LS-B

LAND SURVEYOR - 1986

Part B - Wt. 47.5

1. Part B is the second section of the Land Surveyor Examination and is to be completed in four hours. NOT ALL PROBLEMS IN PART B ARE REQUIRED.

2. Each test item is contained in a separate folder appropriately marked on the front. Your answers must be completed on the paper provided within each folder. IMPORTANT: Do not remove the test item or your answer sheets from the folder as this may affect the Board's ability to grade your examination. If you need additional grid sheets, ask your proctor. Be sure to secure these additional pages within the appropriate folder.

3. You may withdraw from scoring any part of your work by isolating that part and writing "VOID" across it. Delineate the voided part clearly.

4. Enter your identification number in the upper right-hand corner on EACH PAGE of the answer sheets where space is provided and INDICATE THE APPROPRIATE PROBLEM NUMBER.

5. Your work is a Land Surveyor report. Computations should be neat and orderly and show a good basic, orderly development of the problem solution.

6. This portion of the Land Surveyor Examination consists of the following:

Problem B1	10.0 points
Problem B2	5.0 points
Problem B3 or B4	12.5 points
Problem B5, B6, B7, or B8	20.0 points
(You must answer two of these four problems.)	
TOTAL	47.5 points

7. After you have completed this portion of the examination, check your work, assemble the folders containing your answer sheets in sequential order, be sure to include all pages (including diagrams if required), and turn it in to the Examination Proctor.

Department of Consumer Affairs
State Board of Registration for Professional Engineers
and Land Surveyors

1986

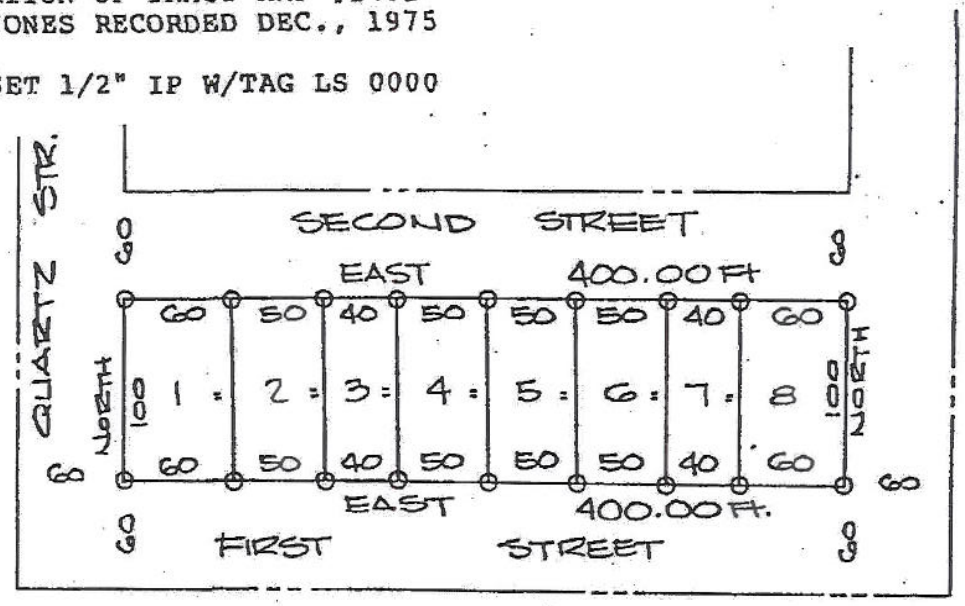
Problem B1 - Wt. 10.0 points

PROBLEM STATEMENT

Mr. Jake wants you to set the corners of his property in tract #1401. You find the following records.

A PORTION OF TRACT MAP #1401
FOR JONES RECORDED DEC., 1975

O = SET 1/2" IP W/TAG LS 0000

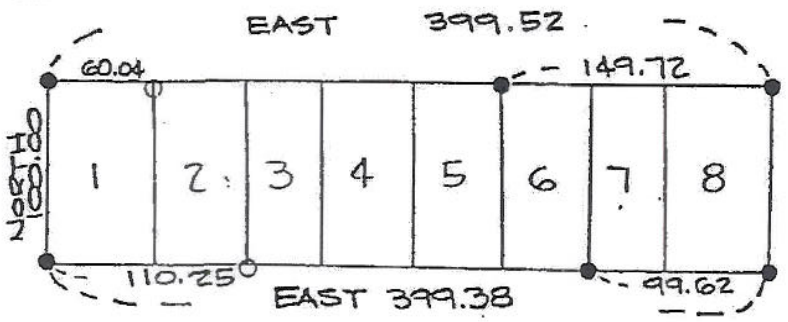


CHAIN OF TITLE

JONES TO SMITH	JUNE 4, 1979	LOT 3 AND THE ELY 25 FT. OF LOT 2 PER TRACT MAP #1401
JONES TO KENT	FEB. 3,1980	LOT 1 AND THE WLY 1/2 OF LOT 2 PER TRACT MAP #1401
KENT TO BARNES	MARCH 5, 1984	LOT 1 AND THE WLY 1/2 OF LOT 2 PER TRACT MAP #1401
BARNES TO JOHNSON	JAN. 4, 1985	LOT 1 AND THE WLY 25 FT OF LOT 2 PER TRACT MAP #1401
SMITH TO JAKE	MARCH 14,1986	LOT 3 AND THE ELY 25 FT OF LOT 2 PER TRACT MAP #1401

YOU FIND THE FOLLOWING IN THE FIELD.

● = FD 1/2" IP W/TAG LS 0000
O = FD 1" IP



Problem B1 - continued:

NOTES: All records, etc. have been thoroughly searched and no additional records are found.

All found 1/2" IPS on the north and south lines are aligned E-W. 1" IPS are 0.2 ft. south of this alignment; distances on sketch to the 1" IPS are to the pipes themselves.

