Worksheet - Constructions, loci, bearings, plans and elevations

Year: Year 11 · 20

Show your working.

Question 1

Question 1 – Three-figure bearings *(Section A · Skills practice)*

Bearings are measured clockwise from north and written with three figures.

a. Write down the bearing for each compass direction: east, south, west, south-east. [2 marks]
b. The bearing of B from A is 065°. Work out the bearing of A from B. [2 marks]
c. Work out the back bearing of each: 230°, 312°, 148°. [3 marks]
d. Explain the rule for finding a back bearing. [1 mark]

Question 2

Question 2 – Scale drawings and maps *(Section A · Skills practice)*

A map has a scale of $1 : 25\,000$.

a. Work out the real distance, in kilometres, represented by 4 cm on the map. [2 marks]
b. The real distance between two villages is 3.5 km. What is it on the map, in centimetres? [2 marks]
c. On another map with scale $1 : 50\,000$ a lake is 12 cm long. How many kilometres is that? [2 marks]
d. Write the scale $1 : 25\,000$ as "1 cm represents ... m". [1 mark]

Question 3

Question 3 – Ruler and compass constructions *(Section A · Skills practice)*

Use the standard constructions to answer these questions. You should describe the steps.

a. Describe how to construct the perpendicular bisector of a line AB of length 8 cm. [3 marks]
b. Every point on this bisector is the same distance from A and B. A point P is on the bisector and 3 cm from the line AB. How far is P from A? [3 marks]
c. Describe how to bisect an angle of 70°. What size is each half? [3 marks]

Question 4

Question 4 – Standard loci *(Section A · Skills practice)*

Describe the locus (set of points) in each case.

a. The points that are 3 cm from a fixed point P. [1 mark]
b. The points that are the same distance from two points A and B. [1 mark]
c. The points that are the same distance from two crossing straight lines. [1 mark]
d. The points that are exactly 2 cm from a straight line segment AB of length 6 cm. Work out the perimeter of the boundary of the points that are at most 2 cm from AB, to 1 decimal place. [4 marks]

Question 5

Question 5 – Plans and elevations *(Section A · Skills practice)*

A square-based pyramid has a base of side 6 cm and a vertical height of 4 cm.

a. Describe the plan view (from above). [2 marks]
b. Describe the front elevation. [2 marks]
c. Work out the slant height of one triangular face. [3 marks]
d. Work out the area of one triangular face and then the total area of the four faces. [3 marks]

Question 6

Question 6 – A ship in two legs *(Section A · Skills practice)*

A ship sails 12 km on a bearing of 040° and then 9 km on a bearing of 130°.

a. Show that the two legs are at right angles. [2 marks]
b. Work out how far the ship is from its starting point. [2 marks]
c. Work out the bearing of the ship from the start, to the nearest degree. [3 marks]
d. Work out the bearing of the start from the ship. [1 mark]

Question 7

Question 7 – A ferry route *(Section B · Real-life practice)*

A ferry leaves port P, sails 20 km on a bearing of 060° to island A, and then 20 km on a bearing of 150° to island B.

a. Show that angle $PAB = 90^\circ$. [2 marks]
b. Work out the distance PB to 2 decimal places. [2 marks]
c. Work out the bearing of B from P. [3 marks]
d. Work out the bearing of P from B. [1 mark]

Question 8

Question 8 – The lifeboat *(Section B · Real-life practice)*

A lifeboat station H is 15 km from a lifeboat L on a bearing of 120° from H. A ship S is 8 km from L on a bearing of 210° from L.

a. Work out the bearing of H from L. [1 mark]
b. Show that angle $HLS = 90^\circ$. [2 marks]
c. How far is the ship from the station? [2 marks]
d. Work out the bearing of the ship from the station, to 1 decimal place. [3 marks]

Question 9

Question 9 – A walking route on a map *(Section B · Real-life practice)*

A walking map has a scale of $1 : 50\,000$. A route has three straight sections measuring 4.2 cm, 6.8 cm and 3.0 cm on the map. The straight-line distance from start to finish measures 9.6 cm.

a. Work out the real length of each section. [3 marks]
b. Work out the total length of the route in kilometres. [2 marks]
c. Walkers go at 4 km/h. How long does the route take? [2 marks]
d. How much shorter is the straight-line distance? [2 marks]

Question 10

Question 10 – Buried treasure *(Section B · Real-life practice)*

Two trees A and B are 10 m apart. Treasure is buried so that it is nearer to A than to B and also within 6 m of A. Draw a scale diagram using 1 cm for 1 m.

a. Describe how you would draw the boundary for "nearer to A than to B". [2 marks]
b. Describe the boundary for "within 6 m of A". [1 mark]
c. A spade is at a point on the line AB, 6 m from A. Could the treasure be there? Explain. [2 marks]
d. The treasure is on the line AB. What is the greatest and least distance it can be from A? [2 marks]

