

# Angle facts, polygons and bearings



Hints online, answers free with an account:  
[mathswariz.uk/worksheets/angles/](https://mathswariz.uk/worksheets/angles/)

Grades 4–9 About 80 minutes No calculator 90 marks

Name \_\_\_\_\_

Class \_\_\_\_\_

Date \_\_\_\_\_

## **A** Before you start

Grades 4–5

You will need these in every question below.

**A1** Two angles on a straight line are  $127^\circ$  and  $x$ . Work out  $x$ .

[1 mark]

Answer \_\_\_\_\_

**A2** Three angles meet at a point. Two of them are  $95^\circ$  and  $140^\circ$ . Work out the third angle.

[1 mark]

Answer \_\_\_\_\_

**A3** Two angles of a triangle are  $53^\circ$  and  $74^\circ$ . Work out the third angle.

[1 mark]

Answer \_\_\_\_\_

**A4** Write down the three-figure bearing of the direction due west.

[1 mark]

Answer \_\_\_\_\_

**A5** An isosceles triangle has one angle of  $40^\circ$  between its two equal sides. Work out the size of each of the other two angles.

[2 marks]

Answer \_\_\_\_\_

Your teacher works through each example with you. Then try the one beside it on your own.

**EXAMPLE 1**

The angles of a triangle are  $x^\circ$ ,  $(2x + 15)^\circ$  and  $(3x - 21)^\circ$ . Work out the size of the largest angle.

**Hint** The three angles add up to  $180^\circ$ . Solve for  $x$  first, then work out all three angles.

**B1** The angles of a triangle are  $(x + 20)^\circ$ ,  $2x^\circ$  and  $(4x - 29)^\circ$ . Work out the size of the largest angle. [3 marks]

Answer .....

**EXAMPLE 2**

Work out the size of each interior angle of a regular polygon with 12 sides.

**Hint** Find one exterior angle first: the exterior angles of any polygon add up to  $360^\circ$ .

**B2** Work out the size of each interior angle of a regular polygon with 18 sides. [2 marks]

Answer .....

**EXAMPLE 3**

Each interior angle of a regular polygon is  $162^\circ$ . How many sides does the polygon have?

**Hint** The interior and exterior angles at a corner add up to  $180^\circ$ . Then use the  $360^\circ$  total of the exterior angles.

**B3** Each interior angle of a regular polygon is  $165^\circ$ . How many sides does the polygon have? [2 marks]

Answer .....

**EXAMPLE 4**

The bearing of  $B$  from  $A$  is  $064^\circ$ . Work out the bearing of  $A$  from  $B$ .

**Hint** Draw a north line at each point. The two north lines are parallel, so the back bearing differs by  $180^\circ$ .

**B4** The bearing of  $Q$  from  $P$  is  $295^\circ$ . [2 marks]  
Work out the bearing of  $P$  from  $Q$ .

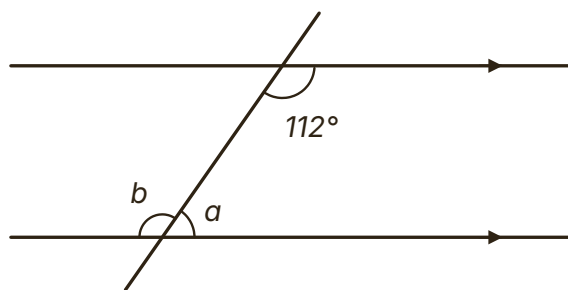
Answer .....

**C Practice**

Grades 5–7

Each question asks for something different. Show your working.

**C1** The diagram shows two parallel lines and a straight line crossing them.



Not drawn accurately

**(a)** Work out the size of angle  $a$ . Give a reason for your answer.

[2 marks]

Answer .....

**(b)** Work out the size of angle  $b$ . Give a reason for your answer.

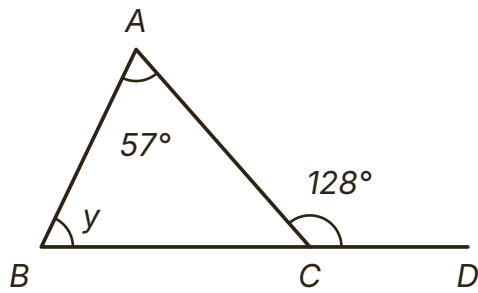
[2 marks]

Answer .....

