NAME_____   Score_____

CEEN 113 Sections 1-6   Engineering Measurements   Dr. Nelson   Exam #2 Fall 2001
November 15-19 (Late fee on November 19th)
CLOSED BOOK - CALCULATORS REQUIRED – EQUATION SHEET PROVIDED AT END
Any answer requiring an angle should be given in Degrees-Minutes-Seconds format.
For the most part these problems are all or nothing so be careful. Clearly identify your answer, but I still
suggest you show your work.

1. Calculate the Azimuth for BC and CD from the following diagram (8 pts).

North

Az = 64°32'   97°23'

147°48'

A   C

D
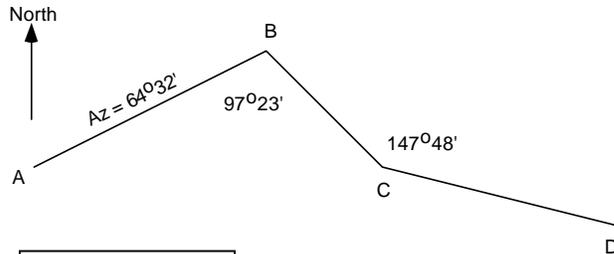
Az BC 147°09'
Az CD 114°57'

2. A grade g_1 of –2.00% passes station 26+00.00 at an elevation of 861.22 ft., and a grade g_2 of
    +2.35% passes station 53+00.00 at an elevation of 848.86 ft. Compute the station and
    elevation of the point of intersection of these two grades. **Hint**: The 27 stations between the
    two given elevations do not define the length of a vertical curve. You are only asked to find
    the PVI in this case from which an appropriate equal-length vertical curve could be defined.
    (7 pts).

Station 43+42.76
Elevation 826.36 ft

3. Calculate the area of the thirty-foot wide roadway cross section in the diagram below. The grid squares represent 10 feet horizontal and 2 feet vertical (i.e. the vertical scale is exaggerated by a factor of 5). (8 pts).
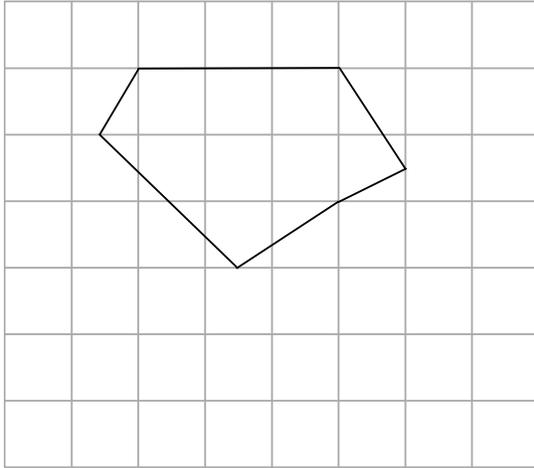
170 ft^2

4. Calculate the slope intercepts at the left and right of a 30 foot roadway at elevation 102.0 with 3:1 side slopes for the existing ground elevation data shown in the table below. (10 pts)

Distance from Center line	Ground Elevation (ft)
50 feet left	100.9
25 feet left	103.1
Centerline	103.8
25 feet right	105.2
50 feet right	102.5

Left x = 18.82
   y = 103.27
Right x = 24.52
   y = 105.17

5. For a horizontal circular curve, the PI is at station 43+28.30, I is 27°10', and the degree of curve D is 4°10'. Compute the following curve information: (15 pts)

a) R [1375.10].

b) PC [39+96.05].

c) PT [46+48.05].

d) Deflection angles to the nearest second from the PC to the point on the curve for the first full 100-foot station after the PC and the last full 100-foot station before the PT.

At 40+00 0°04'56"
At 46+00 12°34'56"

6. For the vertical curve shown below determine the required elevation and or station information listed on the answer sheet. g_1=5.2%, g_2=-1.8%, the PVI is at station 47+00 at an elevation of 532.45, and the length of the curve is 900 feet (15 pts).

L = 900 ft.

g_2 = -1.8%

PVI

g_1 = 5.2%

PVT

PVC

PVI 47+00 at elev. 532.45
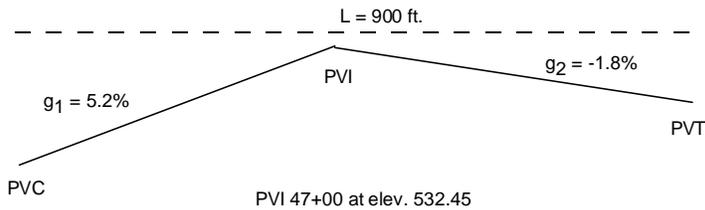
a) Station and elevation of the PVC = [42+50   509.05].

b) Station and elevation of the PVT = [51+50   524.35].

c) The elevation at station 45+50 = [521.15].

d) Station and Elevation of the high point on the curve [49+18.6   526.43].

