

# Types and Uses of Compass

- **Compass:** A compass is a small instrument essentially consisting of magnetic needle, a graduated circle, and a line of sight. The compass can not measure angle between two lines directly but can measure angle of a line with reference to magnetic meridian at the instrument station point is called magnetic bearing of a line. The angle between two lines is then calculated by getting bearing of these two lines.
- There are two forms of compass available:
- **The Prismatic Compass**
- **The Surveyor's Compass**



# Compass Surveying

## **The Prismatic Compass**

The prismatic compass is a magnetic compass which consists of the following parts.

### **Cylindrical Metal Box**

Cylindrical metal box is having diameter of 8 to 12 cm. It protects the compass and forms entire casing or body of the compass. It protects compass from dust, rain etc.



# PARTS



# The Prismatic Compass

## **Pivot**

- Pivot is provided at the centre of the compass and supports freely suspended magnetic needle over it.

## **Lifting Pin and Lifting Lever**

- A lifting pin is provided just below the sight vane. When the sight vane is folded, it presses the lifting pin. The lifting pin with the help of lifting lever then lifts the magnetic needle out of pivot point to prevent damage to pivot head.

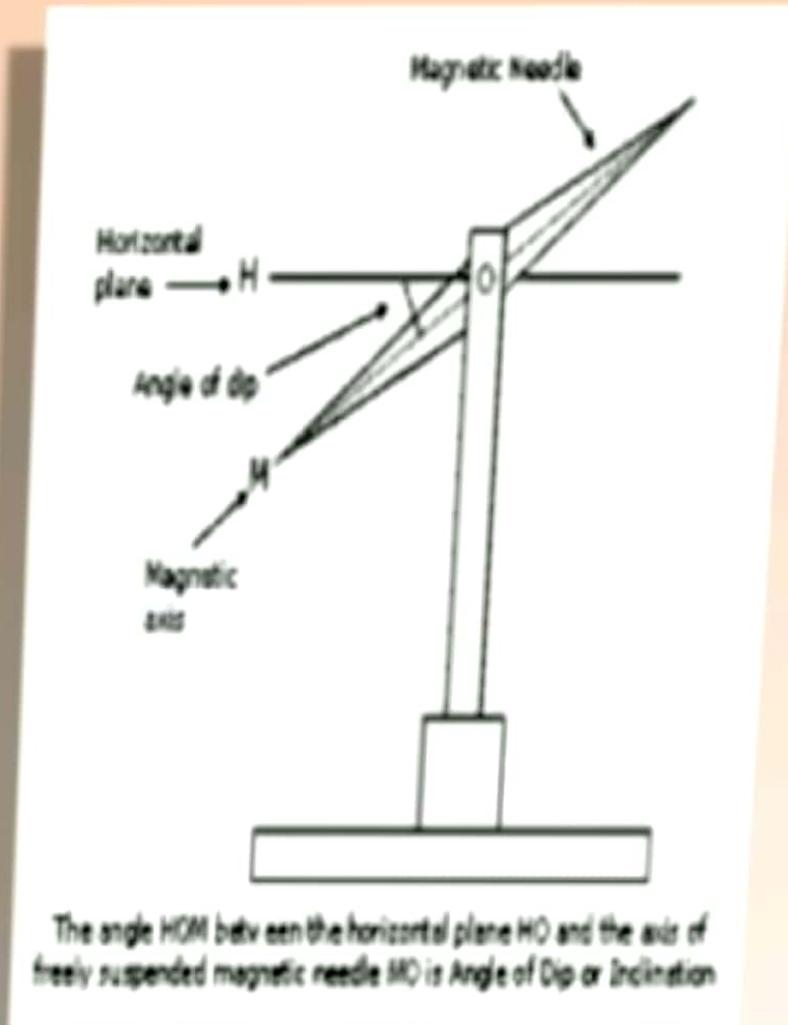
## **Spring Brake or Brake Pin**

- To damp the oscillation of the needle before taking a reading and to bring it to rest quickly, the light spring brake attached to the inside of the box is brought in contact with edge of the ring by gently pressing inward the brake pin.



# The Prismatic Compass

- **Magnetic Needle:** Magnetic needle is the heart of the instrument. This needle measures angles of a line from magnetic meridian and the needle always remains pointed towards north and south pole at the two ends of the needle when freely suspended on any support.
- **Graduated Circle or Ring:** This is an aluminium graduated ring marked with  $0^{\circ}$  to  $360^{\circ}$  to measure all possible bearings of lines, and attached with the magnetic needle. The ring is graduated to half a degree.



# The Prismatic Compass

- **Prism**

Prism is used to read graduations on ring and to take exact reading by compass. It is placed exactly opposite to object vane. The prism hole is protected by prism cap to protect it from dust and moisture.

- **Object Vane**

Object Vane is diametrically opposite to the prism and eye vane. The object vane is carrying a horse hair or black thin wire to sight object in line with eye sight.

- **Eye Vane**

Eye Vane is a fine slit provided with eye hole at bottom to bisect the object from the slit and to take reading simultaneously from the eye hole. This eye vane is provided with prism and can be lifted up and down by the stud to bisect the object of higher level.



# The Prismatic Compass

- **Glass Cover:** It covers the instrument box from the top such that needle and graduated ring is seen from the top.
- **Sun Glasses:** These are used when some luminous objects are to be bisected. These are placed in front of the eye slit and in bunch of three or four shades of different colours to give sharp picture of the object only.
- **Reflecting Mirror:** It is used to get image of an object located above or below the instrument level while bisection. It is placed on the object vane.



# Working of the Prismatic Compass

- When the needle of the compass is suspended freely. It always points towards the north. Therefore, all the angles measured with prismatic compass are with respect to north (magnetic meridian).
- “The horizontal angle made by a survey line with reference to magnetic meridian in clockwise direction is called the bearing of a line.”
- While using the compass, it is usually mounted on a light tripod which is having vertical spindle in the ball and socket arrangement to which the compass is screwed.



# Temporary Adjustment of a Prismatic Compass

- The following procedure should be adopted after the prismatic compass on the tripod for measuring the bearing of a line:

## Centering

Centering is the operation in which compass is kept exactly over the station from where the bearing is to be determined. The centering is checked by dropping a small pebble from the underside of the compass. If the pebble falls on the top of the peg then the centering is correct, if not then the centering is corrected by adjustment the legs of the tripod.

## Levelling

Levelling of the compass is done with the aim to freely swing the graduated circular ring of the prismatic compass. The ball and socket arrangement on the tripod will help to achieve a proper level of the compass. This can be checked by rolling round pencil on glass cover.

## Focusing

The prism is moved up or down in its slide till the graduations on the aluminium ring are seen clear, sharp and perfect focus. The position of the prism will depend upon the vision of the observer.



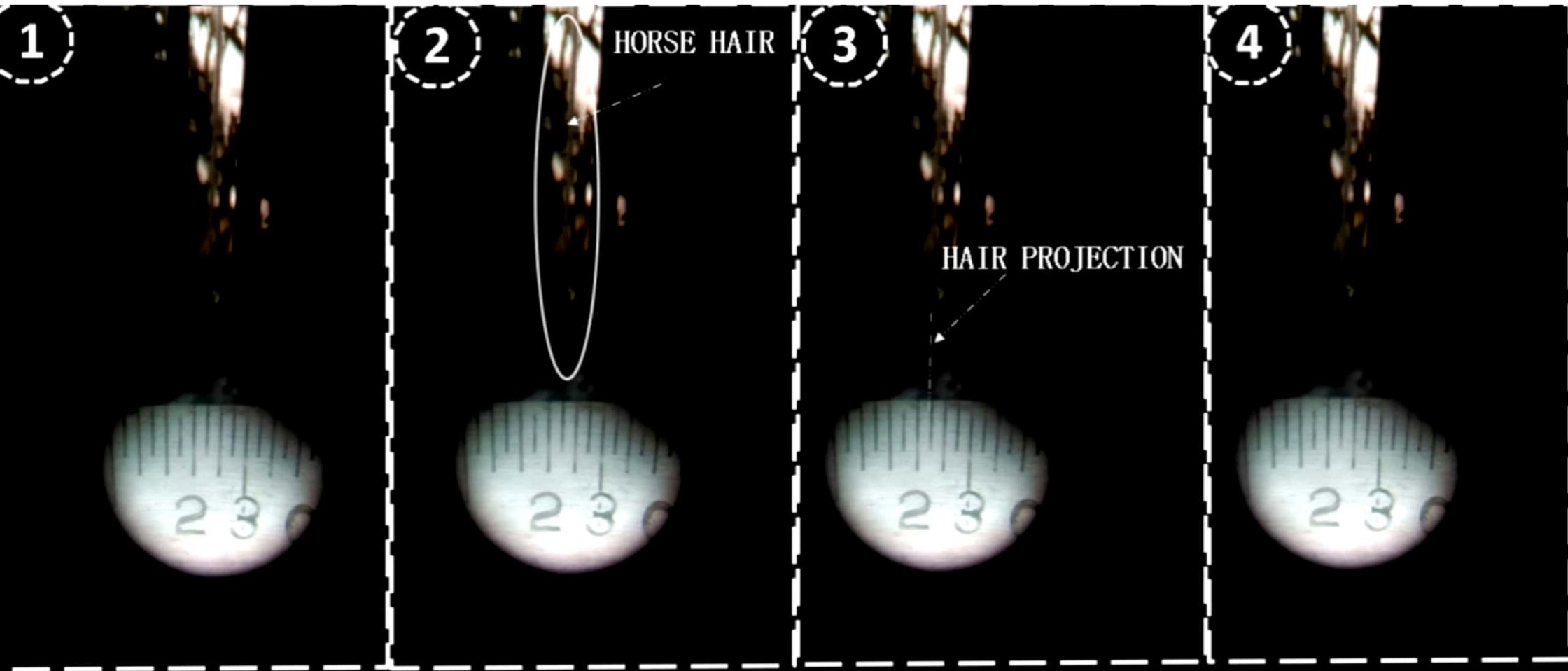
MOUNT THE COMPASS ON THE TRIPOD  
HOLD PLUMB BOB AT THE CENTER OF  
THE BOTTOM OF THE COMPASS TO SEE  
WHETHER IT FALLS OVER STATION  
POINT OR NOT



