

CALIFORNIA STATE BOARD OF REGISTRATION  
FOR PROFESSIONAL ENGINEERS

LS

C

1982

LAND SURVEYOR

PRINCIPLES AND PRACTICE

1. This examination is given in two four-hour periods on the same day. The subject matter relates to the principles and practice of land surveying. Part "C" is the first of two parts.
2. In the workbook, you are to work ALL Problems C-1 through C-7. There are no optional questions.
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 workbook where space is provided and IDENTIFY THE PROBLEM NUMBER according to the schedule given in (6) below.
5. Read the instructions on the workbook cover page.
6. This portion of the Land Surveyors Examination consists of the following:

Problem C-1	5	Points
Problem C-2	5	Points
Problem C-3	10	Points
Problem C-4	7.5	Points
Problem C-5	7.5	Points
Problem C-6	5	Points
Problem C-7	10	Points

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TOTAL 50 Points

YOU ARE TO WORK ALL 7 PROBLEMS

7. After you have completed this portion of the examination, check the problem order, include all pages, and turn it in to the Examination Proctor.
8. You may keep this set of examination questions.

LS-C  
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Page 1

**TURN THIS PAGE IMMEDIATELY AND BEGIN YOUR  
EXAMINATION**

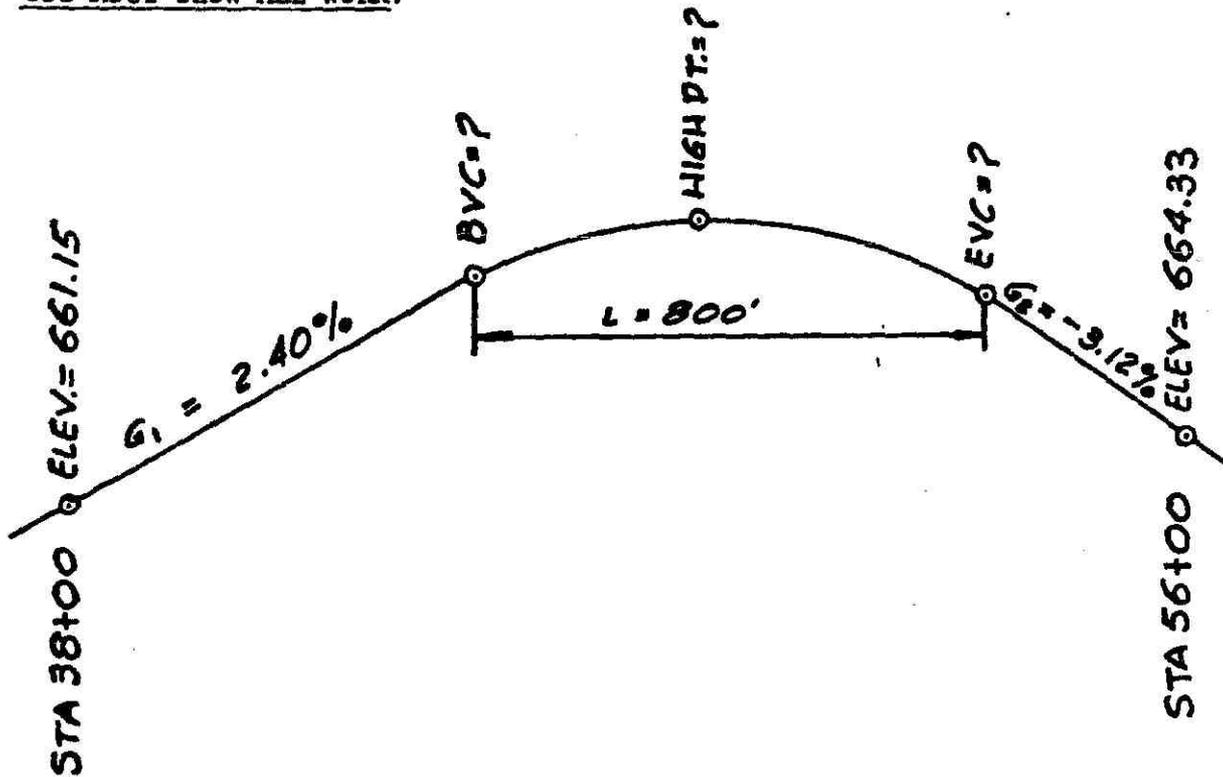
Problem C-1 (5 Points)

REQUIRED

VERTICAL CURVE

Given the data shown below, calculate the STATIONING AND ELEVATION at the B.V.C., E.V.C., and the HIGH POINT. Answers are to be given to the nearest 1/100 of a foot.

YOU MUST SHOW ALL WORK:



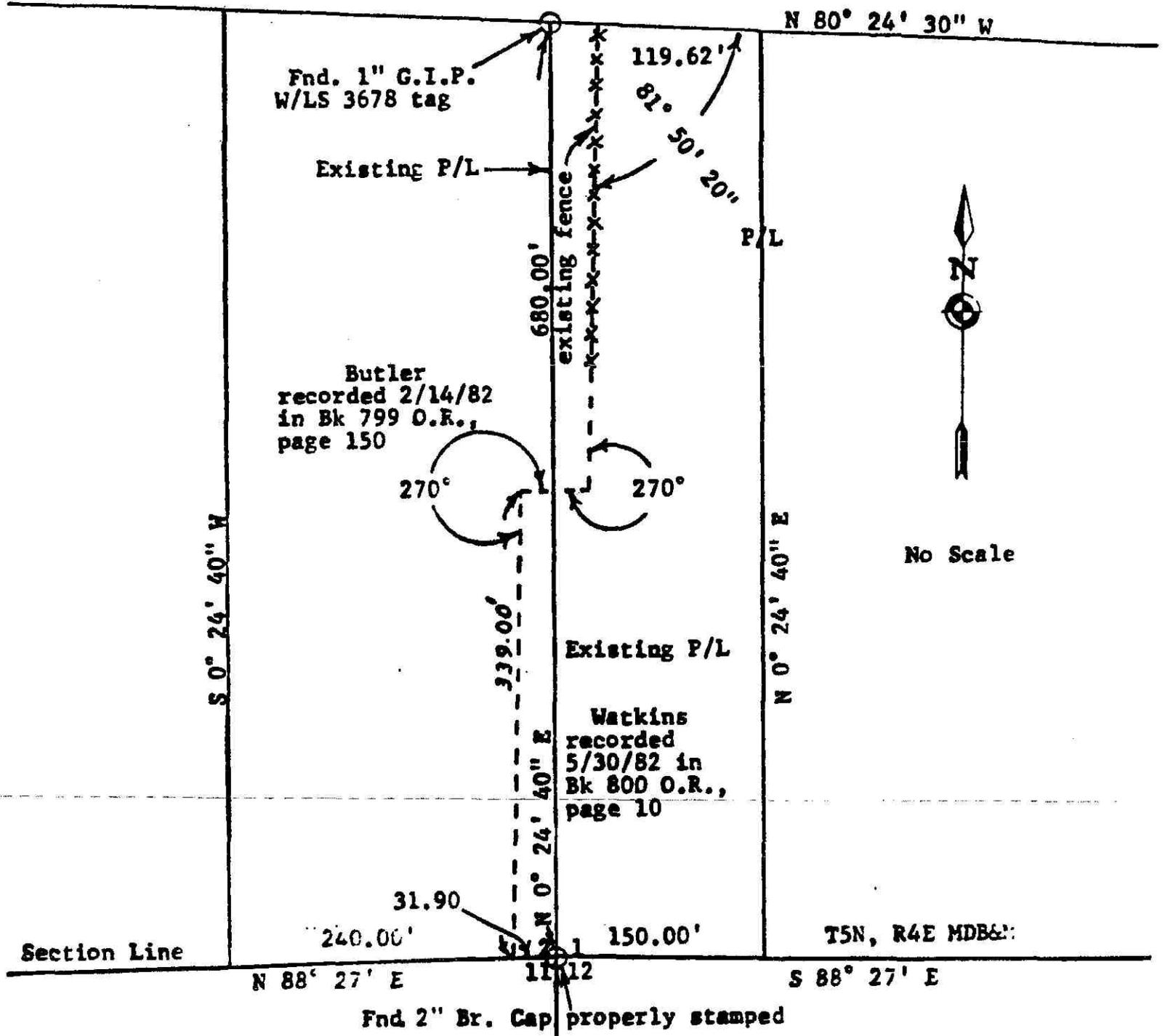


Problem C-3 (10 Points)

REQUIRED

You have been commissioned to monument the angle points for a lot line adjustment and prepare a legal description for both owners. Mrs. Butler and Mr. Watkins have agreed that the location of the existing fence will control the location of the new property line in the front of the property and approximately equal areas will be exchanged. Refer to attached sketch for field and record information. Scaled distances are NOT acceptable. Work need not be shown. Calculate all necessary information and write a complete metes and bounds description for both parcels.