7. A horizontal curve is to be run through point A as shown in the figure below. From the PI the distance to point A is 85.82 feet and the angel from the back tangent to a line from the PI to point A is 21°10'. If I is 62°00', determine the values of R and T (The three dashed lines drawn to point A are provided as a hint to help you solve the problem). (10 pts)
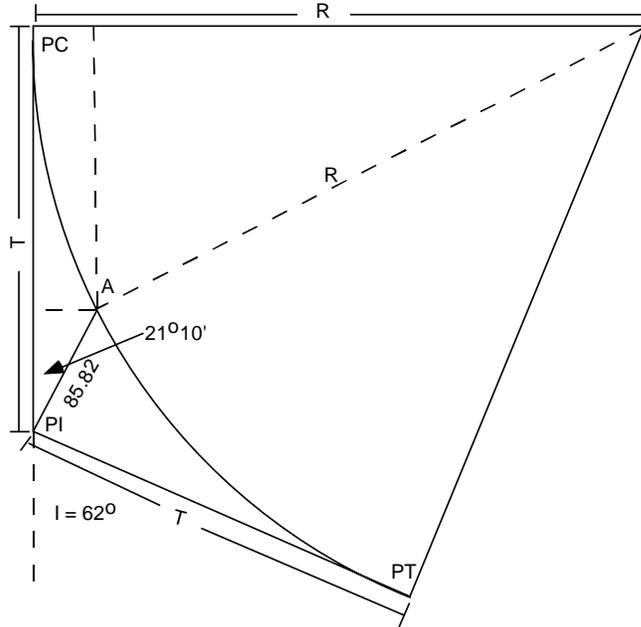

R = 385.05
T = 231.38

8. The following table lists the cross sectional areas of several cross sections along a proposed roadway development. Estimate the total volume (cubic yards) of cut and fill (two separate values) for this development. Clearly state any assumptions about transitions from cut to fill. (6 pts)

Station	Cut Area (ft^2)	Fill Area (ft^2)
13+00	110	
14+00	58	
15+00		29
16+00		85
17+00		76

Cut = 359 yd^3
Fill = 521 yd^3

9. In the diagram below you are given that the coordinates of point A are (100.00,100.00) and point B are (140.00, 190.00). You occupy point C and measure the angle between lines CA and BA to be 61°15'37" and the distances CA = 111.80 ft and CB = 63.25 ft. Find the coordinates at C and the azimuth of line CA. (12 points)

C

63.25

61°15'37"

B (140.00, 190.00)

111.80

North

A (100.00, 100.00)

Cx = 80
Cy = 210
Az = 169°41'35"
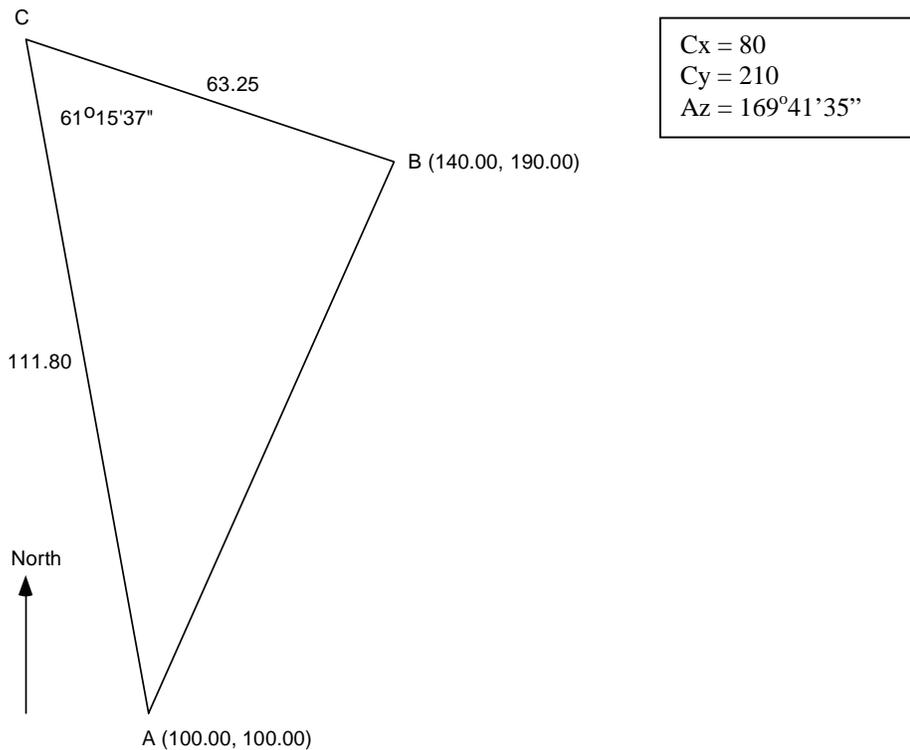
10. You are collecting topographic data to create a contour map using radiation. You determine that the coordinates of the point you are set up over are (100.00, 100.00) with an elevation of 100.00 (all measurements are in feet). You then measure an Azimuth angle of 187°14'31", a Zenith angle of 78°51'49", and a slope distance of 76.32 feet to a point you wish to include in your map. Calculate the X, Y, coordinates of the point and it's elevation. (9 points)

X = 90.56
Y = 25.72
Elevation = 114.74

Equations:

Horizontal Curves

$$R = \frac{5729.58}{D}$$

$$T = R\tan\left(\frac{I}{2}\right)$$

$$LC = 2R\sin\left(\frac{I}{2}\right)$$

$$L = \frac{RI\pi}{180}$$

Vertical Curves

$$TO = d\left(\frac{x}{L/2}\right)^2 \quad \text{(where TO is the tangent offset)}$$

Parabolic equation:

$$y = \frac{1}{2}rx^2 + g_1 x + elevPVC$$