NAME_____   Score_____

CEEN 113-1   Engineering Measurements
Dr. Nelson
Exam #1   Fall 1996
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   Random errors in surveying can be accounted for and corrected.
   T   F   A zenith angle is the angle to a line of sight, measured clockwise from North.
   T   F   Three wire leveling is based on stadia measurements.
   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 lowest reading observed.
   T   F   If a correction for inclined stadia readings is not made, the computed distance using the formula D = 100S will always be too long.
   T   F   When prolonging a straight line by triangulation (using the Law of Sines), a right triangle is more preferable than an isoceles triangle.
   T   F   In the CEEN lab, the Wild theodolite is more accurate than the TOPCON.
   T   F   A prism can be somewhat misaligned with respect to the EDM and still be effective.
   T   F   A level line is a line which is perfectly parallel to a horizontal datum.

Section II - Short Answer (20 pts)

   A)   When measuring with tacheometry, what is the stadia interval coefficient?

   B)   When would you use trigonometric leveling?

   C)   Explain curvature and refraction?

   D)   How can errors associated with curvature and refraction be eliminated?

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

   F)   What does TBM stand for?

   G)   Sketch a deflection angle of 20° L.

   H)   Give two examples of systematic errors.

I) Express the value, (your answer) in powers of 10 to the correct number of significant figures for the following:
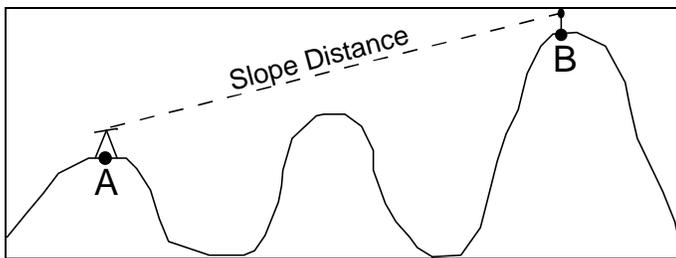
    a) Square of 17638

    b) Quotient of 9430.72 divided by 5.93

J) What three major components make up a total station?

Section III - Problems (70 pts)

A. (5 pts) Given the diagram below with the following information:

Elevation at A: 7248.25 ft.
Slope Distance: 2719.95 ft.
Zenith Angle: $79°15'36"$

Determine the elevation of B.

ANSWER_____

B. (5 pts) Using a clinometer, Bob measures a $15°$ angle to Joe standing on top of a nearby hill. It took Joe 88 paces to get to the top of the hill and 74 paces coming back. If Joe's calibrated pace is 2.75 ft/pace, what is the approximate height of the hill from where Bob stands?
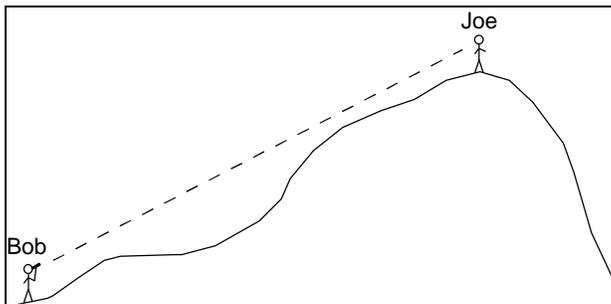
ANSWER_____

C. (15 pts) You send a crew to establish a bench mark to use for the construction of a new bridge. The crew begins at a bench mark of known elevation = 2246.52 and runs a level circuit to the proposed bridge site and back to the original benchmark. 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 the elevation of the new benchmark before you leave the office.

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

2) Neglecting the effects of curvature and refraction, what is the correct elevation of the new bridge benchmark?

ANSWER_____

2) If the total distance traveled on this circuit was 3,482 feet, and the backsights and foresights were reasonably leveled, what order of accuracy did the crew perform?

ANSWER_____

Point	B.S.	H.I.	I.F.S	F.S.	Elev.
BM #1	0.67				2246.52
TP #1	0.23			23.16	
TP #2	0.85			19.43	
TP #3	1.02			21.12	
TP #4	0.59			22.96	
TP #5	3.36			13.47	
Bridge				7.83	
Bridge	6.32				
TP #6	21.72			1.43	
TP #7	18.55			0.84	
TP #8	20.67			0.76	
TP #9	23.14			1.27	
TP #10	18.81			2.14	
BM #1				1.47	

D. (10 pts) You are using stadia to make measurements. The upper stadia hair has a reading of 10.23 and the lower stadia hair has a reading of 2.37 on the distant rod. The zenith angle to the center cross hair measures $83°13'49''$ and the center cross hair is on 6.30

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 5.22 ft.)?

ANSWER_____

E. (16 pts) A steel "Add" tape, under the following standardized (calibrated) conditions, was found to actually be 100.006 ft.: T = 68° F.; w = .02 lb/ft.; A = 0.0060 sq. in.; P = 12-1b; and tape fully supported.

Using this tape in the field, the following conditions and measurements between points A and B were recorded: T = 98° F.; P = 20 lbs.; tape supported at ends only: 100.00 ft., 100.00 ft., 100.00 ft., and 88.79 ft. What is the corrected length of line AB? Show your intermediate corrections.

ANSWER_____

F. (5 pts) While using a directional theodolite, you sight on a point Q and read an angle of 312°52'21". You want to turn a clockwise angel of 87°32'41" 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_____

G. (4 pts) A 10-ft. target rod is used at a station on which a sight is made. If the prism is located on top of the rod and the rod is out of plumb in a direction perpendicular to the line of sight by 1-3/4 inches, what angular (in degrees-minutes-seconds) error is produced in:
a) a 400-ft shot?

ANSWER_____

a) a 150-ft shot?

ANSWER_____

H. (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 -8°24'38" was measured to the target, which was 4.83 ft. above station B. The EDM center is .35 ft (Δhi) above the theodolite and the reflecting prism was .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).
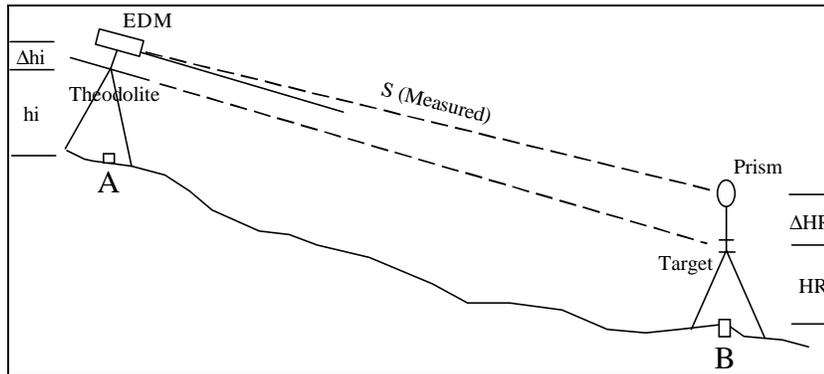
Equations

$$C_t = 0.00000645(T - 68)L \quad \text{(where T is degrees Fahrenheit)}$$

$$C_t = 0.0000116(T - 20)L \quad \text{(where T is degrees Celsius)}$$

$$C_p = \frac{(P - P_s)L}{AE}$$

$$C_s = -\frac{w^2 L^3}{24P^2} = -\frac{W^2 L}{24P^2}$$

$$D = 100S$$

$$H = 100S'\cos^2\theta$$

$$V = 100S'\cos\theta\sin\theta$$

Survey Classification Standards

First Order: $\pm 4\text{mm}\sqrt{K}$ .3048 m/ft

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

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