

Bearings — Prepared by Nikolas Agisilaou

What is a Bearing? (The Three Rules)

A **bearing** is a direction given as an angle. Always:

1. Measured **from North**
2. Measured **clockwise**
3. Written with **three digits** (045° not 45°)

Bearings: 000° to 360°. **West-of-North** α : bearing = $360^\circ - \alpha$

Back Bearings (Reverse Bearings)

The **back bearing** is the bearing to *return* from B to A .

Original $< 180^\circ$: back = original $+ 180^\circ$

Original $\geq 180^\circ$: back = original $- 180^\circ$

Result must lie in $[000^\circ, 360^\circ)$.

Examples: $073^\circ \rightarrow 253^\circ$ $293^\circ \rightarrow 113^\circ$

The Eight Compass Bearings

N 000°	S 180°
NE 045°	SW 225°
E 090°	W 270°
SE 135°	NW 315°

Memory (clockwise): Never Eat Shredded Wheat

Parallel North Lines & Angle Rules

North lines at any two map points are **always parallel**.

The bearing line is the transversal:

- **Alternate (Z-angles):** equal — bearing repeats at far point.
- **Co-interior (C-angles):** sum to 180°
- **Corresponding (F-angles):** equal

Interior angle at vertex: $\angle = \text{back bearing} - \text{forward bearing}$

Subtract 360° if result $> 360^\circ$.

Trigonometry with Bearings

Right-angled $\triangle$ — SOHCAHTOA

$$\sin \theta = \frac{\text{Opp}}{\text{Hyp}} \quad \cos \theta = \frac{\text{Adj}}{\text{Hyp}} \quad \tan \theta = \frac{\text{Opp}}{\text{Adj}}$$

For bearing θ , distance d :

$$\text{East} = d \sin \theta \quad \text{North} = d \cos \theta$$

Sine Rule

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

Use: angle + opposite side known, plus one more piece.

Check for the ambiguous case when finding an angle!

Cosine Rule

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

Use: 2 sides + included $\angle$, or all 3 sides.

Quick Reference: Choosing the Right Approach

Situation	Approach
Draw / read a bearing	Protractor, N, CW
Return-trip bearing	$\pm 180^\circ$
Angle at a vertex	Back – forward bearing
Parallel North lines	Alternate / co-interior
Right-angled $\triangle$	SOHCAHTOA
2 sides + included $\angle$	Cosine Rule
All 3 sides	Cosine Rule (angle)
Angle + opposite side	Sine Rule

Common Traps & Pitfalls

1. **Three-digit trap:** Always 045°, never 45°.
2. **Wrong-point trap:** North line at the *starting* point, not destination.
3. **Direction trap:** *Clockwise* from North — never anti-clockwise.
4. **Angle trap:** Never use a bearing directly as a triangle angle — derive it via back bearing or parallel lines first.
5. **No-diagram trap:** *Always* draw and label a diagram first.

Key Results at a Glance

Back bearing

$$A \rightarrow B = 073^\circ$$

$$\text{Back} = 073 + 180 = \mathbf{253^\circ}$$

Interior angle

$$A \rightarrow B = 073^\circ, B \rightarrow C = 163^\circ$$

$$\text{Back at } B = 253^\circ$$

$$\angle ABC = 253 - 163 = \mathbf{90^\circ}$$

SOHCAHTOA

$$\text{Bearing } 052^\circ, d = 38 \text{ km}$$

$$E = 38 \sin 52^\circ \approx \mathbf{29.9 \text{ km}}$$

$$N = 38 \cos 52^\circ \approx \mathbf{23.4 \text{ km}}$$

Pythagoras + bearing

$$14 \text{ km N}, 11 \text{ km E}$$

$$NP = \sqrt{317} \approx \mathbf{17.8 \text{ km}}$$

$$\text{Bearing} \approx \mathbf{142^\circ}$$