3.3 Trigonometry

Question Paper

Course	DP IB Maths
Section	3. Geometry & Trigonometry
Topic	3.3 Trigonometry
Difficulty	Hard

Time allowed: 100

Score: /82

Percentage: /100

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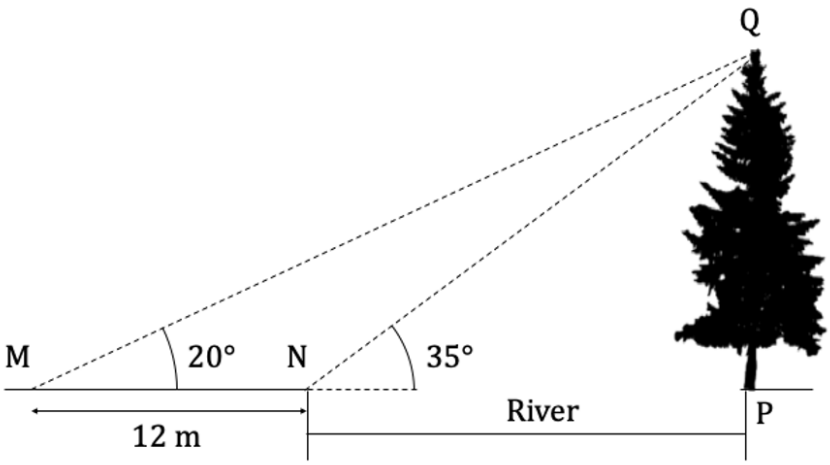
Question 1a

Adah would like to estimate the height of a tree located at point P on the edge of a riverbank, with the top of the tree at point Q. However, due to a raging river, she is unable to reach the base of the tree. From point M she measures an angle of elevation of 20° to the top of the tree, and then from point N (which is on the edge of Adah's bank of the river) she measures an angle of elevation of 35° to the top of the tree. Between the points M and N she measures a horizontal distance of 12 m. Points M, N and P all lie on a single horizontal line, and point Q is vertically above point P. The diagram below shows this information.



(a) Calculate the length of NQ.

[3 marks]

Question 1b

(b) Calculate the height of the tree.

[2 marks]

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Question 1c

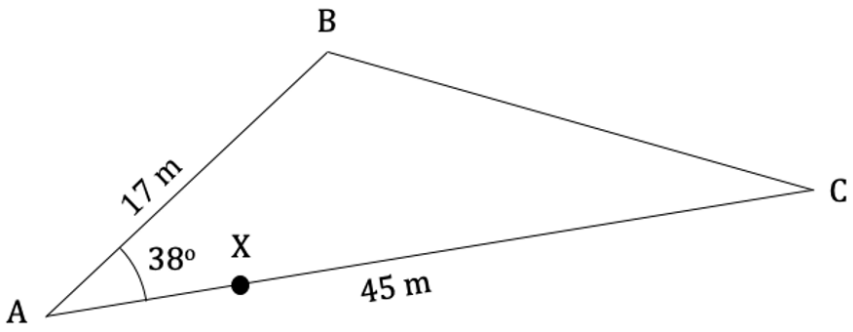
Adah borrows a boat and crosses the river at a rate of 50 metres per 15 minutes.

(c) Assuming that she crosses in a straight line directly from point N to point P, find out how long it takes her to cross the river.

[3 marks]

Question 2a

The diagram below shows a triangular field on a farm. AB = 17 m, AC = 45 m and angle $B\widehat{A}C = 38°$.
X is a point on AC, such that AX : XC is 1 : 4.



The field is going to be used for livestock, so a fence is to be installed around its perimeter.

(a) Calculate the total length of fencing required.

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[3 marks]

Question 2b

The owner of the field had estimated the length of fence required to be 98 m.

(b) Calculate the percentage error in her estimation.

[4 marks]

Question 2c

The field is to be divided into two parts by installing a new fence connecting B to X.

(c) Calculate the area of BXC.

