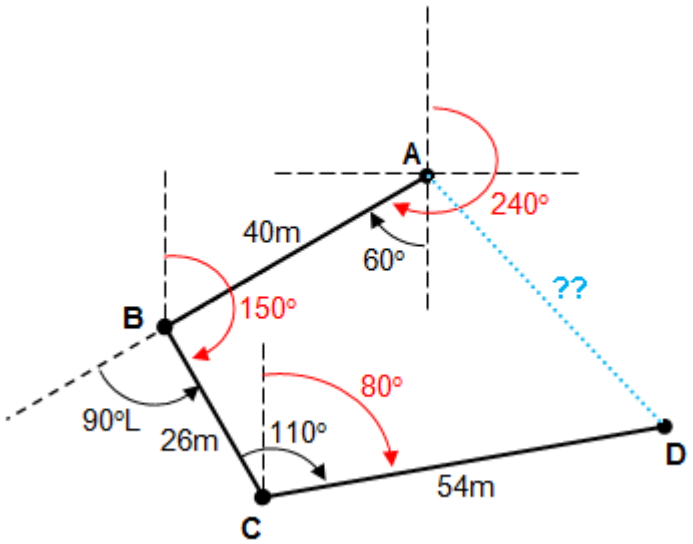
MAD 256 – SURVEYING **March 28th, 2012**
1st MIDTERM EXAM (ANSWERS)

(25 p) 1. Draw the following path according to given information (use scale 1:1000 to draw) and determine the horizontal distance between the points A and D. Also determine Azimuth angle of the line AD in degree.

Bearing of line AB = S60°W — Horizontal distance of line AB = 40 m
Deflection angle at point B = 90°L — Horizontal distance of line BC = 26 m
Angle to the right at point C = 110° — Horizontal distance of line CD = 54 m

Answer:
After drawing the path Azimuth angles of the lines must be determined as follows:



From the figure;
Az.AB=180+60 = 240°
Az.BC=60+90 = 150°
Az.CD=110-(180-150) = 80°

Next we need to determine Departures and Latitudes of the lines;
Dep.AB = 40*sin 240 = -34.64 m
Dep.BC = 26*sin 150 = +13.00 m
Dep.CD = 54*sin 80 = +53.18 m

Lat.AB = 40*cos 240 = -20.00 m
Lat.BC = 26*cos 150 = -22.52 m
Lat.CD = 54*cos 80 = +9.38 m

Sum of departures and latitudes will give us departure and latitude of line AD. Thus;
Dep.AD = -34.64+13.00+53.18 = 31.54 m
Lat.AD = -20.00-22.52+9.38 = -33.14 m

We determine the length of AD by using Dep.AD and Lat.AD as;

AD = $\sqrt{(Dep.AD)^2+(Lat.AD)^2}$ =[(31.54)^2+(33.14)^2]$^{1/2}$ = [994.77+1098.26]$^{1/2}$ = [2093.03]$^{1/2}$

AD = 45.75 m

Az. AD = Atan (Dep.AD/Lat.AD) = Atan (31.54/-33.14) = -43.58°+180 = **136.42°**

(10 p) 2. A horizontal distance was measured as 232.28 m with a 20-m tape that was 20.003 m under standard conditions. If the temperature was 32°C during measurement, determine the corrected distance? (use C_t = 0.0000116(T - 20)L)

Answer:
Error per length due to err tape length =20-20.003 =-0.003 m or -3 mm
Total error = (232.28/20)*-3 = -34.84 mm
Err tape correction ≅ +35 mm
Temperature correction, use Ct = 0.0000116(32 - 20)232.28 = 0.032 m or 32 mm
Correct length = 232.280+0.035+0.032 = **232.347 m**

(10 p) 3. Determine the missing parameters in the following questions.

a) Map distance of AB = 8 cm
Field distance of AB = 400 m
Scale of the map = ??

