NAME_____   Score_____

CEEN 113-1   Engineering Measurements
Dr. Nelson
Exam #1   Spring 1997
Use the space given to answer the questions, you may wish to use scratch paper for calculations.
CLOSED BOOK - CALCULATORS REQUIRED

Section I - Answer the following True/False questions by circling either T or F (10 pts)

T F Errors due to refraction are larger than errors due to curvature.
T F It is possible to determine and angle to 30" even if you are using a 01' transit.
T F Horizontal distances can not be determined with a level.
T F Reciprocal leveling is performed by setting your instrument up at approximately the midpoint
       between the backsight and the foresight.
T F If a rod is out of plumb, the most correct rod reading will be the highest reading observed.

Section II - Short Answer (20 pts)

A) What type of triangle is the most preferable to use when prolonging a straight line by triangulation?

B) Briefly describe how you could find the intersection of the centerlines of two streets?

C) Roughly sketch a vertical line, a level line, and a horizontal line?

D) If a line of sight has an azimuth of $194^o34'$ what is its bearing? What is its back azimuth?

E) Besides the derived formulas, how can curvature and refraction errors in leveling be eliminated?

F) How does a measurement with a repeating theodolite differ from one taken with a directional
     theodolite?

G) What do TP, BM, BS, and IS stand for?

H) Sketch a deflection angle of 35° L.

I) In the figure below the circle represents a bulls-eye level and the three lines legs of a tripod. Which leg should you adjust to try and center the bubble?
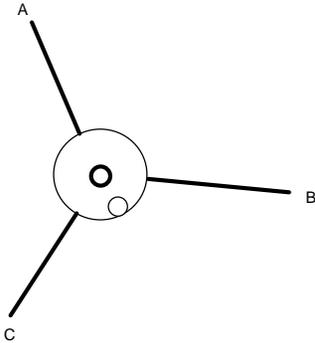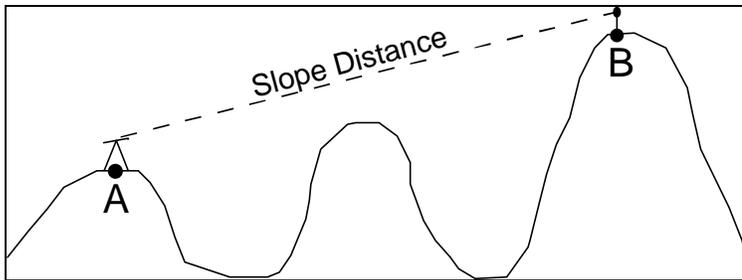

Section III - Problems (70 pts)

A. (6 pts) Solve for r, x, and y in the right triangles shown below.
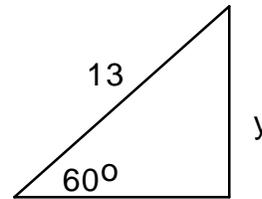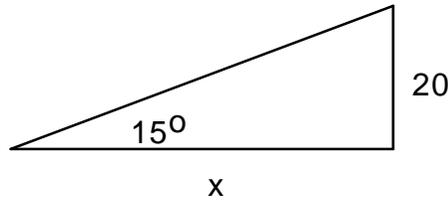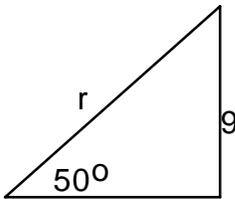
ANSWER_r = _____**x =** _____ **y =** _____

B. (4 pts) Given the diagram below with the following information:


Elevation at A: 6321.42 ft.
Slope Distance: 1568.32 ft.
Zenith Angle: $79°15'36"$

Determine the elevation of B.

ANSWER_____

C. (5 pts) Using a clinometer, Bob measures a 35° vertical angle to Joe standing on top of a nearby hill. It took Joe 82 paces to get to the top of the hill and 76 paces coming back. If Joe's calibrated pace is 2.75 ft/pace, what is the approximate height of the hill Joe climbed from where Bob stands?
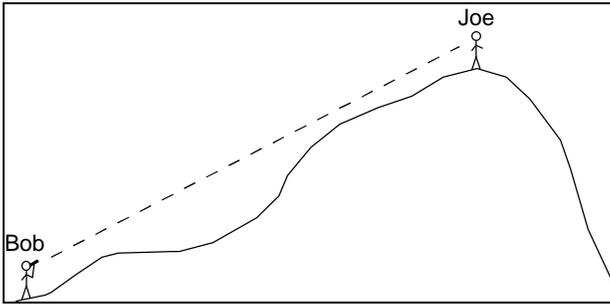
ANSWER_____

D. (10 pts) You send a crew to perform a level loop. The crew begins at a bench mark of known elevation = 213.333 feet and runs a level loop back to the same bench mark. The crew recorded the following field notes for their work but didn't have time to finish the notes before quitting time. Your boss wants you to check their work before you leave the office. All units are in feet, distances are cumulative.

1) Complete the field notes, including proper arithmetic checks.

2) What order of accuracy did the crew perform if the loop distance was 1000 feet?