**Total for C1: 4 marks**

**C2**  $BCD$  is a straight line. Work out the size of angle  $y$ .

[2 marks]

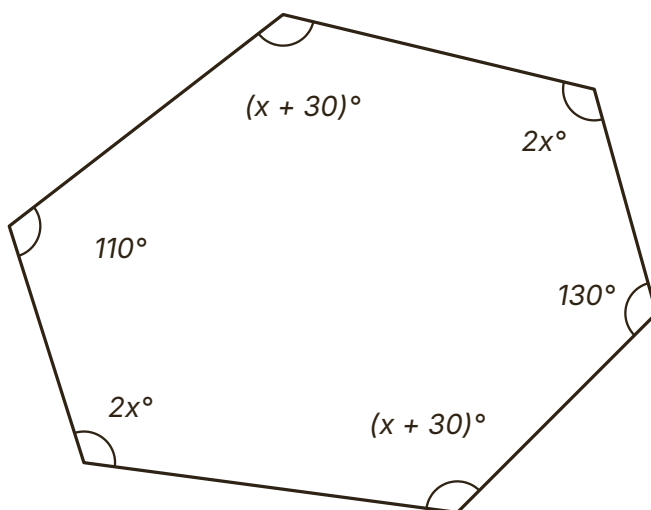


Not drawn accurately

Answer .....

**C3** The diagram shows a hexagon. Work out the value of  $x$ .

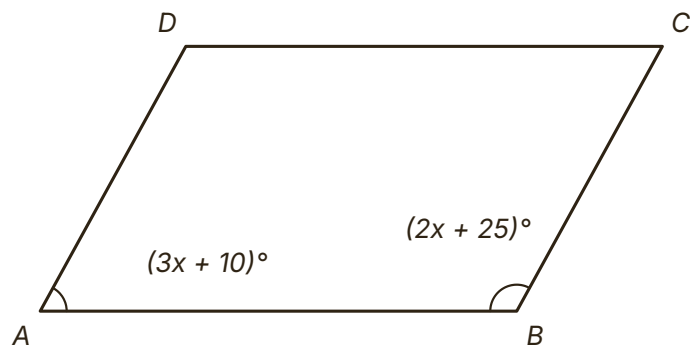
[3 marks]



Not drawn accurately

Answer .....

- C4**  $ABCD$  is a parallelogram. Work out the size of the smallest angle of the parallelogram. [3 marks]

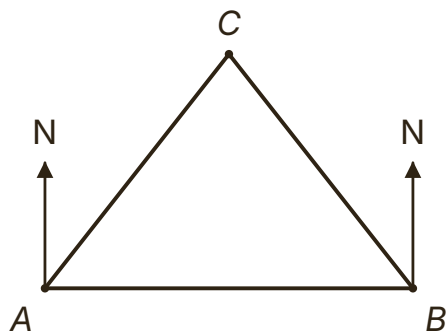


Not drawn accurately

Answer .....

- C5**  $B$  is due east of  $A$ . The bearing of  $C$  from  $A$  is  $052^\circ$ . The bearing of  $C$  from  $B$  is  $318^\circ$ . [3 marks]

Work out the size of angle  $ACB$ .



Not drawn accurately

Answer .....

- C6** A map is drawn to a scale of  $1 : 40\,000$ . Two farms are  $6.3$  cm apart on the map. Work out the real distance between the farms in kilometres. [2 marks]

Answer .....

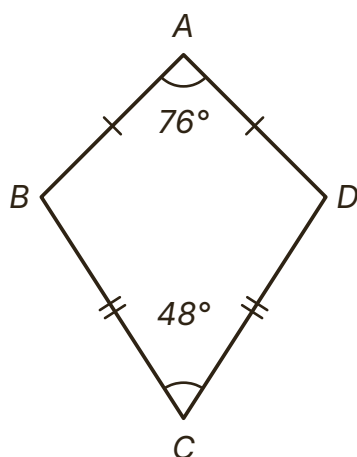
- C7** The interior angles of a polygon add up to  $1980^\circ$ . How many sides does the polygon have? [2 marks]

Answer .....

- C8** A regular pentagon and a regular hexagon are joined along one side, so that they do not overlap. At one end of the shared side, angle  $x$  is the angle outside both shapes. [2 marks]
- Work out the size of angle  $x$ .

Answer .....

- C9**  $ABCD$  is a kite with  $AB = AD$  and  $CB = CD$ .



Not drawn accurately

- (a) Work out the size of angle  $ABC$ . [2 marks]

Answer .....

- (b) The diagonal  $AC$  is drawn. Work out the size of angle  $BAC$ . [1 mark]

Answer .....

