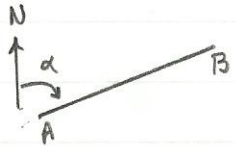
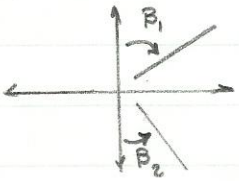
Assignment 1

* Question 1:



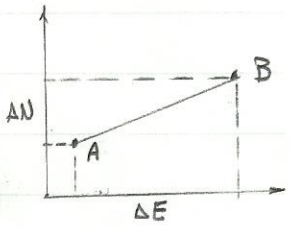
- Bearing of a line:
  The angle between the north direction & the line in clockwise direction

- Reduced bearing of a line:
  The angle between the north or south and the line in clockwise or anticlockwise direction
  The angle is less than 90°

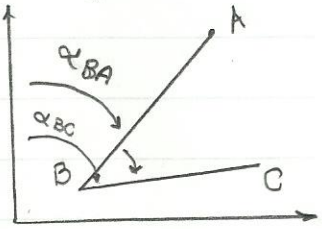


- Departure of a line:
  The difference between two points in east $\Delta E_{AB} = E_B - E_A$

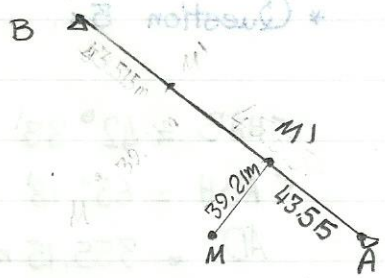
- Latitude of a line:
  The difference between two points in North $\Delta N_{AB} = N_B - N_A$



- The relation between the bearings of two lines and their subtended angle:
  The subtended angle is the difference between the bearing of two lines
  $\angle ABC = \alpha_{BC} - \alpha_{BA}$



3- Question 3:



$A\ (1542.214, 3054.098)$

$B\ (1444.087, 3200,551)$

$MM' = 39.21\ m$

$AM' = 43.515\ m$

$AM = 58.574\ m$

$BM' = 176.2878 - 58.574 = 132.7728\ m$

$\tan \hat{ABM} = \frac{39.21}{43,515} = 0.901 \Rightarrow A\hat{B}M = 42^\circ\ 1'\ 16''$

$\alpha_{BA} = \tan^{-1} \frac{\Delta E}{\Delta N} = \tan^{-1} \frac{98.127}{-146.453} = 146^\circ\ 10'\ 37''$

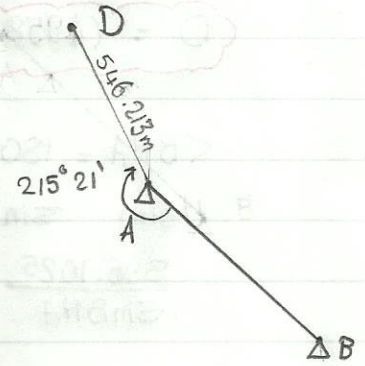
$\alpha_{BM} = \alpha_{BA} + A\hat{B}M = 188^\circ\ 11'\ 53''$

$E_M = E_B + l_{BM} \sin \alpha_{BM} = 1444.087 + 132.7728 \sin \alpha_{BM} = 1517.992\ m$

$N_M = N_B + l_{BM} \cos \alpha_{BM} = 3090.248\ m$

$M = (1517.992, 3090.248)\ m$

4- Question 4:



$A = (1403.197, 608.199)$

$B = (1511.197, 199.608)$

$AD = 546.213\ m$

$\hat{BAD} = 215^\circ\ 21'\ 32'$

$\alpha_{AB} = \tan^{-1} \frac{\Delta E}{\Delta N} = 165^\circ\ 11'\ 38''$

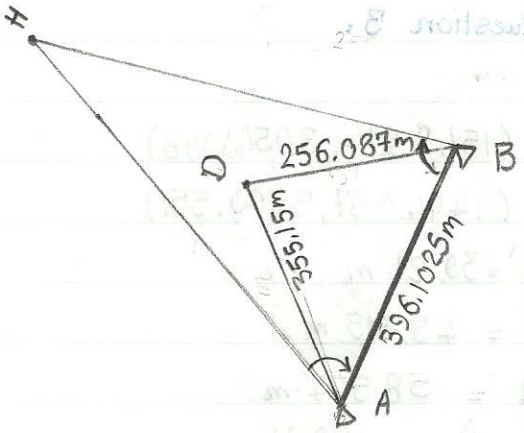
$\alpha_{AD} = \alpha_{AB} + \langle BAD = 380^\circ\ 33'\ 10''$

