7.12 The Sine Rule: 2-hour Pack

EDEXCEL 1MA1 · Calculator allowed · about 120 minutes

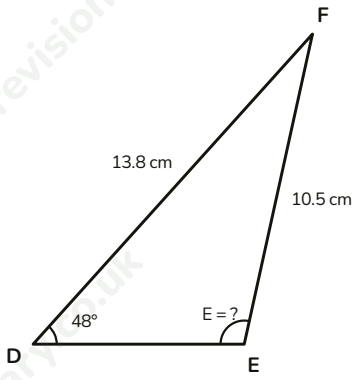
Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 In triangle DEF, angle D = 48 degrees, EF = 10.5 cm and DF = 13.8 cm. Angle E is obtuse. Work out the size of angle E. Give your answer correct to 1 decimal place.

Diagram NOT accurately drawn

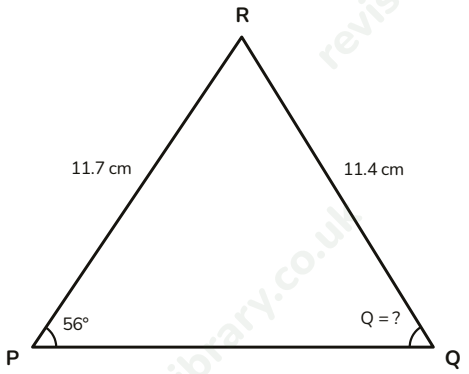


(Total for Question 1 is 4 marks)

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2 In triangle PQR, angle P = 56 degrees, QR = 11.4 cm and PR = 11.7 cm. Angle Q is acute. Work out the size of angle Q. Give your answer correct to 1 decimal place.

Diagram NOT accurately drawn

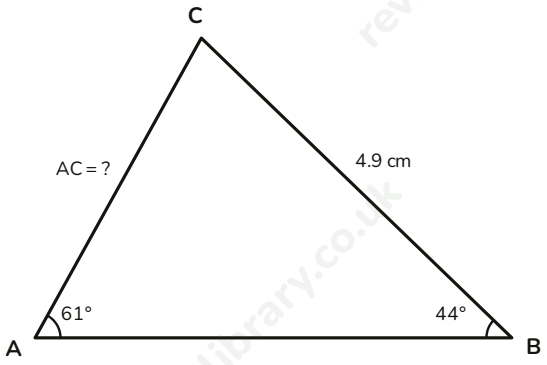


(Total for Question 2 is 3 marks)

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3 In triangle ABC, angle A = 61 degrees, angle B = 44 degrees and BC = 4.9 cm. Work out the length of AC. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

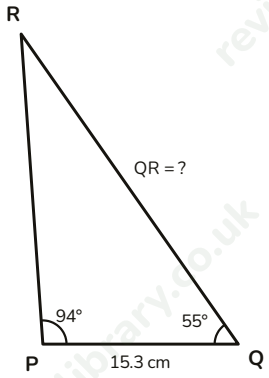


(Total for Question 3 is 3 marks)

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4 In triangle PQR, angle P = 94 degrees, angle Q = 55 degrees and PQ = 15.3 cm. Work out the length of QR. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

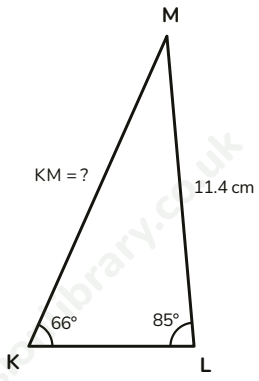


(Total for Question 4 is 4 marks)

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5 In triangle KLM, angle K = 66 degrees, angle L = 85 degrees and LM = 11.4 cm. Work out the length of KM. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

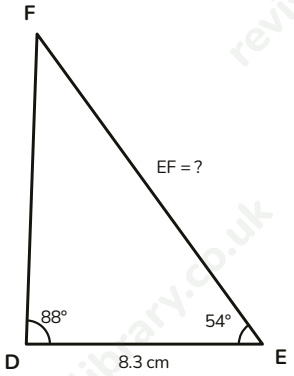


(Total for Question 5 is 3 marks)

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6 In triangle DEF, angle D = 88 degrees, angle E = 54 degrees and DE = 8.3 cm. Work out the length of EF. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

