GCSE ONLINE TUTORING

GEOMETRY & MEASURES / TOPIC GUIDE 41

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Bearings

Shared core with trigonometric extensions

Describe direction using three-figure bearings, work between parallel north lines and interpret scale journeys. Higher extensions connect bearing diagrams with trigonometry, keeping the geometry visible before calculating.

Clockwise from north • Three figures

The bearing of B from A is measured at A.

UNDERSTAND THE IDEA. EXPLAIN THE METHOD.

Detailed teaching • Worked examples • Discussion • Original practice • Full solutions

Name: _____

INDEPENDENT GCSE MATHS • WEBSITE EDITION • NOVEMBER 2026

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Your learning guide

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Independent educational resource

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Before you begin

Measure angles, use parallel-line facts and read scale drawings. Higher work needs sine and cosine rules.

Your route through this notebook

1. Reading and drawing three-figure bearings
2. Reverse bearings and parallel north lines
3. Scale journeys and right-angled components
4. Triangle routes with trigonometry — Higher

How to use it

Read a lesson, cover the worked solutions and try the examples yourself. Complete its practice page before checking the answers at the back. Finish with the mixed review, then return to any method you could not explain.

YOUR PROGRESS

After each lesson, ask: Can I explain the idea? Can I choose a method? Can I check my result? Record any questions you want to revisit.

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LESSON 1 / UNDERSTAND

Reading and drawing three-figure bearings

A bearing is measured clockwise from north at the starting point and written with three digits. East is 090°, south 180° and west 270°. North is conventionally 000° in this guide. A direction 35° east of north is bearing 035°, whereas 35° north of east is 055°.

The bearing of B from A is measured at A, not at B. Mark a north line at the starting point, turn clockwise through the specified angle and draw the direction ray. A compass direction alone does not give distance, so a location needs both a direction and an appropriate length or scale.

A reliable method

1. Underline the starting point in the wording.

2. Draw its north line and measure clockwise.

3. Write exactly three digits, including leading zeros.

Worked example 1

Write bearings for northeast and southeast.

STEP-BY-STEP SOLUTION

Northeast is halfway between north and east: 045°. Southeast is halfway between east and south: 135°.

Worked example 2

A direction is 28° north of east. Find its bearing.

STEP-BY-STEP SOLUTION

East is 090°. Move 28° back towards north: 090 − 28 = 062°.

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LESSON 1 / DISCUSS & PRACTISE

Explain it, then try it

DISCUSSION • TEST THE IDEA

“B from A” means stand at A and look towards B. Reversing the wording reverses the direction and normally changes the bearing by 180°.

Say it in your own words

Explain the key idea to someone else. Use a small example to support your explanation. If you disagree with a claim, show why it fails.

1.1 Write the bearing of west.

1.2 Write a bearing for 17° east of north.

1.3 A direction is 40° west of south. Find bearing.

1.4 A direction is 25° north of west. Find bearing.

Check before turning to the answers: is the size sensible, is the notation clear, and have you included any required units?

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LESSON 2 / UNDERSTAND

Reverse bearings and parallel north lines

Local north lines in a plane bearing diagram are treated as parallel. Reversing a direction adds or subtracts 180°, giving a result within 000° to 359°. Add 180° for bearings below 180°; subtract 180° for bearings at least 180°. The geographic model assumes the usual small-area flat diagram.

Parallel-line angle facts can find interior triangle angles between route segments. At an intermediate point, use the incoming route’s reverse bearing before comparing it with the outgoing bearing. Comparing two bearings measured at different points without translating the direction can select the wrong angle.

A reliable method

1. Reverse the incoming direction when changing viewpoint.
2. Use parallel north lines to place directions at a common vertex.
3. Find the smaller or stated interior angle, not an arbitrary difference.

Worked example 1

B is on bearing 068° from A. Find A from B.

STEP-BY-STEP SOLUTION

068 + 180 = 248°.

Worked example 2

B from A is 040°. C from B is 110°. Find angle ABC.

STEP-BY-STEP SOLUTION

A from B is 220°. Compare BA at 220° with BC at 110°: the smaller angle is 110°.

