3.3 Trigonometry

Question Paper

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

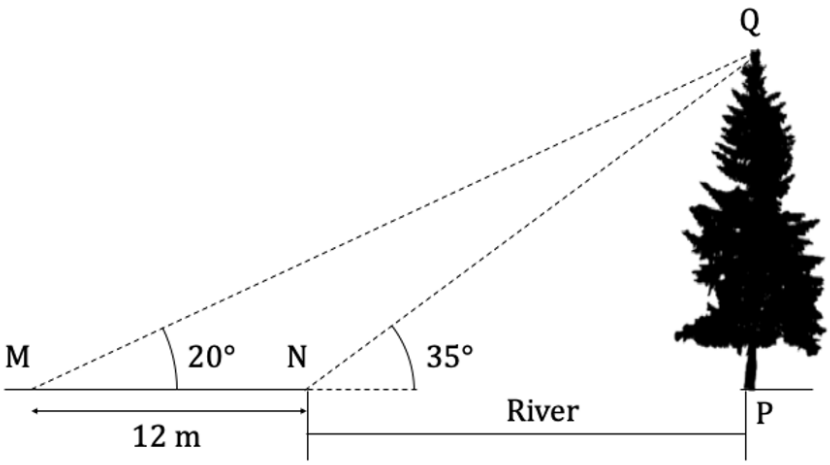
Time allowed: 90

Score: /71

Percentage: /100

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]

Question 1c

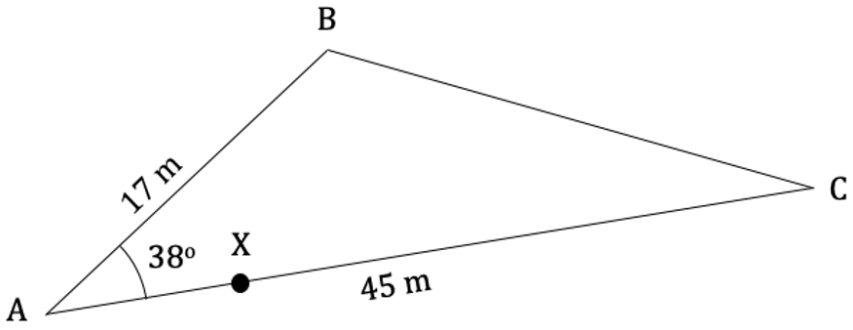
Adah borrows a boat and crosses the river at a rate of 50 metres per 15 minutes.

(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.

[3 marks]

Question 2b

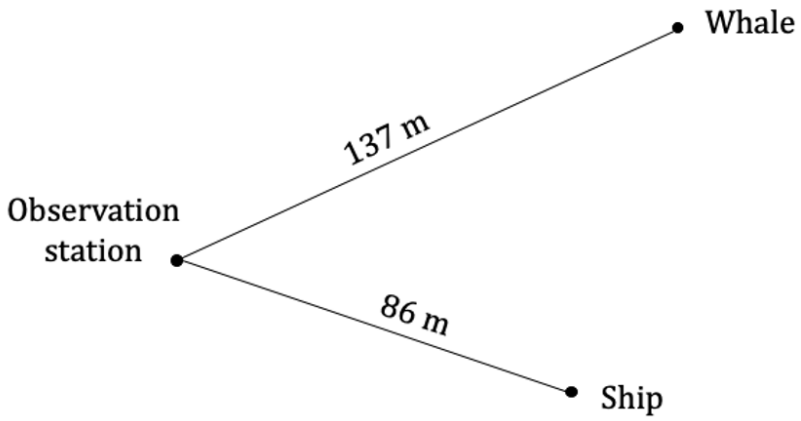
The field is to be divided into two parts by installing a new fence connecting B to X.

(b) Calculate the area of BXC.

[4 marks]

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]

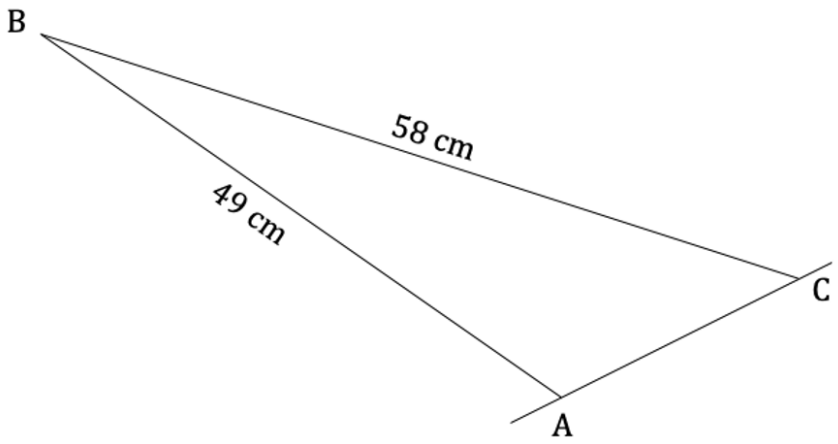
Question 3b

(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]