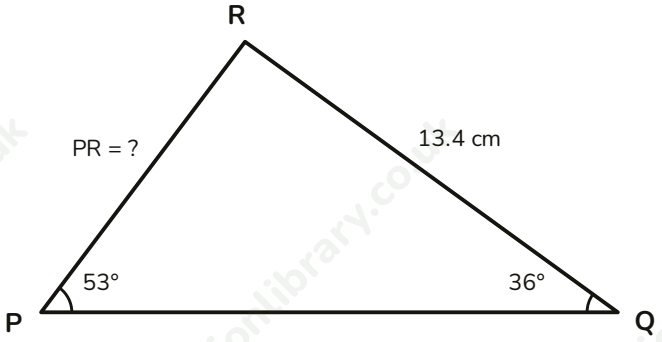


(Total for Question 6 is 4 marks)

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7 In triangle PQR, angle P = 53 degrees, angle Q = 36 degrees and QR = 13.4 cm. Work out the length of PR. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

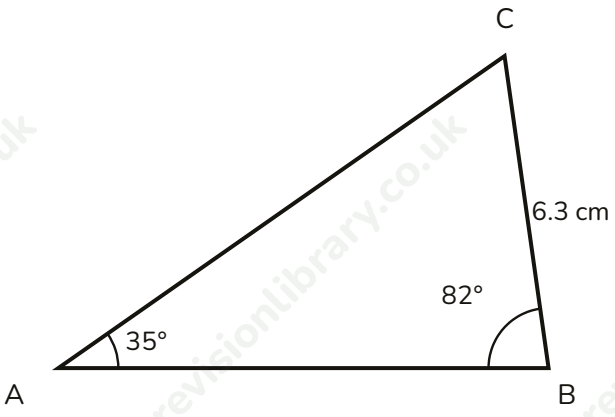


(Total for Question 7 is 3 marks)

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8 In triangle ABC, angle A = 35 degrees, angle B = 82 degrees and BC = 6.3 cm (BC is opposite angle A). Calculate the length of AB (opposite angle C). Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

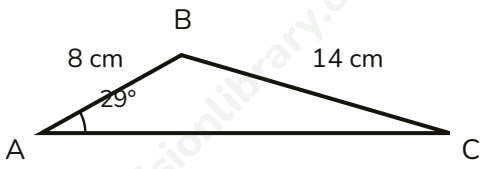


(Total for Question 8 is 4 marks)

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9 In triangle ABC, angle BAC = 29 degrees, BC = 14 cm (opposite angle A) and AB = 8 cm (opposite angle C).

Diagram NOT accurately drawn



(a) Calculate the size of angle ACB. Give your answer correct to 1 decimal place. **(3)**

.....

(b) Hence calculate the length of AC. Give your answer correct to 3 significant figures. **(3)**

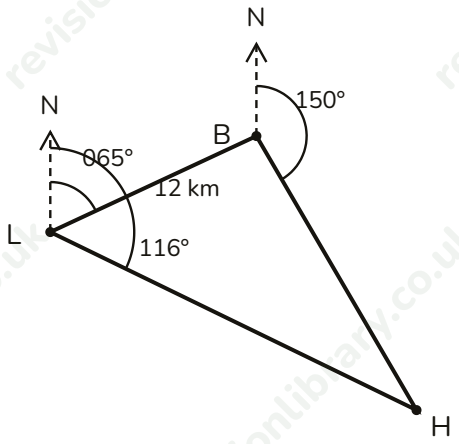
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(Total for Question 9 is 6 marks)

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10 A ship sails from a lighthouse L to a buoy B, a distance of 12 km, on a bearing of 065 degrees. A harbour H is on a bearing of 116 degrees from L, and on a bearing of 150 degrees from B.

Diagram NOT accurately drawn



(a) Show that angle BLH = 51 degrees. **(1)**

(b) Show that angle LBH = 95 degrees. **(1)**

(c) Hence calculate the distance BH, giving your answer correct to 3 significant figures. **(4)**

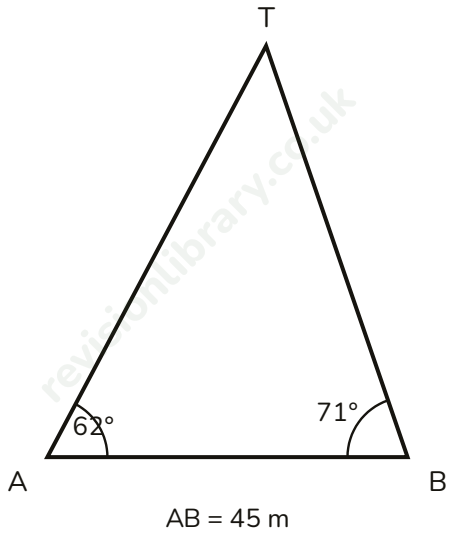
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(Total for Question 10 is 6 marks)