[4 marks]

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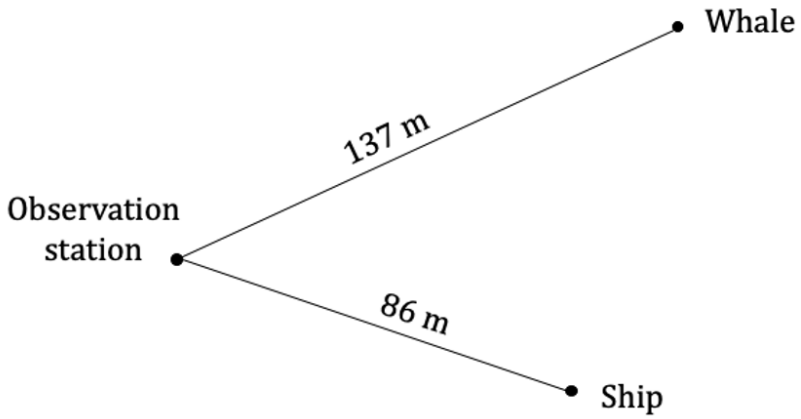
Question 3a

The diagram below shows a ship that is located 86 m from an observation station, and a whale that has been spotted from the observation station at a distance of 137 m.



The bearing of the ship from the observation station is 110° and the whale is located along a bearing of 072° from the observation station.

(a) Calculate the distance between the ship and the whale.

[3 marks]

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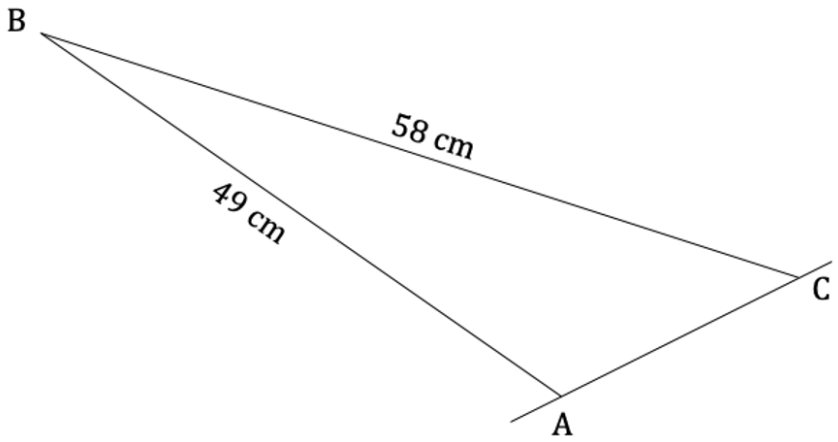
Question 3b

(b) Work out the bearing that the ship needs to travel on to reach the whale. Give your answer to 1 decimal place.

[4 marks]

Question 4a

The cross-section of a unicorn horn can be modelled by the triangle ABC shown in the diagram below. The length AB = 49 cm and length BC = 58 cm. The cross-sectional area of the horn is 168 cm^2.



(a) Find the size of the angle $A\widehat{B}C$ formed at the tip of horn.

[3 marks]

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Question 4b

(b) Calculate the length of the base AC that is attached to the unicorn's head.

[3 marks]

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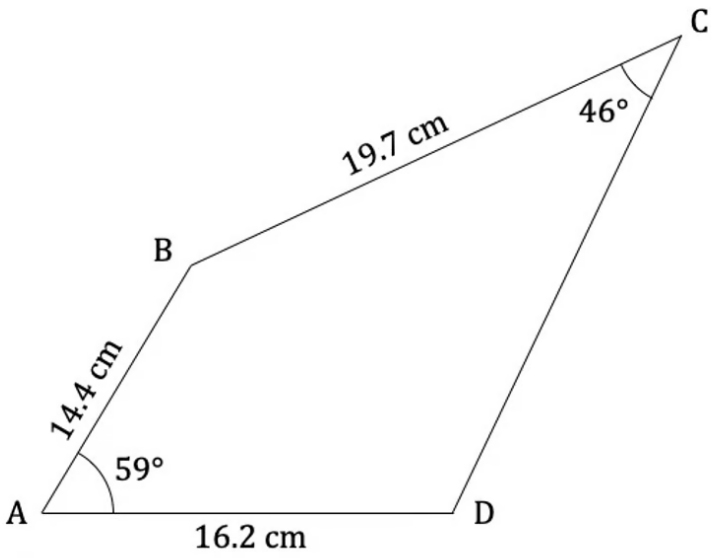
Question 5a

