Part II:
Sample Introductory Course

Sample Syllabus

15-Week, 3 Credit, Semester Course

Required Text: Ghilani, Charles D. and Paul R. Wolf. **Elementary Surveying (An Introduction to Geomatics), 14th Ed**. Prentice Hall, Upper Saddle River, NJ.

Materials:

- Safety vest
- Field book and 3H or 4H pencil
- Computation note pad
- Scientific calculator with 10-digit display
- Engineer's Scale

Grading:

- Homework ... 15%
- Practical exercises20%
- Quizzes (5)..... 5%
- Hour exams (3)30%
- Article reviews (3) 6%
- Portfolio 4%
- Final exam.... 20%

Lecture Schedule

Week	Lecture No.	Subject	Reading	Homework
1	1	Class policies, Introduction	Chapter 1	–
	2	Introduction	Chapter 1	–
2	3	Units Significant Figures	2.1 to 5	2.1, 3, 5, 10, 14
	4	Field Notes	2.6 to 15	–
3	5	Errors - mean, standard deviation, probable error	3.1 to 16	3.3, 6, 11, 16
	6	Error propagation	3.17 to 21	3.19, 21, 27, 30(a)
4	7	Leveling - Theory and Methods	Chapter 4, Part 1	4.1, 4, 13, 16, 18
	8	Leveling - Equipment	Chapter 4, Part 2	4.19, 20, 24, 28

5	–	Exam 1	–	–
5,6	9–10	Leveling - Field Procedures	Chapter 5	5.1, 3, 9, 13, 23
6	11	Taping	Chapter 6,Part 1	6.6, 9, 11, 19, 22
7	12	EDM	Chapter 6, Part 2	6.25, 28(b), 33, 38, 43
	13	Angles, Azimuths, and Bearings	7.1 to 9	7.3, 6, 11, 24, 39
8	14	The Compass and Magnetic Declination	7.10 to 16	7.31, 37
	15	Total Station Instruments	Chapter 8, Part 1	–
9	16	Angle Measurements	Chapter 8, Part 2	8.2, 4, 12, 21, 35
	17	Traversing	Chapter 9	9.5, 10, 12, 13, 24
10	–	Exam 2		
	18	Traverse Computations	Chapter 10	
11	19–20	Traverse Computations	Chapter 10	10.12, 13, 14, 15, 24, 25
12	21–22	COGO – Intersections	11.1 to 6	11.4, 10, 12, 16, 17
13	23–24	COGO – Resection and Coordinate Transformations	11.7 to 11	11.20, 22, 23, 24, 27
14	25	Area by Simple Figures	12. 1 to 12.4	–
	–	Exam 3	–	–
15	26–27	Area by Coordinates	12.4 to 11	12.2, 4, 13, 24, 26

Article Reviews

A short review of journal articles will be due in the following weeks of the course. Possible sources for articles are listed at the end of each chapter in the book. Papers will be graded on completeness of thought, grammar, spelling, and punctuation. All reviews should be word processed and contain the following items.

Citation: See examples of proper citations in the bibliography at the end of each chapter.

Author's thesis: A brief statement or two on the main focus of the article.

Author's argument: A review of the article stating how the author supported the thesis.

Reviewer's opinion:Not all that is written is correct. Write a brief paragraph on why you agree or disagree with the author's thesis and how this article relates to this class.

Week	Subject
2	Problems 1.20 or 21
7	Write an article review on one of articles listed in the bibliography for Chapter 4.
12	Write an article review on one of articles listed in the bibliography for Chapter 8.

Practical Exercises (Refer to the list of Sample Practical Exercises on the following pages.)

Week	Practical Exercise
1 – 2	A
3	B
4	D
5 – 6	E
7	F
8	G
9 – 10	H
11	I
12	J, Problem 11.18
13	J, Problem 11.37
14	K
15	Review for final

Sample Practical Exercises

To fully understand and appreciate the theory discussed in Elementary Surveying, a student should be exposed to a series of practical, hands-on exercises. This section covers a sample set of exercises for your consideration. Some exercises assume that the instructor has assigned a set of traverse stations to the students for leveling, distance and angle observations.

