CEEN 113-1   Engineering Measurements   Final Exam   Fall 1999
Open Book, Closed Note, Calculator Required
3 Hour Time Limit 1 point deduction for every two minutes over

1. (5 pts) Your boss has asked you to quickly estimate the area of a **rectangular** property by pacing. You pace the larger of the sides three times and count your paces to be 41, 43, and 48. You pace the smaller of the sides three times and count your paces to be 32, 33, and 32 (it is a rectangle so you only need to pace two of the sides). If your calibrated pace is 2.73 feet, what area for the property (sq ft) will you report to your boss?

> 10600 sq. feet

2.   (12 pts) Using the following set of field notes (the top values represent rod readings with the given HI, and the bottom values are distances left/right of the center line) determine the slope intercepts on both the left and right side of the roadway centerline.   The **roadway** for this cross section is a 30-ft wide level roadbed with cut slopes of 1.5:1 at an elevation of 858.9 ft.

| HI = 879.3		12.0	8.4	4.6	2.4	10.3	6.5	
	Left	50	36	20	CL	12	50	Right

3.

> Left 33.8' left of CL at elev 871.4

> Right 33.4' right of CL at elev 871.1

(10 pts) You are interested in determining the height of a building. You are unable to place a prism on top of the building and measure slope distance so instead you use a 100 foot steel tape to measure the distance (247.89 feet) from where you have set up a theodolite to the building (hi = 4.36'). You then turn a vertical angle (41°21'13") from this point to the top of building. a) What is the height of the building? b) If the tape measure you are using is actually 100.06 feet, what is the corrected horizontal distance measured? (You should use the uncorrected distance of 247.89 feet for the calculation in part a).

Height = 222.55
Correct distance = 248.04

41°21'13"

247.89'

4.36 ft
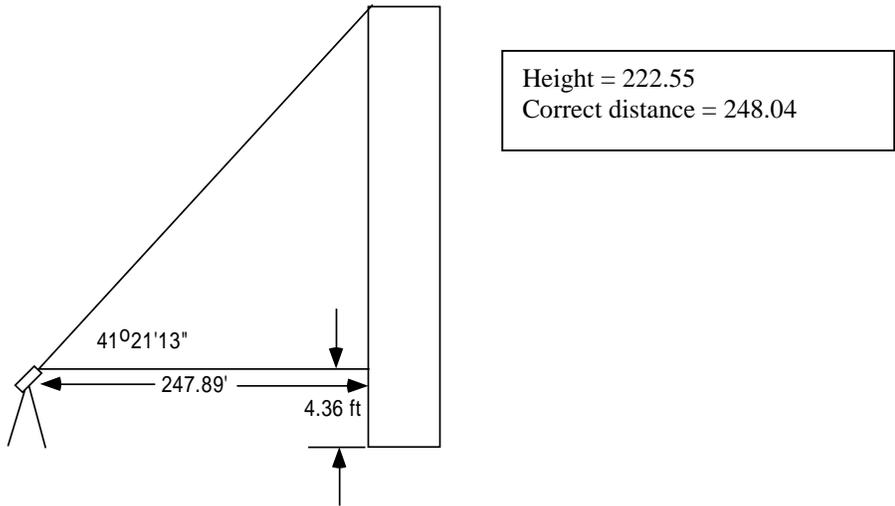
4. (5 pts) Compute the area (sq. feet) of the cross-section shown below (HINT: Set it up to use the coordinate area method).

CL

33.8'

20.0'

12'

33.3'

12.5'

15.8'

18.0'

10.1'

12.2'

15'