REQUIRED

1) Use the blank sketch of lots 1, 2 and 3 to show the correct distances along the north and south lines of the lot to the nearest 0.01 ft.

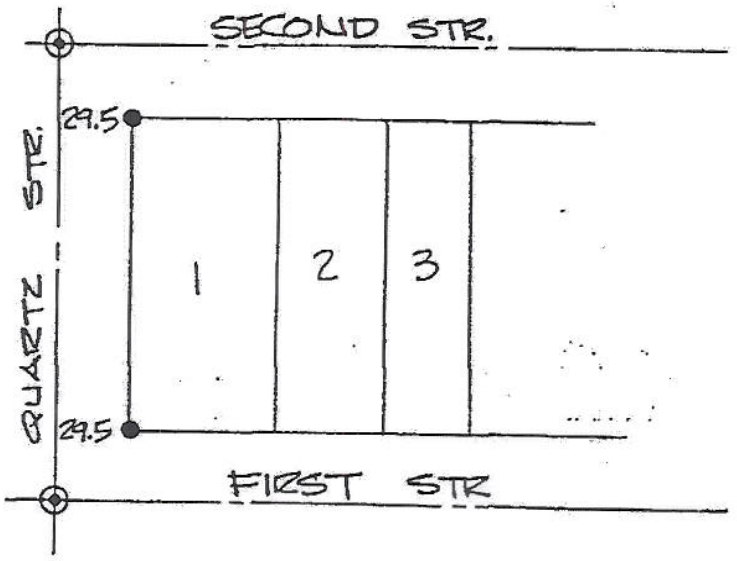
2) Show all calculations necessary and provide a brief narrative about your method and reasoning.

3) Is a map required? If so, why and what type; if no map is required, why not?

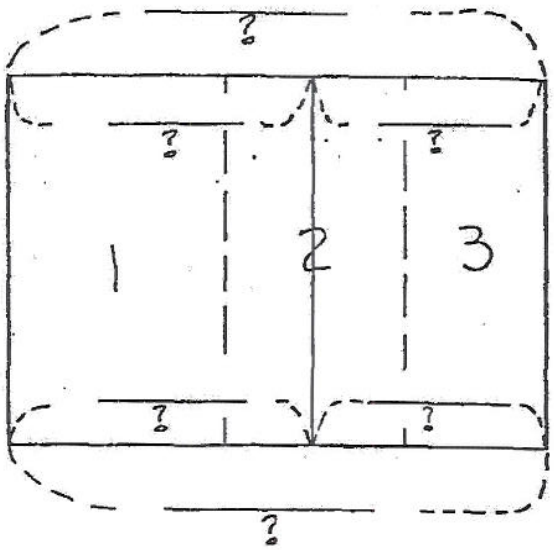
REQUIRED ITEM 4 IS A SEPARATE PART OF THIS PROBLEM AND INFORMATION GIVEN BELOW IS FOR ITEM 4 ONLY

4) For this part only, assume that original monuments, per some prior record (showing a 60' R/W), are found at the C/L intersections of quartz & first and quartz & second. Explain in a brief narrative what effect this might have on the east-west position of Mr. Jake's and Mr. Johnson's property corners. See sketch below.

⊙ = FD C/L MONUMENT PER 1950 SURVEY
● = FD 1/2" IP W/TAG LS 0000 PER 1975 SURVEY



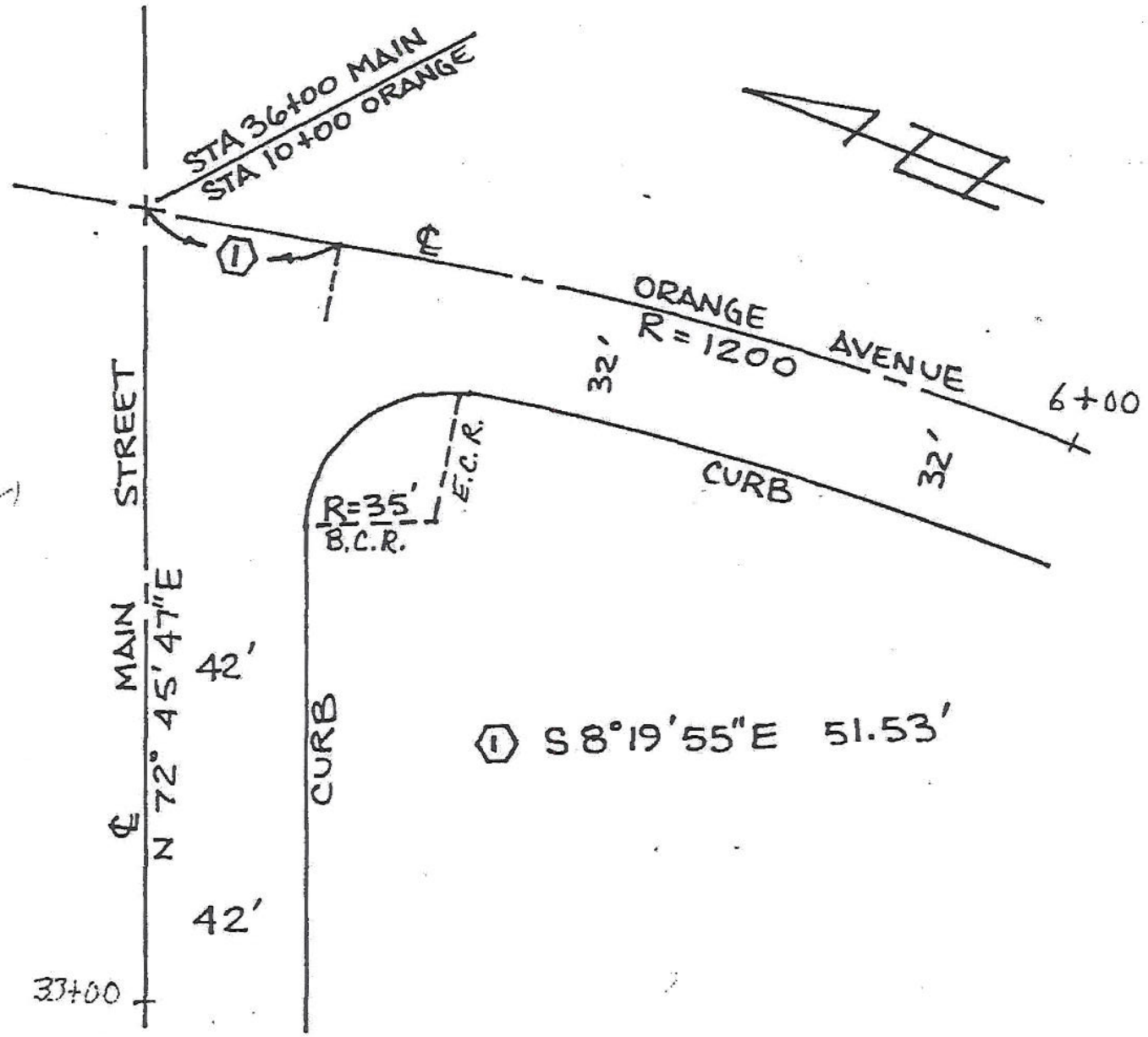
Problem B1 - continued:



Problem B2 - Wt. 5.0 points

PROBLEM STATEMENT

Given the intersection of these two streets, calculate the information necessary to stake the curb return. Show all calculations.



REQUIRED

1) The station of the B.C.R.
2) The station and radial bearing to the E.C.R.
3) The curve data for the curb return.

Problem B3 - Wt. 12.5 points

PROBLEM STATEMENT

See diagrams on the following pages.

You are employed to survey and monument Government Lot 2, Section 18.

REQUIRED

1. How would the true point for the 1/4 sec. cor. of Sections 17 and 18 be determined?

2. How would you reestablish the 1/4 sec. cor. of Sections 13 and 18? Perform the required calculations and determine the bearings and distances between the corners along the West boundary of Section 18, including the NW corner Lot 2.

3. Explain how the subdivision of Section 18 would proceed in order to establish the northeast and southeast corners of Lot 2.

If proportioning is involved, show the elements of the proportions.

Problem B3 - continued:

NOTE: ALL DIAGRAMS ARE FOR THE SAME SECTION.
DISTANCES ARE IN CHAINS.

Diagram 1:
Portion of 1881 GLO Plat
Original Survey

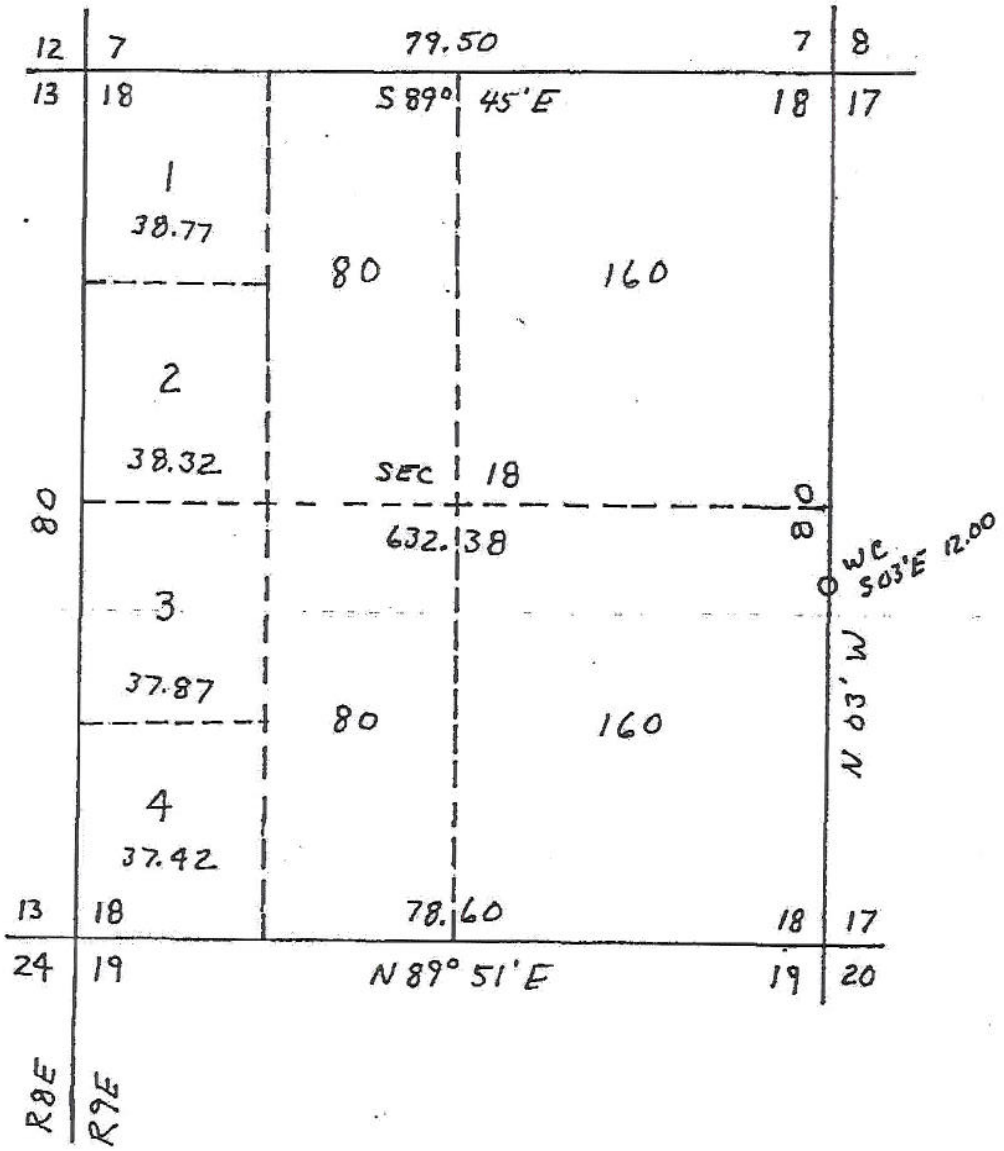


Diagram 2:
Portion of 1920
GLO Plat - Dependent
resurvey of Range
Line.