LOOK THROUGH EYE SLIT\*  
LINE UP HORSE HAIR  
WITH RANGING ROD

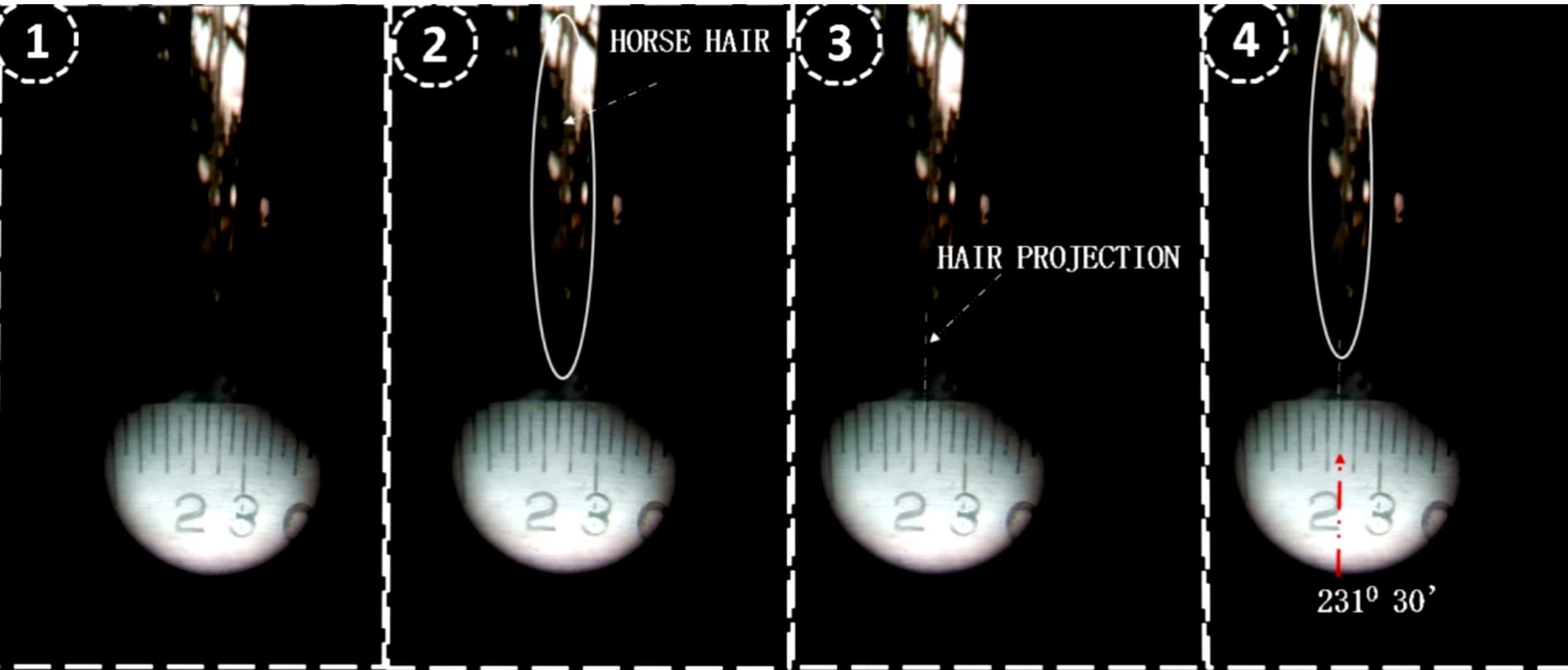
\* GROOVE ON EYE VAN IS  
REFERRED TO EYE SLIT



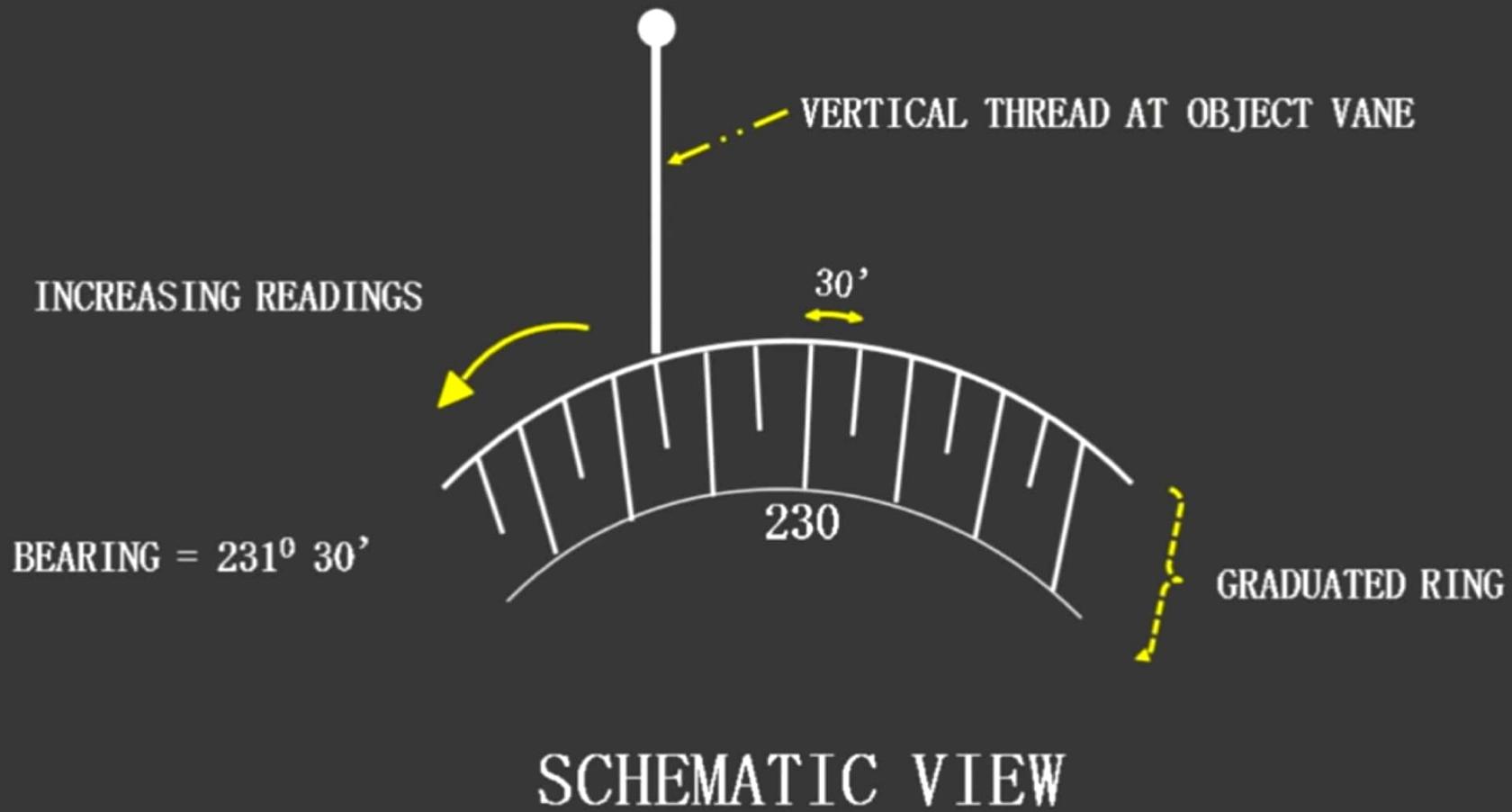


SEE THROUGH EYE HOLE, LINE UP THE HAIR PROJECTION WITH THE GRADUATED RING AND READ THE OBSERVATION TO THE NEAREST DEGREE





**S** In this case our bearing value is 231 Degrees and 30 minutes  
**R** OUND AND READ THE OBSERVATION TO THE NEAREST DEGREE



# Bearing

- The bearing of a line is the horizontal angle which it makes with a reference line (meridian) depending upon the meridian, there are four types of bearings.

