Bearings and scale drawings

G15, R2 · Geometry and measures · revision notes

Bearings give directions as angles measured clockwise from north, and scale drawings and maps use a scale to represent real distances. You measure and draw bearings and lengths, convert using scales, and calculate bearings using angle facts and trigonometry.

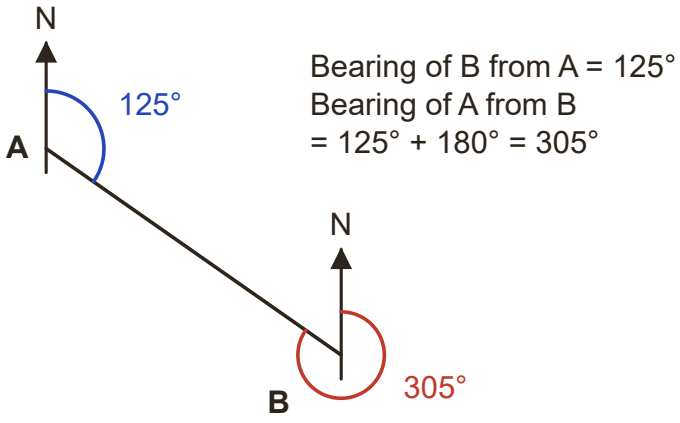
Key facts

- Bearing: from north, clockwise, three figures
- Back bearing = bearing ± 180°
- Scale 1 : n → 1 cm represents n cm
- 'Bearing of B from A': measure at A
- North lines are parallel: co-interior angles add up to 180°
- 100 cm = 1 m; 1000 m = 1 km; 100 000 cm = 1 km

Notes

Bearings

- A bearing is an angle measured **clockwise** from **north**, written with **three figures**: 45° is written as 045°.
- 'The bearing of B from A' means stand at A, face north and turn clockwise until you face B. So you measure at A.
- North lines at different points are parallel, so you can use alternate, corresponding and co-interior angles.
- Back bearing: the bearing of A from B is the bearing of B from A plus 180° (if it is less than 180°) or minus 180° (if it is more).



Measure clockwise from the north line at the point you are measuring FROM.

- For a bearing over 180° with a semicircular protractor, measure the anticlockwise angle from north and take it away from 360°.
- When the triangle is not right-angled, use the sine or cosine rule to find distances and angles. Grade 7+ only

Scales

- A scale such as 1 cm to 4 m, or a ratio such as 1 : 400, links lengths on the drawing to real lengths.
- Drawing to real life: multiply by the scale. Real life to drawing: divide.
- A ratio scale has no units: 1 : 25 000 means 1 cm represents 25 000 cm, which is 250 m.
- Convert units carefully: 100 cm = 1 m and 1000 m = 1 km, so 100 000 cm = 1 km.

Scale drawings

- Use a sharp pencil, a ruler (to the nearest millimetre) and a protractor (to the nearest degree).
- Work out all the drawing lengths first, then draw.
- Draw a north line at each point where you need to measure or draw a bearing.

How to answer each type of question

M = method mark, A = answer mark, B = a mark on its own.

Use a map scale and draw a bearing 4 marks **Grade 4**

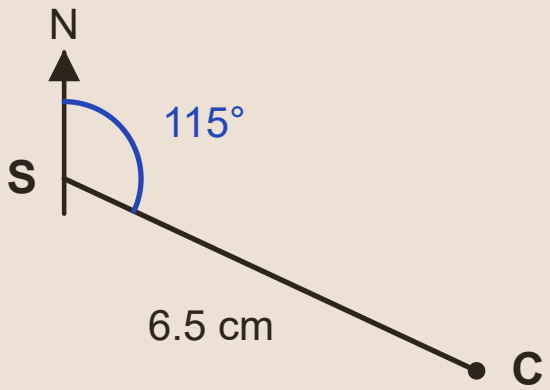
1. Convert with the scale: multiply for real distances, divide for map distances, then change units.
2. Draw a north line at the starting point.
3. Measure the bearing clockwise from north and mark the distance along that line.

Example. On a map with scale 1 : 20 000, a church C is 6.5 cm from a school S, on a bearing of 115° from S.
(a) Work out the real distance from S to C. Give your answer in km. (2 marks)
(b) Describe how to mark C accurately on the map. (2 marks)

Model answer.

(a) 6.5 × 20 000 = 130 000 cm (M1) = 1.3 km (A1)

(b) Draw a north line at S and measure 115° clockwise from it (B1). Draw a line in that direction and mark C 6.5 cm from S (B1)



Back bearings and angles from bearings

3 to 4 marks **Grade 5**

1. Draw north lines at each point and mark the bearings you know.
2. Use ±180° for a back bearing.
3. Use straight-line, parallel-line and triangle facts to find the angle you want.