Greenpoint Rd Co. No. 123



Fnd. 1" G.I.P.  
W/LS 3678 tag

Existing P/L

existing fence

Butler  
recorded 2/14/82  
in Bk 799 O.R.,  
page 150

270°

270°

Existing P/L

Watkins  
recorded  
5/30/82 in  
Bk 800 O.R.,  
page 10

No Scale

Section Line

N 88° 27' E

1112

S 88° 27' E

Fnd 2" Br. Cap properly stamped

O=Monuments set & shown  
on map filed in book 25  
of Surveys, pg. 52, Sacramento  
County Records.

- - - - = New Property Line

Section Line

Problem C-4 (7.5 Points)

REQUIRED

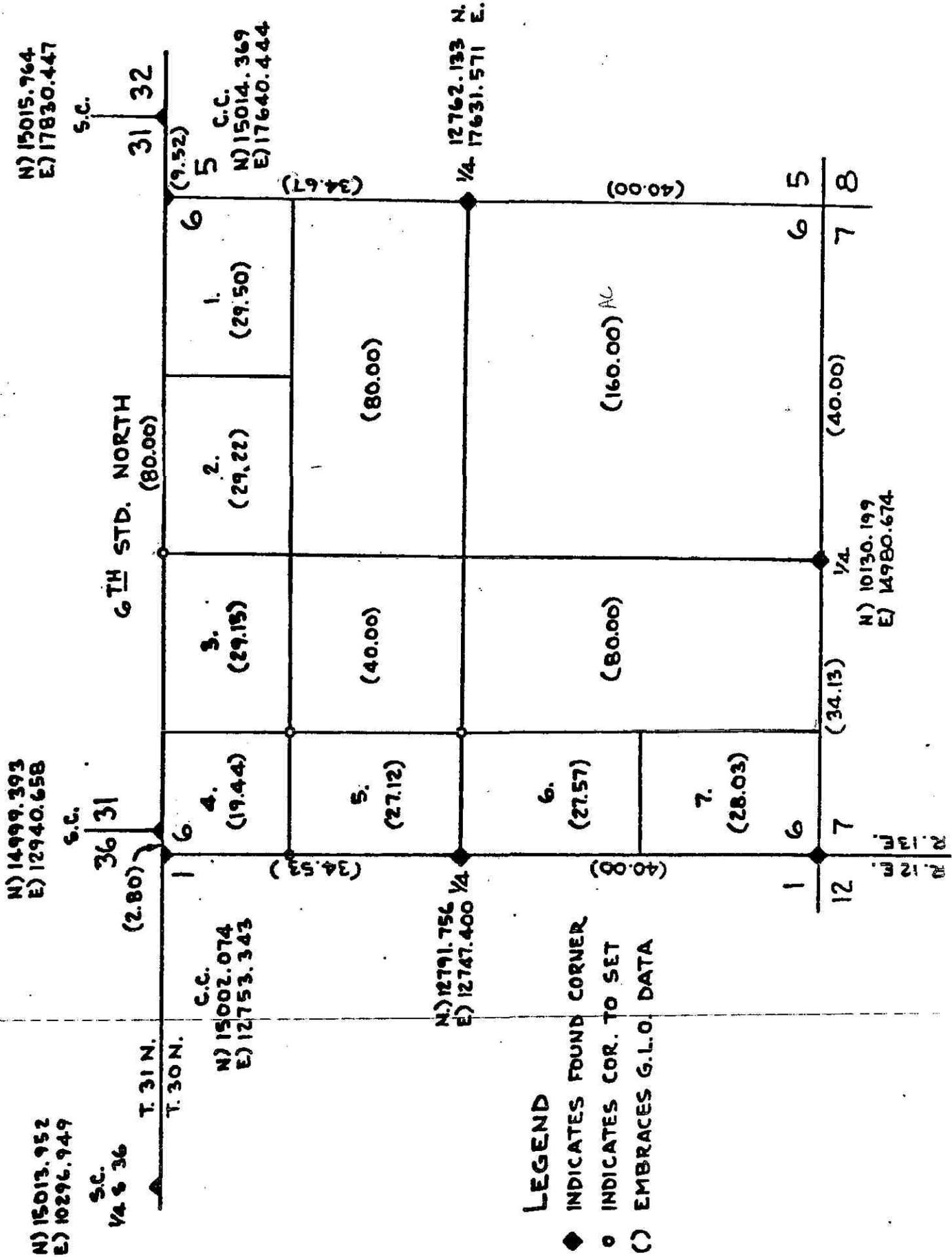
You have been retained to locate and monument Government Lot 5 of Section 6 as shown on the sketch. Coordinates of existing monuments are shown. All other monuments are considered lost. G.L.O. Data is shown in brackets.

What are the coordinates of the following corners?

1. Northwest corner Section 6.
  2. Northeast corner Section 6.
  3. North Quarter corner Section 6.
  4. Center Quarter corner Section 6.
  5. Northwest corner of Lot 5.
  6. Southeast corner of Lot 5 (CW1/16).
  7. CN1/16 corner Section 6.
  8. Northeast corner Lot 5.
-

Problem C-4 (7.5 Points)

REQUIRED



Problem C-5 (7.5 Points)

REQUIRED

The following questions pertain to existing State Law, U.S. Government Law and principles of boundary control. Complete the sentence by providing the missing words. Use only the number of words indicated.

1. Owners of a parcel of land created prior to March 4, 1972 may be required to obtain a \_\_\_\_\_ prior to obtaining a permit or other grant of approval for development of the parcel.
2. A final map shall be required for all subdivisions creating five or more parcels except where each parcel created has a gross area of \_\_\_\_\_ or more, and has an approved access to a \_\_\_\_\_ or \_\_\_\_\_.
3. If the surveyor or engineer of record dies prior to setting the monuments shown on a recorded map, another surveyor or engineer may set the monuments but must file a \_\_\_\_\_ or an \_\_\_\_\_ prior to setting.
4. A record of survey may not show the division of a parcel of land shown on the latest adapted county assessment roll as a unit or as contiguous units unless there is attached there to a \_\_\_\_\_ by the county surveyor or city engineer.
5. A "lost" interior section corner in a township must be restored by the \_\_\_\_\_ method.
6. An \_\_\_\_\_ right that grows into a fee right extinguishes all other rights and ranks first in importance of conflicting elements in boundary determination.
7. A quit claim deed carries no \_\_\_\_\_ rights.
8. A \_\_\_\_\_ law takes precedence over common law.

Problem C-5 (7.5 Points)

REQUIRED

9. The county recorder shall not have more than \_\_\_\_\_ within which to examine a final or parcel map and either \_\_\_\_\_ or \_\_\_\_\_ it for filing.
10. A \_\_\_\_\_ corner determines the direction of a line, not necessarily its terminus. (public lands)
11. Monuments called for in a deed, either directly or by reference to a plat which the parties acted by are subordinate to \_\_\_\_\_ rights, but are superior to \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.
12. The filing for record of a final or parcel map by the county recorder shall automatically and finally determine the validity of such map and when recorded shall impart \_\_\_\_\_ notice thereof.
13. Every licensed land surveyor or registered civil engineer may administer and certify \_\_\_\_\_ when it becomes necessary to take testimony for the identification and establishment of \_\_\_\_\_ or \_\_\_\_\_ corners.
14. Excess or deficiency occurring within a block should not be \_\_\_\_\_ among other blocks.
15. When the end lot measurement is not given, all the excess or deficiency is presumed to be given to \_\_\_\_\_.
16. Proportionate measurement can not be used to alter an acceptable original \_\_\_\_\_ position.
17. An approved or conditionally approved tentative map shall expire \_\_\_\_\_ after its approval or conditional approval or after such additional period of time as may be prescribed by local ordinance, not exceed an additional \_\_\_\_\_.