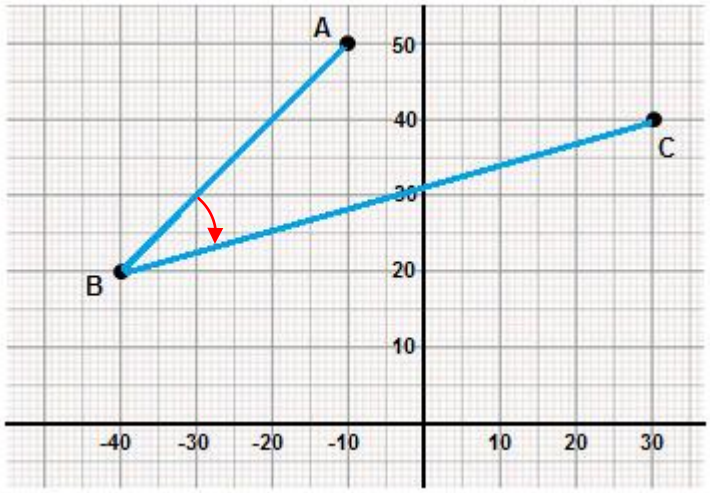
b) Scale of the map = 1/10000
Field distance of CD = 620 m
Map distance of CD = ?? mm

Answer:
a) Scale factor = 400*100/8 = 5000 then **Scale: 1/5000**
b) Acc. to scale 10 m is 1 mm on the map. Then, 620/10 = **62 mm**

(20 p) 4. The coordinates of the points ABC (a broken line) are given. Determine the angle to the right at point B in degree unit. Use the azimuths of lines.

	Coordinates (m)	
Point	Easting	Northing
A	-10	50
B	-40	20
C	30	40

Answer:



Angle to the right at point B = Az.BC-Az.BA

Az.BC = atan $[(E_C-E_B)/(N_C-N_B)]$ = atan [(30+40)/(40-20)] = atan (70/20) = 74.05^o

Az.BA = atan $[(E_A-E_B)/(N_A-N_B)]$ = atan [(-10+40)/(50-20)] = atan (30/30) = 45^o

Angle to the right at point B = 74.05^o-45^o = **29.05^o**

(15 p) 5. The interior angles (A, B, C and D) of a quadrilateral were measured as $105^o28'36"$, $68^o59'27"$, $96^o43'25"$ and $88^o49'52"$, respectively. Determine the error in this measurement and then correct the angles.

Answer:

Sum of angles = $105^o28'36"+68^o59'27"+96^o43'25"+88^o49'52" = 357^o179'140" = 360^o\,01'\,20"$

Error = measured-true = $360^o\,01'\,20" - 360^o = 01'\,20" = 80"$

Correction for each angle = -80"/4 = -20"

Corrected angle A = $105^o28'36"$-20" = $105^o28'16"$

Corrected angle B = $68^o59'27"$-20" = $68^o59'07"$

Corrected angle C = $96^o43'25"$-20" = $96^o43'05"$

Corrected angle D = $88^o49'52"$-20" = $88^o49'32"$

TOTAL = $357^o179'60" = 360^o$ (check done)

(10 p) 6. Slope from point A to B is +5% and the horizontal distance between the points is 240 m. If the elevation of point B is +420.40 m, determine the elevation of point A.

Answer:

Acc to the slope point B is above point A.