The diagram below shows a quadrilateral ABCD. Angle $B\hat{A}D = 59°$ and angle $B\hat{C}D = 46°$. AB = 14.4 cm, AD = 16.2 cm and BC = 19.7 cm.



(a) Calculate the length BD.

[2 marks]

Question 5b

(b) Find the size of the angle $C\hat{D}B$.

[2 marks]

Question 5c

(c) Show that the area of the quadrilateral is 235 cm^2 correct to the nearest cm^2.

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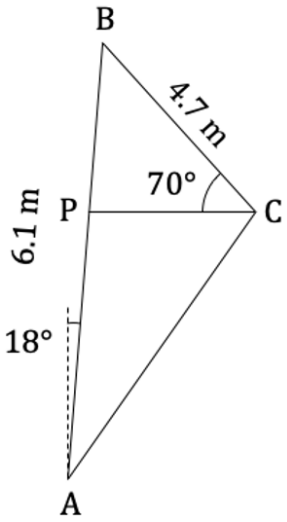
[2 marks]

Question 6a

The diagram below shows the triangular sail of a windsurfing board, ABC, with a horizontal boom PC. AB = 6.1 m and makes an angle of 18° to the vertical. BC = 4.7 m and $B\hat{C}P = 70°$.



(a) Find the area of the whole sail.

[4 marks]

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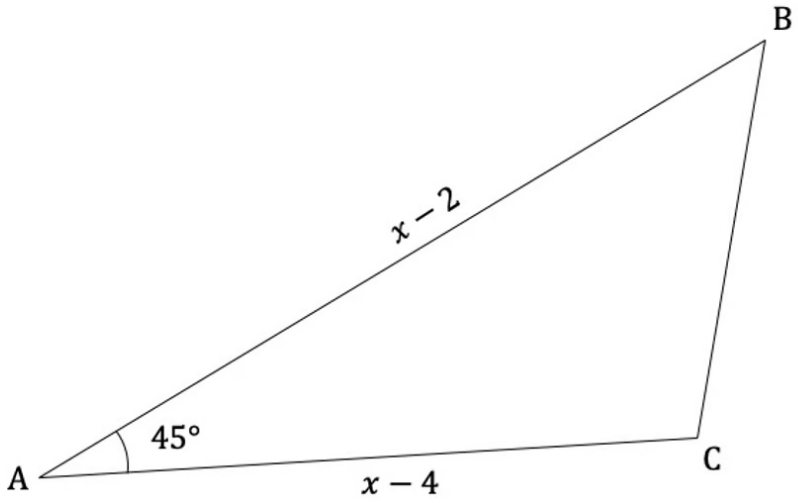
Question 6b

(b) Calculate the length of the boom PC.

[2 marks]

Question 7a

The area of triangle ABC is $12\sqrt{2}$.



(a) Calculate the value of x.

[5 marks]

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Question 7b

(b) Hence, find BC.

[3 marks]

Question 7c

Heron's formula states that it is actually possible to find the area of any triangle given only its side lengths a, b and c.

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$

The value of s is known as the 'half perimeter' where $s = \frac{a+b+c}{2}$

(c) Verify that Heron's formula works for triangle ABC.

