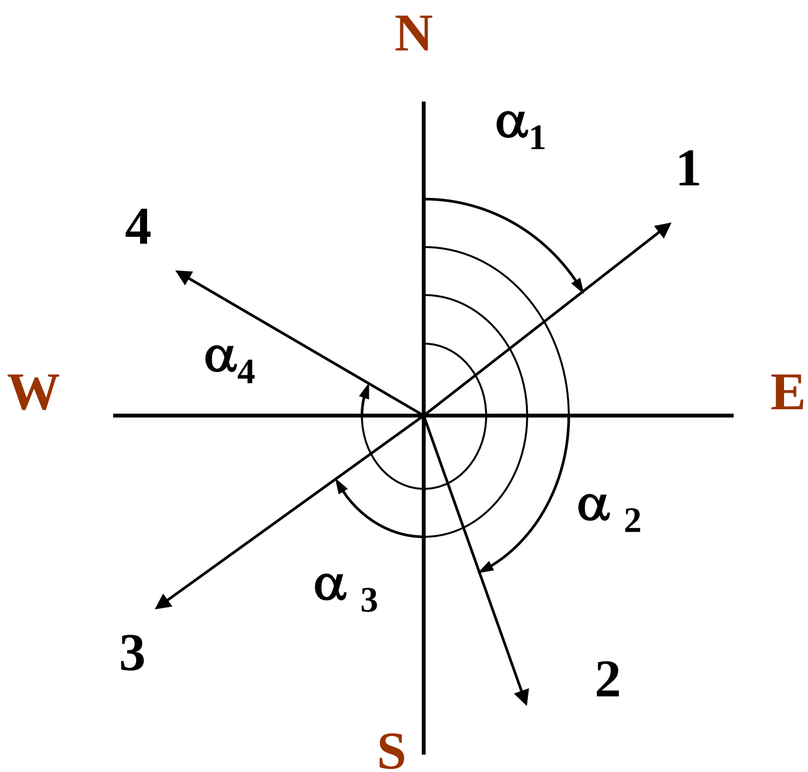
Azimuths and Coordinates

The Azimuth

It represents the orientation (direction) of objects in the horizontal plane (2D).



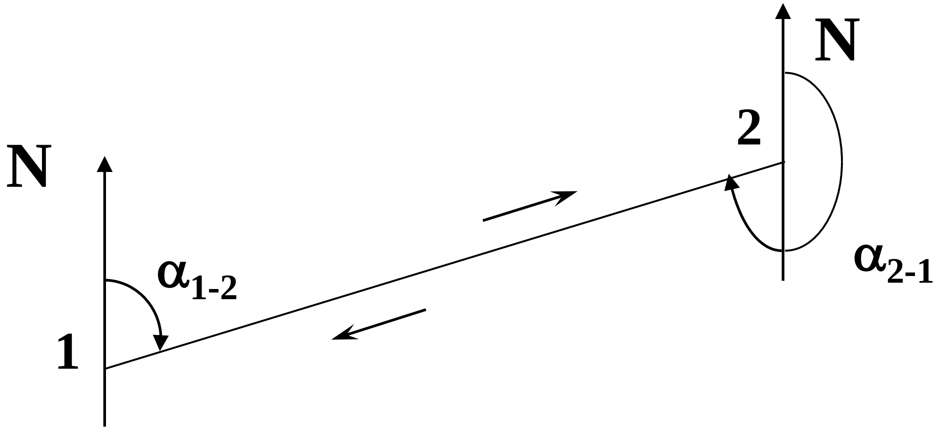
$$0 < \alpha < 360$$

Quadrant	Azimuth
1	$0 < \alpha < 90$
2	$90 < \alpha < 180$
3	$180 < \alpha < 270$
4	$270 < \alpha < 360$

The Back Azimuth

Every line has two azimuths.

A forward azimuth **(α1-2)** and a backward azimuth **(α2-1)**



$$\alpha_{2\text{-}1} = \alpha_{1-2} + 180^{\circ}$$

Special cases:

-If the azimuth is greater than 360 degrees, subtract 360 degrees.