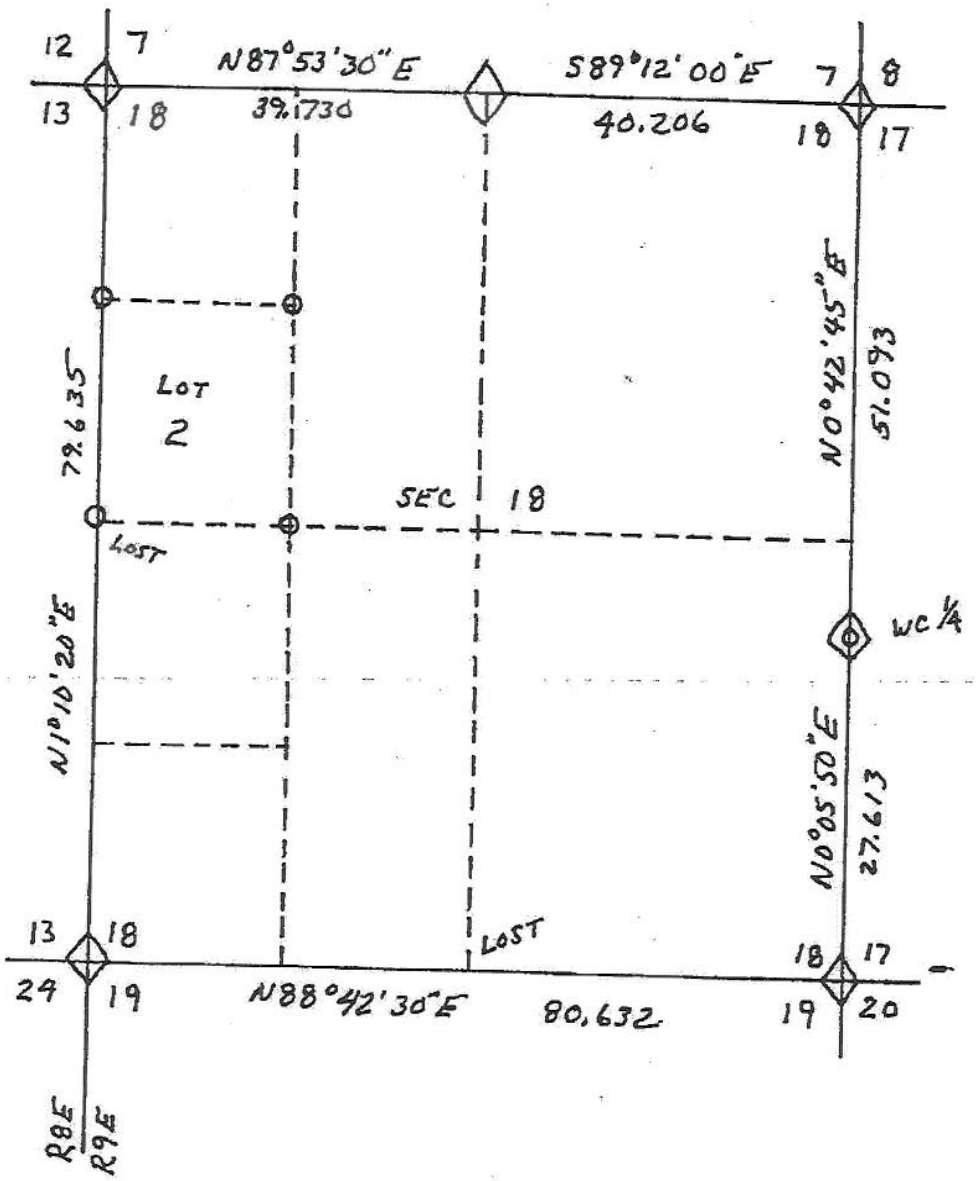
Legend
◇ Found Original Corner
O Corner to be set

Problem B3 - continued:

Diagram 3:

Your 1986 Retracement and recovery data.

NOTE: RETRACEMENT DATA REFLECTS ADJUSTED MEASUREMENTS BETWEEN FOUND CORNERS.



Problem B4, Optional - Wt. 12.5 points

PROBLEM STATEMENT

(Public Land Surveying)

Figure 1 on page 9 summarizes the record of the original surveys as follows:

- Survey of the boundary of "Lost Rancho" in 1856.
- Survey of the subdivisional lines Sec. 3, closes against Rancho, in 1867 with lines platted and lotted as shown.
- Lot 3 and SE 1/4 Sec. 3 are remaining Federal Public Domain, shaded.

Figure 2 on page 10 summarizes 1986 retracement information.

REQUIRED

Based on the BLM Manual of Surveying Instructions, 1973, answer the following:

1. The monuments along the E. side of Sec. 3 with the exception of the original CC of Secs. 2 and 3 (E) are considered lost.

   A. State the method or procedure you would use to restore the SE Sec. Cor. (B).

   B. Explain which monuments and what record measurements you would use to control the reestablishment,; show the actual numerical values you would use in your computation.