For 5% slope, vertical difference = (240/100)*5 = 12 m

Then Elevation of pnt A = El.B-21.02 = 420.40-12 = **408.40 m**

(10 p) 7. Make necessary conversions for the following angles.

a) 126^o= ? grade **b)** $7\pi/5$= ? degree **c)** 54^o= ? radian **d)** 170 grade= ? radian

Answer:

D/180 = G/200 = R/π

a) (126*200)/180 = 140 grade

b) (180*(7π/5)/π) = 252 degree

c) (54*π/180) = 3π/10 or 0.943 radian

d) (170*π/200) = 17π/20 or 2.67 radian

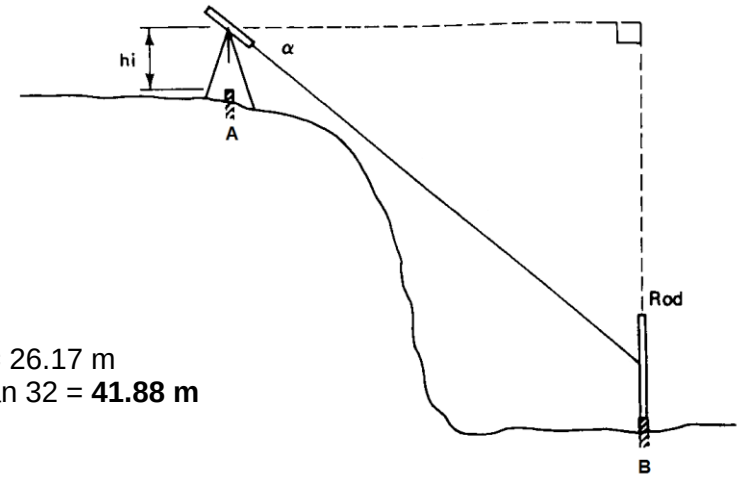
MAD 256 – SURVEYING **May 16th, 2012**
2nd MIDTERM EXAM (ANSWERS)

Name&Surname : ……..

Notes : i) Use maximum 3 digits for decimal parts of numbers (e.g., 25.127)
ii) Analytical solutions are required for all questions. You can use graphics to control your calculations.
iii) Draw a rectangular box around your final result to highlight.

(15 p) 1. Determine the horizontal distance between the points A and B for the following case.

Elevation at point A = 790.48 m
Elevation at point B = 762.79 m
Height of instrument (h_i) = 1.72 m
Rod reading = 3.24 m
Vertical angle reading (α) = 32°

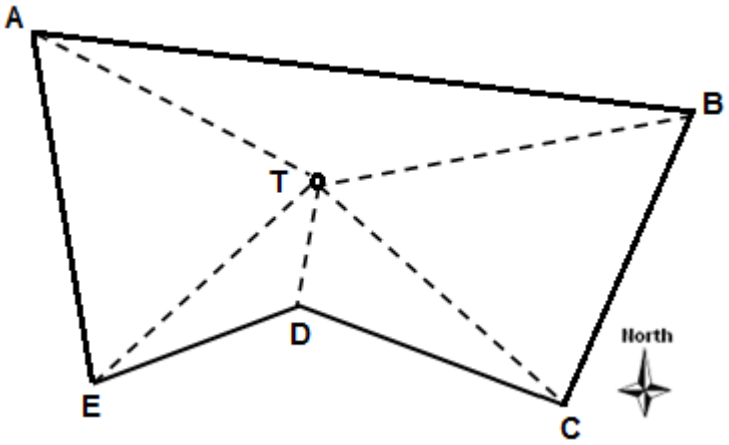


ANSWER

$El._A + h_i - S \sin \alpha - RR = El._B$ then
790.48+1.72-S Sin α-3.24=762.79
S Sin α =790.48+1.72-3.24-762.79 = 26.17 m
Hor.Dist. =(S Sin α)/tan α = 26.17/tan 32 = **41.88 m**

(25 p) 2. A theodolite was set up at point T that is within the limits of a five-sided property. Azimuth angles and distances to the property corners were measured as follows. Determine the area of the property (m^2) by using triangulation method as Area of a triangle=1/2*s_1*s_2*sin α.