ANSWER_____

Point	B.S.	H.I.	F.S.	Elev.
BM #1	2.71			573.22
TP #1	3.62		4.88	
TP #2	3.51		3.97	
TP #3	3.17		2.81	
TP #4	1.47		1.62	
BM #1			1.21	

E. (10 pts) You are using stadia to make measurements. The upper stadia hair has a reading of 10.37 feet and the lower stadia hair has a reading of 7.11 feet on the distant rod. The zenith angle to the center cross hair measures 86°52'49" and the center cross hair is on 8.74 feet.
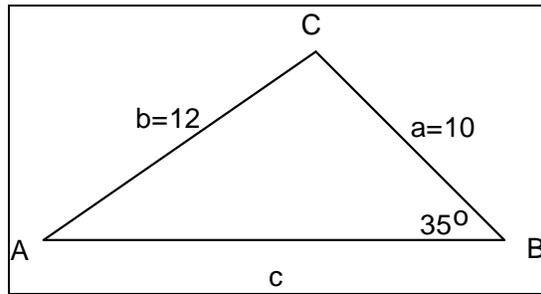
What is the horizontal distance between instrument and rod?

ANSWER_____

What is the difference in elevation between the ground directly under the instrument and the ground base of the rod (the instrument height is 6.81 ft.)?

ANSWER_____

F. (5 pts) Given the information shown in the figures below, find the remaining sides and angles of the triangle

   ANSWER_____

G. (5 pts) A triangular parcel of land has 375 feet of frontage, and the other boundaries have lengths of 250 feet and 300 feet. What angles does the frontage make with the other two boundaries?

   ANSWER_____

H. (5 pts) While using a directional theodolite, you sight on a point Q and read an angle of 245°13'41". You want to turn a clockwise angle of 156°06'12" in order to set point R. What angle must you read on your theodolite in order to properly set point R? Show a sketch of the points.

   ANSWER_____

I. (10 pts) A four sided closed traverse has the following angles and distances:
   A = 51°23'   AB = 713.93 ft.
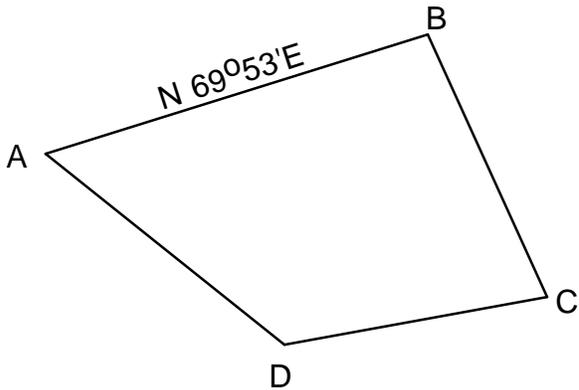   B = 105°39'   BC = 606.06 ft.
   C = 78°11'   CD = 391.27 ft.
   D = 124°47'   DA = 781.18 ft.

   Does the traverse check for angular closure?

Compute both bearings and azimuths for all four sides.

J.   (10 pts) With reference to the figure shown below, a top-mounted EDM is set up at station A where the elevation is 432.35 ft. Using the following values, compute:

a)   the horizontal distance from A to B

   ANSWER_____

a)   the elevation at B

   ANSWER_____

Given: The optical center of the theodolite is 4.92 ft (hi) above station A. An angle of -38°13'27" was measured to the target, which was 4.83 ft. above station B. The EDM center is .50 ft (Δhi) above the theodolite and the reflecting prism was 1.43 ft. (ΔHR) above the target. The slope distance was recorded as 632.49 ft. (Some of the dimensions in the figure have been exaggerated in order to help visualize the relationships).
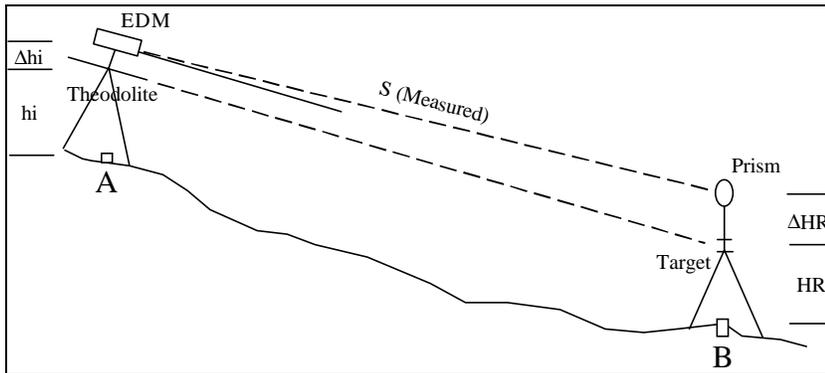
Equations

Stadia

D = 100S

H = 100S'cos²θ

V = 100S'cosθsinθ

Law of Sines and Cosines

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc(\cos A) \qquad \text{or} \qquad \cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$$b^2 = a^2 + c^2 - 2ac(\cos B) \qquad \text{or} \qquad \cos B = \frac{a^2 + c^2 - b^2}{2ac}$$

$$c^2 = a^2 + b^2 - 2ab(\cos C) \qquad \text{or} \qquad \cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

Angle Adjustment for EDM Measurements

$$\sin \Delta\alpha = \frac{X \cos \alpha}{S}$$

Survey Classification Standards

First Order: $\pm 4\text{mm} \sqrt{K}$

Second Order: $\pm 8\text{mm} \sqrt{K}$

Third Order: $\pm 24\text{mm} \sqrt{K}$

Conversions

.3048 m/ft

5280 ft/mile