15'
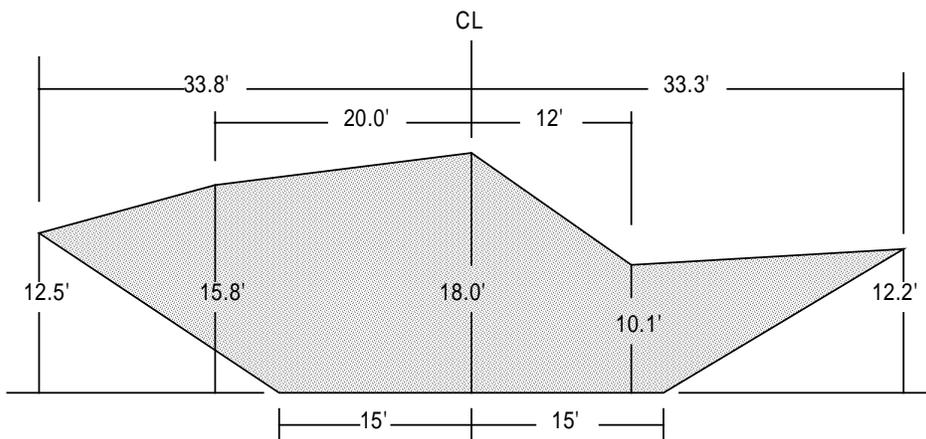
A = 710.2 sq. ft.

5. (5 pts) If two consecutive cross-sections 80 feet apart have areas of 336 sq. ft. (fill) and 187 sq. ft. (fill), what is the approximate volume (in cubic yards) of fill required?

775 cubic yards

6. (10 pts) Determine the volume (in cubic feet) taken from the borrow pit shown in the diagram below if the grid cells are 50 feet by 50 feet and the numbers represent the amount of cut in feet (NOTE: the irregular sections can be determined by observing that the line on the bottom begins 50 feet from the right and connects to a point half way between the bottom and the top of the pit).

2.8   3.7   3.9   3.3

3.4   4.2   3.7   2.9

2.9

2.6   3.1   2.9   2.8

2.7

2.2   2.4
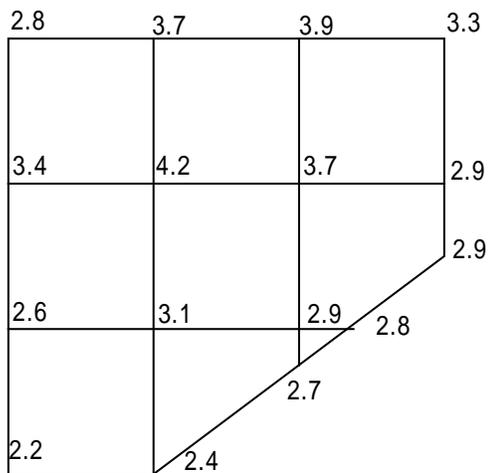
60,346 cu ft or 60,300 cu ft
Other answers that were close were acceptable because there is more than one way to do this.

7. (5 pts) What present magnetic bearing is needed to retrace a line for the conditions stated in the following problems.

| 1875 Magnetic Bearing	1875 Declination	Present Declination	Present Magnetic Bearing
N75°25'E	3°30'E	2°20'W	

N78°55'E and N81° 15'E

8. (5 pts) A sanitary sewer is to be constructed from an existing MH #1 (invert elevation = 139.28 ft.) @ .5 percent slope (that is .5ft/100feet) **downhill** for a distance of 347 ft. to proposed MH #2. The elevations of the offset grade stakes are as follows: 0+00=148.21, 0+50=149.02, 1+00=147.78, 1+50=147.14, 2+00=146.54, 2+50=148.63, 3+00=148.27, 3+47=147.98. Prepare a grade sheet showing stake-to-batter-board distances in feet. Use a 12 foot grade rod for your calculations.

Cuts
8.93
9.99
9.00
8.61
8.26
10.6
10.49
10.43

9. (5 pts) Using the two maps below indicate (with one x on each map) where the NE1/4, SE1/4, Section 21, T2S, R4E would be.