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11 A radio mast is supported by a cable attached to the top, T, of the mast and anchored to the ground at point A. A second cable runs from T to a point B on the ground, on the opposite side of the mast from A, with A, B and the foot of the mast in view. Angle TAB = 62 degrees, angle TBA = 71 degrees, and AB = 45 m. Calculate the length of cable TA. Give your answer correct to 3 significant figures.

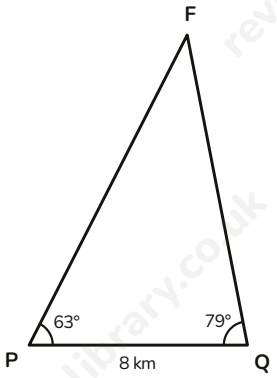
Diagram NOT accurately drawn



(Total for Question 11 is 4 marks)

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12 Two coastguard stations, P and Q, are 8 km apart along a straight stretch of coastline. A distress flare is spotted out at sea, at point F. The angle FPQ = 63 degrees and the angle FQP = 79 degrees.



(a) Calculate the size of angle PFQ. **(1)**

.....

(b) Calculate the distance QF, from station Q to the flare. Give your answer correct to 3 significant figures. **(3)**

.....

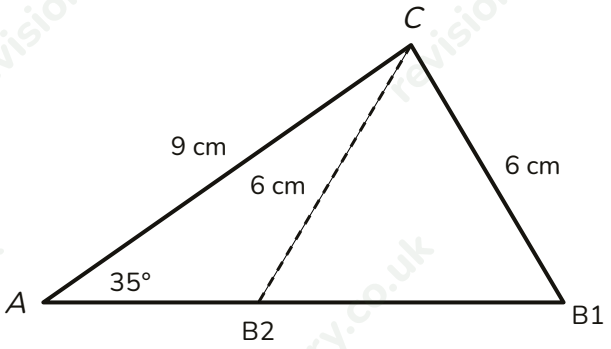
(c) Hence calculate the shortest (perpendicular) distance from the flare to the coastline PQ. Give your answer correct to 3 significant figures. **(3)**

.....

(Total for Question 12 is 7 marks)

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13 In triangle ABC, angle A = 35 degrees, BC = 6 cm (opposite angle A), and AC = 9 cm (opposite angle B). This information gives two possible triangles.



(a) Calculate the two possible values of angle B. Give your answers correct to 1 decimal place. **(2)**

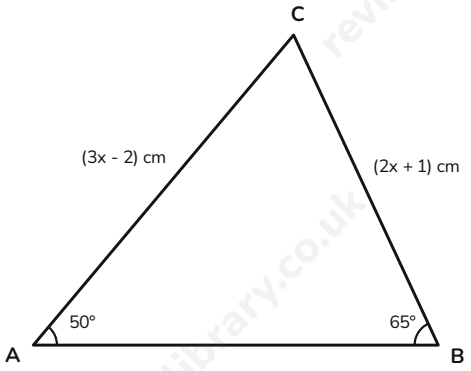
(b) Hence find the two corresponding possible values of angle C. **(2)**

(c) Explain why this information gives two possible triangles. **(1)**

(Total for Question 13 is 5 marks)

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14 In triangle ABC, angle A = 50 degrees, angle B = 65 degrees, BC = (2x + 1) cm (opposite angle A), and AC = (3x - 2) cm (opposite angle B). Use the sine rule to find the value of x. Give your answer correct to 2 decimal places.