Course	Azimuth	Distance (m)
TA	300°	64
TB	65°	81
TC	158°	56
TD	196°	25
TE	217°	52



ANSWER

Area of triangle TAB = [64*81*sin((360-300)+65)]/2 = 2123.24 m^2
Area of triangle TBC = [81*56*sin(158-65)]/2 = 2264.89 m^2
Area of triangle TCD = [56*25*sin(196-158)]/2 = 430.96 m^2
Area of triangle TDE = [25*52*sin(217-196)]/2 = 232.94 m^2
Area of triangle TEA = [52*64*sin(300-217)]/2 = 1651.60 m^2

AREA OF PROPERTY = 6703.63 m^2

(15 p) 3. Set of elevation measurements is given as follow. After calculations elevation of BM21 was found as 300.45 m. Calculate the elevations of all other stations. Perform the arithmetic check. (Show details of your calculations, write the results on table).

Station	BS (m)	IS (m)	FS (m)	ΔH (m)	ΔH (m)	Elevation (m)
BM 20	3.27					298.78
TP #1	4.21		2.60	0.67	0.67	299.45
0 + 00		3.30		0.91	0.91	300.36
0 + 50		2.60		1.61	0.70	301.06
0 + 80		3.71		0.50	-1.11	299.95
1 + 00		1.10		3.11	2.61	302.56
TP #2	2.33		1.66	2.55	-0.56	302.00
1 + 50		3.80		-1.47	-1.47	300.53
2 + 00		2.97		-0.64	0.83	301.36
BM 21			3.88	-1.55	-0.91	300.45
TOTAL	**9.81**		**8.14**		**1.67**	

one of these columns

SOLUTION:

ΔH = BS-FS (assume IS as FS as well) or $\Delta H = IS_{prev} - IS_{itself}$

Arithmetic check ➔ ΣBS-ΣFS = 9.81-8.14 = 1.67 m. is equal to ΣΔH = 1.67 m.
BM21-BM20 = ΣBS-ΣFS then BM20 = 300.45-1.67 = 298.75 m.

(30 p) 4. Latitudes and departures of the courses of a four-sided closed traverse are given. Determine its area by using DMD (Double Meridian Distance) method.

Course	Latitude (m)	Departure (m)
AB	30S	60W
BC	70N	20W
CD	30N	50E

SOLUTION:

First of all, latitude and departure of the missing course (DA) should be determined to satisfy ΣLatitude=0 and ΣDeparture=0. Then:

-30+70+30+LatDA =0 ➔ LatDA = 70S and -60-20+50+DepDA =0 ➔ DepDA = 30E

If we draw the reference meridian line passes the most westerly point (which is C), then:

DMD of course CD = Departure of itself = 50
DMD of course DA = DMD of CD+Dep.of CD+Dep.of DA = 50+50+30 = 130
DMD of course AB = DMD of DA+Dep.of DA+Dep.of AB = 130+30-60 = 100
DMD of course BC = DMD of AB+Dep.of AB+Dep.of BC = 100-60-20 = 20 (= dep.of BC)

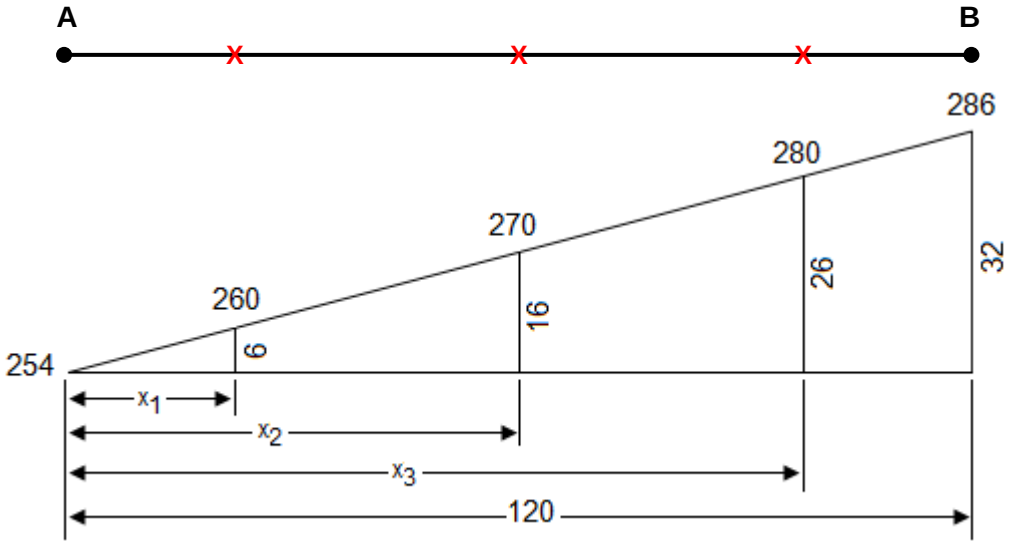
Now we can determine double areas by using DMD*Latitude;