Problem C-5 (7.5 Points)

REQUIRED

18. \_\_\_\_\_ refers to a map made for the purpose of showing the design and improvement of a proposed subdivision.
  
19. The term \_\_\_\_\_ is applied to a new measurement made on a line to determine one or more positions on that line.
  
20. A lost closing corner will be re-established on the \_\_\_\_\_ that was closed upon and at the proper proportional interval between the \_\_\_\_\_  
\_\_\_\_\_ to the right and left.

Problem C-6 (5 Points)

REQUIRED

- A) Give five examples of current State and National problems being discussed in the surveying profession:
- B) Give seven examples of criteria generally discussed as a requirement in being a Professional Land Surveyor:
- C) List five periodical publications available to Land Surveyors, which relate directly to land surveying in the nation and State of California.

Problem C-7 (10 Points)

REQUIRED

- (A) You have received the topographic map shown from a photogrammetric firm and have made a field check to determine its accuracy by running diagonal profiles from the northwest corner to the southeast corner and from the northeast corner to the southwest corner. The distances and elevations of your check profiles are shown.

Assume that National Map Accuracies require that 90% of all contours must check within one half of a contour interval and all contours must check within one contour interval. Further 90% of all spot elevations determined photogrammetrically must check within one quarter of a contour interval and all spot elevations must check within one half of a contour interval.

Compute the differences between the photogrammetric contours or the spot elevations determined photogrammetrically and your check profiles. Show the differences in the space provided next to the field elevations. Indicate which check elevations meet National Map Accuracy Standards for the indicated contour interval or spot elevation in the space next to the elevation differences. Does the map pass or fail this test for National Map Accuracies?

<u>CHECK PROFILE FROM A TO C</u>					<u>CHECK PROFILE FROM B TO D</u>				
Dist.	Elev.	Diff.	Pass	Fail	Dist.	Elev.	Diff.	Pass	Fail
0	54.2	_____	_____	_____	0	62.1	_____	_____	_____
321	56.5	_____	_____	_____	20	59.7	_____	_____	_____
402	57.0	_____	_____	_____	103	57.0	_____	_____	_____
555	57.2	_____	_____	_____	161	53.9	_____	_____	_____
642	56.3	_____	_____	_____	205	57.4	_____	_____	_____
867	54.1	_____	_____	_____	343	59.3	_____	_____	_____
902	52.9	_____	_____	_____	518	61.7	_____	_____	_____
921	53.5	_____	_____	_____	560	61.3	_____	_____	_____
1006	55.2	_____	_____	_____	607	60.2	_____	_____	_____
1148	57.0	_____	_____	_____	739	59.3	_____	_____	_____
1268	59.3	_____	_____	_____	804	56.1	_____	_____	_____
1380	59.2	_____	_____	_____	966	53.8	_____	_____	_____
1543	61.3	_____	_____	_____	1158	52.4	_____	_____	_____
1722	62.0	_____	_____	_____	1308	50.8	_____	_____	_____
1739	63.8	_____	_____	_____	1421	50.4	_____	_____	_____
1761	66.3	_____	_____	_____	1682	47.7	_____	_____	_____
1780	68.8	_____	_____	_____	1820	46.9	_____	_____	_____
1799	71.3	_____	_____	_____					

- (B) What is the maximum permitted error in a spot elevation for this mapping contour interval ?
- (C) What is the allowable error in 90% of all contour checks for this mapping contour interval ?



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D

1982

LAND SURVEYOR

PRINCIPLES AND PRACTICE

1. This part of the examination - "Part D" - is the second part of the Land Surveyor examination, and is to be completed in 4 hours.
2. Your answers are to be completed in your workbook - use separate answer sheets for each problem, unless otherwise instructed.
3. This portion of the Land Surveyor examination consists of the following:

Problem D-1	REQUIRED	10.0 Points
Problem D-2 OR Problem D-3	CHOOSE ONE	10.0 Points
Problem D-4 OR Problem D-5	CHOOSE ONE	5.0 Points
Problem D-6	REQUIRED	5.0 Points
Problem D-7	REQUIRED	10.0 Points
Problem D-8	REQUIRED	5.0 Points
Problem D-9	REQUIRED	5.0 Points
TOTAL		50.0 Points

4. Do not work both problems where a choice is offered. Credit will be allowed for one (1) problem only.
5. Problem D-3 requires that you remove one sheet that is to be attached to your workbook.
6. After you have completed this portion of the examination, check the problem order, include all pages (including diagrams if required) and turn it in to the examination proctor.
7. You may keep this set of examination questions.

Problem D-1 (10 Points)

REQUIRED

Radio Station KPLN is installing a new radio tower and is required to give the F.C.C. the geographic position (to the nearest 10") of the tower. You have been asked to establish the position of the tower; to do this you will set on control point "Green", back-sight control point "Red" and tie in the radio tower. The data gathered is as follows:

"Green" : State Plane Coordinates (zone IV)  $x=1,453,181.23$   
 $y=11,287.00$ ; Elevation = 1850' Geodetic Azimuth to  
 "Red" (north) =  $358^{\circ}22'59.9$

Field angle (right) to radio tower  $210^{\circ}15'04"$

Horizontal ground distance to radio tower = 10,368.074'

radio tower elevation = 2250'

What is the latitude and longitude of the radio tower ?

Constants	IV	V
C	2,000,000	2,000,000
Central Meridian	$119^{\circ} 00'$	$118^{\circ} 00'$
$R_b$	28,652,931.96	30,649,424.27
$T_0$	470,526.63	455,278.73
$l$	0.59658 71443	0.57001 19219
$\frac{1}{2\rho_0^2 \sin 1''}$	$2.360 \times 10^{-10}$	$2.361 \times 10^{-10}$
$\log \frac{1}{2\rho_0^2 \sin 1''}$	0.372 8843 - 10	0.373 0670 - 10
$\log l$	9.77567 38907 - 10	9.75588 39391 - 10
$\log k$	7.62714 43424	7.63926 75454

Lambert Projection for California IV

Problem D-1 (10 Points)

Table I

REQUIRED

Lat.	R feet	Y <sup>1</sup> y value on central meridian feet	Tabular difference for 1 sec. of lat.	Scale in units of 7th place of logs	Scale expressed as a ratio
35° 20'	28,652,931.96	0	101.12700	+836.6	1.0001926
21	28,646,864.34	6,067.62	101.12667	+808.6	1.0001862
22	28,640,796.74	12,135.22	101.12633	+781.1	1.0001799
23	28,634,729.16	18,202.80	101.12600	+753.8	1.0001736
24	28,628,661.60	24,270.36	101.12567	+727.0	1.0001674
25	28,622,594.06	30,337.90	101.12533	+700.4	1.0001613
35° 26'	28,616,526.54	36,405.42	101.12500	+674.3	1.0001553
27	28,610,459.04	42,472.92	101.12467	+648.5	1.0001493
28	28,604,391.56	48,540.40	101.12433	+623.1	1.0001435
29	28,598,324.10	54,607.86	101.12417	+598.0	1.0001377
30	28,592,256.65	60,675.31	101.12383	+573.3	1.0001320
35° 31'	28,586,189.22	66,742.74	101.12350	+548.9	1.0001264
32	28,580,121.81	72,810.15	101.12317	+524.9	1.0001209
33	28,574,054.42	78,877.54	101.12300	+501.3	1.0001154
34	28,567,987.04	84,944.92	101.12283	+478.0	1.0001101
35	28,561,919.67	91,012.29	101.12250	+455.1	1.0001048

Table II (Cont'd)