## **True Bearing**

The true bearing of a line is the horizontal angle between the true meridian and the survey line. The true bearing is measured from the true north in the clockwise direction.

## **Magnetic Bearing**

The magnetic bearing of a line is the horizontal angle which the line makes with the magnetic north.



# Bearing

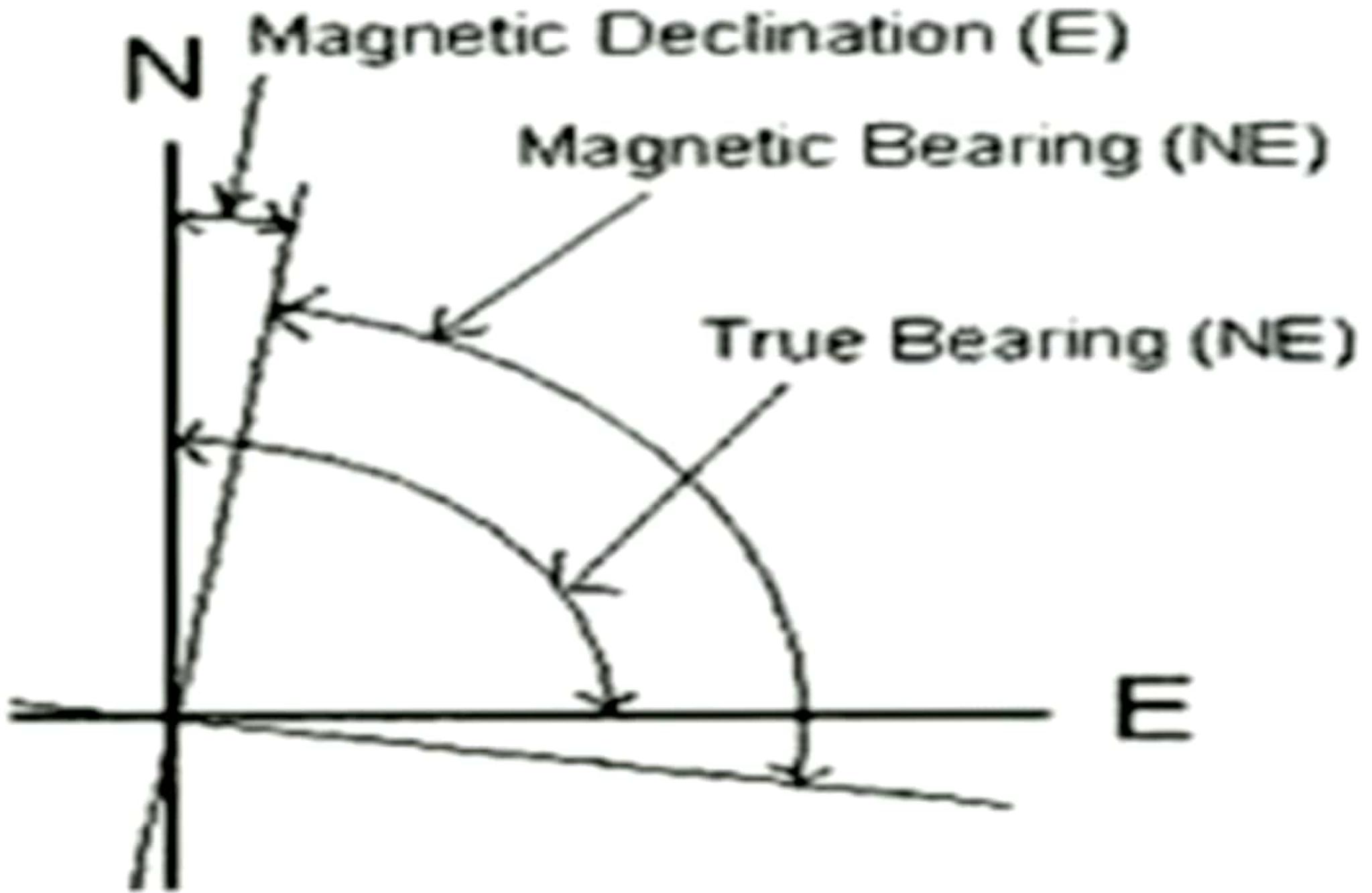
## **Grid Bearing**

The grid bearing of a line is the horizontal angle which the line makes with the grid meridian.

## **Arbitrary Bearing**

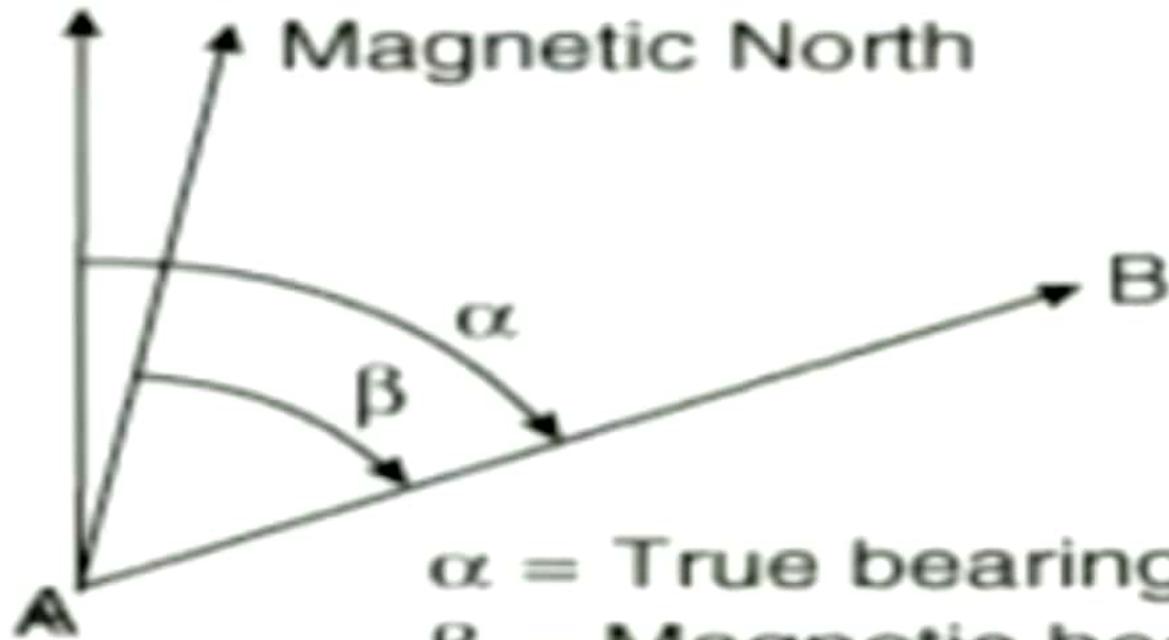
The arbitrary bearing of a line is the horizontal angle which the line makes with the arbitrary meridian