For course CD, Double area = 50*30 = +1500
For course DA, Double area = 130*(-70) = - 9100
For course AB, Double area = 100*(-30) = - 3000
For course BC, Double area = 20*70 = +1400

Sum of double areas = abs(2900-12100) = 9200 m^2, then

Area of traverse ABCDE = 9200/2 = 4600 m^2

(15 p) 5. Horizontal distance between the points A and B is 120 m. Elevations of the points A and B are 254 m and 286 m respectively. It is aimed to draw 10 m contours between the points. Determine the position of the contours and mark on the following figure (assume linear slope between the points).



SOLUTION:

Scale : 12/12000 : 1/1000

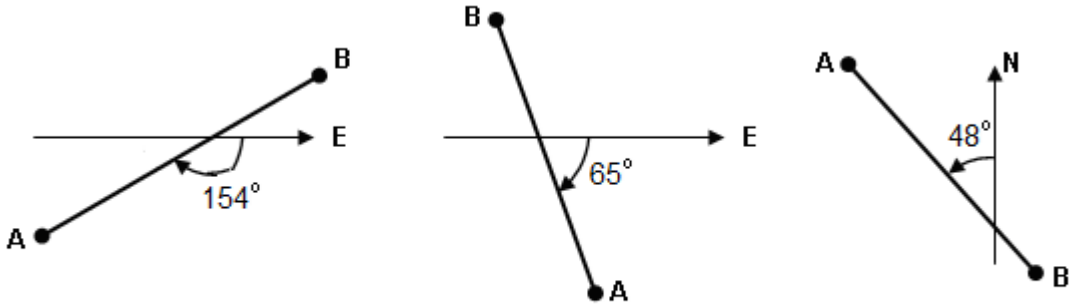
$(x_1/120) = (6/32)$ ➔	$x_1 = 6*120/32 = 22.5$ m	scaled: 2.25 cm
$(x_2/120) = (16/32)$ ➔	$x_2 = 16*120/32 = 60$ m	scaled: 6.00 cm
$(x_3/120) = (26/32)$ ➔	$x_3 = 26*120/32 = 97.5$ m	scaled: 9.75 cm

MAD 256 – SURVEYING **May 25th, 2012**
FINAL EXAM – ANSWERS

Name&Surname : ……

Notes : i) Use maximum 3 digits for decimal parts of numbers (e.g., 25.127)
ii) Analytical solutions are required for all questions. You can use graphics to control your calculations.
iii) Draw a rectangular box around your final result to highlight.