[3 marks]

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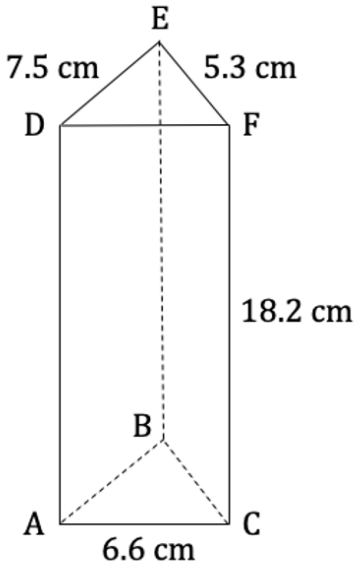
Question 8a

The diagram shows a triangular prism ABCDEF of height 18.2 cm. ED = 7.5 cm, EF = 5.3 cm and AC = 6.6 cm.



M is the midpoint of BC.

(a) Calculate the length DM.

[5 marks]

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Question 8b

(b) Find the size of the angle $E\widehat{M}D$.

[3 marks]

Question 8c

(c) Find the area of the triangle EDM.

[2 marks]

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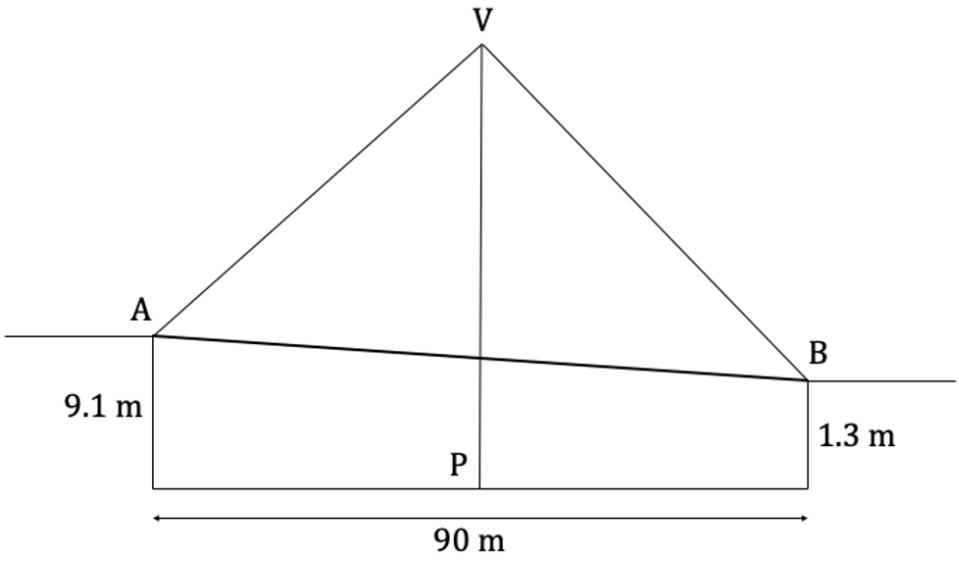
Question 9a

The diagram below shows a cable-stayed bridge crossing a river from A to B. The height of the embankment at A, measured from the horizontal river bed, is 9.1 m and this drops to a height of 1.3 m at B. The width of the river bed is 90 m. A vertical central column of height 15 m is situated at the midpoint of the river bed, P, and connects to the exterior supporting cables at point V. The other ends of the cables are attached at points A and B respectively.



(a) Find the size of angle $V\hat{B}A$, between the exterior supporting cable and the bridge span.

[4 marks]

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Question 9b

(b) Calculate the total length of the two exterior supporting cables.

[6 marks]

Question 10a

Wynken, Blynken and Nod are three mathematics students. While the three are revising trigonometry, Nod sets the following problem for his two companions:

> "ABC is a triangle with $AC = 8.1$ cm, $BC = 9.8$ cm and $A\hat{B}C = 47°$. To three significant figures, what is the size of the largest angle in the triangle?"

Wynken and Blynken set to work, and several minutes pass. "70.8 degrees," states Wynken confidently. "118 degrees," insists Blynken a moment later.

(a) Demonstrate that Wynken's and Blynken's responses may both be correct answers to the problem Nod has set them.

[6 marks]

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Question 10b

(b) Suggest an additional piece of information that Nod could provide, that would allow his problem to have a single unique solution.

[1 mark]

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