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LESSON 2 / DISCUSS & PRACTISE

Explain it, then try it

DISCUSSION • TEST THE IDEA

Subtracting 110 − 40 gives 70°, but those original bearings are measured at different starting points. The internal angle at B uses BA, the reverse of AB.

Say it in your own words

Explain the key idea to someone else. Use a small example to support your explanation. If you disagree with a claim, show why it fails.

2.1 Reverse bearing 125°.

2.2 Reverse bearing 287°.

2.3 Reverse bearing 180°.

2.4 B from A is 075° and C from B is 135°. Find the smaller angle ABC.

Check before turning to the answers: is the size sensible, is the notation clear, and have you included any required units?

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LESSON 3 / UNDERSTAND

Scale journeys and right-angled components

A bearing-and-distance journey can be represented on a scale diagram. Choose a scale that fits the page, draw each route from the endpoint of the previous leg and measure the final direct line if the task asks for a graphical estimate. Mark north at every new point to keep the reference direction fixed.

For bearing θ measured clockwise from north, an east component is d sin θ and a north component is d cos θ in a Cartesian model. On simple cardinal journeys, these become ordinary horizontal and vertical distances. Pythagoras gives a resultant length for perpendicular legs; it does not directly add route lengths or determine an angle.

A reliable method

1. Draw route legs in order with matching scales.
2. For perpendicular legs, identify the right triangle.
3. Separate distance travelled from direct distance from the start.

Worked example 1

Walk 3 km east then 4 km north. Find direct distance from the start.

STEP-BY-STEP SOLUTION

The legs are perpendicular, so distance = $\sqrt{(3^2 + 4^2)} = 5$ km. Travelled distance is 7 km.

Worked example 2

At scale 1 cm:2 km, draw 10 km on bearing 120°.

STEP-BY-STEP SOLUTION

From the start mark north, turn 120° clockwise and draw a ray 5 cm long. The diagram locates the endpoint relative to the start.

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LESSON 3 / DISCUSS & PRACTISE

Explain it, then try it

DISCUSSION • TEST THE IDEA

A direction of 120° points southeast, so its north component is negative. A sketch catches component-sign mistakes before calculator work.

Say it in your own words

Explain the key idea to someone else. Use a small example to support your explanation. If you disagree with a claim, show why it fails.

3.1 Travel 5 km north then 12 km east. Find direct distance.

3.2 Travel 8 km east then 3 km west. Find final displacement distance and bearing.

3.3 At 1 cm:4 km, how long is a 14 km leg?

3.4 A leg has bearing 210°. State whether east and north components are positive or negative.

Check before turning to the answers: is the size sensible, is the notation clear, and have you included any required units?

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LESSON 4 / UNDERSTAND

Triangle routes with trigonometry — Higher

For non-perpendicular journeys, determine the included angle of a route triangle before using a cosine or sine rule. At an intermediate stop, reverse the first route's bearing. Once a side or angle is found, combine it with a known direction to obtain the required bearing. Give bearings in three figures.

For a right-triangle resultant with positive east and north components, the angle east of north is $\tan^{-1}$(east/north). Other quadrants need a diagram to place the angle correctly. Use degree mode and keep unrounded values until the final result. A calculated interior angle is not automatically the final bearing.

A reliable method

1. Find the correct triangle angle from the bearings.

2. Choose Pythagoras, SOHCAHTOA, sine rule or cosine rule from the known data.

3. Place the solved angle on the north-based diagram.

Worked example 1

A journey ends 6 km east and 8 km north of its start. Find its bearing to 1 decimal place.

STEP-BY-STEP SOLUTION

Angle east of north = $\tan^{-1}(6/8) \approx 36.8699°$. Bearing = 036.9° to 1 decimal place; to the nearest degree it would be 037°.

Worked example 2

AB = 10 km on bearing 090°. BC = 10 km on bearing 030°. Find AC.

STEP-BY-STEP SOLUTION

At B, BA has bearing 270° and BC is 030°, so the smaller included angle is 120°. $AC^2 = 100 + 100 - 200\cos120° = 300$. $AC = 10\sqrt{3} \approx 17.32$ km.