Question 11

Question 11 – Wi-fi coverage *(Section B · Real-life practice)*

A router reaches 15 m in every direction. A rectangular office is 20 m by 12 m.

a. The router is placed at the centre of the office. Work out the distance from the router to a corner. [3 marks]
b. Does the router cover the whole office? [1 mark]

c. The router is moved to one corner. Does it cover the opposite corner? Show your working. [3 marks]
d. Work out the area of the circle of coverage, in m² to 1 decimal place. [2 marks]

Question 12

Question 12 – A flight path *(Section B · Real-life practice)*

A small plane flies 200 km north and then 150 km east.

a. Work out the direct distance from its starting point. [2 marks]
b. Work out the bearing of its current position from the start, to the nearest degree. [3 marks]
c. Work out the bearing it must fly on to return directly to the start. [1 mark]
d. The plane flies at 250 km/h. How long does the direct return take? [2 marks]

Question 13

Question 13 – Radio masts *(Section B · Real-life practice)*

Two radio masts A and B are 10 km apart. The signal from A reaches 6 km and the signal from B reaches 7 km.

a. Explain why the two signals overlap. [1 mark]
b. A house is on the line AB, 4 km from A. Does it receive both signals? [2 marks]
c. How long is the stretch of the line AB that receives both signals? [3 marks]
d. A house on the line AB is 8 km from A. Which signal(s) does it receive? [2 marks]

Question 14

Question 14 – Designing a garden *(Section B · Real-life practice)*

A garden plan uses a scale of $1 : 100$. The lawn is a rectangle 8.5 m by 6 m.

a. What are the dimensions of the lawn on the plan? [2 marks]
b. Work out the real area of the lawn. [1 mark]
c. Turf costs £4.20 per square metre. Work out the cost of turfing the lawn. [2 marks]
d. A fence goes all the way round the lawn. Fencing costs £18 per metre. Work out the cost. [3 marks]

Question 15

Question 15 – Bearings with Pythagoras and trigonometry *(Section C · Problem solving)*

Town B is 24 km from town A on a bearing of 050°. Town C is 18 km from B on a bearing of 140°.

a. Show that angle $ABC = 90°$. [3 marks]
b. Work out the distance AC. [2 marks]
c. Work out the bearing of C from A to the nearest degree. [3 marks]
d. Work out the bearing of A from C to the nearest degree. [2 marks]

Question 16

Question 16 – A region from two loci *(Section C · Problem solving)*

$ABCD$ is a rectangle with $AB = 10$ cm and $AD = 6$ cm. Use axes with A at $(0, 0)$, B at $(10, 0)$ and D at $(0, 6)$. The region R contains all the points inside the rectangle that are nearer to A than to B and are less than 4 cm from D.

a. Describe the boundary line for "nearer to A than to B". [2 marks]
b. Describe the other boundary. [1 mark]
c. Is the point $(3, 5)$ in R? Show your working. [3 marks]
d. Is the point $(4, 1)$ in R? Is $(6, 5)$ in R? Explain. [4 marks]

Question 17

Question 17 – The L-shaped prism *(Section C · Problem solving)*

The plan of a prism is an L-shape made from four squares each of side 3 cm (three in a row with one more on top of one end). The prism is 5 cm tall.

a. Sketch the plan and the front elevation (from the long side). [3 marks]
b. Work out the volume of the prism. [3 marks]
c. Work out the total surface area. [4 marks]

Question 18

Question 18 – An accurate construction *(Section C · Problem solving)*

Construct triangle ABC with $AB = 7$ cm, $AC = 6$ cm and angle $BAC = 50°$, then measure BC.

a. Describe the steps of the construction. [3 marks]
b. Use the cosine rule to work out BC to 2 decimal places. [3 marks]
c. Measuring gives 5.6 cm. Is this consistent with your answer? [1 mark]
d. Bisect angle BAC and say what angle the bisector makes with AB. [2 marks]

Question 19

Question 19 – A goat tied to a shed *(Section C · Problem solving)*

A goat is tied by a 5 m rope to the corner of a rectangular shed that measures 8 m by 6 m. The goat can graze on grass outside the shed. The rope is fixed to the outside corner.

a. Explain why the goat can graze three quarters of a circle. [2 marks]
b. Work out the grazing area to 1 decimal place. [3 marks]
c. Why can the goat not graze around the long side? [2 marks]

Question 20

Question 20 – Challenge: a longer rope *(Section D · Challenge)*

The goat is now tied with a 10 m rope to the same corner of the shed (8 m by 6 m).

a. Explain why part of the grazing area is three quarters of a circle of radius 10 m. [1 mark]
b. The goat can go round the 8 m side and the 6 m side. Show that the extra areas are quarter circles of radius 2 m and 4 m. [4 marks]
c. Work out the total grazing area in terms of π and then to 1 decimal place. [5 marks]