   C. State the method or procedure you would use to restore the E. 1/4 cor. of Sec. 3. (C).

   D. Compute the positions (B and C) showing the final bearings (to seconds) and distances (to 0.01 ft.) along the E. half of the south boundary, and at least along the S. half of the E. boundary. (G to restored B to C)

2. Cor. number 2 of the "Lost Rancho" is considered lost.

   A. State the method or procedure you would use to restore the cor. Explain which monuments and what record measures you would use to control the reestablishment.

   B. Compute the position showing the final bearings (to seconds) and distances (to 0.01 ft.) from "Lost Rancho" cor. 1 through the computed cor. 2 to cor. 3.

Problem A5 - Wt. 10.0 points

PROBLEM STATEMENT

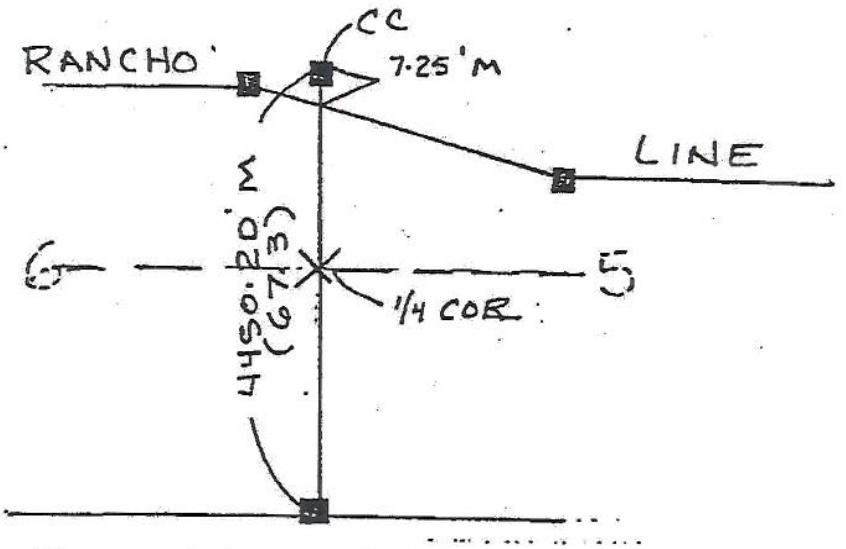
Questions 1 through 8 refer to the U.S. Public Lands Survey System.

LEGEND: ( ) Denotes record distance per official township plat;
M Denotes measured distance per your survey;
■ Denotes found original monument;
X Denotes lost corner;
CC Denotes closing corner;
WC Denotes witness corner.

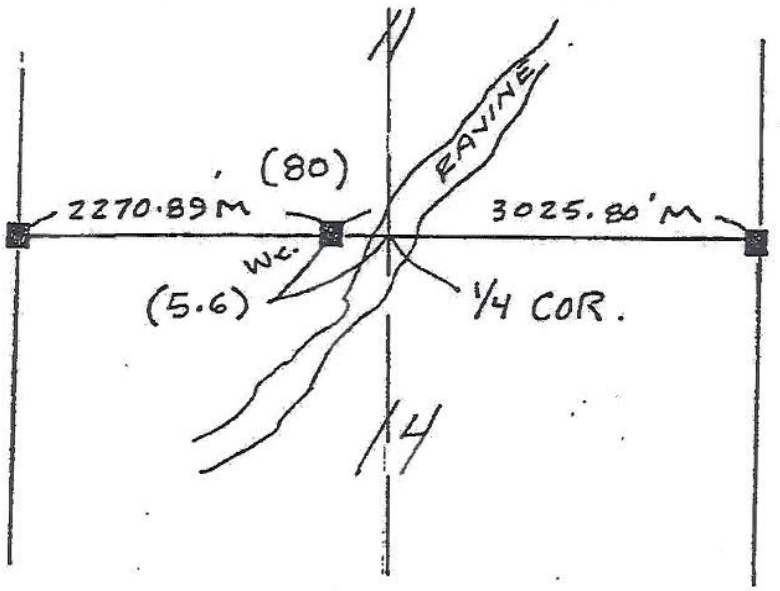
Your answer may be shown in feet or chains. Show all calculations.

REQUIRED

(1) Where would you position the missing 1/4 corner?