Chapter	Number	Exercise
2	A	Students should read the manual for their survey controller and determine the proper procedure for setting up a project.
3	B	Outdoor lab: Develop a pacing lab. In this lab layout a 100-yard, -meter, line on a level section of ground. Have students pace the line 10 times estimating the length of the last pace. Following this, have the students pace the traverse that will be assigned to them for distance measurement in Chapter 6. Students should develop a report giving the length of their pace and the standard deviation. They should compute the length of the lines of the traverse in feet or meters along with the estimated error in the length. $$E = E_{pace}\sqrt{n}$$ where n is the number of paces.
3	C	Inside lab: Hang a plumb bob from the ceiling of your room. Have the students measure the length of the string from support to the tip of mass center of the bob. Now measure the period of the plumb bob using a stopwatch. Repeat this procedure ten times. Student should develop a report providing the average period (T) of the pendulum, and its standard deviation. They should then compute the "approximate" value for gravity using the formula $$g = \frac{\pi^2 \ell \left(1 + \frac{h}{8\ell}\right)^2}{T^2}$$ where l is the length of the string, h is the height the pendulum falls during a half oscillation. Note the pendulum string is not weightless, nor the pivot frictionless, so do not assume this to be an accurate value for gravity.

4	D	Have the students perform a collimation test of their automatic/digital level following the method discussed in Section 4.15.5. Have the student report on the collimation error in their instrument and discuss how this error will be removed when using the instrument for differential leveling. They should also compute the maximum allowable difference in plus and minus sight distances if this error is to be kept under on-half of their reading. For example 0.005 ft if the minimum reported elevation is to 0.01 ft.
5	E	Using a nearby bench mark as control, the students should run a leveling loop from the bench mark, over their stations, and back to the bench mark meeting Third Order leveling specifications. The report should contain a listing of the final adjusted elevations for each station, discuss any problems encountered in the field, include a copy of the final field notes, and provide the misclosure in the loop. If the exercise for Chapter 4 was performed, then collimation error should be removed from each elevation.
6	F	Using a tape, measure the length of each course in the assigned traverse. The line should be measured twice and a precision computed. The report should contain a copy of the field notes, and discuss any problems encountered.
6	G	Using a EDM, determine the horizontal length of each course in a line. The line should be measured from two stations. The report should contain a copy of the field notes, the average length for each line, and discuss any problems that may have occurred in the field.
8	H	Using a theodolite or total station, the students should close the angular horizon about each of their stations turning each angle two times with each face of the instrument (2DR). Using this information, the students should determine the horizon misclosure, adjust the angles at each station, and then adjust the interior angles of the traverse. The report should contain the original field notes, list the horizon misclosure at each station, adjusted angles, traverse misclosure, and the correct geometric sum of each angle. Students should make sure that all angles are geometrically closed.

10	I	Using the distances observed in Chapter 8 and the angles observed in Chapter 8, and an assigned or assumed azimuth for one course of their traverse, students should perform a compass rule adjustment of the traverse. Using starting coordinates of (1000.000, 5000.00), the report should contain the linear precision, relative precision, the adjusted latitudes and departures, coordinates for each station, and adjusted observations.
11	J	Do problem 11.18, 11.37, 11.38, or 11.39.
12	K	Compute the area of the traverse from the exercise for Chapter 10.
13	L	Do Problem 13.35 and 13.36.
14	M	Do Problem 14.40.
14	N	Perform a rapid static survey of your traverse. Adjust the baselines and the network. Report on the adjusted baseline vector components, the loop closures as discussed in Section 14.5.4.
15	O	Have students perform an kinematic mapping surveying of a local area.
16	P	Do one of the problems from 16.41 to 16.45.
17	Q	Have students collect radial data to map an assigned area around their traverse. If a controller is available, the students should use the codes discussed in Section 17.11 that are appropriate for your software.
18	R	Have students create a map of the data collected in exercise Q.
19	S	Have students create the program for Problem 19.43 or 19.44.
20	T	Have students create the program for Problem 20.47 or 20.48.
21	U	Research the deeds for you school or an assigned parcel and perform a boundary survey. In the report, note the survey procedures used, their closures, found monuments in agreement with the deed, monuments that do not agree, and monuments not found.
22	V	Layout a township at a 1/10th scale following the procedures discussed in Chapter 22.
23	W	Perform a profile level courses for the traverse from Chapter 10 using 25-ft stationing.

