

# 19

## Stretch lesson: Problem solving with trigonometry

### Stretch objectives

Before you start this chapter, mark how confident you feel about each of the statements below:


I can apply Pythagoras' theorem, bearings and trigonometry to more complex problems.

## 19.1 Problem solving

There will usually be a question on one of the exam papers which involves you applying **trigonometry**, **Pythagoras' theorem**, or both.

The problems often require you to complete a number of steps before you reach the final answer.

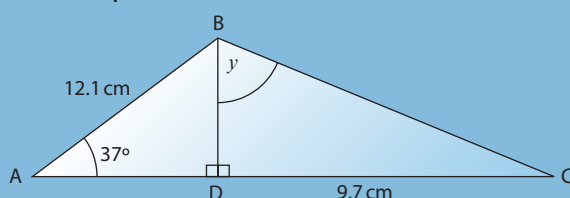
Example

1

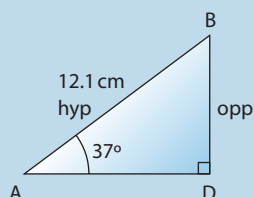
**Q** The diagram shows a triangle ABC.

AB = 12.1 cm, CD = 9.7 cm,  $\angle BAD = 37^\circ$ .

Calculate the size of the angle marked  $y$ . Give your answer correct to one decimal place.



**A** First find the length of BD.

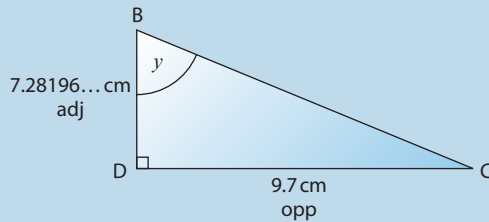


$$\sin 37^\circ = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 37^\circ = \frac{BD}{12.1}$$

$$\begin{aligned} BD &= 12.1 \times \sin 37^\circ \\ &= 7.28196\dots \text{ cm} \end{aligned}$$

Then find the size of angle  $y$ .



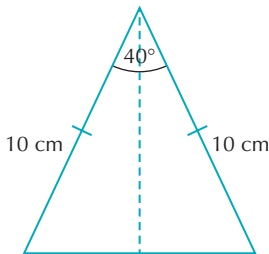
$$\begin{aligned}\tan y &= \frac{\text{opp}}{\text{adj}} \\ &= \frac{9.7}{7.28196...} \\ y &= \tan^{-1}(1.33205...) \\ &= 53.103... \\ &= 53.1^\circ \text{ (1 d.p.)}\end{aligned}$$

**Exam tips** Remember not to round numbers until the last line of your working.

## Practice questions

- 1 A ship leaves port A and sails on a bearing of  $025^\circ$  for 50 km.  
How far east of port A is the ship?

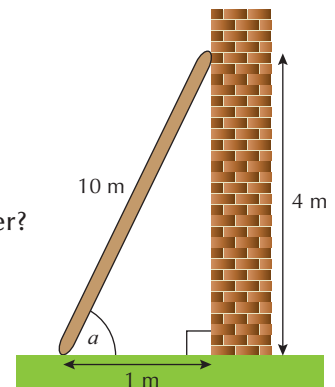
- 2 Calculate the area of the triangle.



### Hint

Remember, area of a triangle =  $\frac{1}{2} \times \text{base} \times \text{perpendicular height}$ , so start by working out the perpendicular height.

- 3 In order to use a ladder safely, the rule is: '1 unit out for every 4 units up'.  
Eva has a 10 m ladder. She places the ladder against a wall following the safety rule.  
a How far up the wall does the ladder reach?  
b How far from the base of the wall is the bottom of the ladder?

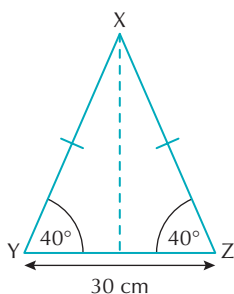


- 4 Martin walks 40 metres due north. He then walks on a bearing of  $150^\circ$  until he is directly east of his starting point.  
What is the shortest distance back to his starting point?  
Give your answer correct to one decimal place.