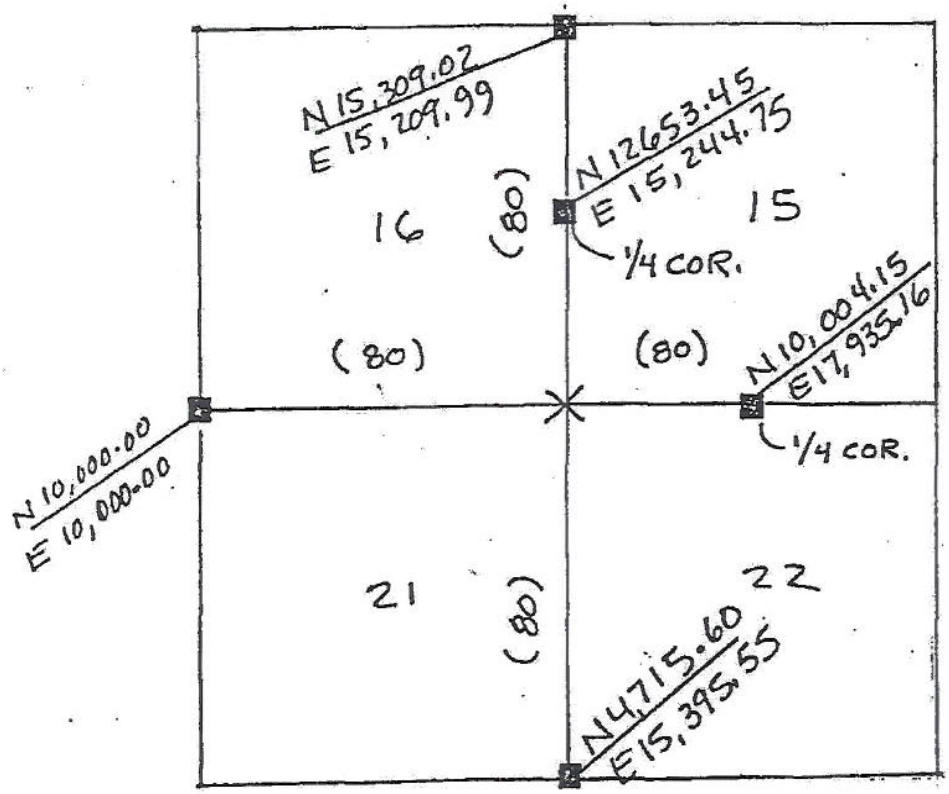


(2) Where would you position the missing 1/4 corner?

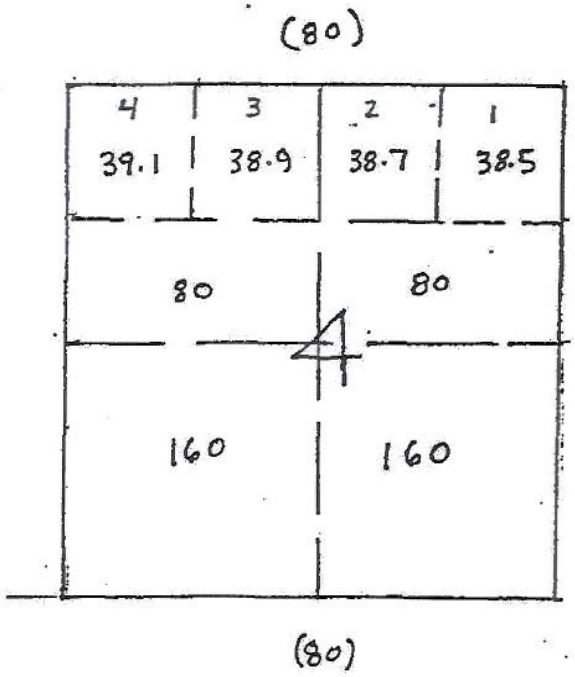


Problem A5 - continued:

(3) What are the coordinates of the missing section corner common to 16, 15, 22 and 21 as you would reestablish it on the ground?



(4) What are the dimensions of Lot 2?



Problem B5, Optional - Wt. 10.0 points

PROBLEM STATEMENT

A project is to be controlled vertically as shown on the sketch below. Bench marks I, II, and III are to be held fixed. Leveling procedures were as follows: BM_I to BM_V First Order, Class II; BM_{II} to BM_V Second Order, Class II; BM_{III} to BM_V Second Order, Class II.

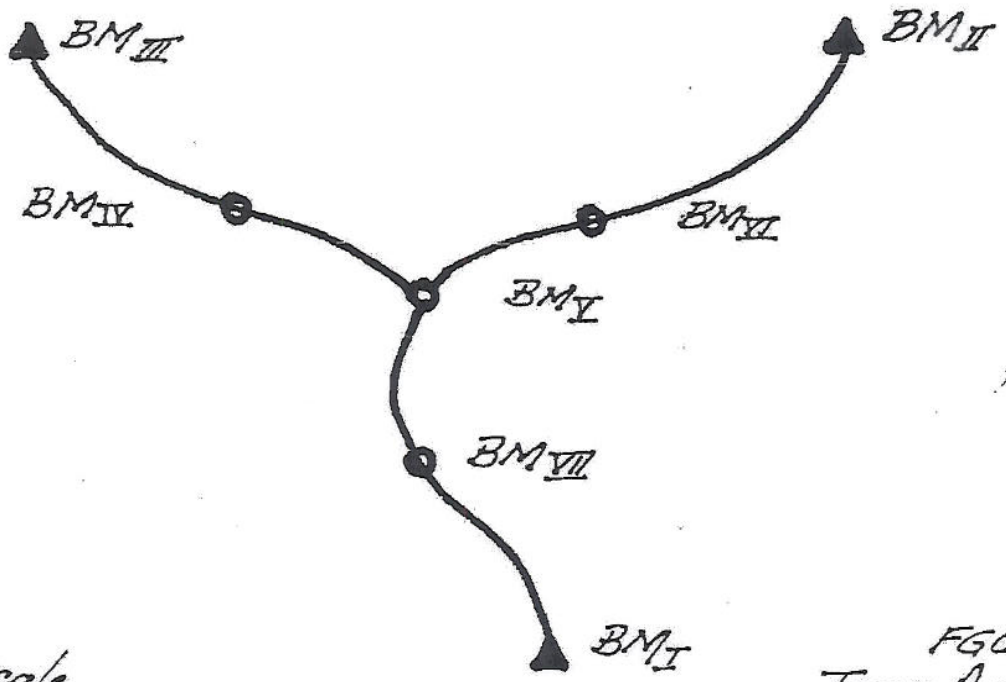
CRITERIA

	(km) Length	Meas Forward	Elev Backward
BM_I to BM_{VII}	16.8	-42.208	+42.232
BM_{VII} to BM_V	5.6	-19,980	+19.964
BM_{II} to BM_{VI}	10.2	+ 1.010	- 1.002
BM_{VI} to BM_V	8.7	+ 5.825	- 5.843
BM_{III} to BM_{IV}	21.5	-18.552	+18.524
BM_{IV} to BM_V	6.2	- 6.189	+ 6.175

Elevation BM_I = 562.160, BM_{II} 493.165, BM_{III} 524.671 (Elevations in meters)

REQUIRED

1. Show all calculations; list any assumptions; list all references.
2. Do the sections meet the required field closures?
3. From the data given, what are the adjusted elevations for the bench marks IV, V, VI, and VII?