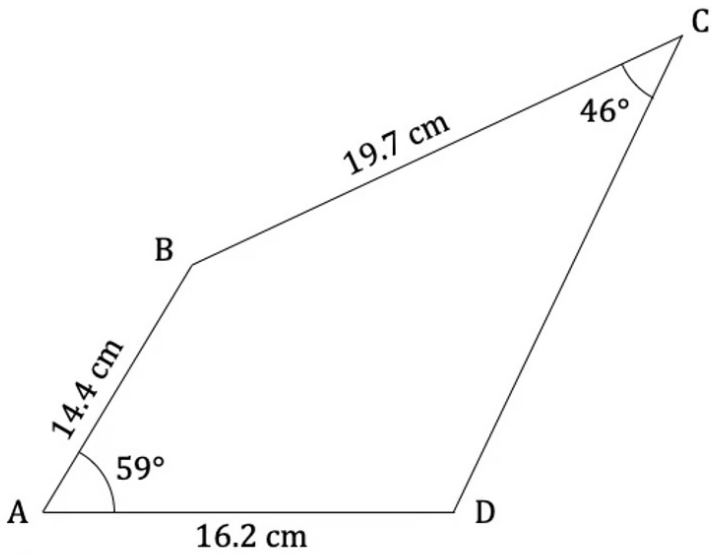
Question 4b

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

[3 marks]

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]

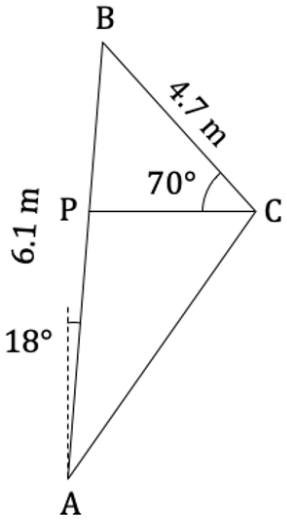
Question 5c

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

[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]

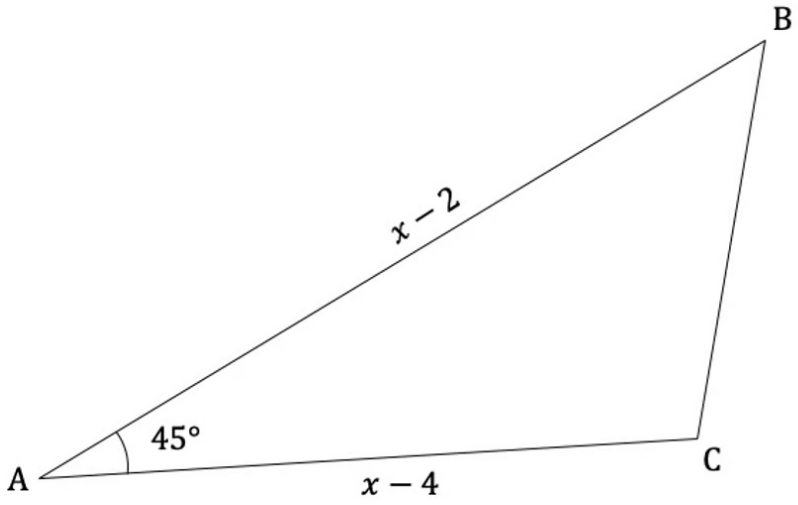
Question 6b

(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]

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.

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

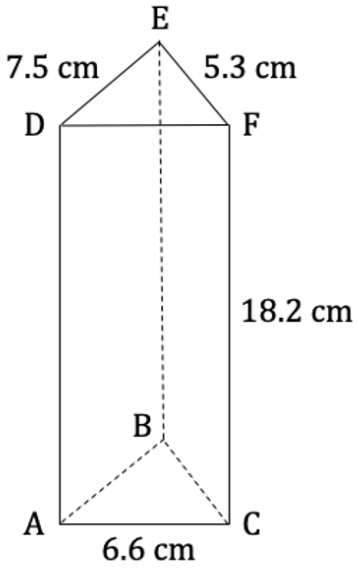
The value of s is known as the 'half perimeter' where $s = \frac{a+b+c}{2}$

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

[3 marks]

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]

Question 8b

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

[3 marks]

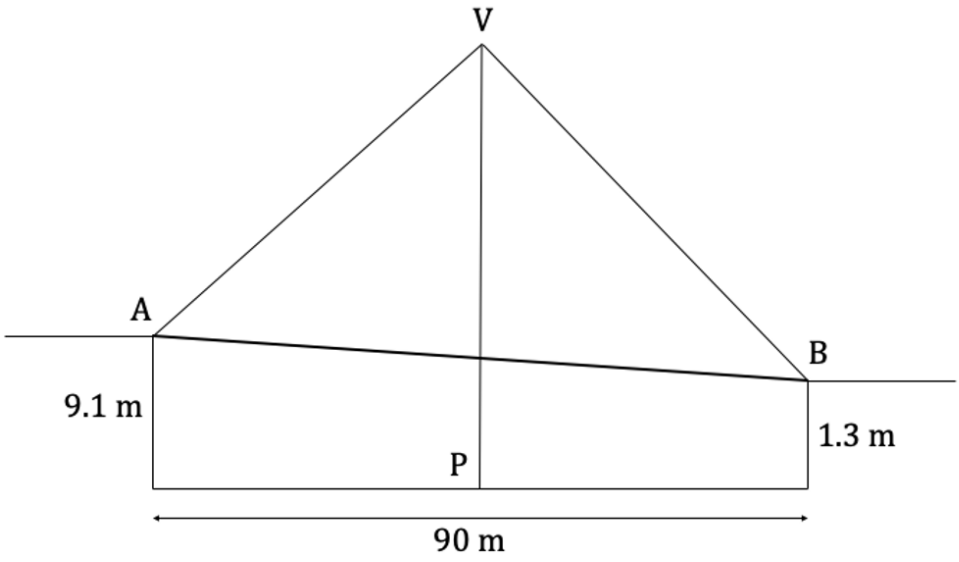
Question 8c

(c) Find the area of the triangle EDM.

[2 marks]

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]

Question 9b

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

[6 marks]