Example. (a) The bearing of a lighthouse L from a boat B is 062°. Work out the bearing of B from L. (1 mark)
(b) Town Q is due east of town P. Town R is on a bearing of 040° from P and on a bearing of 320° from Q. Work out the size of angle PRQ. (3 marks)

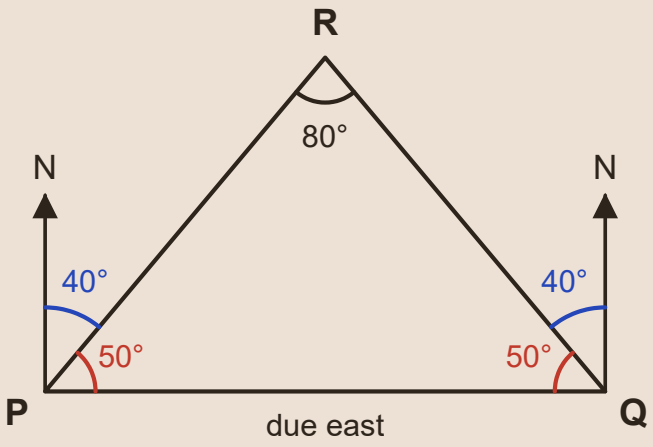
Model answer.

(a) 062° + 180° = 242° (B1)

(b) PQ is due east (090°), so angle RPQ = 90° − 40° = 50° (M1)

From Q, P is due west (270°), so angle PQR = 320° − 270° = 50° (M1)

Angle PRQ = 180° − 50° − 50° = 80° (A1)



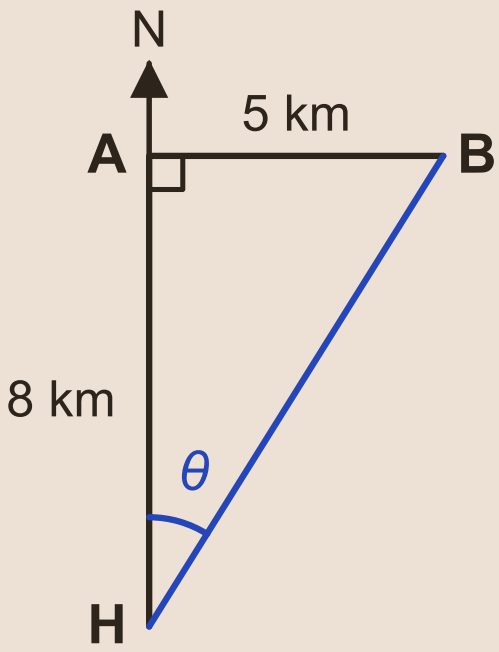
Calculate a bearing using trigonometry

3 marks | Grade 5

1. Sketch the journey with north lines and find the right-angled triangle.
2. Use SOH CAH TOA to find the angle at the starting point.
3. Turn the angle into a bearing (measured clockwise from north, three figures).

Example. A ship sails 8 km due north from a harbour H to a point A. It then sails 5 km due east to a point B.
Work out the bearing of B from H. Give your answer to the nearest degree.

Model answer.



$\tan \theta = 5 \div 8$ (M1)

$\theta = \tan^{-1}(5 \div 8) = 32.0°$ (M1)

The angle is measured clockwise from north at H, so the bearing is 032° (A1)

Don't lose marks

- Measuring anticlockwise, or measuring at the wrong point.
- Writing a bearing with fewer than three figures, e.g. 45° instead of 045°.
- Reading the wrong scale on a semicircular protractor.
- Converting units wrongly with ratio scales (cm to m to km).
- Measuring a line from the end of the ruler instead of from 0.

More tips

Memory tricks

- The word 'from' tells you where to put the protractor: the bearing of B from A is measured at A.
- Estimate first: north-east is 045°, east 090°, south 180°, west 270°.
- A bearing and its back bearing always differ by exactly 180°.
- For a 1 : n map scale, 1 km is 100 000 cm, so dividing by 100 000 changes cm to km.

Exam technique

- Draw a north line at every point you use, then mark the angles on the diagram.
- Measure carefully: drawn bearings and lengths usually only score if they are within a degree or two and a couple of millimetres.
- Give real distances in the units the question asks for, with the unit written.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3 — **Use a scale to find real distances**
e.g. on a 1 : 50 000 map, 4 cm represents 200 000 cm = 2 km.

Grade 3 — **Measure and draw lines and angles accurately**
Measure lengths to the nearest millimetre and angles to the nearest degree.

Grade 4 — **Measure and draw bearings**
Measure clockwise from north at the starting point, and write the bearing with three figures.

Grade 4 — **Make a scale drawing from real measurements**
Divide each real length by the scale, e.g. at 1 cm to 5 m, 20 m is drawn as 4 cm.

Grade 5 — **Find a back bearing**
Add or subtract 180°: if B is on a bearing of 070° from A, then A is on a bearing of 250° from B.

Grade 5 — **Calculate bearings and angles using angle facts**
Use parallel north lines with co-interior and alternate angles.

Grade 5 — **Use right-angled trigonometry in bearing problems**
Use Pythagoras and SOH CAH TOA when the journey makes a right-angled triangle.

Grade 7 — **Use sine and cosine rules with bearings**
When the triangle is not right-angled, use the sine rule or the cosine rule.

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