Not to Scale

FGCC
TABLE ATTACHED

GEODETIC LEVELING

Only a compensator or tilting leveling instrument with an optical micrometer should be used for first-order leveling. Leveling rods should be one piece. Wooden or metal rods may be employed only for third-order work. A turning point consisting of a steel turning pin with a driving cap should be utilized. If a steel pin cannot be driven, then a turning plate ("turtle") weighing at least 7 kg should be substituted. In situations allowing neither turning pins nor turning plates (sandy or marshy soils), a long wooden stake with a double-headed nail should be driven to a firm depth.

Calibration Procedures

Order / *Class*	*First* *I*	*First* *II*	*Second* *I*	*Second* *II*	*Third*
Leveling instrument					
Maximum collimation error, - single line of sight (mm/m)	0.05	0.05	0.05	0.05	0.10
Maximum collimation error, reversible compensator type instruments, mean of two lines of sight (mm/m)	0.02	0.02	0.02	0.02	0.04
Time interval between collimation error determinations not longer than (days)					
Reversible compensator	7	7	7	7	7
Other types	1	1	1	1	7
Maximum angular difference between two lines of sight, reversible compensator	40"	40"	40"	40"	60"
Leveling rod					
Minimum scale calibration standard	N	N	N	M	M
Time interval between scale calibrations (yr)	1	1	—	—	—
Leveling rod bubble verticality maintained to within	10'	10'	10'	10'	10'

(N—National standard)
(M—Manufacturer's standard)

Compensator-type instruments should be checked for proper operation at least every 2 weeks of use. Rod calibration should be repeated whenever the rod is dropped or damaged in any way. Rod levels should be checked for proper alignment once a week. The manufacturer's calibration standard should, as a minimum, describe scale behavior with respect to temperature.

Field Procedures

Order / *Class*	*First* *I*	*First* *II*	*Second* *I*	*Second* *II*	*Third*
Minimal observation method	micrometer	micrometer	micrometer or 3-wire	3-wire	center wire
Section running	SRDS or DR or SP	SRDS or DR or SP	SRDS or DR† or SP	SRDS or DR*	SRDS or DR§

Field Procedures—Continued

Order / *Class*	*First* *I*	*First* *II*	*Second* *I*	*Second* *II*	*Third*
Difference of forward and backward sight lengths never to exceed					
per setup (m)	2	5	5	10	10
per section (m)	4	10	10	10	10
Maximum sight length (m)	50	60	60	70	90
Minimum ground clearance of line of sight (m)	0.5	0.5	0.5	0.5	0.5
Even number of setups when not using leveling rods with detailed calibration	yes	yes	yes	yes	—
Determine temperature gradient for the vertical range of the line of sight at each setup	yes	yes	yes	—	—
Maximum section misclosure (mm)	$3\sqrt{D}$	$4\sqrt{D}$	$6\sqrt{D}$	$8\sqrt{D}$	$12\sqrt{D}$
Maximum loop misclosure (mm)	$4\sqrt{E}$	$5\sqrt{E}$	$6\sqrt{E}$	$8\sqrt{E}$	$12\sqrt{E}$
Single-run methods					
Reverse direction of single runs every half day	yes	yes	yes	—	—
Nonreversible compensator leveling instruments					
Off-level/relevel instrument between observing the high and low rod scales	yes	yes	yes	—	—
3-wire method					
Reading check (difference between top and bottom intervals) for one setup not to exceed (tenths of rod units)	—	—	2	2	3
Read rod 1 first in alternate setup method	—	—	yes	yes	yes
Double scale rods					
Low-high scale elevation difference for one setup not to exceed (mm)					
With reversible compensator	0.40	1.00	1.00	2.00	2.00
Other instrument types:					
Half-centimeter rods	0.25	0.30	0.60	0.70	1.30
Full-centimeter rods	0.30	0.30	0.60	0.70	1.30

(SRDS—Single-Run, Double Simultaneous procedure)
(DR—Double-Run)
(SP—SPur, less than 25 km, double-run)
D—shortest length of section (one-way) in km
E—perimeter of loop in km
† Must double-run when using 3-wire method.
* May single-run if line length between network control points is less than 25 km.
§ May single-run if line length between network control points is less than 10 km.

Double-run leveling may always be used, but single-run leveling done with the double simultaneous procedure may be used only where it can be evaluated by loop closures. Rods should be leap-frogged between setups

Problem B6, Optional - Wt. 10.0 points

PROBLEM STATEMENT

The southerly line of an 84.00 ft. right-of-way passes through an existing structure. You are directed to locate the structure and calculate the centerline curve data that will enable the southerly right-of-way limits to clear the structure by 35.00 ft. Data collected by your field crew is shown.