- If the calculated azimuth has a negative value, add 360 degrees.

Why!!

Exercise

- In which quadrants the following azimuths are located:

  123, 87, 245, 341, 18, 322, 184, 217.

- What are the backward azimuths for the following fore azimuths:

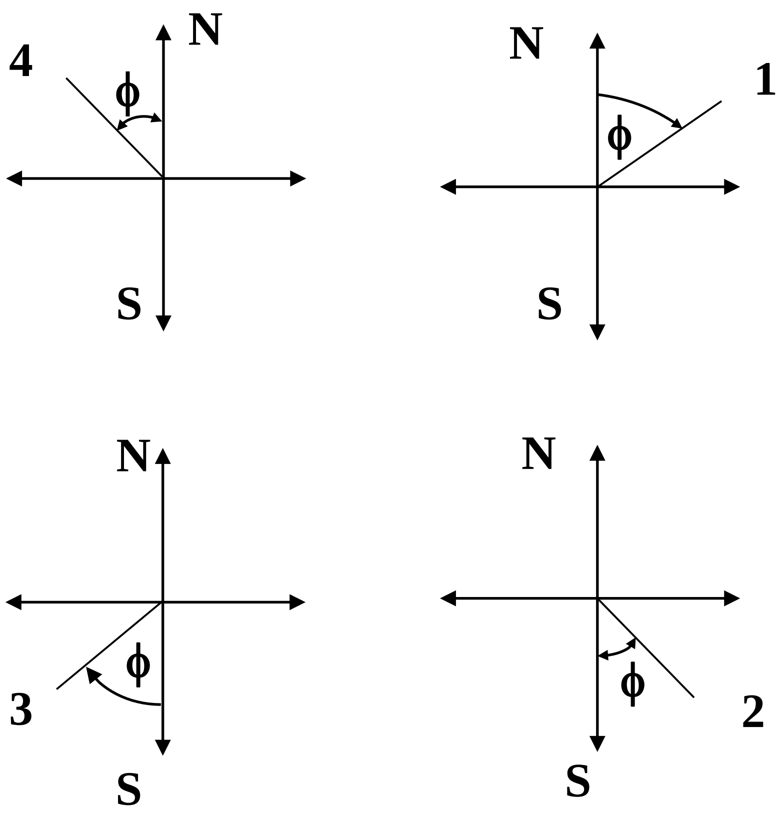
  64, 215, 162, 319.

- What are the fore azimuths for the following back azimuths:

  115, 82, 236, 341.

The (Reduced) Bearing

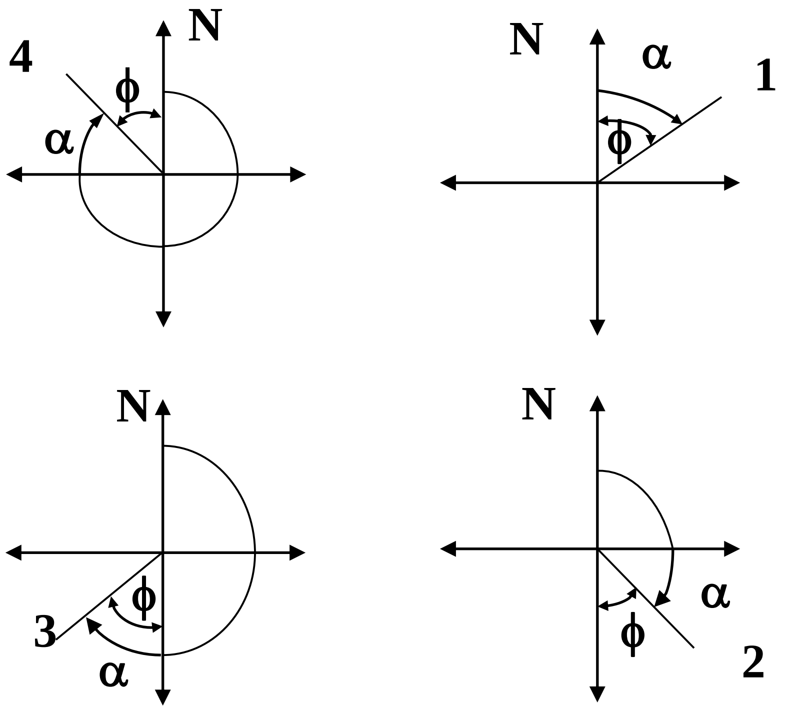
It represents the orientation in the horizontal plane (2D).