(15 p) 1. Determine the bearing and the azimuth angles of the lines AB in each of the following figures. (Show your drawings and calculations)



(a) (b) (c)

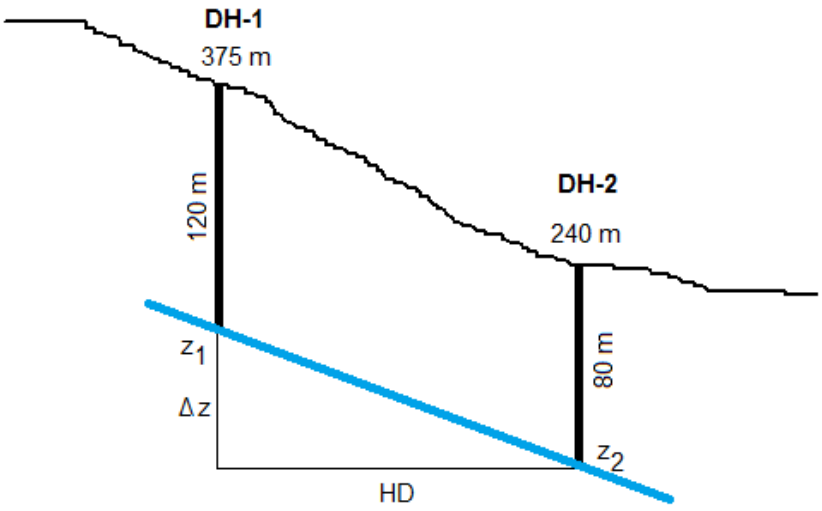
Answer :

a) Azimuth AB = 90-(180°-154°)= 64° Bearing (NE quadrant) = N (154°-90°) E = N64°E
b) Azimuth AB = 360-(90°-65°)= 335° Bearing (NW quadrant) = N (360°-335°) E = N25°W
c) Azimuth AB = 180°-48°= 132° Bearing (SE quadrant) = S (180°-132°) W=S48°E

(15 p) 2. Two drill-holes are done at the site with the followin coordinates (X, Y, Z). DH-1 intersects the coal seam at a depth of 120 m below surface where the other one intersects at a depth of 80 m below surface. Determine the seam inclination (slope) in degree between these two points (from DH-1 towards DH-2).

Drill	Northing	Easting	Z (m)
DH-1	2245	520	375
DH-2	1630	980	240

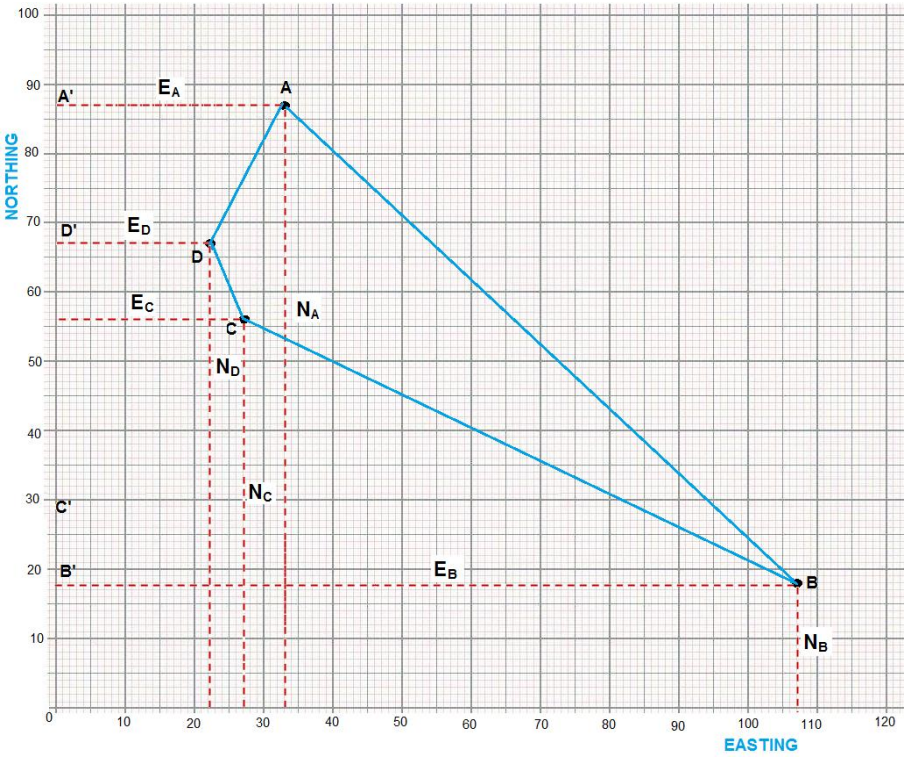
Answer :