24	X	Compute the stakeout notes for a horizontal curve with an intersection angle of 60° and length of 300 ft or 100 m. If you are using English units, use 25-ft stationing. If you are using metric units, use 10-m stationing. Stake the curve in the field using the incremental chord method. If you have a data collector, use WOLFPACK to compute coordinates for the given horizontal curve and stake it out using the controller's stake out functions.
25	Y	After profile-leveling the horizontal curve staked out in the previous exercise, compute a vertical alignment that minimizes excavation.
26	Z	Do Problem 26.31 or 26.32.
27	AA	Have students do either Problem 27.38, 27.39, 27.40, or 27.41.
28	BB	Using a GIS software package and the shape files provided by the NGS at http://www.ngs.noaa.gov/cgi-bin/datasheet.prl develop a GIS that allows the user to find NGS control stations in your county and sort by type and quality.

Sample Quizzes

Quiz 1

1. One acre equal _____ square feet and _____ square Gunter's chains.
2. Give the answer of the following problems rounded to the correct number of significant figures:
   a. Sum of 0.0237, 30.05, 254.0 _____
   b. Product of 31.75 × 4.0 _____
   c. Quotient of 793.82 ÷ 71 _____

Quiz 2

1. For the following ten repeated EDM observations what are
   325.686, 325.685, 325.687, 325.681, 325.691, 325.686, 325.681, 325.686, 325.690, and 325.689

   a. Most probable value _____
   b. Standard error in a single observation _____
   c. 95% probable error _____

Quiz 3

1. For the following sequential minus (FS) and plus (BS) sights observed on a closed level circuit, set up the left-side of a standard set of level notes and give an adjusted elevation for BM A.

   BM X (elev = 850.25): 3.87

   TP 1: FS = 3.73, BS = 6.80

   TP 2: FS = 7.04, BS = 6.22

   BM A: FS = 9.16, BS = 3.49

   TP 3: FS = 7.20, BS = 8.65

   TP 4: FS = 6.38, BS = 6.00

   BM X FS = 1.58

Quiz 4

1. A 100-ft tape is calibrated at 68° F, fully supported with 15 lbs of tension and found to be 99.987 ft long. Is this tape is used fully supported with 15 lbs of tension at 86° F to measure a distance that is recorded as 136.48 ft, what is the corrected length of the line?

_____

2. If a certain EDM has a centering error of 3 mm and a scalar error of 3 ppm, what is the uncertainty in a observed distance of 1380.25 ft?

_____

Quiz 5

1. In 1895 when the magnetic declination was 6°45′ East, line AB had a magnetic bearing of S 7 30 E.
   a. What is the magnetic bearing of AB today if the current magnetic declinations is 2 30 W?

_____

   b. What are the true bearing and true azimuth of this line?

Quiz 6

1. If the slope of a line is 0.3258, what is the azimuth of the line? _____
2. What is the area in square units of a polygon with coordinates at its vertices of (103.45, 214.87), (250.34, 567.98), and (185.02, 386.94) _____

Sample Exams

Exam 1

(1 point each)

True – False [Fill in the circle indicating whether the statement is true (T) or false (F).]

○ T ○ F 1. The current definition of the meter is 39.37 inches is equivalent to one meter.
○ T ○ F 2. The length of 1429.75 m is equivalent to 4690.72 survey feet to the correct number of significant figures.
○ T ○ F 3. Random errors may be mathematically computed and removed from observations.
○ T ○ F 4. The number 1.0020 has five significant figures.
○ T ○ F 5. A set of precise observations is always accurate.
○ T ○ F 6. National representation of surveying interest is the principal interest of the American Congress on Surveying and Mapping.
○ T ○ F 7. One acre is 43, 560 square feet.
○ T ○ F 8. A Gunter's chain is 100 ft long.
○ T ○ F 9. The correctly round sum of 46.328 + 1.03 + 375.1 is 422.4.
○ T ○ F 10. The National Geodetic Survey is responsible for establishing a network of survey control monuments.
○ T ○ F 11. The arrangement of a field book is a matter of personal preference.
○ T ○ F 12. It is best to only enter a minimum amount of data into a field book.
○ T ○ F 13. A new page should be started in the field book for each new day of work.
○ T ○ F 14. The geoid is an equipotential surface.
○ T ○ F 15. Earth curvature always causes rod readings to be too high.
○ T ○ F 16. Parallax exists when the focal point of the objective lens does not coincide with the focal point of the eyepiece lens.
○ T ○ F 17. The NAVD 88 datum is based on the average elevation of 26 tide gage stations.
○ T ○ F 18. A page check in differential leveling only provides an arithmetic check of the notes.
○ T ○ F 19. Automatic levels guarantee a horizontal line of sight at each setup.
○ T ○ F 20. The statistical term used to express the precision of a data set is called standard deviation.