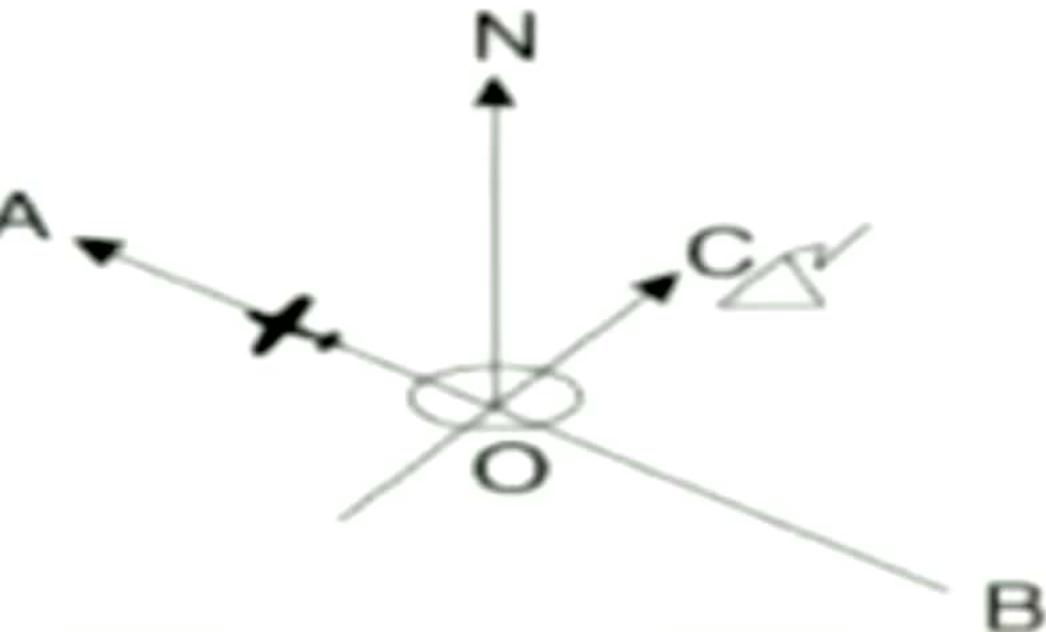
True North

Magnetic North



$\alpha =$  True bearing of B from A

$\beta =$  Magnetic bearing of B from A



Relative bearing = AOC

True bearing = NOC

True heading = NOA

# Designation of Bearings

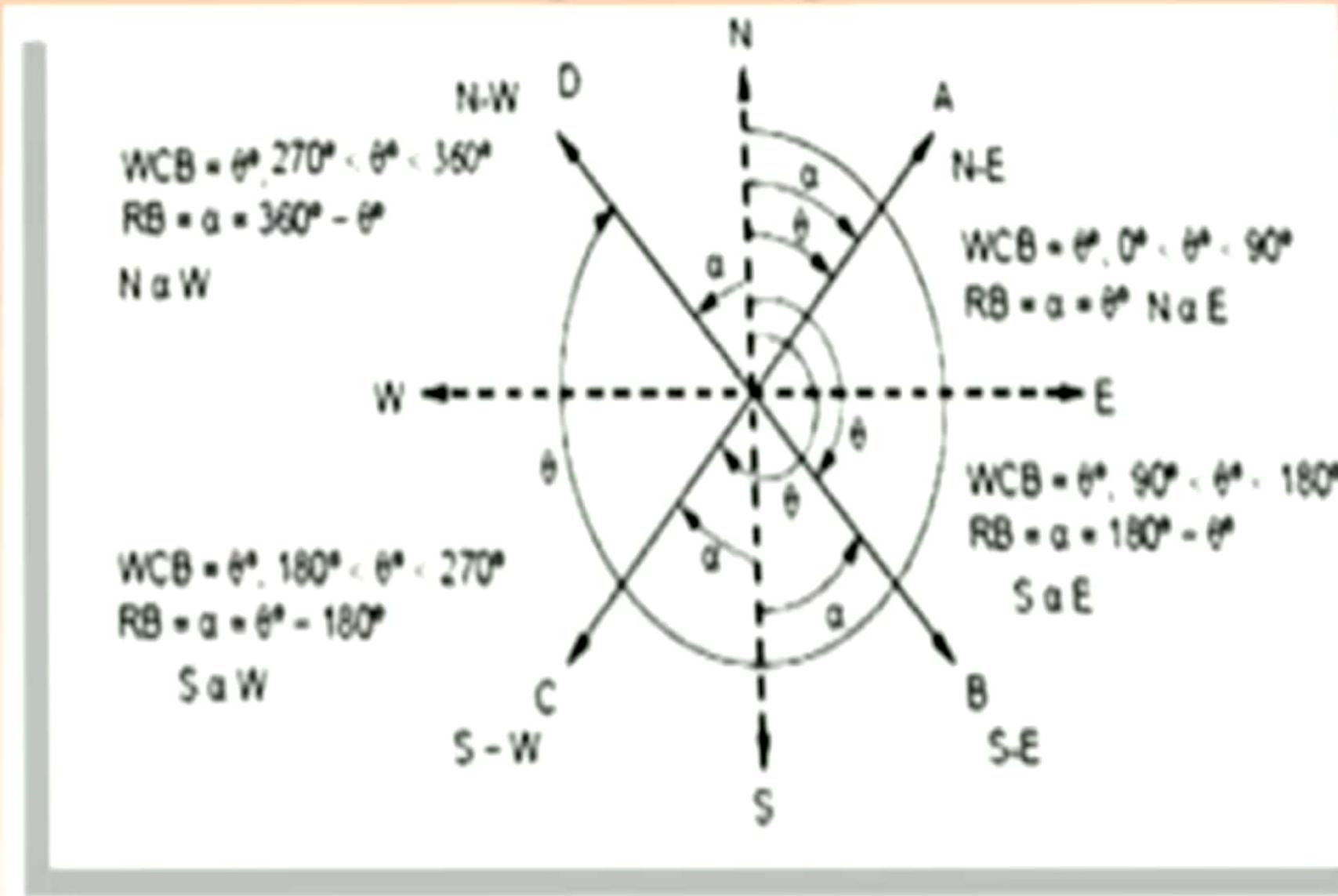
- The bearing are designated in the following two systems.
- Whole Circle Bearing System (W.C.B)
- Quadrantal Bearing System ( Q.B.)

# Whole Circle Bearing System (W.C.B)

- The bearing of a line measured with respect to magnetic meridian in clockwise direction is called magnetic bearing and its value varies between  $0^{\circ}$  to  $360^{\circ}$ .
- The Quadrants start from North and Progress in a clockwise direction as the first quadrant is  $0^{\circ}$  to  $90^{\circ}$  in clockwise direction, 2<sup>nd</sup>  $90^{\circ}$  to  $180^{\circ}$ , 3<sup>rd</sup>  $180^{\circ}$  to  $270^{\circ}$ , and up to  $360^{\circ}$  is 4<sup>th</sup> one.



# Whole Circle Bearing System (W.C.B)



# Whole Circle Bearing System (W.C.B)



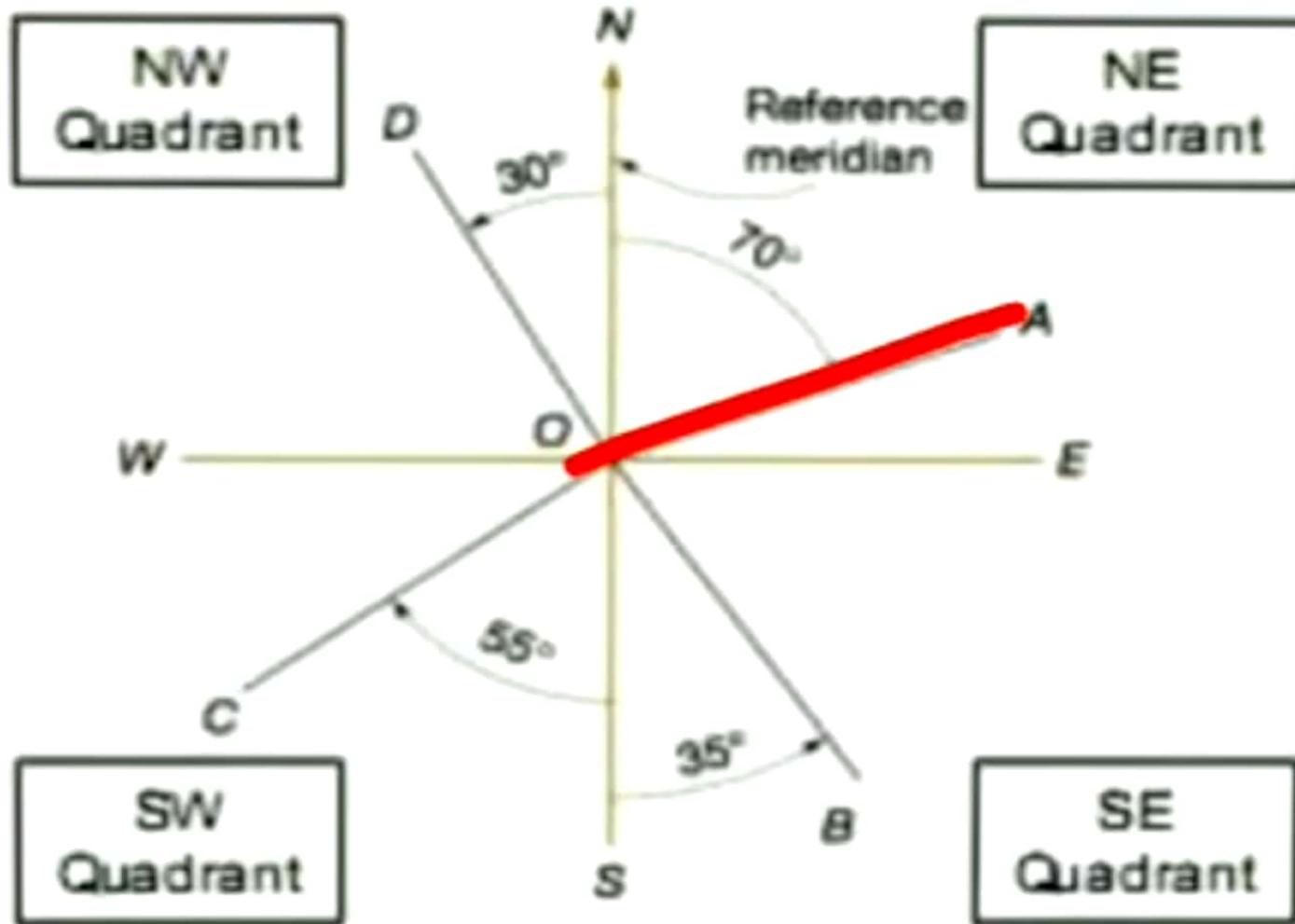
# Quadrant Bearing System (Q.B.)