1" of Long. = 0.159658714 of  $\theta$

Long.	$\theta$	Long.	$\theta$	Long.	$\theta$
120° 46'	-1° 03' 14.12942	121° 21'	-1° 24' 07.1272	121° 56'	-1° 44' 59.9602
47	-1 03 50.0895	22	-1 24 42.9225	57	-1 45 35.7555
48	-1 04 25.8847	23	-1 25 18.7177	58	-1 46 11.5507
49	-1 05 01.6799	24	-1 25 54.5129	59	-1 46 47.3459
50	-1 05 37.4752	25	-1 26 30.3082	122° 00'	-1 47 23.1412
120° 51'	-1 06 13.2704	121° 26'	-1 27 06.1034	122° 01'	-1 47 58.9364
52	-1 06 49.0656	27	-1 27 41.8986	02	-1 48 34.7316
53	-1 07 24.8608	28	-1 28 17.6938	03	-1 49 10.5268
54	-1 08 00.6561	29	-1 28 53.4891	04	-1 49 46.3221
55	-1 08 36.4513	30	-1 29 29.2843	05	-1 50 22.1173
120° 56'	-1 09 12.2465	121° 31'	-1 30 05.0795	122° 06'	-1 50 57.9125
57	-1 09 48.0418	32	-1 30 40.8748	07	-1 51 33.7078
58	-1 10 23.8370	33	-1 31 16.6700	08	-1 52 09.5030
59	-1 10 59.6322	34	-1 31 52.4652	09	-1 52 45.2982
121° 00'	-1 11 35.4274	35	-1 32 28.2604	10	-1 53 21.0934

Table I (Cont'd)

Problem D-1 (10 Points)

REQUIRED

Lat.	R feet	y value on central meridian feet	Tabular difference for 1 sec. of lat.	Scale in units of 7th place of logs	Scale expressed as a ratio
35° 16'	30,006,492.15	642,932.12	101.10317	-162.8	0.9999625
17	30,000,425.96	648,998.31	101.10367	-151.2	0.9999652
18	29,994,359.74	655,064.53	101.10417	-139.3	0.9999679
19	29,988,293.49	661,130.78	101.10483	-127.0	0.9999708
20	29,982,227.20	667,197.07	101.10533	-114.4	0.9999737
35° 21'	29,976,160.88	673,263.39	101.10600	-101.4	0.9999767
22	29,970,094.52	679,329.75	101.10667	-88.0	0.9999797
23	29,964,028.12	685,396.15	101.10717	-74.3	0.9999829
24	29,957,961.69	691,462.58	101.10783	-60.2	0.9999861
25	29,951,895.22	697,529.05	101.10833	-45.7	0.9999895
35° 26'	29,945,828.72	703,595.55	101.10900	-30.8	0.9999929
27	29,939,762.18	709,662.09	101.10983	-15.6	0.9999964
28	29,933,695.59	715,728.68	101.11033	0.0	1.0000000
29	29,927,628.97	721,795.30	101.11100	+16.0	1.0000037
30	29,921,562.31	727,861.96	101.11167	+32.3	1.0000074
35° 31'	29,915,495.61	733,928.66	101.11233	+49.0	1.0000113
32	29,909,428.87	739,995.40	101.11300	+66.0	1.0000152
33	29,903,362.09	746,062.18	101.11383	+83.5	1.0000192
34	29,897,295.26	752,129.01	101.11433	+101.3	1.0000233
35	29,891,228.40	758,195.87	101.11517	+119.5	1.0000275

Table II (Cont'd)

1" of Long. = 0.57001192 of e

Long.	e	Long.	e	Long.	e
119° 36'	-0° 54' 43.2687	120° 11'	-1° 14' 40.2937	120° 46'	-1° 34' 37.3187
37	-0 55 17.4694	12	-1 15 14.4944	47	-1 35 11.5195
38	-0 55 51.6701	13	-1 15 48.6951	48	-1 35 45.7202
39	-0 56 25.8708	14	-1 16 22.8959	49	-1 36 19.9209
40	-0 57 00.0715	15	-1 16 57.0966	50	-1 36 54.1216
119° 41'	-0 57 34.2722	120° 16'	-1 17 31.2973	120° 51'	-1 37 28.3223
42	-0 58 08.4730	17	-1 18 05.4980	52	-1 38 02.5230
43	-0 58 42.6737	18	-1 18 39.6987	53	-1 38 36.7237
44	-0 59 16.8744	19	-1 19 13.8994	54	-1 39 10.9245
45	-0 59 51.0751	20	-1 19 48.1001	55	-1 39 45.1252
119° 46'	-1 00 25.2753	120° 21'	-1 20 22.3009	120° 56'	-1 40 19.3259
47	-1 00 59.4765	22	-1 20 56.5016	57	-1 40 53.5266
48	-1 01 33.6773	23	-1 21 30.7023	58	-1 41 27.7273
49	-1 02 07.8780	24	-1 22 04.9030	59	-1 42 01.9280
50	-1 02 42.0787	25	-1 22 39.1037	121° 00'	-1 42 36.1284

IMPORTANT

YOU MUST WORK EITHER D-2 OR D-3 BUT

DO NOT WORK BOTH

Problem D-2 (10 Points)

OPTIONAL

In setting out aerial control you decide to establish the vertical control by trigonometric leveling. Below is the reduced data for the control. The aerial survey is for a topographic map with a 5 foot contour interval. Establish the unadjusted elevations for the control points; determine if the data should be adjusted and if so perform an adjustment explaining your reasons for the adjustment, if no adjustment is required explain why.

<u>Point</u>	<u>HI</u>	<u>Horizontal Dist.</u>	<u>Vertical Angle</u>	<u>Elevation</u>
A	5.20			1123.05
B	5.49	8,323.25	+0°49'16"	
C	5.15	5,529.64	+0°31'03"	
D	5.38	10,436.78	-0°29'32"	
E	5.72	4,991.67	-0°18'40"	
A	5.20	3,875.11	-0°48'57"	1123.05

(HI indicates height for both instrument and sight)

YOU MUST SHOW ALL WORK

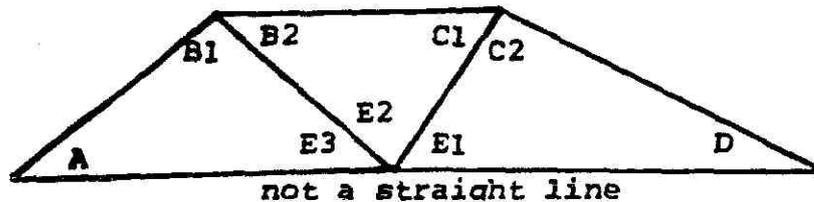
Problem D-3 (10 Points)

OPTIONAL

You are in responsible charge of executing a control survey contract which requires measurement of angles A through E3 shown in the network below. The contract requires that each angle be observed at least 5 times with the precision which will yield a standard error for the mean of each angle not to exceed  $\pm 2.5$  seconds.

Your survey crews have observed the raw angles shown below with a one second theodolite

- Compute and show the mean of each angle after rejecting all blunders and the standard error of the mean. Does the standard error of each angle observed meet the contract specifications?
- Assume that the contract specifications have been met after rejecting all blunders in the data. Adjust angles A through E3 to the nearest 0.1 second weighting the adjustment to each angle in proportion to the standard error of that angle. Round the weights up or down to the nearest integer before making your corrections. Please write your answers in the spaces provided on the next page. This page is to be removed and turned in with your workbook.



Angle A

47° 08' 02"  
47° 07' 58"  
47° 08' 01"  
47° 07' 59"  
47° 18' 00"  
47° 07' 57"

Angle B1

92° 33' 33"  
92° 33' 32"  
92° 33' 29"  
92° 33' 30"  
92° 33' 32"  
92° 33' 28"

Angle E3

40° 18' 30"  
40° 08' 30"  
40° 18' 29"  
40° 18' 32"  
40° 18' 30"  
40° 18' 29"

Angle B2

43° 02' 04"  
43° 02' 04"  
43° 02' 00"  
43° 01' 59"  
43° 02' 02"  
43° 02' 01"

Angle C1

71° 48' 25"  
71° 48' 25"  
71° 48' 26"  
71° 48' 27"  
71° 48' 24"  
71° 48' 26"

Angle E2

65° 09' 37"  
65° 09' 38"  
65° 09' 36"  
65° 09' 38"  
65° 09' 39"  
65° 09' 36"

Angle C2

66° 35' 59"  
66° 36' 04"  
66° 36' 03"  
66° 36' 00"  
66° 36' 04"  
66° 36' 02"

Angle D

38° 51' 50"  
38° 51' 48"  
38° 51' 47"  
38° 51' 49"  
38° 51' 49"  
38° 51' 50"

Angle E1

74° 32' 00"  
74° 31' 57"  
74° 31' 56"  
74° 32' 01"  
74° 31' 00"  
74° 32' 01"

Problem D-3 (10 Points)

OPTIONAL

<u>ANGLE</u>	<u>MEAN VALUE</u>	<u>STD ERROR</u>	<u>WEIGHT</u>	<u>CORRECTED ANGLE</u>	<u>FAIL</u>	<u>PAS</u>
A	_____	_____	_____	_____	_____	_____
B1	_____	_____	_____	_____	_____	_____
B2	_____	_____	_____	_____	_____	_____
C1	_____	_____	_____	_____	_____	_____
C2	_____	_____	_____	_____	_____	_____
D	_____	_____	_____	_____	_____	_____
E1	_____	_____	_____	_____	_____	_____
E2	_____	_____	_____	_____	_____	_____
E3	_____	_____	_____	_____	_____	_____

NOTE: REMOVE THIS PAGE FROM BOOKLET AND TURN  
IN WITH YOUR ANSWERS.