Problems/Short answers

(5 points)

A. Discuss why the term geomatics is being used to identify the profession of surveying.

(10 points)

B. State the number of significant figures in each of the following values.

_____ 0.0024 _____ 7620 _____ 0.0007621 _____ 1050.130 _____ 750.

(10 points)

C. Convert the following observations as indicated.
(a) 164.803 m to U.S. Survey feet _____
(b) 215.648 grads to degrees-minutes-seconds _____
(c) 12 ch 7 lks to survey feet _____
(d) 123,600 sq. ft. to acres _____
(e) 153 26 14 to radians _____

(15 points)

D. Compute the most probable value, standard deviation, and 95% probable error for the following set of angle observations.

116°13′46″,116°13′46″,116°13′48″,116°13′44″,116°13′50″

MPV = _____

σ = _____

$E_{95\%}$ = _____

(5 points)

E. Compute the combined Earth curvature and refraction on a 3000-ft site. _____

(20 points)

F. A differential leveling circuit is starts at bench mark Hydrant (Elevation 430.330 m) and ends at bench mark Post (Elevation 430.002 m). The readings (in meters) list in the order taken are 0.983 on Hydrant, 5.467 and 4.086 pm TP1, 0.952 and 3.905 on Mark; and 2.886 on Post. Use this information to complete the left-side of differential leveling notes.

Exam 2

(1 point each)

True – False [Fill in the circle indicating whether the statement is true (T) or false (F).]

○ T ○ F 1. EDM's are unaffected by refraction.
○ T ○ F 2. The length correction in taping is an example of a random error.
○ T ○ F 3. The velocity of an electromagnetic wave does not change when passing through atmosphere.
○ T ○ F 4. A cut tape is graduated with an extra foot beyond the zero mark.
○ T ○ F 5. The NGS as specifications for "third-class leveling."
○ T ○ F 6. A collimation test checks if the line of sight in a leveling instrument is horizontal.
○ T ○ F 7. When measuring distance with an EDM, the line of sight should never be within 1 m anywhere along its path.
○ T ○ F 8. A rod level will increase both the accuracy and speed in the field.
○ T ○ F 9. In general, humidity is irrelevant when measuring distances with a near-infrared EDM.
○ T ○ F 10. Magnetic declination is the difference between geodetic azimuth and magnetic azimuth.
○ T ○ F 11. A total station is in adjustment if its line-of-sight axis is perpendicular to its vertical axis.
○ T ○ F 12. One-second of arc is about 0.05 ft in 10,000 ft.
○ T ○ F 13. The DIN 18723 standard is based on the observation of a single direction.
○ T ○ F 14. The "principle of reversion" is used when adjusting level bubbles.
○ T ○ F 15. In practice, instruments should always be kept in good adjustment, but used as though they might not be.

(1 point each)

Fill in the blank

The kinds of horizontal angles most commonly observed in surveying are:

(1) _____, (2) _____, and (3) _____.

A. Azimuths may be (1) _____, (2) _____,

(3) _____, (4) _____, (5) _____, and

(6) _____.

Short Answer Problems

(10 points)

B. A distance is measured with an EDM having the instrument/reflector offset constant set to 0 mm. The slope distance is reported as 2435.672 m with a zenith angle reading of 93°34′05″. The offset is later determined to be 23 mm. What is the correct horizontal distance for this observation?

(10 points)

C. A 100-ft steel tape has a length 99.987 ft when fully supported at a temperature of 68° F and tension of 10-lbs. What is the corrected length of a measured by this fully-supported tape if the recorded length, temperature and tension are 83.05 ft, 33° F, and 25 lbs of tension, respectively.

(10 points)

D. A 867.89 ft distance is measured with an EDM that has a manufacturer's specified accuracy of 3 mm + 3 ppm. Both the instrument and target miscentering errors are assumed to be ±0.005 ft. What is the uncertainty in this observation?