- In this system, the bearing of survey lines are measured with respect to north line or south line which ever is the nearest to the given survey line and either in clockwise direction or in anticlockwise direction.
- The bearing of lines which fall in I<sup>st</sup> and IV<sup>th</sup> Quadrant are measured with respect to north line is nearer than south line, and bearing of lines fall in II<sup>nd</sup> and III<sup>rd</sup> quadrants are measured from south line as south is the nearer line. The surveyor's compass measures the bearing of lines in the quadrant system.

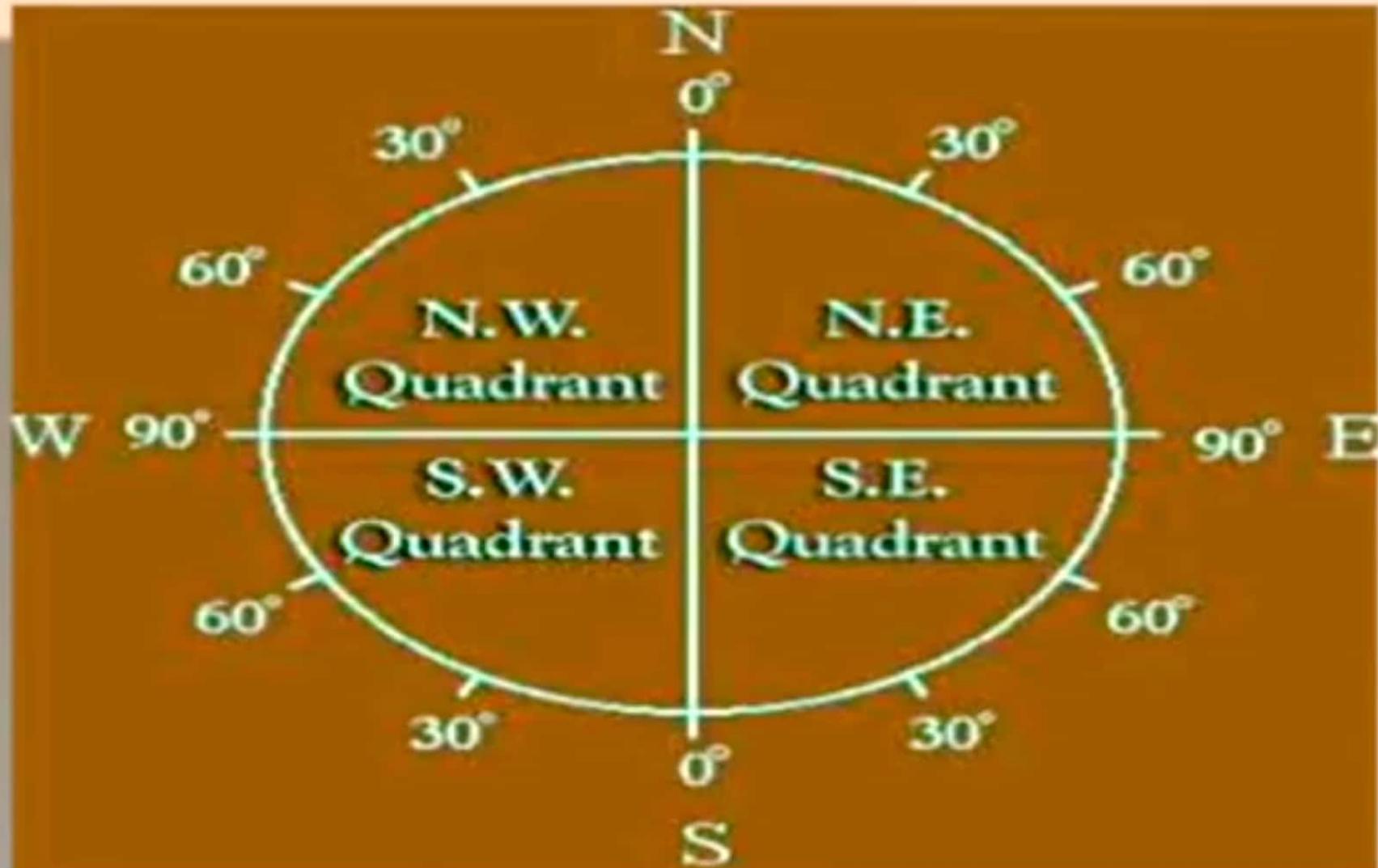
# Reduced Bearing (RB)

- When the whole circle bearing of a line is converted into quadrantal bearing it is termed as 'Reduced Bearing'. Thus, the reduced bearing is similar to the quadrantal bearing. Its value lies between  $0^{\circ}$  to  $90^{\circ}$ , but the quadrants should be mentioned for proper designation.

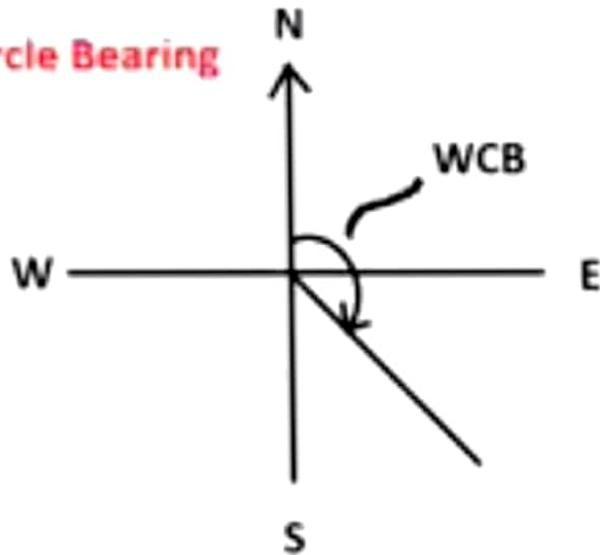
# Reduced Bearing (RB)



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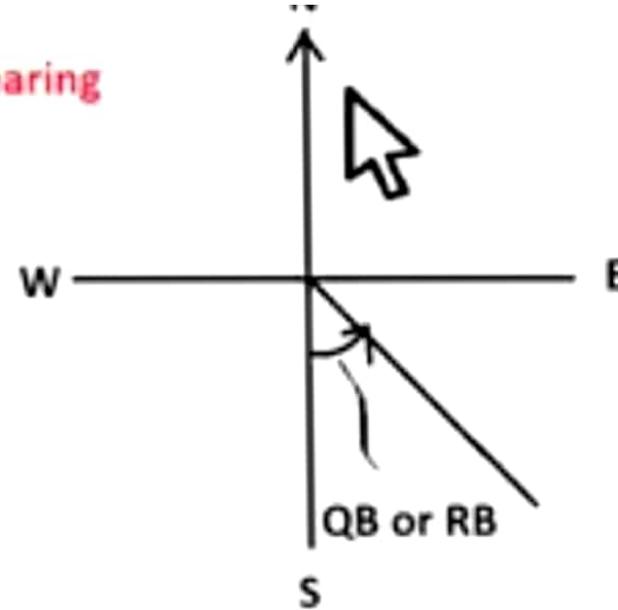


### Whole Circle Bearing



- \* Always measured from north
- \* Clockwise direction only
- \* Varies from  $0^\circ$  to  $360^\circ$

### Quadrantal Bearing

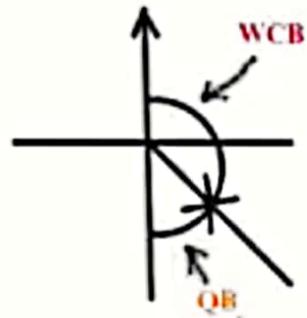


- \* Measured from north or south- **nearer**
- \* Clockwise or anti-clockwise
- \* Varies from  $0^\circ$  to  $90^\circ$
- \* Hence specify the quadrant