ENTER YOUR I.D. NO. IN SPACE PROVIDED ABOVE

LS-D  
1982  
Page 8

IMPORTANT

YOU MUST WORK EITHER D-4 OR D-5 BUT

DO NOT WORK BOTH



Problem D-5 (5 Points)

OPTIONAL

Ground survey control is frequently required for medium and large scale engineering photogrammetric mapping, particularly in cases where analytical control extension is not cost justified. In most of the cases where large scale (1" to 100' varying to 1" = 20') mapping is used, the type selection of targets, their size and location procedures becomes important in map accuracy production.

The following are not trick questions. They are based on logical understanding of the photogrammetric process and knowledge of the peculiarities of contemporary wide-angle mapping cameras. The most correct answers would respond to the minimum sufficient, accuracy and survey cost considerations.

For all of the following, select the nearest correct answer, assuming the following criteria: 6" f.l. Pleogon or Avlogon lens camera; photo scale 1" to 240' (1:2880); Mapping scale 1" to 40' (1:480); the terrain and planimetric feature types in the area to be photogrammetrically mapped: semi-urban as may be found in the periphery of most medium sized cities in California, with a mixture of developed portions along with areas of flat, open field and grasslands free of trees, along with areas of tall conifers (60 to 100 feet in height) and slopes varying from 1% to 45%.

No. 1 Wt. 0.5 The targets should be placed as a minimum condition:

- a) Always free of any tree shadows.
- b) Free of tree shadows at least between 8:00 A. M. and 4:00 P. M.
- c) Free of tree shadows between 10:00 A. M. and 2:00 P. M. sun time.

Problem D-5 (5 Points)

OPTIONAL

No. 2 Wt. 0.5 When it is required that targets be placed close to trees, the surveyor needs to be concerned with:

- a) Only with the potential of hiding the target with tree shadows.
- b) That the targets should never be placed within a horizontal distance less than the height of the trees adjoining.
- c) Only, that either shadows or photo displacement of tall trees in the outer edges of the stereo model might hide the target.

No. 3 Wt. 0.5 Choose one answer from the following target visibility considerations; in the correct order of their photogrammetric importance:

- a) Length of target legs, width of legs, contrast, and number of legs of the target.
- b) Width of legs, number of legs, contrast, and length of legs.
- c) Contrast, length of legs, width of legs, number of legs.

No. 4 Wt. 0.5 Target size: In order to clearly identify targets, the overall target length and the leg width expressed as a measurement in feet of a portion of the photo scale is used as a criteria. The correct answer is the minimum size of the choices below considering the 5 diameter magnification of the projection type "Kalsh" plotter and the photo scale of 1" to 240'.

- a) Target leg 0.01" for length; 0.002" for leg width of the photo scale.

Problem D-5 (5 Points)

OPTIONAL

- b) 0.1" for length; 0.01" for leg width of the photo scale.
- c) 0.005" for length; 0.0025" for leg width of the photo scale.

No. 5 Wt. 0.5 Terrain selection with targets is a consideration. One of the following is the most correct assumption:

- a) A good target, with the correct size and contrast will be good for both horizontal and vertical control in all cases.
- b) A target of correct size and contrast may be adequate for horizontal, but dubious for vertical control if placed on a steep slope.
- c) Targets of correct size and contrast should always be separate for horizontal and vertical control because their function is so different that photogrammetric and optic needs would so require.

No. 6 Wt. 1.0 Target density: Only one of the following statements is most correct for the majority of large scale mapping projects:

- a) Since economics in survey control costs are very important, targets should be spaced to attempt to only straddle the area to be mapped, particularly with narrow strips such as road right-of-way strip mapping.
- b) Economical surveying control is important. However, to please the stereo operator of the photogrammetric machine if control spread selected is narrow, it is only necessary to increase the density of points to compensate.

Problem D-5 (5 Points)

OPTIONAL

c) Control density requires a minimum of three vertical and two horizontal points per stereo model. Four vertical points and three horizontal points provide a check in each model. Consistent with survey economy, widespread control is generally the best answer regardless of the width of the mapping strip.

No. 7 Wt. 0.5 Accuracy of horizontal control: In terms of economics the surveyor will choose one of the following position closures as a working guide in providing large scale mapping control. The criteria is 1" to 40' final scale mapping, assuming a mapping strip of approximately two miles.

- a) 1:50,000
- b) 1:36,000
- c) 1:10,000
- d) 1:5,000
- e) 1:3,000

No. 8 Wt. 0.5 One of the following statements regarding vertical control points is most correct. The prudent surveyor will:

- a) Always loop levels and give elevation data to the top of monument at the target.
- b) In addition to "a)", he will furnish a sketch of the target.
- c) He will loop levels, give elevation to the top of monument, sketch and determine elevation of the top of target panel if it is different than the monument at the target.
- d) He will perform all of the above in "c)" and take two views in polaroid color of the target in every case.

Problem D-5 (5 Points)

OPTIONAL

No. 9 Wt. 0.5 Targets set out prior to photography eliminate uncertainties of the elevation and/or horizontal location of the required survey control to the stereo plotter operator. Only one of the following statements is true considering the majority of large scale mapping projects:

- a) Effective and accurate aerial mapping should always be pre-targeted, with panel location and panel size carefully selected. A loss of (or unusability of) more than 30% of the panels may seriously effect the mapping accuracy completion.
- b) Pre-targeting is usually cost effective because the pre-selection of traverse and level routes can be determined. The loss of, or unsuitability of, 30% of the panels may increase the survey control costs. However, control identification without targets is normally easily possible in large scale photography.
- c) In areas requiring control, particularly where fields are freshly cultivated, control targets are mandatory. If they are lost or obliterated, the stereo plotter operator will have no other option than to order new mapping flights.

Problem D-6 (5 Points)

REQUIRED

PUBLIC LAND LAWS

- 1.) Where does one find the authority for the Public Land Laws?
- 2.) Where does one find the authority for, and range of powers of, the Bureau of Land Management?
- 3.) If you are contracted by the Bureau of Land Management to perform a boundary survey of Public Lands, do you need to be a Licensed Land Surveyor? (of which state?) Cite authority for your answer.
- 4.) Where does one find that the township is the basis of subdividing the Public Lands?
- 5.) Is it possible for the U. S. Government to re-survey an entire township in which over 50% of the land is in private ownership, re-setting all section corners and make or have the new corners control over the originals?

Problem D-7 (10 Points)

STATEMENT OF CONDITIONS

REQUIRED

With their common boundary in dispute, both parties, jointly, have hired you to establish in the field their property line.

You have performed a diligent preliminary records search for data and located or determined the following:

- 1) Your clients own lots #10 and #11 of block 'B'.
- 2) You have obtained from public records a copy of the original subdivision (dated 1912) - portions containing the relevant information are shown on the attached page(s).
- 3) There are no records or monumentation data available from either the City or the County.
- 4) While field examination discloses an existing fenceline, it is too deteriorated to retrace.
- 5) A preliminary field survey has determined that, based upon measurements of the existing improvements which confirm the 60' right-of-way widths, the field distance from the centerline of High Street to the centerline of Bayo Vista Avenue, along the centerline of Fairview Avenue, is 654.06 feet. All streets are fully improved.

\* \* \* \* \*

PROBLEM

- A) Review the existing data. If there are other steps which could be taken, outline them with reasons and/or possible goals.
- B) You are to determine the location of your clients' common southerly property corner (common with the Fairview Ave. Right-of-Way). For consistency of answers, this must be expressed as measured along the centerline of Fairview from the centerline of Bayovista and thence 90' to the corner. Show, carefully, your calculations, any reasonings, and all intermediate results.
- C) If you must make any assumptions, state them clearly, citing your reasoning and/or authority.