Seam elevation at DH-1 (z_1) = 375-120 = 255 m
Seam elevation at DH-2 (z_2) = 240-80 = 160 m
Difference in elevation (Δz) = 160-255 = -95 m
Horizontal distance (HD) = $[(\Delta N^2+\Delta E^2)]^{1/2}$ = $[(2245-1630)^2+(980-520)^2)]^{1/2}$ = $[(615^2+460^2)]^{1/2}$ =
Horizontal distance (HD) = 768 m
Inclination (slope) = $\tan^{-1}$ (Δz/HD) = $\tan^{-1}$ (-95/768) = -7° (sloping down)

(25 p) 3. The coordinates of a four sided property are given as follows. Draw the shape by using a scale of 1/1000 and determine its area (m^2) by using trapezoidal area method.

Point	E (m)	N (m)
A	33	87
B	107	18
C	27	56
D	22	67



Answer :

Area ABCD = Area A'ABB'-(Area A'ADD'+Area D'DCC'+Area C'CBB')

= ½ {(E_A+E_B)(N_A-N_B)-[(E_A+E_D)(N_A-N_D)+(E_D+E_C)(N_D-N_C)+(E_C+E_B)(N_C-N_B)]}

= ½ {(33+107)(87-18)-[(33+22)(87-67)+(22+27)(67-56)+(27+107)(56-18)]}

= ½ {(140*69)+[(55*20)+(49*11)+(134*38)]} = ½ [9660- (1100+539+5092)]

= ½ (9660-6731)

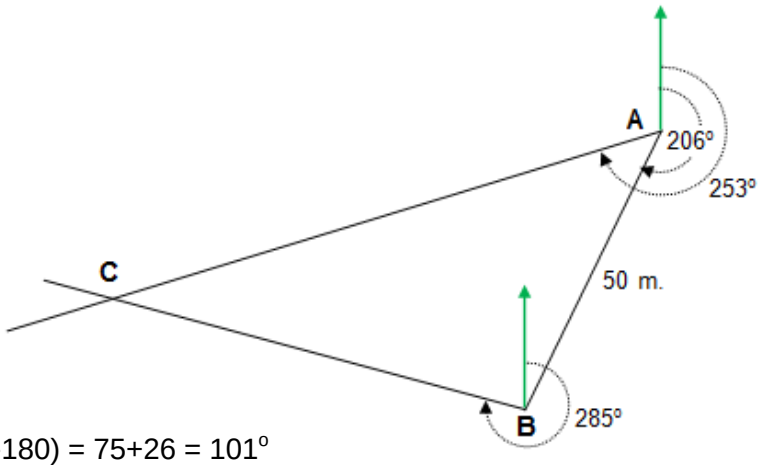
Area ABCD = 1464.5 m^2

(15 p) 4. Following measures were obtained from a triangular property with the corners A, B and C.

Determine its area in m^2 by using S=1/2*a*b*sinα and $\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$

Azimuth AB = 206° Azimuth AC = 253° Azimuth BC = 285° Side AB = 50 m.

Answer :



Angle A = 253-206 = 47°

Angle B = (360-285) + (206-180) = 75+26 = 101°

Angle C = (285-253) or [180-(101+47)] = 32°

$\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$ where a=BC, b=AC, c=AB then

BC = AB*(sin A/sin C) = 50*(sin 47/sin 32) = 50*0.73/0.53 = 50*1.38 = 69.00 m.