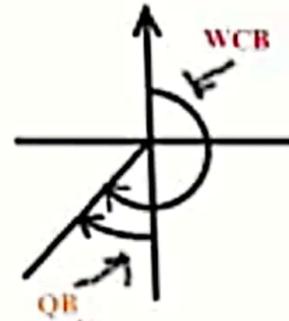
**I<sup>ST</sup> Quadrant**

$$WCB = QB$$



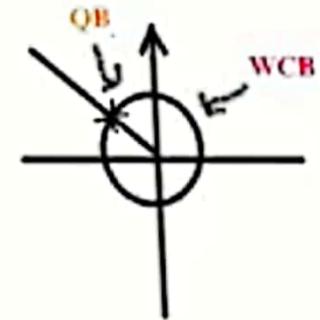
**II<sup>ND</sup> Quadrant**

$$QB = 180^\circ - WCB$$



**III<sup>RD</sup> Quadrant**

$$QB = WCB - 180^\circ$$



**IV<sup>th</sup> Quadrant**

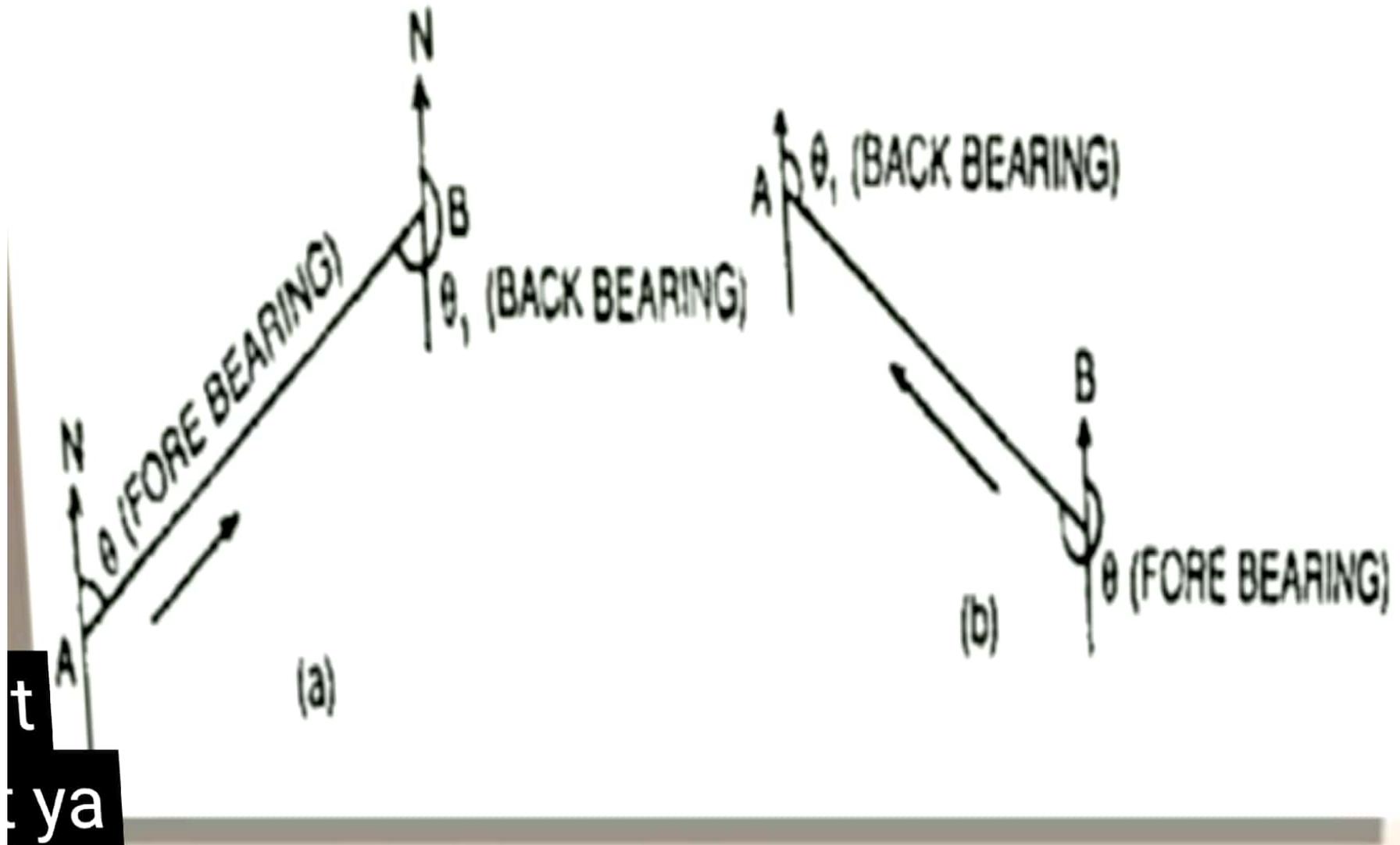
$$QB = 360^\circ - WCB$$

# Fore Bearing and Back Bearing

- The bearing of a line measured in the forward direction of survey line is called the 'Fore Bearing' (FB) of that line.
- The bearing of the line measured in the direction opposite to the direction of the progress of survey is called the 'Back Bearing' (BB) of the line.

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# Fore Bearing

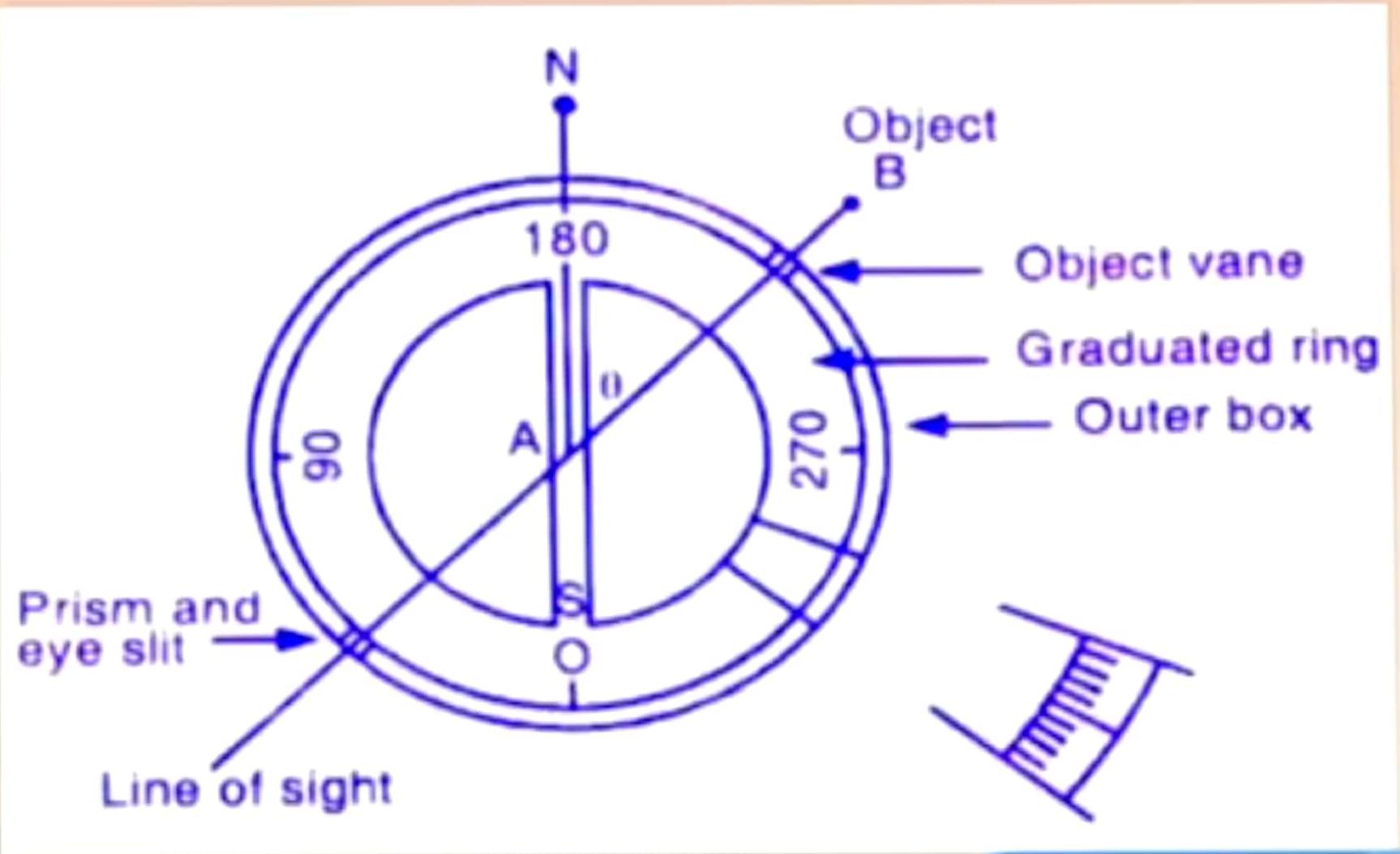


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# Observing Bearing of a line

- Consider a line AB of which the magnetic bearing is to be observed.
- Let the ranging rod be fixed at B in line AB and the compass is centered on A.
- Turn the compass in the direction of line AB.
- When B is bisected by the vertical hair, i.e. when ranging rod at B comes in line with the slit of eye vane and the vertical hair, i.e. when ranging rod at B comes in line with the slit of eye vane and the vertical hair of the object vane, the reading, under the vertical hair through prism is taken, which gives the bearing of line AB. The enlarged portion gives actual pattern of graduations marked on ring.