# A PORTION OF WATERSIDE TERRACE ALAMEDA, CAL.

1912

Scale 60 Feet = 1" = 60'

Problem D-7. (10 Points)

LS-D  
1982  
Page 17

REQUIRED

(See over for enlargement of "LEGEND")

BAYO VISTA AVENUE (60' Right of Way)

74.47

LOT 14  
165.06

LOT 7	40
LOT 8	40
LOT 9	40
LOT 10	40
LOT 11	40
LOT 12	40
LOT 13	40

FAIRVIEW AVENUE (60' Right of Way)

LOT 6  
120

HIGH STREET

NORTHERLY  
1" = 60'

BLOCK 'B'

*[Faint, illegible text, likely a legend or notes for the map.]*

**LEGEND**

*Boyle Vista Ave. S side - B.C.T.P. - 5063 ft angle from High Street  
Curve - Radius - 216.87  
Angle of intersection - 45° 16' 30" Thence parallel  
with & distant 340 from the E. of Ferriside  
Boulevard to an intersection with Fairview  
Ave. at an angle of 30° 40' 30"*

*N side - B.C.T.P. - 5063 ft angle from High St.  
Radius - 216.87  
Angle of intersection - 45° 16' 30" Thence parallel  
with & distant 340 from the E. of Ferriside  
Boulevard to an intersection with Fairview  
Ave. at an angle of 50° 40' 30"*

*Division Curve - B.C.T.P. - 120 North easterly and 120 South  
in Block E - easterly from the N.E. cor. of High Street  
& Boyle Vista Ave. Thence along curve Radius  
- 432.02. Angle of intersection - 45° 16' 30" Thence parallel  
with & distant 160 from the E. of Ferriside Boulevard*

*Fairview Ave. - S side - B.C.T.P. - 7589 ft angle from Ferriside  
Curve - Boulevard - Radius - 74.47  
Tangent - 24.43  
S side - B.C.T.P. - 7589 ft angle from Ferriside  
Boulevard  
Radius - 134.47 Tangent - 44.11*

*Small Curves - Radial pt. of intersect'd center line of path  
with Westerly line of U.S. Tidal Canal  
Radius - 30*

MAP OF  
WATERSIDE TERRACE  
Alameda Co., Calif.  
1912

Problem D-8 (5 Points)

REQUIRED

The Subdivision Map Act was originally a part of the Business and Professions Code until it was recodified into the Government Code in March of 1975. Answer the parts of this question according to the current Government Code of the Subdivision Map Act.

- A. What is a subdivision?
- B. Name two examples where a Parcel Map is required instead of a tentative and final Subdivision Map?
- C. When a Parcel Map is required, the surveyor shall base the map upon a field survey made in conformity with the Land Surveyor's Act. What is another method allowed of indicating the boundaries of a Parcel Map?
- D. After a final map or parcel map is filed in the office of the County Recorder, what are the reasons that would cause it to be amended by certificate of correction or amending map?
- E. Describe the procedure for setting monuments for a subdivision on which the original engineer or surveyor has died?
- F. Name the types of improvement security allowed by the Subdivision Map Act?
- G. Name three types of offers of dedication within the Subdivision which may be imposed by local ordinance?

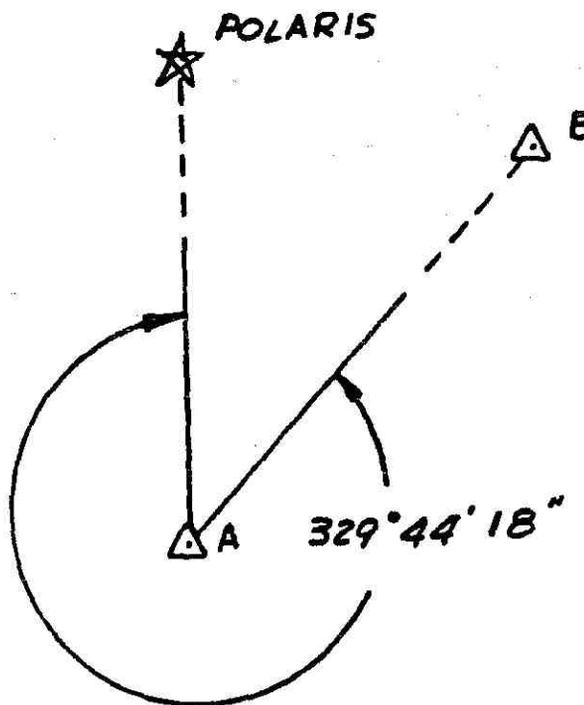
Problem D-9 (5 Points)

REQUIRED

**AZIMUTH DETERMINATION**

You are to determine the astronomic bearing of line AB to the nearest second based on the following data:

1. Station 'A' is occupied
2. Scaled Latitude =  $36^{\circ} 10' 42''$  N
3. Scaled Longitude =  $118^{\circ} 36' 24''$  W
4. Date of the observation, May 17, 1982
5. Mean chronometer time of the observation is 8:20:42 PM PDST
6. Chronometer is 0:03:18 fast
7. Barometric pressure is at 30.2 inches
8. Temperature is at  $65^{\circ}$ F
9. Mean measured altitude of POLARIS is  $35^{\circ} 37' 06''$



SEE EPHEMERIS TABLES NEXT 4 PAGES

Problem D-9 (5 Points)

REQUIRED

**POLARIS AT ANY TIME**

27. Example. Time of observation May 5, 1982; watch reading, 8:28:23 PM, 90th Meridian time; watch known to be 0:02:03 slow; latitude (from map) N42° 22.6'; longitude (from map) W92° 58.3'; clockwise angle, mark to star 25° 53.0'.

Find the *LHA* and *t* (see Sec. 14) as shown below.

Watch time	8:28:23 PM
Watch correction (slow is plus)	2:03 slow
Standard time (90th meridian)	8:30:26 PM
Correction to 24 hour basis	+ 12
90th meridian time	20:30:26
Correction for time zone	+ 6
GCT (Sec. 5)	26:30:26
GCT May 6, 1982	2:30:26
GHA (Sec. 2) 0 <sup>h</sup> May 6, 1982 Table 1	190° 27.3'
Correction for 2 <sup>h</sup> 30 <sup>m</sup> (Table 5)	+ 37 36.2
Correction for 26' (Table 5)	+ 6.5
GHA	228° 10.0'
Less west longitude (from map)	- 92° 58.3'
LHA (Sec. 14)	135° 11.7'
<i>t</i> = LHA or 360 - LHA (use smaller)	135° 11.7'

**CELESTIAL OBSERVATIONS**

28. Computation. The bearing of Polaris (*Z*) (Sec. 15) is found from the formula:

$$Z = \frac{\sin t}{\cos h} p \dots\dots\dots(5)$$

where

*t* (Sec. 14) is the meridian angle just computed above.

*h* (Sec. 20) is the true altitude. It is usually obtained from the known latitude *l*, using Table 6, and then it need not be observed.

*p* (Sec. 17) is the polar distance.

Four optional procedures for the computation are given below. Procedure A is the solution which is familiar to K&E Solar Ephemeris users. Procedures B, C and D are added to give a more precise solution under different conditions of latitude and instrumentation.

**Procedure A**

Table 10 gives values of *Z* for selected values of *LHA* and *l* when *p*=0° 49.00'. By a two-way interpolation the value of *Z* can be found from the known values of *LHA* and *l*. Table 11 gives the correction to be applied for values of *p* other than 0° 49.00'.

Example.