(10 points)

E. The magnetic bearing of a line in 1884 was N 23 15'W . The magnetic declination at this times was 5 12 W. What is the true bearing of this line?

(10 points)

F. A zenith angle was measured twice direct giving values of 92 14 26 and 92 14 28 , and twice reversed yielding readings of 267 45 30 both times. What is the mean zenith angle, and the indexing error?

(10 points)

G. Discuss the field procedure used to prolong a line of sight.

Exam 3

(1 point each)

True – False [Fill in the circle indicating whether the statement is true (T) or false (F).]

○ T ○ F 1. A closed traverse begins and ends at a station of known coordinates.
○ T ○ F 2. If the azimuth of a line is 272°15′26″, then the bearing of the same line is S92°15′26″W.
○ T ○ F 3. Excepts for deflection angles, surveyors should always turn angles clockwise.
○ T ○ F 4. Angles to the right are clockwise angles with backsights at the "rearward" station and the foresights on the "forward" station.
○ T ○ F 5. To avoid ambiguity, only two reference ties should be used to reference a station.
○ T ○ F 6. Adjustment of angles is dependent on the size of the angle.
○ T ○ F 7. The departure of a course is the change in the *x* coordinate.
○ T ○ F 8. Open traverses should only be used as a last resort in surveying.
○ T ○ F 9. A single angular mistake can be identified by extending the perpendicular bisector of the linear closure line.
○ T ○ F 10. The intersection of two lines with known lengths always results in two possible solutions.

(5 points)

A. What is the geometric closure on a closed polygon traverse with 18 sides? _____

(10 points)

B. What is the azimuth of line CD if the azimuth of AB is 105°39′12″, angle ABC is 67°35′08″, and angle BCD is 275°10′15″?

_____

(10 points)

C. If line AB has an azimuth of 156°14′34″ and line BC has an azimuth of 41°56′42″, what is angle ABC?

_____

(5 points)

D. What is the angular misclosure on a five-sided traverse with observed interior angles of 83°07′23″, 105°23′01″, 124°56′48″, 111°51′31″, and 114°41′27″?

(15 points)

E. Fill in the missing parts of the closed traverse table below.

Azimuth	Distance	Departure	Latitude
45°32′15″	415.76		
101°56′35″			−112.85
	644.65	−502.27	
209°23′00″	668.46		

(10 points)

F. Station A has *xy* coordinates (in feet) of (42992.36, 14354.37) and station B has *xy* coordinates of (43476.79, 15110.90). What are the course length and azimuth?

(10 points)

G. If the sum of the departures in a closed polygon traverse having a total perimeter of 3911.05 ft is 0.22 ft, what is the correction to a course of length 1007.38 ft have a departure of 726.76 ft?

(10 points)

H. What is the linear misclosure and relative precision of a traverse of 2169.91ft if the misclosure in departure and latitude are −0.017 ft and −0.086 ft, respectively?

(10 points)

I. The azimuth of a line in an assumed coordinate system is 242°15′26″. The azimuth of the same line in a datum is 168°38′22″. What is the rotational angle needed to perform a two-

dimensional conformal coordinate transformation?

_____

(5 points)

J. If the standard error for each angle measurement of a traverse is ±3″, what is the estimated error in the geometric closure in the sum of the angles for a 12-sided traverse?

_____

Final Exam

Equation Sheet

$\pm\sqrt{E_a^2 + E_b^2 + E_c^2 + \ldots}$ $\quad \bar{M} - M$ $\quad \pm\sqrt{\frac{\Sigma v^2}{n-1}}$

$\pm E\sqrt{n}$ $\quad \left(\frac{l - l'}{l'}\right)L$ $\quad L\cos\alpha$

$0.65\times10^{-5}(T_1 - T)L$ $\quad (P_1 - P)\frac{L}{\left(29\times10^6\right)A}$ $\quad -\frac{w^2 L_S^3}{24P_1^2}$

$R\theta$ $\quad \frac{2\times E_{DIN}}{\sqrt{n}}$ $\quad \alpha\tan(v)$

$0.574\,M^2 = 0.0206\,F^2$ $\quad 0.0675\,K^2$ $\quad S\sin\alpha$

$hi + V - r$ $\quad \frac{R_B - r_A - r_B + R_A}{2}$ $\quad Elev + BS - FS$

$(n-2)180°$ $\quad L\sin\alpha$ $\quad L\cos\alpha$

$-\frac{\text{(total departure misclosure)}}{\text{traverse perimeter}}\times\text{length of } AB$ $\quad -\frac{\text{(total latitude misclosure)}}{\text{traverse perimeter}}\times\text{length of } AB$