Area of ABC = 1/2*AB*BC*sin α = ½*50*69*sin 101 = 1725*0.982 = 1693.3 m^2

Area of ABC = 1693.3 m^2

(40 p) 5. A five sided closed traverse was measured and the following readings were obtained. The interior angles (given as angle to the left) and side distances are given in the table. Also given Azimuth of AB = 46° Northing of A : 235 m. Easting of A : 150 m.

a) Calculate angular misclose and then adjust the interior angles.
b) Compute azimuth angles according to adjusted interior angles.
c) Compute the coordinates of each point starting with given coordinates of point A and find linear misclose at point A.
d) Determine accuracy of the measurement.
e) Adjust departure (ΔE) and latitude (ΔN) for each side according to compass rule.
f) Determine corrected coordinates of the points.

Answer :

Pnt	Side	Side L.	Int.Ang	Adjust Int.Ang	Azi.	Dep.	Lat.	Coordinates		Compass Rule Correction		Corrected		Corrected Coordinates	
		(m)	(Deg)	(Deg)	(Deg)	(meter)	(meter)	Easting	Northing	in dep.	in lat.	Dep. (meter)	Lat. (meter)	Easting	Northing
A			81.00	80.00				150.000	235.000					150.000	235.000
	AB	87.00			46.00	62.583	60.435			0.664	-0.389	63.247	60.046		
B			123.00	122.00				212.583	295.435					213.247	295.046
	BC	120.00			104.00	116.435	-29.031			0.916	-0.537	117.352	-29.568		
C			76.00	75.00				329.018	266.405					330.599	265.478
	CD	65.00			209.00	-31.513	-56.850			0.496	-0.291	-31.016	-57.141		
D			122.00	121.00				297.505	209.554					299.583	208.337
	DE	108.00			268.00	-107.934	-3.769			0.825	-0.483	-107.109	-4.252		
E			143.00	142.00				189.571	205.785					192.473	204.085
	EA	53.00			306.00	-42.878	31.153			0.405	-0.237	-42.473	30.915		
A								**146.693**	**236.938**					**150.000**	**235.000**
		433.00	**545.00**	**540.00**		**-3.307**	**1.938**			**3.307**	**-1.938**	**0.000**	**0.000**		

a) 81+123+76+122+143 = 545° Misclose =545-(5-2)*180 = 5 degree
then -1 degree from each interior angle

b) $Az._{BC}$ = (46+180)-122 = 104 $Az._{CD}$ = (104+180)-75 = 209
$Az._{DE}$ = (209+180)-121 = 268 $Az._{BC}$ = (268+180)-142 = 306

c) Departure = Side length*Sin (Az) Latitude = Side length*Cos (Az)
For side AB, Dep_{AB} = 87*Sin (46) = 62.583 Lat_{AB} = 87*Cos (46) = 60.435
After calculating all departures and latitude we sum up them to see any misclose
Sum Dep = -3.307 Sum Lat = 1.938 (miscloses)
Linear misclose = $[(\text{Dep mis})^2+(\text{Lat mis})^2]^{1/2}$ = $[(-3.307)^2+(1..938)^2]^{1/2}$ = $[14.692]^{1/2}$ = 3.833 m
Az of misclose = $\tan^{-1}$ (-3.307/1.938) = -59.63° (4th quadrant) therefore
Az of misclose = -59.63° +360 = 300.37° (4th quadrant)

d) Accuracy = Linear misclose/total perimeter = 3.833/433 = 1/113

e) For side AB (acc to Compass rule) Hint : correction must be opposite of mistake (misclose)
Correction in departure = (87/433)*3.307 = 0.664
then corrected deparature of AB = 62.583+0.664 = 63.247
Correction in latitude = (87/433)*(-1.938) = -0.389
then corrected latitude of AB = 60.435-0.389 = 60.046
check, sum of corrections provide total misclose in both departure and latitude

f) Corrected coordinates of side AB
Easting B = Easting A+Dep_{AB} = 150+63.247 = 213.247 m
Northing B = Northing A+Lat_{AB} = 235+60.046 = 295.046 m