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Name: _____

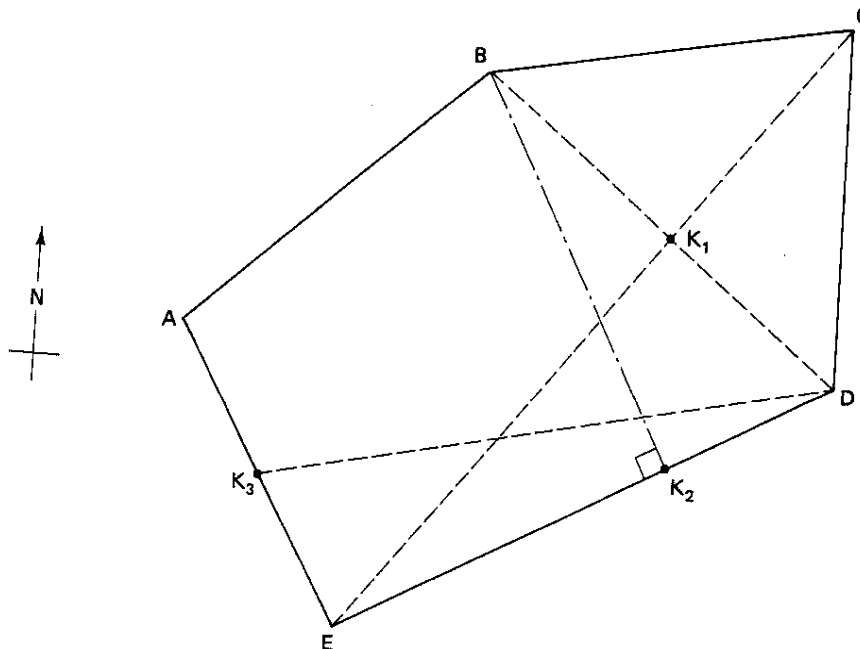
CEEn 113
Exam #2
Fall Semester 2006

INSTRUCTIONS: Closed book. Closed notes. Calculator allowed. Except as required for a particular problem, answer on separate paper. Clearly label each problem and answer. Show all your work. You may receive partial credit even if you don't get the correct answer for a problem but you must be neat and orderly in the solution. If I can't follow your work, you won't get partial credit. It may help you solve the problem and help me follow your work if you make a sketch for some of the problems.

This exam has a time limit of 2 hours 30 minutes. The testing center will have time out and time in stamps. Don't keep working beyond the time limit. I will not score the exam if the time stamps show that you had it for more than 2 hours 10 minutes.

Problem 1 (15 points)

Given the coordinates of Points A through E as shown below, calculate the coordinates of Point K_1 .



Station	Coordinates	
	North	East
A	1000.00	1000.00
B	1250.73	1313.61
C	1302.96	1692.14
D	934.77	1684.54
E	688.69	1160.27

Problem 3 (15 points)

The coordinates of Point A are N=700, E=650. The coordinates of Point B are N=1100, E=1250. Point C lies on the northerly side of the line A to B. Distance from A to C is 434.50. Distance from B to C is 458.10. Calculate the N and E coordinates of Point C.

Problem 4 (10 points)

Using a total station you are collecting data for a topographic map. The station is set up over a known Point A with coordinates of N=1000, E=1000, Elev=1000. The optical center of the station is 4.88 feet above the Point A. The center of the prism is 4.88 feet above the bottom of the rod. Your rodman holds the prism rod vertically on Point B. You sight on the prism and measure an azimuth angle of $168^{\circ}27'$ and a zenith angle of $82^{\circ}14'$. What are the N, E and Elev of Point B?

slope distance = 300.00 ft

Problem 5 (20 points)

Given a simple circular horizontal curve connecting two tangents on a highway centerline with $\Delta=12^{\circ}50'$, $D_a=12^{\circ}$, PI station = 241+78. Calculate the stations of PC, PT, and the deflection angles and long chord lengths from PC to each half station (i.e. station 241+00, 241+50, 242+00, etc.) along the entire length of the curve.

Problem 6 (20 points)

Before excavation of a borrow pit, the ground surface elevation (in feet) was measured at each point on a 50-ft grid as shown on the next sheet. When excavation was complete the ground surface elevation (again in feet) at each point on the same grid was measured. The top number at each grid point is the elevation before excavation. The bottom number is the elevation after excavation. (a) On the grid, sketch a contour map of the site before excavation. Use a 1-foot contour interval. (b) Calculate the volume (in cubic yards) of earth removed from the site.