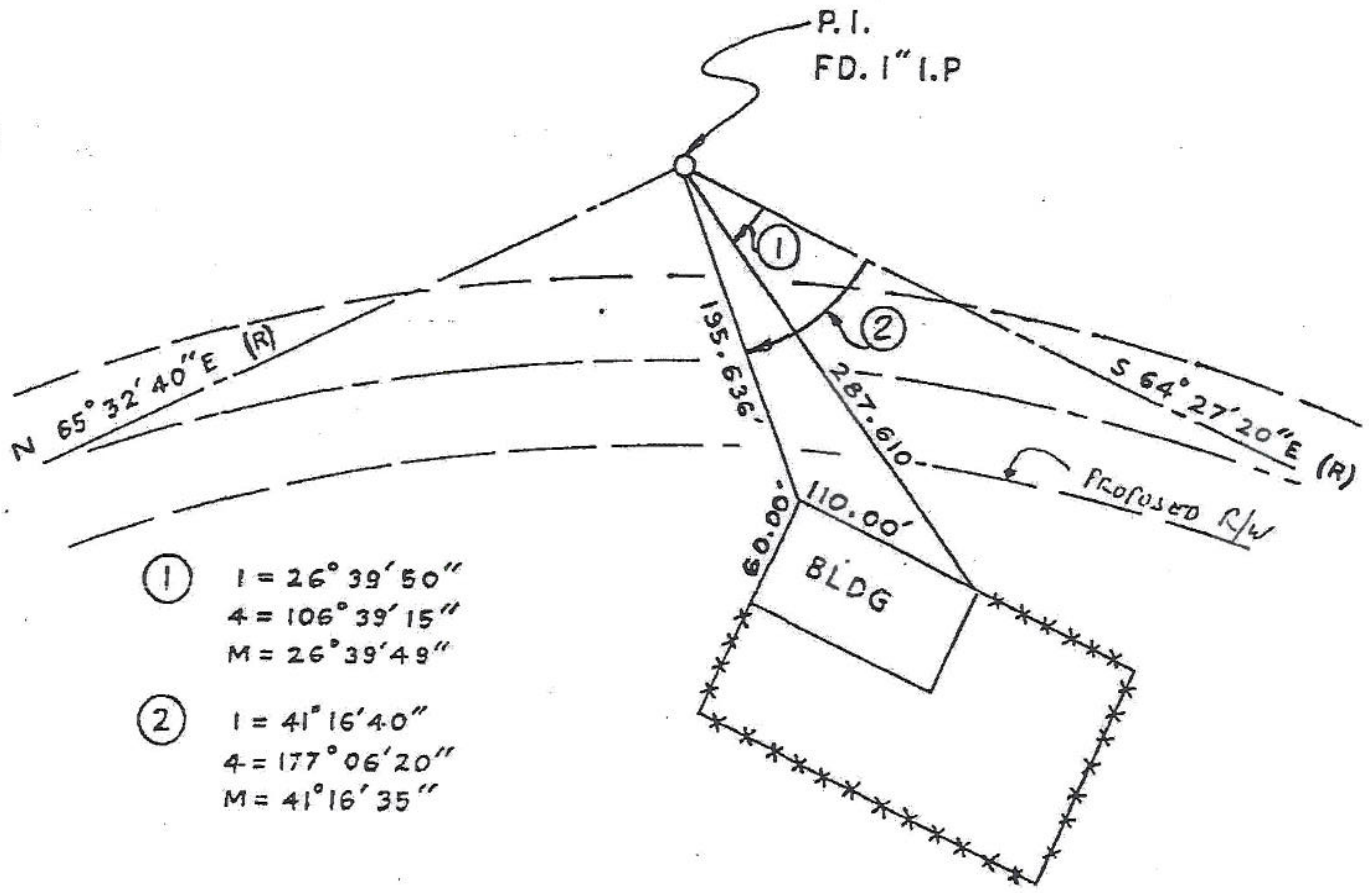
REQUIRED

Calculate the following centerline data:

Delta = ?, Radius = ?, Tangent = ?, Arc Length = ?

Answers are to be given to the nearest 1/100 of a foot.

Show all work so method used can be evaluated.



Problem B7, Optional - Wt. 10.0 points

PROBLEM STATEMENT

You are responsible for the subcontracting of an aerial mapping project. It is required that the subcontractor use a 6" focal length camera with a 9" X 9" format. Compilation of the map will be five times the photo scale on a plotter with a "C" factor of 1500. Map scale will be 1" = 100'. Ninety percent of the contours will be accurate to within one-half contour interval.

The area to be mapped is 6,000' X 10,800'. Average elevation of the mapping area is 900' above sea level. The total relief in the mapping area is 300'.

The following is a map check made on the subcontractor's previous work:

Point	Field Elevation	Map Elevation	Point	Field Elevation	Map Elevation
1	1587.7	1588	6	1584.7	1584
2	1604.5	1604	7	1579.5	1580
3	1600.3	1600	8	1591.6	1592
4	1594.8	1594	9	1587.1	1588
5	1591.9	1592	10	1583.2	1584

REQUIRED

1. How many models will be required?
2. How many photographs will be required using 60% overlap?
3. What is the photo scale?
4. What is the contour interval for this project?
5. If you are going to fully control each model of your project, indicate by drawing a sketch showing the location and number of horizontal and vertical control points to be used in each model and explain why. **
6. If you were going to control the job for analytical aerotriangulation, indicate by drawing a sketch showing the location and number of horizontal and vertical control points to be used. **
7. What is the 90% error of the subcontractor's previous work?
8. What is the calculated C-factor of the map check when the flying height is 3,000' above mean ground?

** Horizontal control point =
Vertical control point =
Horiz & Vert control point =

Problem B8, Optional - Wt. 10.0 points

PROBLEM STATEMENT

You have been requested by your client to establish an astronomic bearing and latitude for a guidance checkout stand (Station TABLE). The following two sets of data are meaned values abstracted from your field notes.

	Observ #1	Observ #2
Star observed: Polaris at station TABLE		
Date of observ:	4-4-86 PST	4-4-86 PST
Time of Observ:	8-36-15 pm	8-41-20 pm
Longitude of TABLE:	118°24'24" W	
Observ altitude of Polaris:	45°01'20"	45°00'22"
Barametric pressure:	28.5"	28.5"
Temp:	65° F	65° F
Horiz ∠ ;STOP to Polaris:	45°28'30".0	45°29'01".0

REQUIRED

Calculate the mean astronomic bearing of the line TABLE to STOP and the mean astronomic latitude of station TABLE. Show your calculations.

NOTE: TO ACHIEVE DESIRED RESULTS CALCULATIONS SHOULD BE CARRIED OUT TO A MINIMUM OF NINE DECIMAL PLACES.

FINAL RESULTS TO BE WITHIN ± 2" FROM THE MEAN.