative method 2

$\sqrt{14^2 + 8^2 + 7^2}$ or $\sqrt{309}$

or [17.578,17.6]

EC

May be seen in stages

e.g. Work out AC with correct method then work out their $AC^2 + 7^2$ then square roots

Condone use of $2\sqrt{65}^2$ for AC^2

M1

sin (x) = $\frac{7}{\text{their } EC}$ (× sin 90)

or

cos (x) = $\frac{\sqrt{8^2 + 14^2}}{\text{their } EC}$

cos (x) = $\frac{8^2 + 14^2 + \text{their } EC^2 - 7^2}{2 \times \text{their} \sqrt{8^2 + 14^2} \times \text{their } EC}$

Condone use of $2\sqrt{65}^2$ for AC^2

M1dep

[23.4667, 23.5]

A1

[3]

Q7.

$60^2 + 80^2$ (= 10 000)

or

$80^2 + 120^2$ (= 20 800)

or

$60^2 + 120^2$ (= 18 000)

100 (may be seen on diagram)

or

[144.2, 144.2221]

or

[134.1, 134.2]

M1

$\sqrt{60^2 + 80^2 + 120^2}$

(= $\sqrt{3600 + 6400 + 14\,400}$)

oe *eg 1* $\sqrt{100^2+120^2}$

eg 2 $\sqrt{10000+120^2}$

eg 3 $\sqrt{24400}$ *or* $20\sqrt{61}$

This mark implies M1 M1

M1dep

[156, 156.205]

A1

[3]

Q8.

(a) $(AC=)\ \sqrt{10^2+6^2}\ \ (=\sqrt{136})$

[11.66, 11.7]

M1

(AX =) their $AC \div 2$

(= [5.8, 5.85])

$(AX=)\ \sqrt{5^2+3^2}\ \ (=\sqrt{34})$ is M2

*Do **not** allow their AC to be 10*

M1

$$\tan(VAX)=\frac{5}{\text{their } AX}$$

Dep on at least one M mark gained

$(AV=)\ \sqrt{5^2+\text{their } AX^2}\ (=\sqrt{59})$ **and**

$$\sin(VAX)=\frac{5}{\text{their } AV}(\times\sin 90)$$ **or**

$$\cos(VAX)=\frac{\text{their } AX}{\text{their } AV}$$ **or**

correct use of cosine rule in triangle VAX

*Do **not** allow their AX to be their AC*

M1dep

[40.5, 40.8]

Allow 41 if correct method seen

SC3 Answer [0.707, 0.7115]

SC3 Answer [45.02, 45.293]

A1

(b) $\tan VMY=\frac{2}{5}$

oe

(M is midpoint of RQ, Y is the centre of PQRS))

M1

[21.8, 21.80141]

Allow 22 if correct method seen

SC1 Angle VMY clearly marked on a diagram
SC1 Answer [0.38, 0.381]
SC1 Answer [24.2, 24.224]

A1

[6]

Q9.

$\frac{1}{3} \times 14 \times 8 \times h = 336$

oe

M1

$h = \frac{336 \times 3}{14 \times 8}$ or $h = 9$

oe

M1

$BX^2 = 7^2 + 4^2$

or $BD^2 = 14^2 + 8^2$

or $BX = \sqrt{65}$ or $BD = 2\sqrt{65}$

or $VB = \sqrt{146}$

oe

M1

Identifies $V\hat{B}X$

oe

M1

$\tan V\hat{B}X = \frac{\text{their } 9}{\text{their } \sqrt{65}}$

$\cos V\hat{B}X = \frac{\text{their } \sqrt{65}}{\text{their } \sqrt{146}}$

or $\sin V\hat{B}X = \frac{\text{their } 9}{\text{their } \sqrt{146}}$

48 or 48.1…

A1

[6]

Q10.

$\cos 36 = \frac{AC}{13.3}$

oe

M1

$AC = 13.3 \times \cos 36$

or 10.75… or 10.76

oe

M1dep

tan *CAT* = $\frac{9.6}{\text{their } 10.76}$

oe

M1dep

41.7

Allow 42 with working

A1

[4]

Q11.

$4^2 + 4^2$ or 16 + 16 or 32
or $2^2 + 2^2$ or 4 + 4 or 8

oe

M1

$\sqrt{32}$ or $4\sqrt{2}$ or $\sqrt{8}$ or $2\sqrt{2}$

Allow use of decimals to 2 dp or better

M1

$\cos x = \frac{\sqrt{8}}{6}$ or 0.47...

oe

$\cos x = \frac{6^2 + 32 - 6^2}{2 \times 6 \times \sqrt{32}}$

M1

[61.8, 61.9] or 62

A1

[4]