Total for C9: 3 marks

## D Exam-style questions

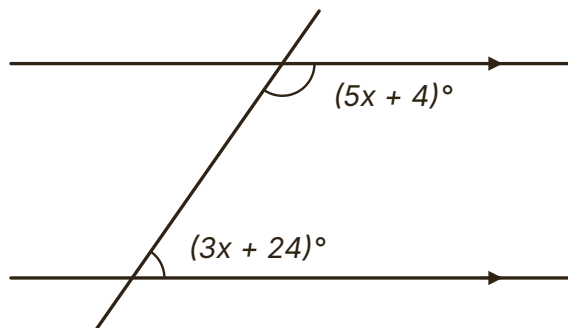
Grades 6–9

Answer every question in the space given. Show your working: most of the marks are for method.

**D1** The diagram shows two parallel lines and a straight line crossing them.

[4 marks]

Work out the value of  $x$ . Give reasons for your working.



Not drawn accurately

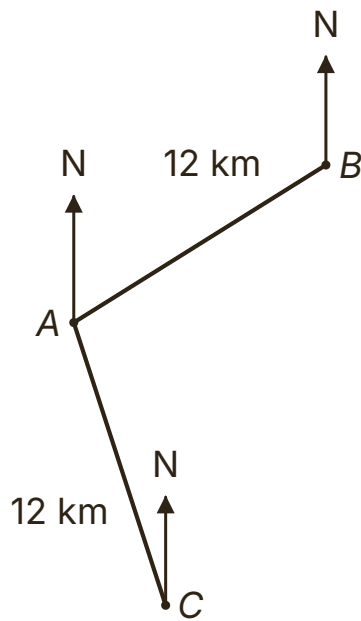
Answer  $x = \dots\dots$

**D2** Priya says, "A regular polygon can have interior angles of  $145^\circ$ ."

[2 marks]

Explain why Priya is wrong.

- D3** Town  $B$  is 12 km from town  $A$  on a bearing of  $070^\circ$ . Town  $C$  is 12 km from town  $A$  on a bearing of  $150^\circ$ .



Not drawn accurately

- (a)** Work out the size of angle  $BAC$ .

[1 mark]

Answer .....

- (b)** Work out the bearing of  $C$  from  $B$ .

[4 marks]

Answer .....

- (c)** Hence write down the bearing of  $B$  from  $C$ .

[1 mark]

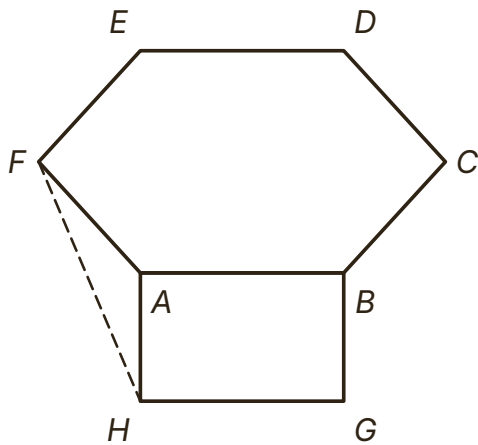
Answer .....

**Total for D3: 6 marks**

- D4**  $ABCDEF$  is a regular hexagon.  $ABGH$  is a square.  $F$  is joined to  $H$ .

[5 marks]

Work out the size of angle  $AHF$ . You must show your working.



Not drawn accurately

Answer .....

- D5** Each exterior angle of a regular polygon is  $x^\circ$ . Each interior angle is  $4x^\circ$ .

[3 marks]

Work out the number of sides of the polygon.

Answer .....

- D6** On a map with a scale of 1 : 20 000, two churches are 4.5 cm apart. Ellie cycles from one church to the other at an average speed of 12 km/h.

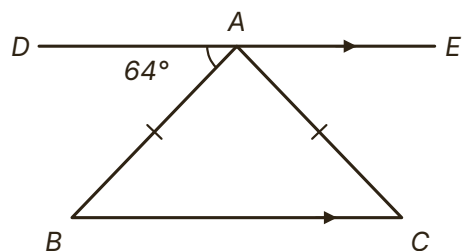
[3 marks]

How many minutes does the journey take?

Answer .....

- D7**  $ABC$  is an isosceles triangle with  $AB = AC$ . The line  $DAE$  is parallel to  $BC$ . Angle  $DAB = 64^\circ$ . [4 marks]

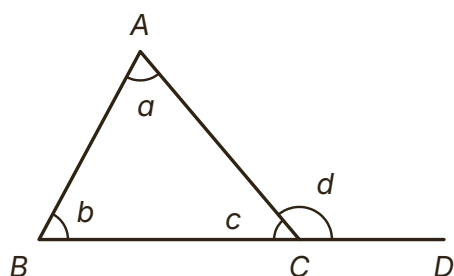
Work out the size of angle  $BAC$ . Give reasons for your working.



Not drawn accurately

Answer .....