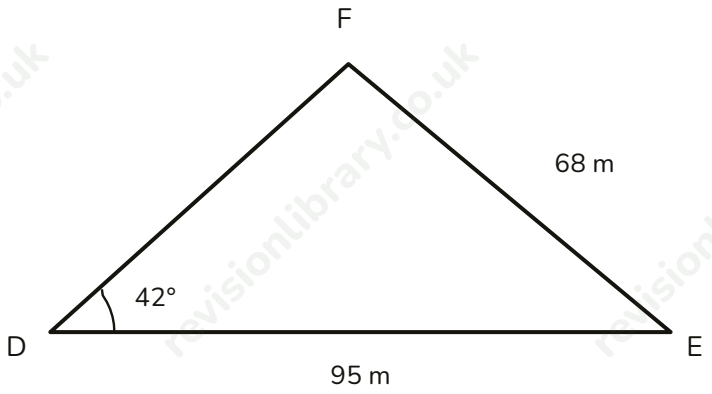


(Total for Question 14 is 4 marks)

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15 In triangle DEF, angle D = 42 degrees, EF = 68 m (opposite angle D) and DE = 95 m (opposite angle F).

Diagram NOT accurately drawn



(a) Calculate the two possible values of angle F. Give each answer correct to 1 decimal place. **(3)**

(b) Given that angle DFE is obtuse, calculate the length of DF. Give your answer correct to 3 significant figures. **(4)**

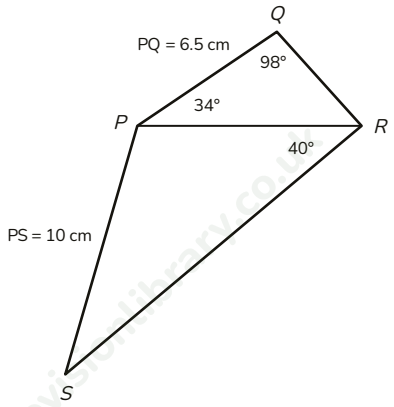
(c) Explain why, without being told that angle DFE is obtuse, there would be two possible lengths for DF. **(1)**

(Total for Question 15 is 8 marks)

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16 The diagram shows quadrilateral PQRS, made up of triangle PQR and triangle PRS joined along the diagonal PR. In triangle PQR, angle QPR = 34 degrees, angle PQR = 98 degrees and PQ = 6.5 cm (opposite angle R). In triangle PRS, angle PRS = 40 degrees and PS = 10 cm (opposite angle R).

Diagram NOT accurately drawn



(a) Calculate the length of PR. Give your answer correct to 3 significant figures. **(3)**

.....

(b) Calculate the size of angle PSR. Give your answer correct to 1 decimal place. **(3)**

.....

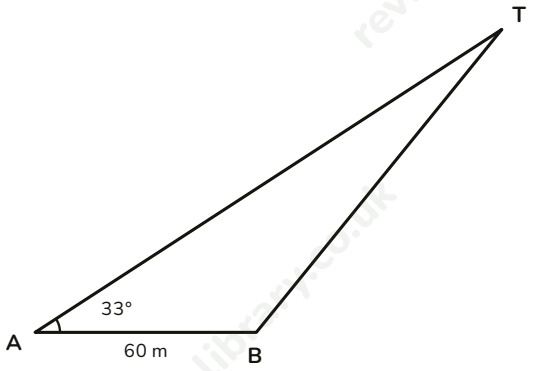
(c) Hence calculate the length of RS. Give your answer correct to 3 significant figures. **(3)**

.....

(Total for Question 16 is 9 marks)

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17 Points A and B lie on level ground, 60 m apart, with the foot of a tall building on the same straight line as A and B, and B closer to the building. The angle of elevation of the top, T, of the building is 33 degrees from A and 51 degrees from B.



(a) Show that angle ATB = 18 degrees. **(3)**

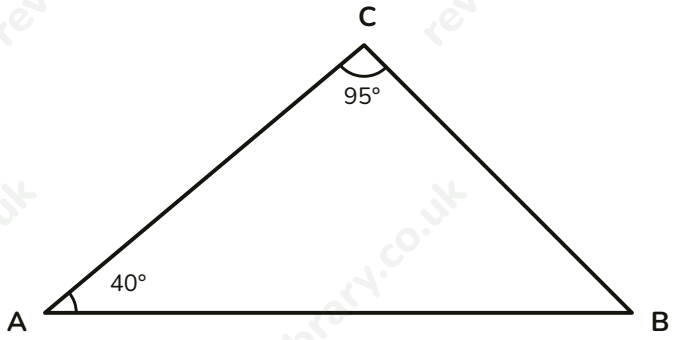
(b) Calculate the length BT. Give your answer correct to 3 significant figures. **(3)**

(c) Hence calculate the height of the building. Give your answer correct to 3 significant figures. **(2)**

(Total for Question 17 is 8 marks)

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18 In triangle ABC, angle A = 40 degrees, angle C = 95 degrees, and the perimeter of the triangle is 32 cm. Calculate the length of BC (opposite angle A). Give your answer correct to 3 significant figures.