# Bearing



Q.] The following are the observed fore bearings of lines

i) AB  $12^{\circ}24'$

ii) CD  $266^{\circ}30'$

iii) PQ  $N18^{\circ}0'E$

iv) QR  $S12^{\circ}24'E$

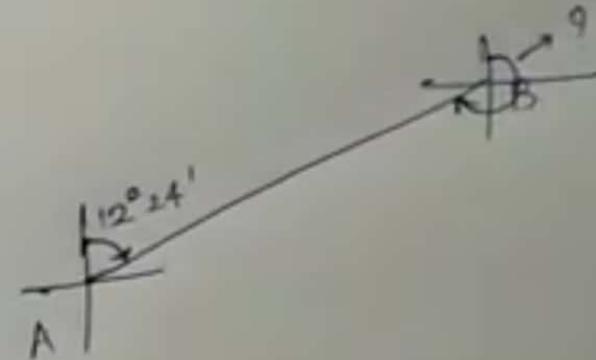
→ i) AB  $12^{\circ}24'$

→  $BB = FB \pm 180^{\circ}$

$$BB = FB + 180^{\circ}$$

$$BB = 12^{\circ}24' + 180^{\circ}$$

$$\boxed{BB = 192^{\circ}24'}$$

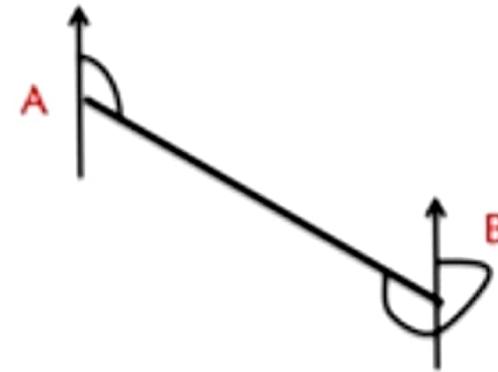


1<sup>st</sup> Quadrant



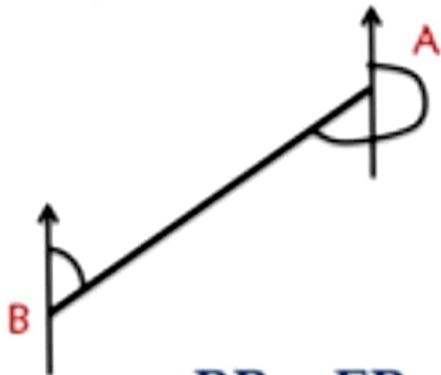
$$BB = FB + 180^\circ$$

2<sup>nd</sup> Quadrant



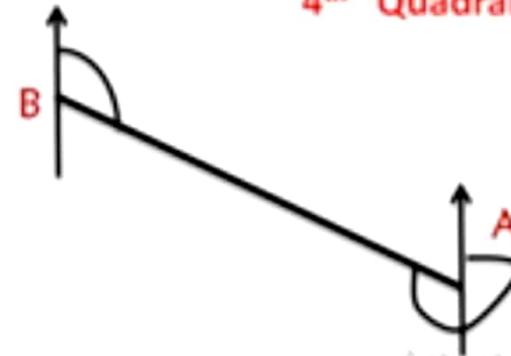
$$BB = FB + 180^\circ$$

3<sup>rd</sup> Quadrant



$$BB = FB - 180^\circ$$

4<sup>th</sup> Quadrant



$$BB = FB - 180^\circ$$

Activate Windows  
Go to Settings to activate Windows.

# Examples

## Solution:

- **The difference between fore bearing and the back bearing of a line must be  $180^\circ$ . Noting that in WCB angle is from  $0^\circ$  to  $360^\circ$ ,**
- **we find  $\text{Back Bearing} = \text{Fore Bearing} \pm 180^\circ$**
- **$+ 180^\circ$  is used if  $\theta$  is less than  $180^\circ$  and**
- **$- 180^\circ$  is used when  $\theta$  is more than  $180^\circ$**

$$\mathbf{BB = FB \pm 180^\circ}$$

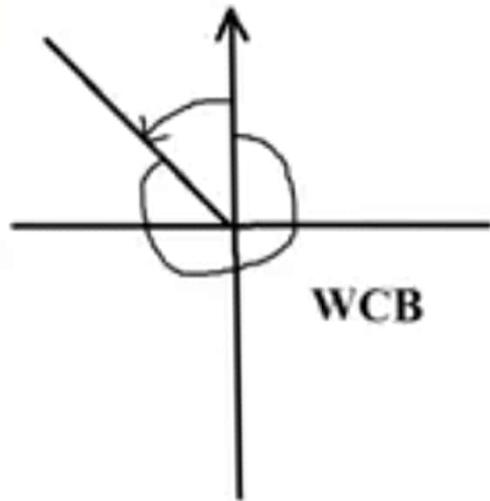
Use '+' Sign , if FB is less than 180°

Use '-' Sign , if FB is grater than 180°

Activate Windows

Go to Settings to activate Windows.

<b>FB</b>	<b>CONVERSION</b>	<b>BB</b>
45° 30'	45°30' + 180°	225° 30'
164° 0'	164° 0' + 180°	344° 0'
227° 20'	227° 20' - 180°	47° 20'
300° 0'	300° 0' - 180°	120° 0'



Convert  $320^{\circ} 30'$  into Quadrantal Bearing (Reduced bearing)

IV TH QUADRANT

$$QB = 360^{\circ} - WCB$$

$$= 360^{\circ} - 320^{\circ} 30'$$

$$= 39^{\circ} 30'$$

$$QB = N 39^{\circ} 30' W$$

# Examples

Hence,

- $BB \text{ of } AB = 145^\circ + 180^\circ = 325^\circ$
- $BB \text{ of } BC = 65^\circ + 180^\circ = 245^\circ$
- $BB \text{ of } CD = 285^\circ - 180^\circ = 105^\circ$
- $BB \text{ of } DE = 215^\circ - 180^\circ = 35^\circ$
- In case of RB, back bearing of a line can be obtained by interchanging N and S at the same time E and W. Thus
- $BB \text{ of } EF = S 36^\circ E$
- $BB \text{ of } FG = N 40^\circ W.$

# Examples

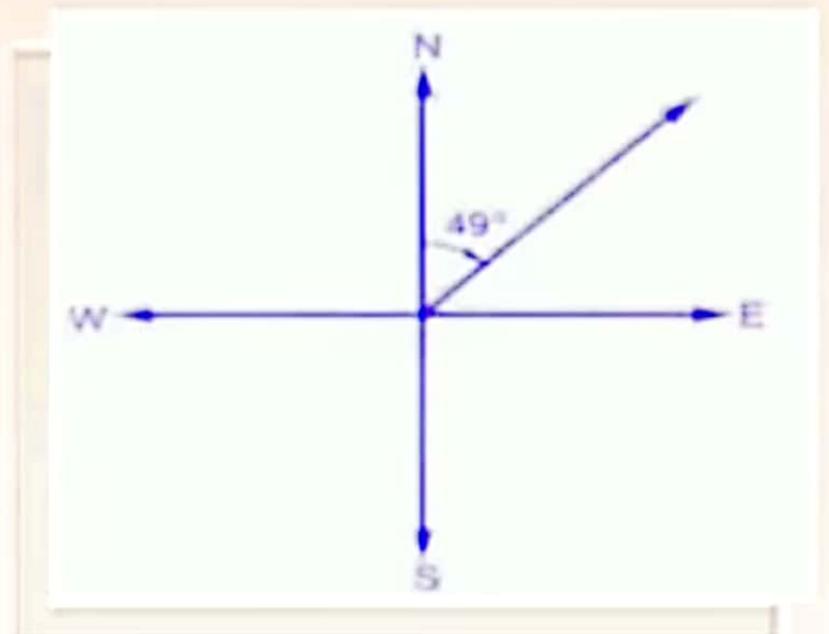
- Convert the following WCB into Reduced Bearing.
- $49^{\circ}$
- $240^{\circ}$
- $133^{\circ}$
- $335^{\circ}$