$$0 < \phi < 90^\circ$$

Quadrant	Ex. on Bearings
1	N 42° E
2	S 33° E
3	S 29° W
4	N 72° W

Transformation between the Azimuth and the Bearing



Quadrant	Relation
1	$\alpha = \phi$
2	$\alpha = 180^{o} - \phi$
3	$\alpha = 180^{o} + \phi$
4	$\alpha = 360^{o} - \phi$

Exercise

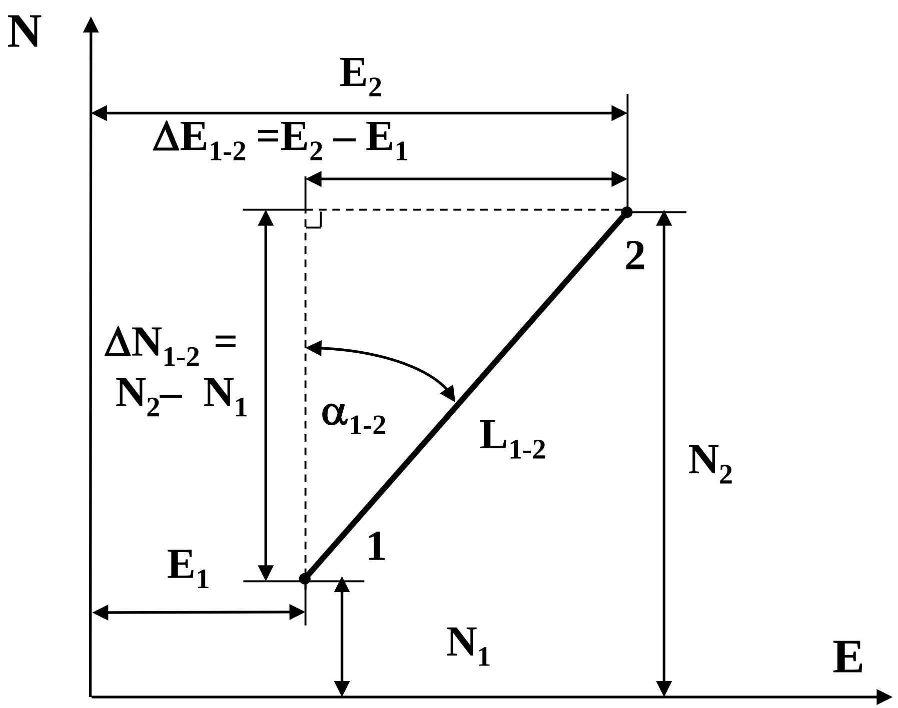
- Transform the following bearings to azimuths:

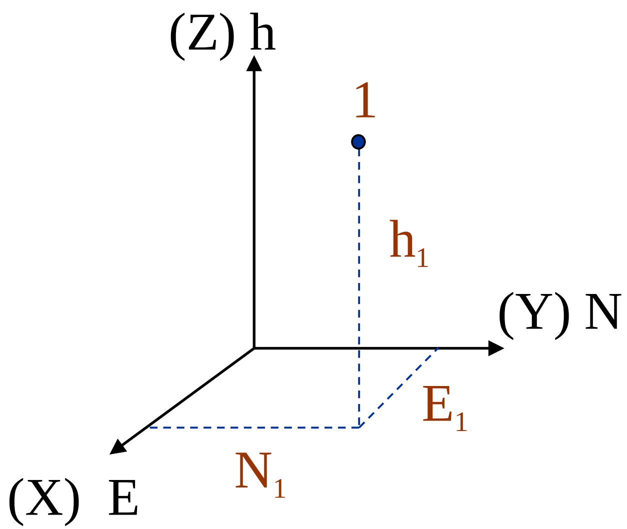
N $59^{\circ}\ 28'\ 33''$ W, S $87^{\circ}\ 18'\ 51''$ W, S $24^{\circ}\ 31'\ 49''$ E.