(Total for Question 18 is 4 marks)

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Mark scheme · 7.12 The Sine Rule: 2-hour Pack

A correct answer earns full marks unless the question asks for working, a method, proof or explanation.

Question 1

sin E/13.8 = sin 48/10.5	**M1**
acute angle 77.6 found	**M1**
subtracts from 180	**M1**
102.4 degrees cao	**A1**

Answer: 102.4 degrees

Question 2

sin Q/11.7 = sin 56/11.4	**M1**
sin Q = 0.8509 or equivalent	**M1**
58.3 degrees cao	**A1**

Answer: 58.3 degrees

Question 3

AC/sin 44 = 4.9/sin 61	**M1**
rearranges to make the unknown side the subject	**M1**
3.89 cm cao	**A1**

Answer: 3.89 cm

Question 4

angle R = 31 degrees	**M1**
QR/sin 94 = 15.3/sin 31	**M1**
rearranges	**M1**
29.6 cm cao	**A1**

Answer: 29.6 cm

Question 5

KM/sin 85 = 11.4/sin 66	**M1**
rearranges to make the unknown side the subject	**M1**
12.4 cm cao	**A1**

Answer: 12.4 cm

Question 6

angle F = 38 degrees	**M1**
EF/sin 88 = 8.3/sin 38	**M1**
rearranges	**M1**
13.5 cm cao	**A1**

Answer: 13.5 cm

Question 7

PR/sin 36 = 13.4/sin 53	**M1**
rearranges to make the unknown side the subject	**M1**
9.86 cm cao	**A1**

Answer: 9.86 cm

Question 8

angle C = 180 - 35 - 82 (=63 degrees)	**M1**
AB/sin63 = 6.3/sin35 oe	**M1**
AB = 6.3 x sin63 / sin35	**M1**
9.79 cm awrt	**A1**

Answer: 9.79 cm (3 sf)

Question 9

(a) sin(ACB)/8 = sin29/14 oe	**M1**
(a) sin(ACB) = 8 x sin29 / 14	**M1**
(a) 16.1 degrees awrt (rejecting the obtuse solution as angle A + angle C would then exceed 180 degrees)	**A1**

(a) Answer: 16.1 degrees (1 dp)

(b) angle ABC = 180 - 29 - 16.1 (=134.9 degrees) ft	**M1**
(b) AC/sin(134.9) = 14/sin29 oe ft	**M1**
(b) 20.4 cm awrt	**A1**

(b) Answer: 20.4 cm (3 sf)

Question 10

(a) 116 - 65 = 51 degrees cso	**B1**

(a) Answer: 51 degrees (answer given)

(b) bearing of L from B = 065+180 = 245, then 245 - 150 = 95 degrees cso	**B1**

(b) Answer: 95 degrees (answer given)

(c) angle LHB = 180 - 51 - 95 (=34 degrees)	**M1**
(c) BH/sin51 = 12/sin34 oe	**M1**
(c) BH = 12 x sin51 / sin34	**M1**
(c) 16.7 km awrt	**A1**

(c) Answer: 16.7 km (3 sf)

Question 11

angle ATB = 180 - 62 - 71 (=47 degrees)	**B1**
TA/sin71 = 45/sin47 oe	**M1**
TA = 45 x sin71 / sin47	**M1**
58.2 m awrt	**A1**

Answer: 58.2 m (3 sf)

Question 12

(a) 38 (degrees), from 180 - 63 - 79	**B1**

(a) Answer: angle PFQ = 38 degrees

(b) QF/sin(63) = 8/sin(38) oe	**M1**
(b) rearranges to QF = 8 x sin(63) / sin(38) oe, or an unrounded value of 11.57... seen	**M1**
(b) awrt 11.6 (km)	**A1**

(b) Answer: QF = 11.6 km (3 s.f.)

(c) identify the right-angled triangle formed by dropping a perpendicular from F to line PQ, with hypotenuse QF and angle FQP = 79 at Q	**M1**
(c) distance = their QF x sin(79) oe (ft their QF)	**M1**
(c) awrt 11.4 (km)	**A1**

(c) Answer: perpendicular distance = 11.4 km (3 s.f.)