①

inverse between E + D

$$\text{lat ED} = 934.77 - 688.69 = 246.08$$

$$\text{dep ED} = 1684.54 - 1160.27 = 524.27$$

$$\text{brng ED} = \text{atan} \frac{\text{dep}}{\text{lat}} = \text{atan} \frac{524.27}{246.08} = \text{N } 64^{\circ} 51' 21'' \text{ E}$$

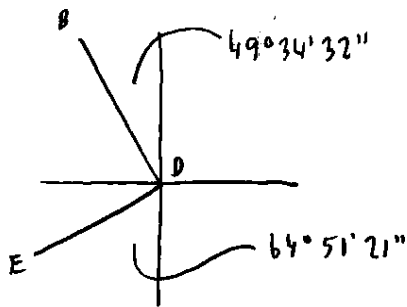
$$\text{dist ED} = \sqrt{\text{lat}^2 + \text{dep}^2} = 579.15$$

brng D to B

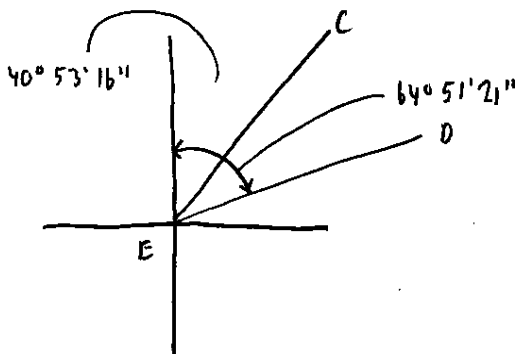
$$\text{brng} = \text{atan} \frac{\text{dep}}{\text{lat}} = \text{atan} \frac{1313.61 - 1684.54}{1250.73 - 934.77} = \text{N } 49^{\circ} 34' 32'' \text{ W}$$

brng E to C

$$\text{brng} = \text{atan} \frac{1692.14 - 1160.27}{1302.96 - 688.69} = \text{N } 40^{\circ} 53' 16'' \text{ E}$$



$$\begin{aligned} \angle EDB &= 180^{\circ} - 49^{\circ} 34' 32'' - 64^{\circ} 51' 21'' \\ &= 65^{\circ} 34' 07'' \end{aligned}$$



$$\begin{aligned} \angle CED &= 64^{\circ} 51' 21'' - 40^{\circ} 53' 16'' \\ &= 23^{\circ} 58' 05'' \end{aligned}$$

$$\angle EK, D = 180^{\circ} - 65^{\circ} 34' 07'' - 23^{\circ} 58' 05'' = 90^{\circ} 27' 48''$$

Law of Sines

$$\frac{ED}{\sin \angle EK, D} = \frac{K, D}{\sin \angle EDK,} \quad K, D = 235.28$$





$$\text{lat } DK_1 = \cos(49^\circ 34' 32'') 235.24 = 152.57$$

$$\text{dep } DK_1 = \sin(49^\circ 34' 32'') 235.24 = -179.11$$

Coordinates of K_1

$$N = 934.77 + 152.57 = 1087.34$$

$$E = 1684.54 - 179.11 = 1505.43$$

1087.34
1505.43

Check:

$$\frac{579.15}{\sin 89^\circ 27' 48''} = \frac{K_1 E}{\sin 65^\circ 34' 07''} \quad K_1 E = 527.31$$

$$\text{lat } EK_1 = \cos(40^\circ 53' 16'') 527.31 = 398.64$$

$$\text{dep } EK_1 = \sin(40^\circ 53' 16'') 527.31 = 345.17$$

Coordinates of K_1

$$N = 688.69 + 398.64 = 1087.33$$

$$E = 1160.27 + 345.17 = 1505.44$$

1087.33
1505.44

③

Inverse A to B

$$\text{lat } AB = 1100 - 700 = 400$$

$$\text{dep } AB = 1250 - 650 = 600$$

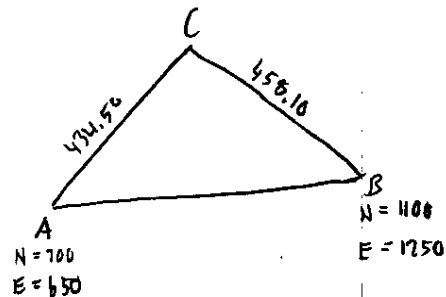
$$\text{dist} = \sqrt{400^2 + 600^2} = 721.11$$

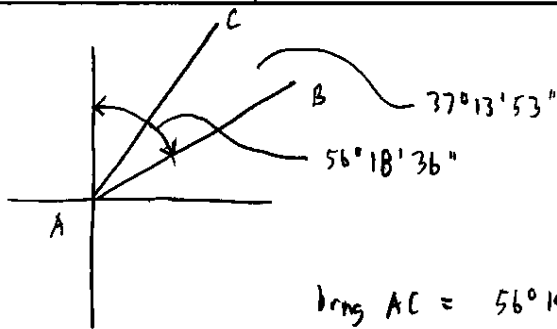
$$\text{brng } AB = \arctan \frac{\text{dep}}{\text{lat}} = \arctan \frac{600}{400} = N 56^\circ 16' 36'' E$$