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LESSON 4 / DISCUSS & PRACTISE

Explain it, then try it

DISCUSSION • TEST THE IDEA

A north/east component ratio can identify an acute angle but not its quadrant alone. Sketch the endpoint relative to the start before reporting a bearing.

Say it in your own words

Explain the key idea to someone else. Use a small example to support your explanation. If you disagree with a claim, show why it fails.

4.1 An endpoint is 3 km east and 3 km north. Find bearing.

4.2 An endpoint is 4 km east and 4 km south. Find bearing.

4.3 Find the nearest-degree bearing of a point 5 km west and 12 km north.

4.4 Two equal 6 km legs are on bearings 090° then 000°. Find direct distance and bearing.

Check before turning to the answers: is the size sensible, is the notation clear, and have you included any required units?

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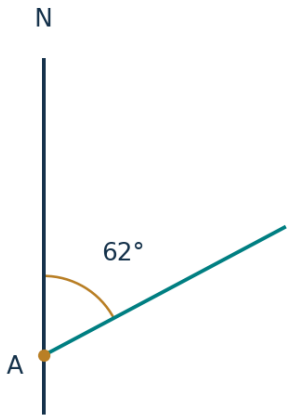
VISUAL EXPLAINER / RELATIONSHIPS, NOT GUESSWORK

Read the geometry

Bearings are clockwise from north at the stated start

Bearing 062°



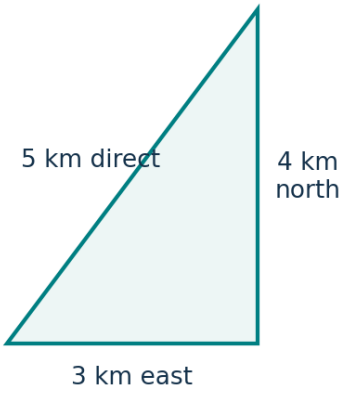
Reverse a direction

A → B: 068°

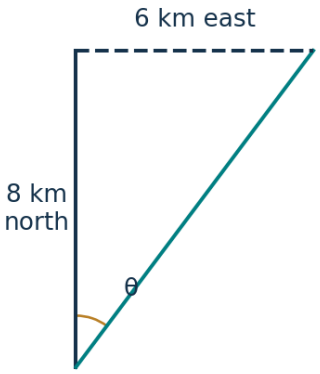
B → A: 248°

Add or subtract 180°

Right-triangle journey



Bearing of a resultant



tan θ = 6/8

WHAT THE FIGURES ESTABLISH

The first angle turns clockwise from north to the ray. A reverse bearing changes by 180°. The route triangle distinguishes travelled distance 7 km from direct distance 5 km. In the final panel the bearing is measured from north, so tangent uses east/north = 6/8, giving about 036.9°.

Discuss: identify the given information, the geometric condition and the conclusion. Recalculate a labelled result or explain a theorem without measuring the sketch. Unless explicitly stated, diagrams are illustrative and are not measurement questions.

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MIXED REVIEW / ORIGINAL EXAM-STYLE PRACTICE

Apply your learning • 1

These questions are independently authored, not taken or adapted from past papers. Marks are suggested for self-assessment. Show your method and explain decisions. Use a calculator only where the arithmetic requires it.

R1. Write the bearing 23° clockwise from north. [1 mark]

R2. A direction is 35° south of east. Find bearing. [2 marks]

R3. B is on bearing 146° from A. Find A from B. [2 marks]

R4. B from A is 060° and C from B is 140°. Find smaller angle ABC. [3 marks]

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MIXED REVIEW / ORIGINAL EXAM-STYLE PRACTICE

Apply your learning • 2

These questions are independently authored, not taken or adapted from past papers. Marks are suggested for self-assessment. Show your method and explain decisions. Use a calculator only where the arithmetic requires it.

