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 $= 360° - \alpha$

The Eight Compass Bearings

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

Memory (clockwise): **N**ever **E**at **S**hredded **W**heat

Back Bearings (Reverse Bearings)

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

Original $< 180°$: back = original $+180°$

Original $\geq 180°$: back = original $-180°$

Result must lie in $[000°, 360°)$.

Examples: $073° \rightarrow$ **253°** $293° \rightarrow$ **113°**

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: $\angle$ = back bearing − forward bearing

Subtract 360° if result > 360°.

Trigonometry with Bearings

Right-angled △ — SOHCAHTOA

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

For bearing θ, distance d:

East $= d\sin\theta$ 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	$\pm 180°$
Angle at a vertex	Back − forward bearing
Parallel North lines	Alternate / co-interior
Right-angled △	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
$A \rightarrow B = 073°$
Back $= 073 + 180 =$ **253°**

Interior angle
$A \rightarrow B = 073°$, $B \rightarrow C = 163°$
Back at $B = 253°$
$\angle ABC = 253 - 163 =$ **90°**

SOHCAHTOA
Bearing 052°, $d = 38$ km
E $= 38\sin 52° \approx$ **29.9** km
N $= 38\cos 52° \approx$ **23.4** km

Pythagoras + bearing
14 km N, 11 km E
$NP = \sqrt{317} \approx$ **17.8** km
Bearing $\approx$ **142°**

The Panda Math Tutor