# Examples

$49^{\circ}$

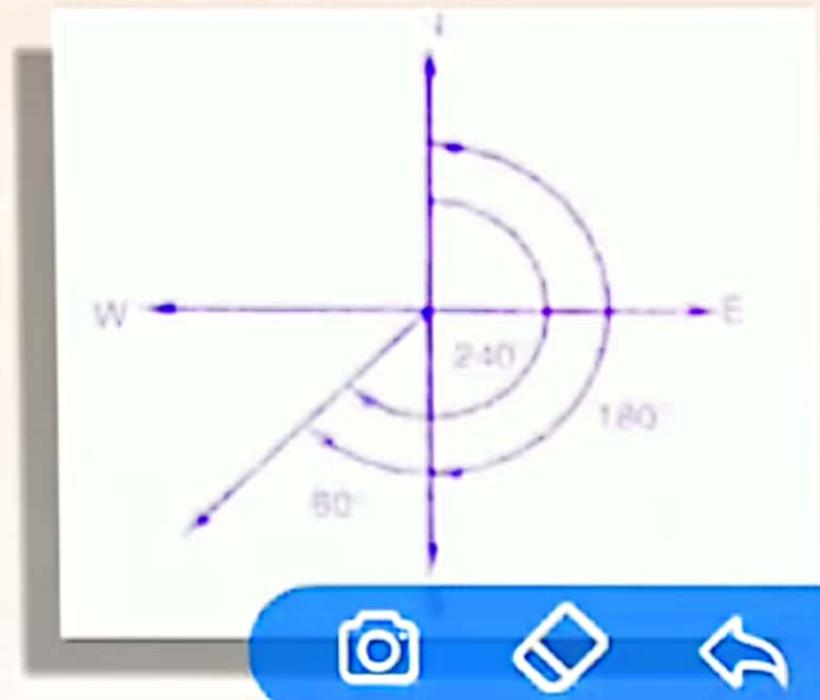
- Since the line falls in the first quadrant therefore the nearer pole is the north pole and is measured from North towards E as  $49^{\circ}$
- **Therefore RB = N  $49^{\circ}$  E**



# Examples

240°

- Since the line falls in the third quadrant therefore the nearer pole is the north pole and is measured from North towards S as °
- $RB = WCB - 180^\circ$
- $RB = 240^\circ - 180^\circ = 60^\circ$
- **RB = S 60° W**

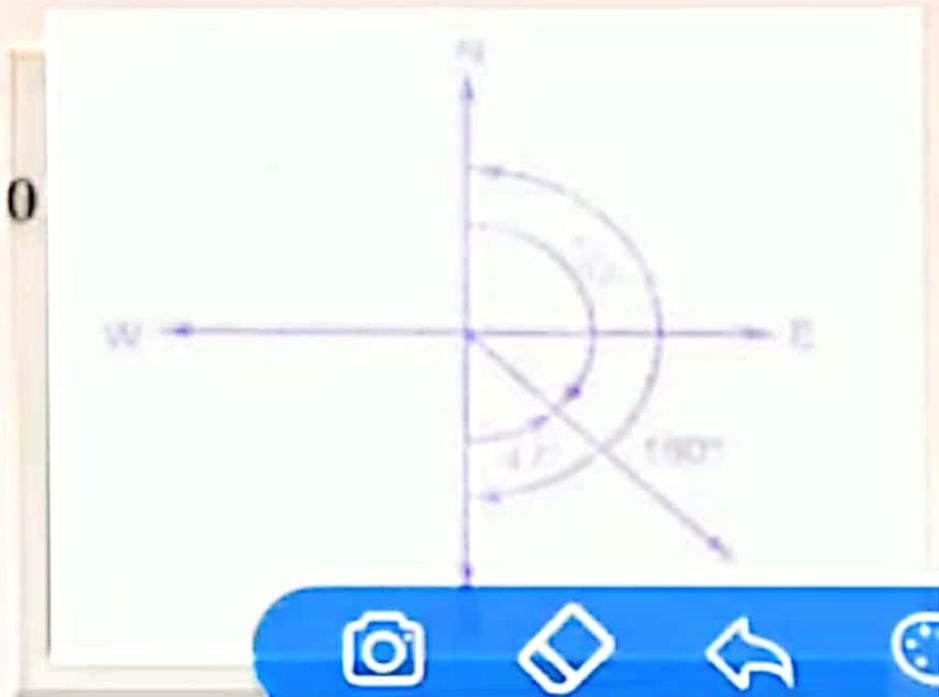


# Examples

133°

• Since the line falls in the second quadrant therefore the nearer pole is the south pole and is measured from South towards E as °

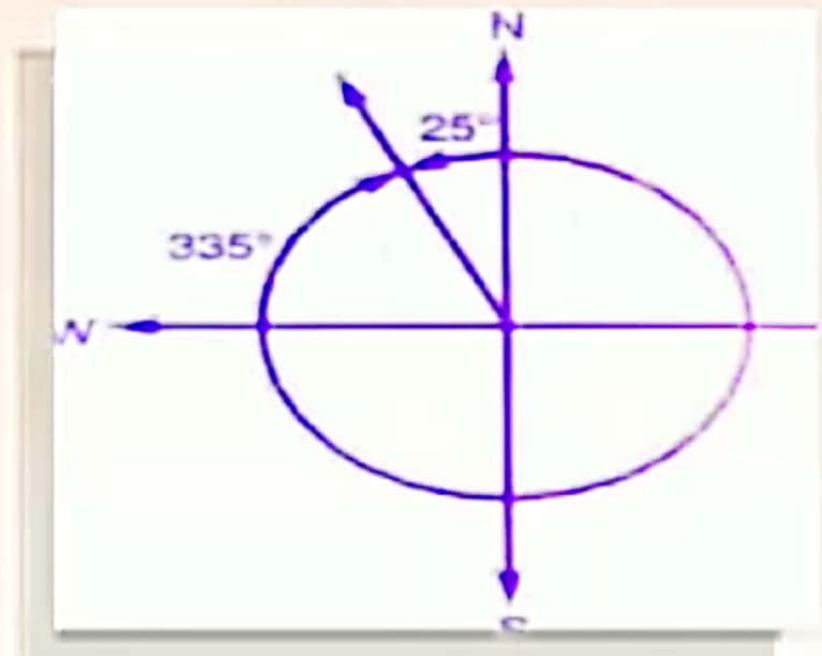
- $RB = 180^\circ - \Theta$
- $RB = 180^\circ - 133^\circ = 47^\circ$
- **RB = S 47° E**



# Examples

**335°**

- Since the line falls in the third quadrant therefore the nearer pole is the north pole and is measured from North towards W as °
- $RB = 360^\circ - WCB$
- $RB = 360^\circ - 335^\circ$
- **RB = N 25° W**



# Examples

Convert the following WCB into RB

- $190^{\circ}$
- $260^{\circ}$
- $315^{\circ}$

# Examples

Sol<sup>n</sup>

**190°**

- $RB = WCB - 180^\circ$
- $RB = 190^\circ - 180^\circ$
- **$RB = S 10^\circ W$**

**260°**

- $RB = WCB - 180^\circ$
- $RB = 260^\circ - 180^\circ$
- **$RB = S 80^\circ W$**



# Examples

Sol<sup>n</sup>

**315<sup>0</sup>**

- $RB = 360^0 - WCB$
- $RB = 360^0 - 315^0$
- **RB = N45<sup>0</sup> W**

# Examples

- Convert the following reduced bearings into whole circle bearings:
- N  $65^{\circ}$  E
- S  $43^{\circ} 15'$  E
- S  $52^{\circ} 30'$  W
- N  $32^{\circ} 42'$  W

# Examples

Let ' $\theta$ ' be whole circle bearing.

*(i) Since it is in NE quadrant,*

$$\theta = \alpha = \mathbf{65^\circ \text{ Ans.}}$$

*(ii) Since it is in South East quadrant*

$$43^\circ 15' = 180^\circ - \theta$$

$$\text{or } \theta = 180^\circ - 43^\circ 15' = \mathbf{136^\circ 45' \text{ Ans.}}$$

# Examples

*(iii) Since it is in SW quadrant*

$$52^\circ 30' = \theta - 180^\circ$$

$$\text{or } \theta = 180^\circ + 52^\circ 30' = \mathbf{232^\circ 30'}$$

*(iv) Since it is in NW quadrant,*

$$32^\circ 42' = 360^\circ - \theta$$

$$\text{or } \theta = 360^\circ - 32^\circ 42' = \mathbf{327^\circ 18'}$$