$E_D = E_A + l_{AD} \sin \alpha_{AD} = 1594.956\ m$

$N_D = N_A + l_{AD} \cos \alpha_{AD} = 1119.644\ m$

$D = (1594.956, 1119.644)\ m$

* Question 5:



$\angle HAB = 42^\circ\ 33'\ 15''$

$\angle ABH = 63^\circ\ 18'\ 08''$

$AD = 355.15\ m$

$BD = 256.087\ m$

$A = (5000, 8000)$

$B = (5214.021, 8333.305)$

$\alpha_{AB} = \tan^{-1}\frac{\Delta E}{\Delta N} = 32^\circ\ 42'\ 18.84''$

$AB = \sqrt{\Delta E^2 + \Delta N^2} = 396.1025\ m$

$l_{DB}^2 = l_{AD}^2 + l_{AB}^2 - 2\, l_{AD}\, l_{AB} \cos \hat{DAB}$

$\angle DAB = 39^\circ\ 23'\ 16''$

$\angle DAB = \alpha_{AB} - \alpha_{AD} \Rightarrow \alpha_{AD} = \alpha_{AB} - \hat{DAB} = -6^\circ\ 40'\ 57''$

$E_D = E_A + l_{AD} \sin \alpha_{AD} = 4958.67\ m$

$N_D = N_A + l_{AD} \cos \alpha_{AD} = 8352.737\ m$

$D = (4958.67, 8352.737)\ m$

$\angle BHA = 180 - (42^\circ\ 33'\ 15'' + 63^\circ\ 18'\ 08'') = 74^\circ\ 8'\ 37''$

Using sin rule:

$\frac{396.1025}{\sin BHA} = \frac{HA}{\sin ABH} \Rightarrow HA = 367.871\ m$

$\angle HAB = \alpha_{AB} - \alpha_{AH} \Rightarrow \alpha_{AH} = \alpha_{AB} - \hat{HAB} = -9^\circ\ 50'\ 56''$

$E_H = E_A + l_{AH} \sin \alpha_{AH} = 4937075\ m$

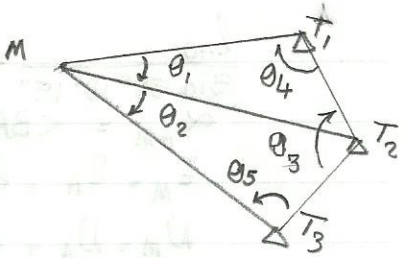
$N_H = N_A + l_{AH} \cos \alpha_{AH} = 8362,45\ m$

$H = (4937.075, 8362.45)\ m$

$l_{HD} = \sqrt{(\Delta E_{HD})^2 + (\Delta N_{HD})^2} = 23.6788\ m$

$\alpha_{HD} = \tan^{-1}\frac{\Delta E}{\Delta N} = 114^\circ\ 13'\ 2''$

6. Question 6:



Get $\alpha_{T_2T_3}$ & $\alpha_{T_2T_1}$

$< T_3T_2T_1 = -\alpha_{T_2T_1} - \alpha_{T_2T_3} = \theta_3$

$\theta_1 + \theta_2 + \theta_3 + \theta_4 + \theta_5 = 360$

$\theta_4 + \theta_5 = 360 - \theta_1 - \theta_2 - \theta_3 \longrightarrow (1)$

Using Sin rule in 2 triangles $\quad \frac{T_1T_2}{\sin\theta_1} = \frac{MT_2}{\sin\theta_4} \Rightarrow MT_2 = \frac{T_1T_2 \sin\theta_4}{\sin\theta_1}$

$\frac{T_2T_3}{\sin\theta_2} = \frac{MT_2}{\sin\theta_5} \Rightarrow MT_2 = \frac{T_2T_3 \sin\theta_5}{\sin\theta_2}$

$\frac{T_1T_2 \sin\theta_4}{\sin\theta_1} = \frac{T_2T_3 \sin\theta_5}{\sin\theta_2}$