- Transform the following azimuths to bearings:

$123^{\circ}\ 29'\ 58''$, $81^{\circ}\ 39'\ 47''$, $328^{\circ}\ 31'\ 17''$.

Relation between plane coordinates and the Azimuth

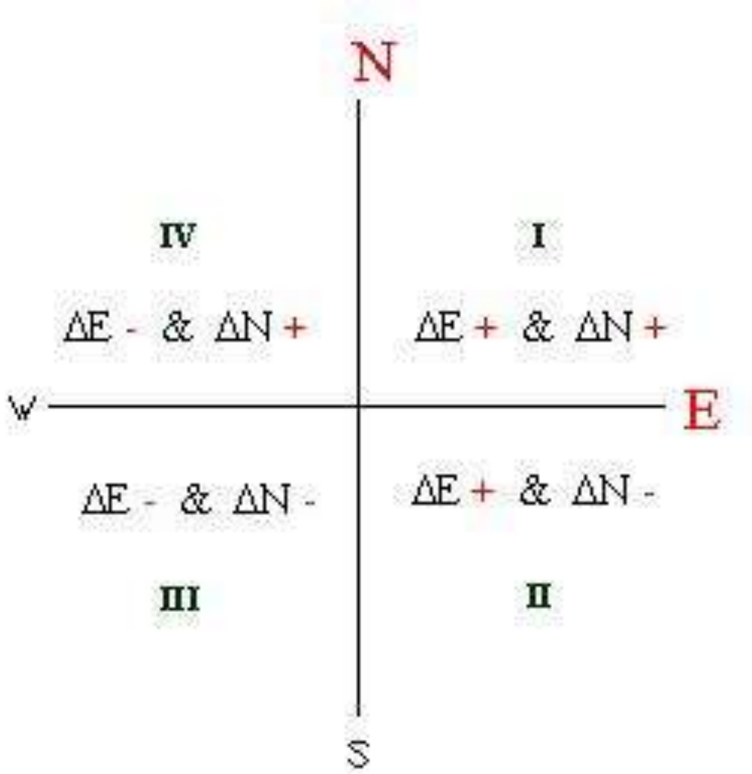




$$\Delta E_{1\text{-}2} = E_2 - E_1 = L_{1\text{-}2} \sin \alpha_{1\text{-}2}$$

$$\Delta N_{1\text{-}2} = N_2 - N_1 = L_{1\text{-}2} \cos \alpha_{1\text{-}2}$$

Signs of ΔE and ΔN



Quadrant	ΔE	ΔN
1	+	+
2	+	-
3	-	-
4	-	+

The Direct Problem

Unknowns: the coordinates of point **2** **(E_2, N_2).**

Known: the coordinates of point **1** **(E1,N1).**

Measurements: **$L_{1\text{-}2}$, $\alpha_{1\text{-}2}$.**

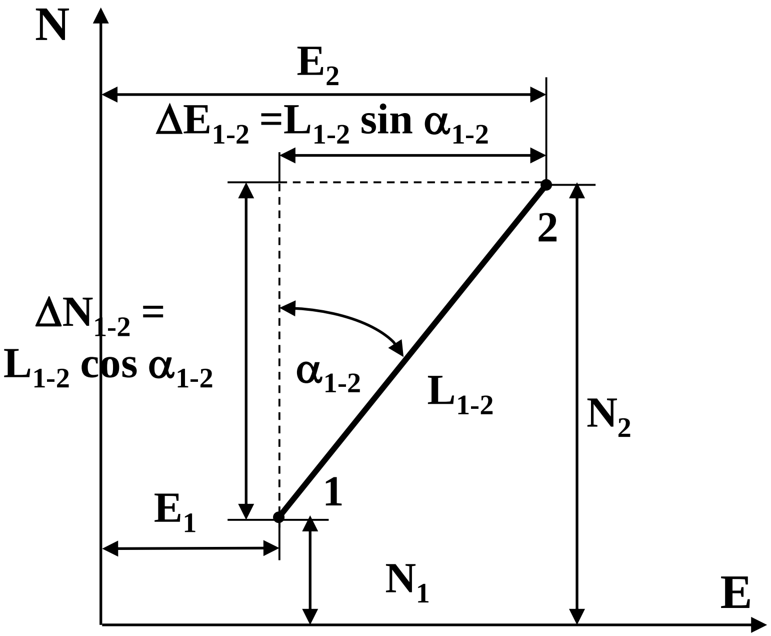
Solution:

$$\Delta E_{1\text{-}2} = L_{1\text{-}2} \sin \alpha_{1\text{-}2}$$

$$\Delta N_{1\text{-}2} = L_{1\text{-}2} \cos \alpha_{1\text{-}2}$$

$$E_2 = E_1 + \Delta E_{1\text{-}2}$$

$$N_2 = N_1 + \Delta N_{1\text{-}2}$$



The Inverse Problem

Unknowns: **L_{1-2}, α_{1-2}.**

Known: the coordinates of points **1** &2 **(E1,N1), (E_2, N_2)**.

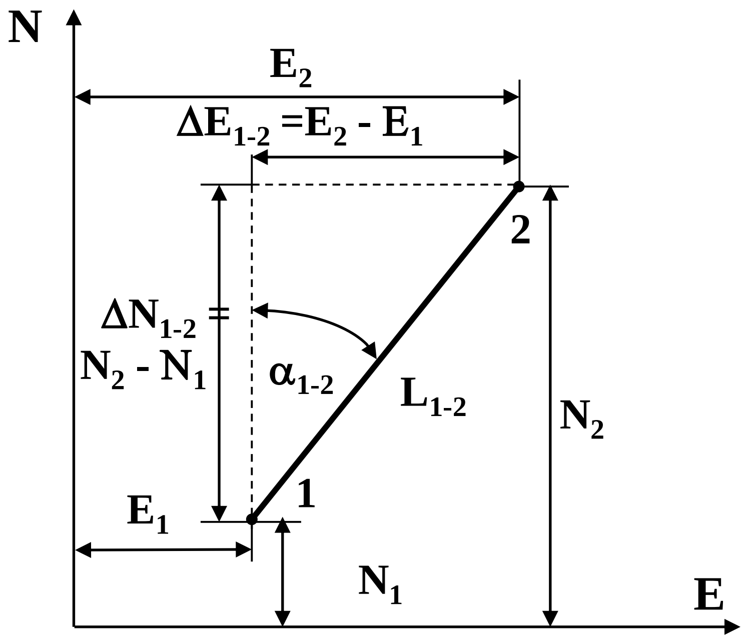
Solution:

$\Delta E_{1-2} = E_2 - E_1$

$\Delta N_{1-2} = N_2 - N_1$

$(L_{1-2})^2 = (\Delta E_{1-2})^2 + (\Delta N_{1-2})^2$

$L_{1-2} = \sqrt{(\Delta E_{1-2})2 + (\Delta N_{1-2})^2}$



* Determine the bearing ϕ:

$\phi = \tan^{-1} (\Delta E_{1-2} / \Delta N_{1-2})$

* Determine the quadrant from the signs of ΔE & ΔN.

* Determine **α_{1-2}** from **ϕ_{1-2}** and the quadrant.

Exercise

- The coordinates of point 1 are (625.23m, 1250.67m), the length L1-2 is 126.34m, and the azimuth of the line 1-2 is $126^{\circ}\,34'\,51''$.

- Determine the length and azimuth of the line joining the two points A & B. The coordinates of the points A & B are (318.36m, 745.67m) and (652.19m, 511.00m), respectively.

Exercise

Determine the azimuth of the line **1-2**, where the points 1 and 2 were determined from the traverse leg **A-B** given that the coordinates of point **A** and **B** are (400,460) and (527,861), respectively. The following measurements were also taken:

i. the length **B-2** is 92.54m, the angle **2-B-A** is 98^{o} 12’ 33”,

ii. the length **A-1** is 81.40m, and the angle **B-A-1** is 42^{o} 15’ 00”.