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Question 13

(a) sin(B)/9 = sin(35)/6 oe **M1**

(a) awrt 59.4 and awrt 120.6 (degrees), both values required **A1**

(a) Answer: angle B = 59.4 degrees or angle B = 120.6 degrees

(b) angle C = 180 - 35 - their B for each case (ft) **M1**

(b) awrt 85.6 and awrt 24.4 (degrees), both values required, correctly paired with their B **A1**

(b) Answer: angle C = 85.6 degrees (when angle B = 59.4) or angle C = 24.4 degrees (when angle B = 120.6)

(c) correct explanation, e.g. because BC (the side opposite the given angle A) is shorter than AC, so BC can swing to meet the base in two different positions, giving an acute and an obtuse value for angle B that both produce a valid triangle **B1**

(c) Answer: BC is shorter than AC, so BC can be drawn in two different positions from C, giving two valid triangles (the ambiguous case).

Question 14

(3x - 2)/sin(65) = (2x + 1)/sin(50) oe **M1**

(3x - 2) x sin(50) = (2x + 1) x sin(65) oe, cross-multiplied **M1**

correct collection of x terms, e.g. x(3sin50 - 2sin65) = sin65 + 2sin50 oe **M1**

awrt 5.02 **A1**

Answer: x = 5.02 (2 d.p.)

Question 15

(a) sinF/95 = sin42/68 oe **M1**

(a) 69.2 degrees awrt (first solution) **A1**

(a) 110.8 degrees awrt (180 - first solution) **A1**

(a) Answer: 69.2 degrees or 110.8 degrees

(b) selects F = 110.8 and finds angle E = 180 - 42 - 110.8 (=27.2 degrees) **M1**

(b) DF/sin27.2 = 68/sin42 oe **M1**

(b) DF = 68 x sin27.2 / sin42 **M1**

(b) 46.4 m awrt (46.5 m accepted if angle E is rounded to 27.2 degrees first) **A1**

(b) Answer: 46.4 m (3 sf)

(c) because both values of angle F found in part (a) give a valid triangle (angle sums are both less than 180 degrees), each leading to a different value of angle E and hence a different length for DF via the sine rule **C1**

(c) Answer: Because both values of angle F give a valid triangle, each produces a different angle E, and so a different value of DF.

Question 16

(a) angle PRQ = 180 - 34 - 98 (=48 degrees) **B1**

(a) PR/sin98 = 6.5/sin48 oe **M1**

(a) 8.66 cm awrt **A1**

(a) Answer: 8.66 cm (3 sf)

(b) sin(PSR)/their PR = sin40/10 oe (ft their PR) **M1**

(b) 33.8 degrees awrt (ft their PR) **A1**

(b) rejects the obtuse solution (146.2) since angle P would then be negative (180-40-146.2 < 0), which is impossible **B1**

(b) Answer: 33.8 degrees (1 dp)

(c) angle RPS = 180 - 40 - 33.8 (=106.2 degrees) ft **M1**

(c) RS/sin(106.2) = 10/sin40 oe ft **M1**

(c) 14.9 cm awrt (ft) **A1**

(c) Answer: 14.9 cm (3 sf)

Question 17

(a) angle ABT = 180 - 51 = 129 (degrees), the angle inside triangle ABT at B is the supplement of the elevation angle since T is beyond B **M1**

(a) angle ATB = 180 - 33 - 129 oe **M1**

(a) = 18 (degrees), correctly shown (cso) **A1**

(a) Answer: angle ATB = 18 degrees

(b) BT/sin(33) = 60/sin(18) oe **M1**

(b) rearranges to BT = 60 x sin(33) / sin(18) oe, or an unrounded value of 105.7... seen **M1**

(b) awrt 106 (m) **A1**

(b) Answer: BT = 106 m (3 s.f.)

(c) height = their BT x sin(51) oe (ft their BT), using the right-angled triangle formed by B, the foot of the building, and T **M1**

(c) awrt 82.2 (m) ft their BT **A1**

(c) Answer: height = 82.2 m (3 s.f.)

Question 18

angle B = 180 - 40 - 95 = 45 (degrees) **M1**

each side written as a common multiple k of the sine of its opposite angle, e.g. BC = k sin(40), AC = k sin(45), AB = k sin(95) **M1**

k(sin40 + sin45 + sin95) = 32, leading to a value for k **M1**

BC = their k x sin(40) = awrt 8.77 (cm) **A1**

Answer: BC = 8.77 cm (3 s.f.)

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