$X_A + \text{departure } AB$
$Y_A + \text{latitude } AB$

$\sqrt{(\text{departure } AB)^2 + (\text{latitude } AB)^2}$

$\tan^{-1}\left(\frac{\Delta X}{\Delta Y}\right) + C$

$\sqrt{s(s-a)(s-b)(s-c)}$

$b\left(\frac{h_0}{2} + h_1 + h_2 + \cdots + \frac{h_n}{2}\right)$

$S \times \sigma_S \sqrt{2}$

$\frac{1}{2}[X_A(Y_E - Y_B) + X_B(Y_A - Y_C) + X_C(Y_B - Y_D) + X_D(Y_C - Y_E) + X_E(Y_D - Y_A)]$

$\text{meridian distance of } AB + \frac{1}{2}\text{departure of } AB + \frac{1}{2}\text{departure of } BC$

$\pi R^2 \times (\theta/360°)$

$\pm\sqrt{A^2E_b^2 + B^2E_a^2}$

$\frac{E}{\sqrt{n}}$

Final Exam

(1 point each)

TRUE - FALSE [Fill in the circle indicating whether the statement is true (T) or false (F).]

❍T ❍F 1. The number 768,000 has six significant digits.

❍T ❍F 2. There are 45,360 square feet in one acre.

❍T ❍F 3. Using the survey foot definition, one meter equals 39.37 inches.

❍T ❍F 4. 24 times 360.01 equals 8640 to the correct number of significant digits.

❍T ❍F 5. 78.149 is equal to 78.2 when round to the tenths place.

❍T ❍F 6. Field notes should be discarded when a project is complete.

❍T ❍F 7. Sketches in a field book should be drawn to an accurate scale.

❍T ❍F 8. A zenith angle is measured in the horizontal plane.

❍T ❍F 9. The sensitivity of a level vial is determined by its radius of curvature.

❍T ❍F 10. In leveling, balancing plus sight and minus sight distances corrects for instrument collimation errors.

❍T ❍F 11. Refraction always causes the line of sight to appear to be too high.

❍T ❍F 12. "*Accuracy*" denotes absolute nearness to the truth.

❍T ❍F 13. Bringing the bubble *halfway back* to center compensates for the fact that the vertical axis of a total station is not perpendicular to the axis of the plate bubble.

❍T ❍F 14. Measuring angles both direct and reverse compensates for the fact that the vertical axis in a total station may not be perpendicular to the horizontal axis.

❍T ❍F 15. Under a fixed set of conditions, random errors have the same magnitude and sign.

❍T ❍F 16. Waving the rod during leveling compensates for curvature and refraction.

❍T ❍F 17. A slope distance measured by EDM must be corrected for atmospheric pressure and temperature.

❍T ❍F 18. Three repeated measurements for a distance are 395.28, 395.27, and 395.29 ft., respectively. These measurements are precise when the true value of the measurement is 395.95 ft.

❍T ❍F 19. Vertical lines at all locations are parallel.

❍T ❍F 20. A ten second level vial is more sensitive than a two second vial.

❍T ❍F 20. A prism causes all electronically measured distances to appear to be too long.

❍T ❍F 21. The geoid is an equipotential surface.

❍T ❍F 22. A zenith angle of 88°15′ is equivalent to a vertical angle of 1°45′.

❍T ❍F 23. The sum of the interior angles of a seven-side closed polygon traverse should be 900°.

❍T ❍F 24. The compass rule adjustment is known as an arbitrary adjustment technique.

❍T ❍F 25. Angles of larger magnitude should always receive the largest corrections.

❍T ❍F 26. A precision of 1:5000 means that there can be 0.5 foot of error in every 2500 ft.

❍T ❍F 27. Surveying plats show slope distances recorded between points.

❍T ❍F 28. When the tape is only supported at its ends, the recorded distance is always too long.

❍T ❍F 29. A link traverse is an example of an open traverse.

❍T ❍F 30. 4129.57 m is equal to 2.56599 mi to the correct number of places.

PROBLEMS

The following are six repeated measurements of a taped distance.