<i>LHA</i> =	<i>l</i> = 42°	42° 22.6'	44°
135°	46.2'	46.5'	47.7'
135° 11.7'		46.3'	
140°	42.0'	42.2'	43.3'

Problem D-9 (5 Points)

REQUIRED

TABLE 1  
SOLAR EPHEMERIS APRIL 1982

For 0<sup>h</sup> Universal Time or Greenwich Civil Time

Day of Month & Week	The Sun's Apparent Declination	Diff. in Declin. for 1 hour	Equation of Time		GHA of Polaris
			True Sol. Time = LCT + Eq. of Time	Differ. for 1 hour	
1 TH	N04 19.7	0.95	-04 07.1	0.75	155 56.9
2 FR	N04 42.9	0.96	-03 49.2	0.74	156 36.1
3 SA	N05 06.0	0.96	-03 31.4	0.74	157 15.4
4 SU	N05 28.9	0.95	-03 13.6	0.73	158 54.7
5 M	N05 51.8	0.95	-02 56.1	0.73	159 34.0
6 TU	N06 14.6	0.94	-02 38.7	0.72	160 13.3
7 W	N06 37.3	0.94	-02 21.6	0.71	161 52.5
8 TH	N06 59.8	0.93	-02 04.6	0.70	162 31.8
9 FR	N07 22.3	0.93	-01 47.6	0.69	163 11.0
10 SA	N07 44.6	0.92	-01 31.1	0.68	164 50.2
11 SU	N08 06.8	0.92	-01 14.8	0.67	165 29.4
12 M	N08 28.8	0.91	-00 58.8	0.65	166 8.6
13 TU	N08 50.7	0.91	-00 43.1	0.64	167 47.7
14 W	N09 12.5	0.90	-00 27.9	0.63	168 26.9
15 TH	N09 34.1	0.89	-00 12.8	0.61	169 66.0
16 FR	N09 55.5	0.89	+00 01.9	0.59	170 45.2
17 SA	N10 16.8	0.88	+00 14.2	0.58	171 24.4
18 SU	N10 37.9	0.87	+00 30.0	0.56	172 3.6
19 M	N11 58.9	0.87	+00 43.5	0.54	173 42.7
20 TU	N11 19.6	0.86	+00 56.6	0.53	174 21.9
21 W	N11 40.2	0.85	+01 09.2	0.51	175 41.1
22 TH	N12 00.6	0.84	+01 21.4	0.49	176 20.3
23 FR	N12 20.8	0.83	+01 33.2	0.47	177 39.4
24 SA	N12 40.8	0.82	+01 44.4	0.45	178 18.5
25 SU	N13 00.6	0.82	+01 55.3	0.43	179 37.6
26 M	N13 20.1	0.81	+02 05.6	0.41	180 16.6
27 TU	N13 39.5	0.80	+02 15.5	0.39	181 35.7
28 W	N13 58.6	0.79	+02 24.9	0.37	182 14.7
29 TH	N14 17.5	0.78	+02 33.8	0.35	183 33.8
30 FR	N14 36.2	0.77	+02 42.2	0.33	184 12.8
31 SA	N14 54.6		+02 50.1		185 31.9

Hourly differences in declination and equation of time are for the 24-hours following 0-hours of date in left column.

TABLE 1  
SOLAR EPHEMERIS MAY 1982

For 0<sup>h</sup> Universal Time or Greenwich Civil Time

Day of Month & Week	The Sun's Apparent Declination	Diff. in Declin. for 1 hour	Equation of Time		GHA of Polaris
			True Sol. Time = LCT + Eq. of Time	Differ. for 1 hour	
1 SA	N14 54.6	0.76	+02 50.1	0.31	185 31.9
2 SU	N15 12.7	0.75	+02 37.4	0.29	186 11.0
3 M	N15 30.7	0.74	+02 24.3	0.26	187 30.1
4 TU	N15 48.3	0.72	+02 10.6	0.24	188 29.2
5 W	N16 05.7	0.71	+02 16.4	0.22	189 28.3
6 TH	N16 22.8	0.70	+02 21.6	0.20	190 27.3
7 FR	N16 39.7	0.69	+02 26.3	0.17	191 26.3
8 SA	N16 56.2	0.68	+02 30.5	0.15	192 25.3
9 SU	N17 12.5	0.67	+02 34.0	0.12	193 24.3
10 M	N17 28.5	0.65	+02 37.0	0.10	194 23.3
11 TU	N17 44.2	0.64	+02 39.4	0.08	195 22.2
12 W	N17 59.7	0.63	+02 41.2	0.05	196 21.2
13 TH	N18 14.8	0.62	+02 42.5	0.03	197 20.2
14 FR	N18 29.6	0.60	+02 43.1	0.00	198 19.2
15 SA	N18 44.1	0.59	+02 43.2	0.02	199 18.2
16 SU	N18 58.2	0.58	+02 42.6	0.05	200 17.2
17 M	N19 12.1	0.56	+02 41.5	0.07	201 16.2
18 TU	N19 25.6	0.55	+02 39.8	0.09	202 15.2
19 W	N19 38.9	0.54	+02 37.6	0.12	203 14.2
20 TH	N19 51.7	0.52	+02 34.8	0.14	204 13.1
21 FR	N20 04.3	0.51	+02 31.4	0.16	205 12.1
22 SA	N20 16.5	0.49	+02 27.4	0.19	206 11.0
23 SU	N20 28.3	0.48	+02 22.9	0.21	207 9.8
24 M	N20 39.8	0.46	+02 17.9	0.23	208 8.7
25 TU	N20 51.0	0.45	+02 12.4	0.25	209 7.6
26 W	N21 01.7	0.43	+02 06.4	0.27	210 6.4
27 TH	N21 12.2	0.42	+02 00.0	0.29	211 5.3
28 FR	N21 22.2	0.40	+02 53.0	0.31	212 4.3
29 SA	N21 31.9	0.39	+02 45.6	0.32	213 3.2
30 SU	N21 41.2	0.37	+02 37.8	0.36	214 2.1
31 M	N21 50.2	0.36	+02 29.6	0.36	215 1.0
32 TU	N21 58.7		+02 21.0		216 0.0

Hourly differences in declination and equation of time are for the 24-hours following 0-hours of date in left column.

Problem D-9 (5 Points)

REQUIRED

TABLE 1

SOLAR EPHEMERIS DECEMBER 1982  
For 0<sup>h</sup> Universal Time or Greenwich Civil Time

Day of Month & Week	The Sun's Apparent Declination	Diff in Declin for 1 hour	Equation of Time		GMA of Polaris
			True Sol. Time - LTT + Eq of Time	Diff. for 1 hour	
1 W	S21 43.0	0.29	+11 13.1	0.93	033 29.4
2 TH	S21 52.3	0.27	+10 50.8	0.95	034 28.4
3 FR	S22 01.3	0.35	+10 27.8	0.98	037 27.9
4 SA	S22 09.8	0.34	+10 04.6	0.95	038 27.2
5 SU	S22 17.9	0.31	+09 40.3	0.92	039 26.5
6 M	S22 25.5	0.30	+09 15.4	1.05	040 25.9
7 TU	S22 32.7	0.28	+08 50.4	1.08	041 25.3
8 W	S22 39.5	0.26	+08 24.4	1.10	042 24.7
9 TH	S22 45.8	0.25	+07 58.3	1.12	043 24.0
10 FR	S22 51.7	0.23	+07 31.5	1.14	044 23.4
11 SA	S22 57.1	0.21	+07 04.2	1.15	045 22.8
12 SU	S23 02.1	0.18	+06 36.4	1.17	046 22.1
13 M	S23 06.6	0.17	+06 08.6	1.18	047 21.5
14 TU	S23 10.7	0.15	+05 40.2	1.20	048 20.8
15 W	S23 14.3	0.13	+05 11.5	1.21	049 20.1
16 TH	S23 17.4	0.11	+04 42.5	1.22	050 19.5
17 FR	S23 20.1	0.09	+04 13.3	1.23	051 18.9
18 SA	S23 22.3	0.07	+03 43.9	1.23	052 18.3
19 SU	S23 24.1	0.05	+03 14.3	1.24	053 17.7
20 M	S23 25.3	0.03	+02 44.5	1.24	054 17.1
21 TU	S23 26.1	0.01	+02 14.7	1.24	055 16.6
22 W	S23 26.5	0.01	+01 44.9	1.23	056 16.1
23 TH	S23 26.3	0.03	+01 14.9	1.24	057 15.5
24 FR	S23 25.7	0.05	+00 45.1	1.24	058 15.0
25 SA	S23 24.6	0.04	+00 15.2	1.24	059 14.5
26 SU	S23 23.1	0.00	-00 14.5	1.24	060 23.4
27 M	S23 21.0	0.10	-00 44.1	1.23	061 23.2
28 TU	S23 18.5	0.12	-01 13.4	1.22	062 22.7
29 W	S23 15.6	0.14	-01 42.5	1.21	063 22.1
30 TH	S23 12.2	0.14	-02 12.0	1.20	064 21.5
31 FR	S23 08.3	0.10	-02 40.9	1.19	065 20.9
32 SA	S23 03.5		-03 09.5		066 20.4

Hourly differences in declination and equation of time are for the 24 hours following 0-hour of date in left column.