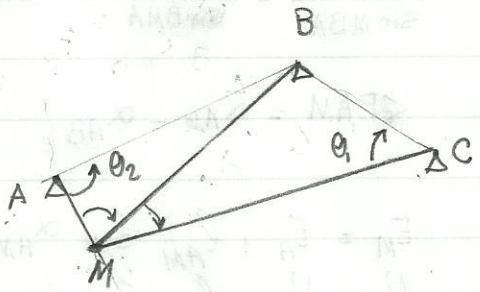
$\sin\theta_4 = \frac{T_2T_3 \sin\theta_1}{T_1T_2 \sin\theta_2} \sin\theta_5 \Rightarrow \sin\theta_4 = K \sin\theta_5 \longrightarrow (2)$

From (1) into (2)

$\sin(360 - \theta_1 - \theta_2 - \theta_3 - \theta_5) = \frac{T_2T_3}{T_1T_2} \frac{\sin\theta_1}{\sin\theta_2} \sin\theta_5$

From this Formula get θ_5 & then θ_4

7. Question 7:



$A = (1024.201, 2154.265) \quad l_{AB} = 272.8\,m$

$B = (1254.054, 2301.201) \quad l_{BC} = 272.465\,m$

$C = (1501.548, 2187.254)$

$< AMB = 53^\circ\ 18'\ 15''$

$< BMC = 42^\circ\ 31'\ 15''$

$\alpha_{BC} = 114^\circ\ 43'\ 17'' \qquad \alpha_{BA} = 237^\circ\ 24'\ 39''$

$< CBA = \alpha_{BA} - \alpha_{BC} = 122^\circ\ 41'\ 22''$

$\theta_1 + \theta_2 = 360 - (122^\circ\ 41'\ 22'' + 53^\circ\ 18'\ 15'' + 42^\circ\ 31'\ 15'')$

$\theta_1 + \theta_2 = 141^\circ\ 29'\ 8'' \longrightarrow (1)$

From sin rule in ΔABM & BCM:

$\sin\theta_2 = \frac{272.465 * \sin 53^\circ\ 18'\ 15''}{272.8 * \sin 42^\circ\ 31'\ 15''} \sin\theta_1$

$\sin\theta_2 = 1.1849 \sin\theta_1 \longrightarrow (2)$

From (1) into (2)

$\sin(141^\circ\ 29'\ 8'' - \theta_1) = 1.1849 \sin\theta_1$

$$\frac{l_{AB}}{\sin 53^\circ 18' 15''} = \frac{l_{AM}}{\sin(180 - 53^\circ 18' 15'' - 84^\circ 21' 34'')} \Rightarrow l_{AM} = 229.1363\ m$$

$\alpha_{AM} = \angle BAM + \alpha_{AB} = 141^\circ 46' 13''$

$E_M = E_A + l_{AM} \sin \alpha_{AM} = 1165.994\ m$

$N_M = N_A + l_{AM} \cos \alpha_{AM} = 1974.27\ m$

} $M = (1165.994, 1974.27)\ m$

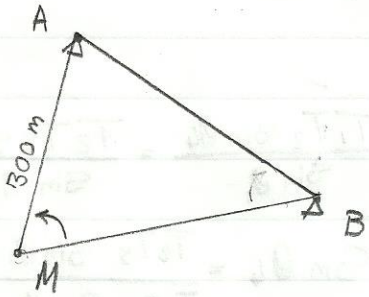
8- Question 8 :

$A = (2541.321, 5124.321)\ m$

$B = (2895.321, 4855.502)\ m$

$MA = 300\ m$

$BMA = 44^\circ 08' 58''$



$\alpha_{AB} = \tan^{-1} \frac{\Delta E}{\Delta N} = 127^\circ 12' 44''$

$l_{AB} = 444.5\ m$

$\frac{300}{\sin MBA} = \frac{444.5}{\sin BMA} \Rightarrow \angle MBA = 28^\circ 2' 27''$

$\angle BAM = 107^\circ 48' 35''$

$\angle BAM = \alpha_{AM} - \alpha_{AB} \Rightarrow \alpha_{AM} = \angle BAM + \alpha_{AB} = 235^\circ 1' 19''$

$E_M = E_A + l_{AM} \sin \alpha_{AM} = 2295.05095\ m$

$N_M = N_A + l_{AM} \cos \alpha_{AM} = 4952.3422\ m$

$M = (2295.05095, 4952.3422)\ m$