429.35 , 429.34, 429.37, 429.32, 429.39, 429.33

{5 points}

A. What is the most probable value of the measurement? (nearest 0.01) MPV = _____

{5 points}

B. What is the standard deviation? (nearest 0.001) σ = _____

The following questions apply to measurements using a steel tape which was calibrated to be 99.890-ft long when fully supported at 68°F and 10-lbs. pull. Its cross-sectional area was 0.0050 square inches.

{5 points}

C. A line AB was measured on flat ground with the tape fully supported using 10 lbs. of pull and recorded to be 275.20-ft. long when the temperature was 43°F. What is its corrected horizontal length? (nearest 0.001 ft)

L = _____

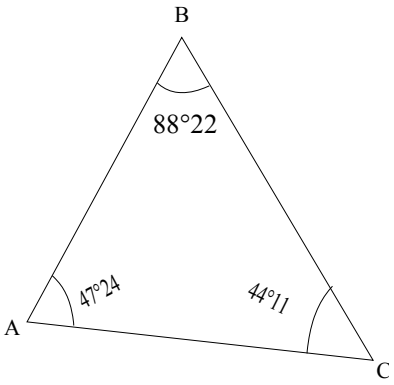
{5 points}

D. A horizontal distance *DE* exactly 275.20 ft. is required to be laid out according to a blue print. If this distance will be laid out on flat ground using the tape fully supported with a 20-lb pull, and the temperature is 85°F what distance must be measured using this tape. (nearest 0.01-ft)

L = _____

{10 points}

E. For the measured angles given on the figure below, and assuming the fixed azimuth of the line AB is 47°45′, calculate the adjusted angles and azimuths of lines BC and CA and show a check. (nearest 1′)



∠A = _____ ° _____ '

∠B = _____ ° _____ '

∠C = _____ ° _____ '

Az_{BC} = _____ ° _____ '

Az_{CA} = _____ ° _____ '

{10 points}

F. What is the area of the five-sided parcel below to the nearest square foot? ... nearest 0.001 acre?

Station	X (ft)	Y (ft)
A	0.00	591.64
B	125.66	847.60
C	716.31	294.07
D	523.62	0.00
E	517.55	202.97

AREA = _____ ft^2

AREA = _____ acres

(10 points)

G. The coordinates of A and B are (23451.23, 10034.56) and (22678.93, 12387.43), respectively. What are the azimuth and distance of the line AB. (nearest 1", nearest 0.01 ft)

AB = _____ ft

Az_{AB} = _____ ° _____ ' _____ "

(10 points)

H Two measurements that presented unusual difficulty in the field were omitted in the survey of a boundary, as shown in the following field notes. Compute the missing distance and azimuth for line *EA*. (nearest 1″; nearest 0.01 ft)

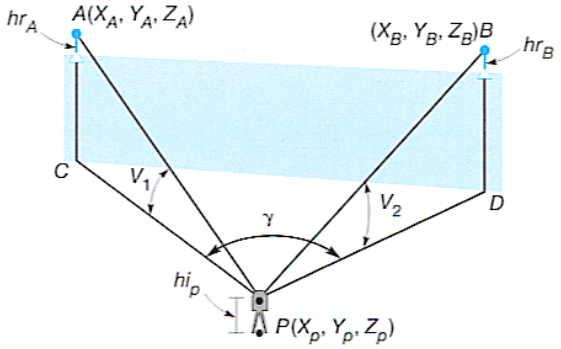
Line	Distance	Azimuth	Departure	Latitude
AB	671.07	88°00′00″		
BC	436.45	91°00′00″		
CD	510.67	206°00′00″		
DE	778.05	318°00′00″		
EA				

EA = _____ ft

Az_{EA} = _____ ° _____ ' _____ "

(10 points)

I In the figure to the right, the *X*, *Y*, and *Z* coordinates (in feet) of station *A* are 3860.83, 4819.98, and 154.06, respectively, and those at *B* are 6865.48, 5007.21, and 135.69, respectively. Determine the three-dimensional of a total station at point *P* base upon the following observations.



v_1 = 0°29′06″ PA = 2423.67 ft

v_2 = −0°03′04″ PB = 2413.00 ft

γ = 76°59′20″

hr_A = 5.20 ft hr_B = 5.20 ft hi_P = 5.20 ft