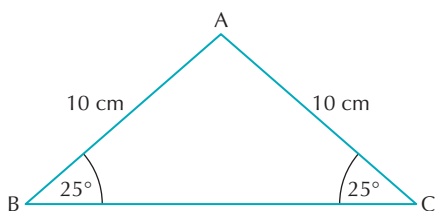
# Exam-style questions

- 1 A boat sails 400 metres in a straight line from a jetty.  
The position of the boat is then 300 metres east in relation to the position of the jetty.  
Work out the two possible bearings the boat could have sailed on.

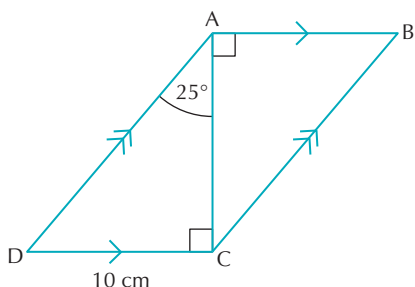
- 2 XYZ is an isosceles triangle.  
Work out the area of the triangle.  
Remember: area of a triangle =  $\frac{1}{2} \times \text{base} \times \text{perpendicular height}$



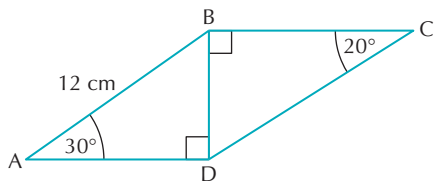
- 3 ABC is an isosceles triangle.  
Work out the area of the triangle.



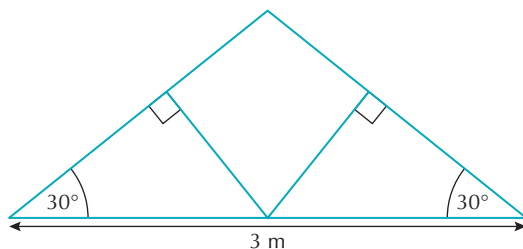
- 4 ABCD is a parallelogram as shown.  
DC = 10 cm and angle DAC = 25°.  
Calculate the length of BC.  
Give your answer correct to one decimal place.



- 5** ABCD is a quadrilateral as shown.  
 $AB = 12$  cm, angle  $A = 30^\circ$  and angle  $C = 20^\circ$ .  
 Calculate the length CD.  
 Give your answer correct to one decimal place.



- 6** Alex designs a symmetrical timber frame for a shed roof she is building.  
 The diagram shows one piece of the frame.  
 Calculate the total length of wood needed for this piece.



- 7** Rafiq walks on a bearing of  $040^\circ$  for 55 metres.  
 He then turns and walks on a bearing of  $060^\circ$  for 70 metres.  
 a In relation to his starting point, work out:  
     i how far north he is      ii how far east he is.  
 b On what bearing should he walk to return directly to his starting point?
- 8** Sandya stands 50 metres from the base of a house which has a chimney.  
 She measures the angle of elevation to the top and bottom of the chimney as  $54^\circ$  and  $52^\circ$  respectively.  
 Work out the height of the chimney.

# Chapter 19 Stretch lesson: Answers

## 19.1 Problem solving

- 1 21.1 km
- 2  $32.14 \text{ cm}^2$
- 3 **a** 9.7 m      **b** 2.4 m
- 4 23.1 m

## Exam-style questions

- 1  $049^\circ$  and  $131^\circ$
- 2  $188.8 \text{ cm}^2$
- 3  $38.3 \text{ cm}^2$
- 4 23.7 cm
- 5 17.5 cm
- 6 7.96 m
- 7 **a** 77.1 m      **b** 96.0 m      **c**  $231^\circ$
- 8 4.82 m