Law of cosines:

$$a^2 = b^2 + c^2 - 2bc (\cos A)$$

$$454.10^2 = 434.10^2 + 721.11^2 - 2(434.10)(721.11)(\cos A) \quad A = 37^\circ 13' 53''$$





$$\text{brng } AC = 56^{\circ}18'36'' - 37^{\circ}13'57'' = N 19^{\circ}04'43'' E$$

$$\text{lat } AC = \cos(19^{\circ}04'43'') 434.50 = 410.63$$

$$\text{dep } AC = \sin(19^{\circ}04'43'') 434.50 = 142.02$$

Coordinates of C:

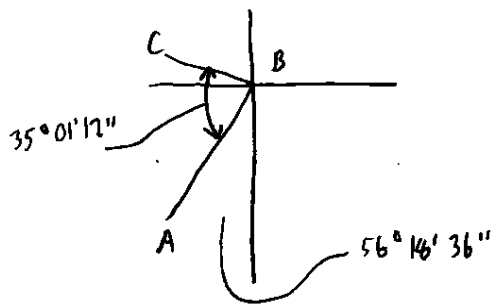
$$N = 700 + 410.63 = 1110.63$$

$$E = 650 + 142.02 = 792.02$$

Check:

$$b^2 = a^2 + c^2 - 2ac(\cos B)$$

$$434.50^2 = 458.10^2 + 721.11^2 - 2(458.10)(721.11)(\cos B) \quad B = 35^{\circ}01'12''$$



$$\text{brng } BC = 180^{\circ} - 56^{\circ}18'36'' - 35^{\circ}01'12''$$

$$= N 88^{\circ}40'12'' W$$

$$\text{lat } BC = \cos(88^{\circ}40'12'') 458.10 = 10.63$$

$$\text{dep } BC = \sin(88^{\circ}40'12'') 458.10 = -457.98$$

Coordinates of C

$$N = 1100 + 10.63 = 1110.63$$

$$E = 1250 - 457.98 = 792.02$$

(4)

Assume $SD = 300$

Find N, E, Elev of Point B

$$VD = \cos Z(SD) = \cos(82^\circ 14') 300 = 40.54$$

$$HD = \sin Z(SD) = \sin(82^\circ 14') 300 = 297.25$$

$$168^\circ 27' = S 11^\circ 33' E$$

$$\text{lat } BA = -\cos(11^\circ 33') 297.25 = -291.23$$

$$\text{dip } BA = \sin(11^\circ 33') 297.25 = 59.52$$

Coordinates of A:

$$N = 1000 - 291.23 = 708.77$$

$$E = 1000 + 59.52 = 1059.52$$

$$\text{Elev} = 1000 + 40.54 = 1040.54$$

(5)

$$R = \frac{5729.58}{D_a} = \frac{5729.58}{12} = 477.47$$

$$T = R \tan \frac{\Delta}{2} = (477.47) \tan \frac{12^\circ 50'}{2} = 53.70$$

$$\begin{aligned} \text{PC sta} &= \text{PI sta} - T = 241 + 78 \\ &= \frac{53.70}{241 + 24.30} \end{aligned}$$

$$L = 2\pi R \frac{\Delta}{360} = 2\pi (477.47) \frac{12^\circ 50'}{360} = 106.95$$

$$\begin{aligned} \text{PT sta} &= \text{PC sta} + L = 241 + 24.30 \\ &= \frac{1 + 06.95}{242 + 31.25} \end{aligned}$$

$$\text{defl/ft of arc} = \frac{\Delta/2}{L} = .06^\circ$$





Station	Dist	SC Defl	LC Defl	LC
PC 241+24 ³⁰				
241+50	25.70	1°32'31"	1°32'31"	25.70
242+00	50.00	3°00'00"	4°32'31"	75.62
242+31 ²⁵	31.25	1°52'30"	6°25'01"	106.72

check $\approx \frac{A}{2}$

⑥ Squares Σ corners = 1805.8
 $\div 4$
 451.45
 $\times 2500$
 1128625 ft³

Small triangles Σ corners = 35.9
 $\div 3$
 11.97
 $\times 2500$
 14962 ft³

Large triangles Σ corners = 42.3
 $\div 3$
 14.1
 $\times 2500$
 35250 ft³

1128625
 14962
35250

1178837 ft³
 $\div 27$

43660 yd³