R5. At scale 1 cm:3 km, find drawn length for 16.5 km. [1 mark]

R6. Travel 9 km north and 12 km east. Find direct distance. [3 marks]

R7. Higher: find nearest-degree bearing of an endpoint 8 km east and 15 km north. [3 marks]

R8. Higher: AB = BC = 8 km. AB bearing is 090°, BC bearing 030°. Find AC exactly. [4 marks]

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SOLUTIONS / LESSON PRACTICE

Check the reasoning

Your layout may differ. Compare the mathematical reasoning as well as the final answer. Correct any error, then reattempt the question without looking.

Lesson 1 • Reading and drawing three-figure bearings

1.1 Write the bearing of west.

270°.

1.2 Write a bearing for 17° east of north.

017°.

1.3 A direction is 40° west of south. Find bearing.

180 + 40 = 220°.

1.4 A direction is 25° north of west. Find bearing.

270 + 25 = 295°.

Lesson 2 • Reverse bearings and parallel north lines

2.1 Reverse bearing 125°.

305°.

2.2 Reverse bearing 287°.

107°.

2.3 Reverse bearing 180°.

000°.

2.4 B from A is 075° and C from B is 135°. Find the smaller angle ABC.

BA has bearing 255°; difference from 135° is 120°.

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SOLUTIONS / LESSON PRACTICE

Check the reasoning • continued

Lesson 3 • Scale journeys and right-angled components

3.1 Travel 5 km north then 12 km east. Find direct distance.

√(25 + 144) = 13 km.

3.2 Travel 8 km east then 3 km west. Find final displacement distance and bearing.

5 km on bearing 090°.

3.3 At 1 cm:4 km, how long is a 14 km leg?

3.5 cm.

3.4 A leg has bearing 210°. State whether east and north components are positive or negative.

Both are negative: the direction is southwest.

Lesson 4 • Triangle routes with trigonometry — Higher

4.1 An endpoint is 3 km east and 3 km north. Find bearing.

045°.

4.2 An endpoint is 4 km east and 4 km south. Find bearing.

135°.

4.3 Find the nearest-degree bearing of a point 5 km west and 12 km north.

Angle west of north = $\tan^{-1}(5/12) \approx 22.62°$. Bearing $360 - 22.62 \approx 337°$.

4.4 Two equal 6 km legs are on bearings 090° then 000°. Find direct distance and bearing.

Endpoint 6 east and 6 north. Distance $6\sqrt{2} \approx 8.49$ km; bearing 045°.

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SOLUTIONS / MIXED REVIEW

Answers and marking guidance

Award the suggested method marks for valid working, even where a later arithmetic slip occurs. Do not count the same step twice. These are independent teaching allocations, not official exam-board mark schemes.

R1. Write the bearing 23° clockwise from north. [1 mark]

023°. [1 for three figures.]

R2. A direction is 35° south of east. Find bearing. [2 marks]

090 + 35 = 125°. [1 for reference; 1 for result.]

R3. B is on bearing 146° from A. Find A from B. [2 marks]

146 + 180 = 326°. [1 for reversal; 1 for result.]

R4. B from A is 060° and C from B is 140°. Find smaller angle ABC. [3 marks]

BA is 240°; difference from BC 140° is 100°. [1 for reverse; 1 for comparison; 1 for angle.]

R5. At scale 1 cm:3 km, find drawn length for 16.5 km. [1 mark]

5.5 cm. [1 for division.]

R6. Travel 9 km north and 12 km east. Find direct distance. [3 marks]

$\sqrt{(9^2 + 12^2)} = 15$ km. [1 for right triangle; 1 for squares; 1 for root/unit.]

R7. Higher: find nearest-degree bearing of an endpoint 8 km east and 15 km north. [3 marks]

$\tan^{-1}(8/15) \approx 28.07°$, giving 028°. [1 for ratio; 1 for angle; 1 for bearing.]

R8. Higher: AB = BC = 8 km. AB bearing is 090°, BC bearing 030°. Find AC exactly. [4 marks]

Angle ABC is 120°. $AC^2 = 64 + 64 - 128\cos120° = 192$, so $AC = 8\sqrt{3}$ km. [1 for angle; 1 for cosine rule; 1 for 192; 1 for exact root.]

Reflect, repair and revisit

Record one secure method, one mistake you corrected and one question to retry. Reattempt the questions you missed in a few days. Explain why your new method works before you compare your answer.

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