- D8** The diagram shows triangle  $ABC$  with the side  $BC$  extended to  $D$ . [3 marks]  
Show that  $d = a + b$ . Give a reason for each step.



Not drawn accurately

- D9** The angles of a quadrilateral are in the ratio  $2 : 3 : 4 : 6$ .

(a) Work out the size of the largest angle. [2 marks]

Answer .....

(b) Explain why the quadrilateral cannot have a pair of parallel sides.

[2 marks]

Total for D9: 4 marks

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**D10** The bearing of  $X$  from  $Y$  is three times the bearing of  $Y$  from  $X$ .

[3 marks]

Work out the bearing of  $Y$  from  $X$ .

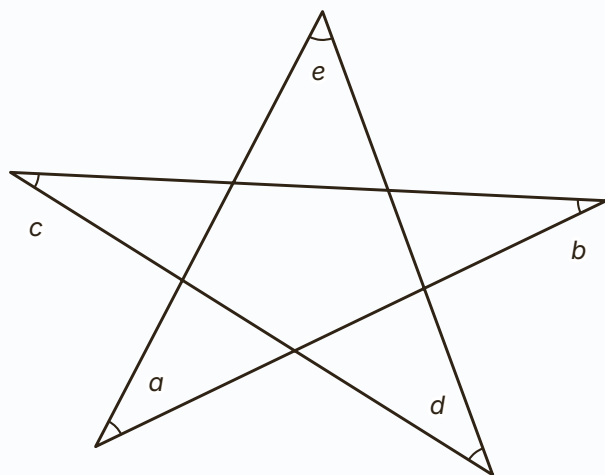
Answer .....

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No route is given. Spend five minutes on a problem before you look at a hint. The hints are on the last page of the worksheet, and you can use one at a time.

- E1** The diagram shows a five-pointed star drawn by joining the corners of a pentagon. The pentagon is not regular. [4 marks]

Work out  $a + b + c + d + e$ .



Not drawn accurately

Answer .....

- E2** Two identical regular polygons and a regular decagon fit together exactly around a point, with no gaps. [3 marks]

How many sides does each of the two identical polygons have?

Answer .....

**E3** A regular polygon has interior angles of at least  $170^\circ$ , and each exterior angle is a whole number of degrees. [3 marks]

How many different polygons like this are there?

Answer .....

**E4** Three boats are at  $A$ ,  $B$  and  $C$ . The bearing of  $B$  from  $A$  is  $040^\circ$ . The bearing of  $C$  from  $B$  is  $100^\circ$ . The bearing of  $A$  from  $C$  is  $250^\circ$ . [4 marks]

Show that  $B$  is the same distance from  $A$  as it is from  $C$ .

## **F** How did it go?

Colour one circle on each line.

|                                                                                                            | Not yet               | Nearly                | Yes                   |
|------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------|-----------------------|
| I can use angle facts on lines, at a point, in triangles and across parallel lines, and give reasons.      | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I can work out interior and exterior angles of polygons, and use the properties of special quadrilaterals. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I can use bearings and scales to solve problems.                                                           | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

## Extension hints

Use one hint at a time. Cover the ones below it with a sheet of paper.

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- E1**
- Hint 1** Look for triangles inside the star. An exterior angle of a triangle equals the two opposite interior angles added.
- Hint 2** Each angle of the small pentagon in the middle has an exterior angle that equals two of the tip angles added together.
- Hint 3** The five exterior angles of the middle pentagon add up to  $360^\circ$ , and each tip angle is counted twice in them. So  $2(a + b + c + d + e) = 360$ .
- 
- E2**
- Hint 1** Find the interior angle of a regular decagon.
- Hint 2** Each interior angle of the decagon is  $144^\circ$ , so the two identical angles add up to  $216^\circ$ .
- Hint 3** Each identical polygon has interior angle  $108^\circ$ , so exterior angle  $72^\circ$ , and  $360 \div 72$  sides.
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- E3**
- Hint 1** Turn the condition on the interior angle into a condition on the exterior angle.
- Hint 2** The exterior angle is at most  $10^\circ$ , and it must divide exactly into 360.
- Hint 3** List the whole numbers from 1 to 10 that divide into 360: 1, 2, 3, 4, 5, 6, 8, 9, 10. Count them.
- 
- E4**
- Hint 1** Draw a sketch with a north line at each boat. Work out each angle of triangle  $ABC$  from the bearings.
- Hint 2** Angle  $BAC = 070 - 040 = 30^\circ$  and angle  $ABC = 220 - 100 = 120^\circ$ .
- Hint 3** So angle  $BCA = 180 - 30 - 120 = 30^\circ$ . Two angles are equal, so the triangle is isosceles and  $BA = BC$ .