Prime Meridian

One Township

Base Line
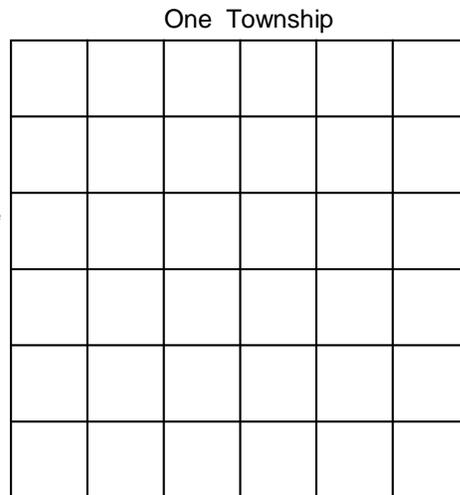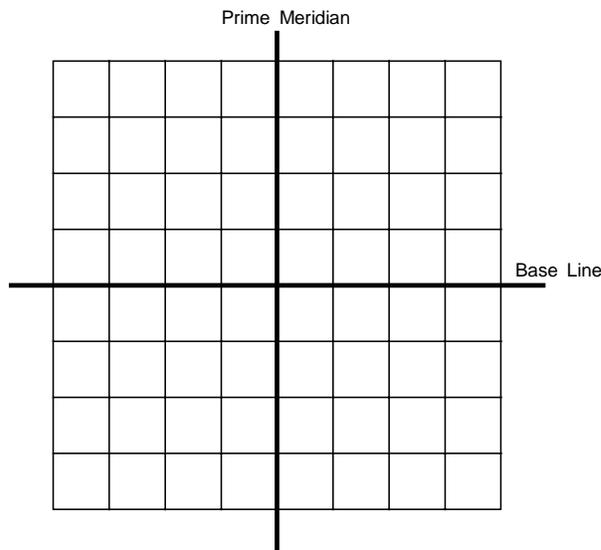
8. (5 pts) Given the two interior angles shown, and the bearing of line AB as S23°13'W, compute the bearing and North Azimuth of ine CD.

B

32°31'

N23°13'W

A

C

105°47'

D
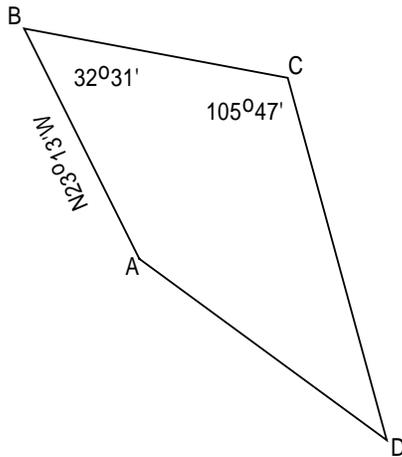
Bearing S18°29'W
Azimuth 198°29'

9. (5 pts) If the coordinates of point A in the same figure as is used in problem 10 are (320.54, 872.63), and the distance AB is 253.81 ft., find the X,Y coordinates at B?

Bx=220.49, By=1105.89

10. (5 pts) The PI of a horizontal curve is at station 77+81.37. The degree of the curve, D=5°28' (arc definition), and the angle of intersection I=11°38' (we have also called this the deflection angle, Δ). Determine the BC, and EC of the curve?

PC=76+74.60, PT=1105.89

11. (10 pts) For a vertical curve g1=2.75% meets g2=-2.25% at station 50+50 and elevation 975.50 ft. If the equal-tangent curve is 1000 ft. long, find the station and elevation of the high point.

PVI=50+50 at elev 975.50

g_1=2.75%

g_2=-2.25%

1000'
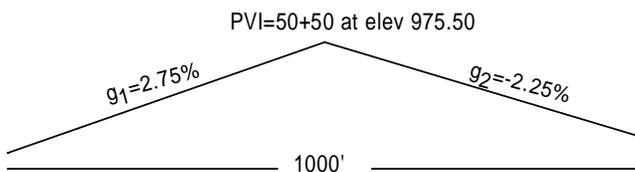
Station = 51+00
Elevation = 969.31

12. (13 pts) You set up over point P and determine the distance from P to A to be 726.56 ft., the distance from P to B to be 1165.46 ft., and the angle from A to B to be 44°29'07". If the X,Y coordinates at point A are (243.7, 828.4), and at B are (972.9, 1210.8), compute the coordinates at P, and the angle (to the nearest second) you must turn from line PA so that you will be directed due North (this problem is very similar to the one you had to solve when collecting elevation points for your topographic map). **NOTE**: If you solve for the interior angle at A recognize that it is greater than 90°(for example the sin(80) = sin(100)).

N

B

Px = 496.4
Py = 147.2

A

726.56'

1165.46'

44°29'07"

P