TABLE 2

REFRACTION AND SUN'S PARALLAX  
(To be applied to observed altitudes. See page 16)  
Bar. = 29.6 in. Temp. = 50° F.

Measured Altitude	Refraction	Sun's Par.	Measured Altitude	Refraction	Sun's Par.
7 30	6.88	0.15	17 30	3.02	0.14
7 40	6.75	0.15	18 00	2.93	0.14
7 50	6.63	0.15	18 30	2.85	0.14
8 00	6.50	0.15	19 00	2.77	0.14
8 10	6.37	0.15	19 30	2.70	0.14
8 20	6.25	0.15	20 00	2.63	0.14
8 30	6.13	0.15	20 30	2.56	0.14
8 40	6.02	0.15	21 00	2.49	0.14
8 50	5.92	0.15	21 30	2.43	0.14
9 00	5.82	0.15	22 00	2.37	0.14
9 10	5.72	0.15	22 30	2.31	0.14
9 20	5.63	0.15	23 00	2.25	0.13
9 30	5.53	0.15	23 30	2.20	0.13
9 40	5.43	0.15	24 00	2.15	0.13
9 50	5.34	0.15	24 30	2.10	0.13
10 00	5.25	0.15	25 00	2.05	0.13
10 10	5.10	0.15	25 30	2.00	0.13
10 20	4.95	0.14	26 00	1.95	0.13
10 30	4.81	0.14	26 30	1.90	0.12
10 40	4.67	0.14	27 00	1.85	0.12
11 00	4.54	0.14	27 30	1.80	0.11
11 10	4.42	0.14	28 00	1.75	0.11
11 20	4.30	0.14	28 30	1.70	0.11
11 30	4.18	0.14	29 00	1.65	0.10
11 40	4.06	0.14	29 30	1.60	0.10
12 00	3.93	0.14	30 00	1.55	0.09
12 10	3.77	0.14	30 30	1.50	0.09
12 20	3.65	0.14	31 00	1.45	0.09
12 30	3.53	0.14	31 30	1.40	0.07
12 40	3.42	0.14	32 00	1.35	0.06
13 00	3.32	0.14	32 30	1.30	0.05
13 10	3.22	0.14	33 00	1.25	0.03
13 20	3.12	0.14	33 30	1.20	0.03

The refraction values in Table 2 are corrected by multiplying them by the multipliers in Table 3a when the barometric pressure and the temperature differ from those on which Table 2 is based, i.e. 29.6 inches and 50° F.

If the barometric pressure is not known, it may be estimated from the elevation of the locality in accordance with the values given in Table 3a. Otherwise the elevations are disregarded.

Problem D-9 (5 Points)

REQUIRED

**TABLE 2a**  
To correct Table 2. See Examples below.  
**MULTIPLIERS FOR OBSERVED BAROMETRIC PRESSURE OR ELEVATION**

Bar. (Inches)	Elev. (Feet)	Multi-plier	Bar. (Inches)	Elev. (Feet)	Multi-plier
30.1	- 481	1.02	30.9	+ 8194	0.81
30.2	- 181	1.02	31.8	6626	0.80
30.3	80	1.01	32.6	6047	0.79
30.4			33.5	5469	0.78
30.5	+ 91	1.01	34.4	4891	0.77
30.6	264	1.00	35.3	4313	0.76
30.7	443	0.99	36.2	3735	0.75
30.8	624	0.98	37.1	3157	0.74
30.9			38.0	2579	0.73
31.0	1207	0.97	38.9	2001	0.72
31.1	1493	0.96	39.8	1423	0.71
31.2	1783	0.95	40.7	845	0.70
31.3			41.6	267	0.69
31.4	2378	0.94	42.5	- 311	0.68
31.5	2678	0.93	43.4	- 889	0.67
31.6	2978	0.92	44.3	- 1467	0.66
31.7	3277	0.91	45.2	- 2045	0.65
31.8	3577	0.90	46.1	- 2623	0.64
31.9	3876	0.89	47.0	- 3201	0.63
32.0			47.9	- 3779	0.62
32.1	4174	0.88	48.8	- 4357	0.61
32.2	4473	0.87	49.7	- 4935	0.60
32.3	4773	0.86	50.6	- 5513	0.59
32.4	5072	0.85	51.5	- 6091	0.58
32.5	5371	0.84	52.4	- 6669	0.57
32.6	5670	0.83	53.3	- 7247	0.56
32.7			54.2	- 7825	0.55
32.8	6164	0.82	55.1	- 8403	0.54
32.9	6463	0.81	56.0	- 8981	0.53
33.0			56.9	- 9559	0.52
33.1	6957	0.80	57.8	- 10137	0.51
33.2	7256	0.79	58.7	- 10715	0.50
33.3	7555	0.78	59.6	- 11293	0.49
33.4	7854	0.77	60.5	- 11871	0.48
33.5	8153	0.76	61.4	- 12449	0.47
33.6	8452	0.75	62.3	- 13027	0.46
33.7	8751	0.74	63.2	- 13605	0.45
33.8	9050	0.73	64.1	- 14183	0.44
33.9			65.0	- 14761	0.43
34.0	9544	0.72	65.9	- 15339	0.42
34.1			66.8	- 15917	0.41
34.2			67.7	- 16495	0.40
34.3			68.6	- 17073	0.39
34.4			69.5	- 17651	0.38
34.5			70.4	- 18229	0.37
34.6			71.3	- 18807	0.36
34.7			72.2	- 19385	0.35
34.8			73.1	- 19963	0.34
34.9			74.0	- 20541	0.33
35.0			74.9	- 21119	0.32
35.1			75.8	- 21697	0.31
35.2			76.7	- 22275	0.30
35.3			77.6	- 22853	0.29
35.4			78.5	- 23431	0.28
35.5			79.4	- 24009	0.27
35.6			80.3	- 24587	0.26
35.7			81.2	- 25165	0.25
35.8			82.1	- 25743	0.24
35.9			83.0	- 26321	0.23
36.0			83.9	- 26899	0.22
36.1			84.8	- 27477	0.21
36.2			85.7	- 28055	0.20
36.3			86.6	- 28633	0.19
36.4			87.5	- 29211	0.18
36.5			88.4	- 29789	0.17
36.6			89.3	- 30367	0.16
36.7			90.2	- 30945	0.15
36.8			91.1	- 31523	0.14
36.9			92.0	- 32101	0.13
37.0			92.9	- 32679	0.12
37.1			93.8	- 33257	0.11
37.2			94.7	- 33835	0.10
37.3			95.6	- 34413	0.09
37.4			96.5	- 34991	0.08
37.5			97.4	- 35569	0.07
37.6			98.3	- 36147	0.06
37.7			99.2	- 36725	0.05
37.8			100.1	- 37303	0.04
37.9			101.0	- 37881	0.03
38.0			101.9	- 38459	0.02
38.1			102.8	- 39037	0.01
38.2			103.7	- 39615	0.00
38.3			104.6	- 40193	0.00
38.4			105.5	- 40771	0.00
38.5			106.4	- 41349	0.00
38.6			107.3	- 41927	0.00
38.7			108.2	- 42505	0.00
38.8			109.1	- 43083	0.00
38.9			110.0	- 43661	0.00
39.0			110.9	- 44239	0.00
39.1			111.8	- 44817	0.00
39.2			112.7	- 45395	0.00
39.3			113.6	- 45973	0.00
39.4			114.5	- 46551	0.00
39.5			115.4	- 47129	0.00
39.6			116.3	- 47707	0.00
39.7			117.2	- 48285	0.00
39.8			118.1	- 48863	0.00
39.9			119.0	- 49441	0.00
40.0			119.9	- 50019	0.00

**MULTIPLIERS FOR TEMPERATURE**

Temp. Deg. F	Multi-plier	Temp. Deg. F	Multi-plier	Temp. Deg. F	Multi-plier
- 20	1.10	+ 30	1.04	+ 80	0.94
- 10	1.11	+ 40	1.02	+ 90	0.92
0	1.12	+ 50	1.00	+ 100	0.91
+ 10	1.08	+ 60	0.98	+ 110	0.89
+ 20	1.06	+ 70	0.96	+ 120	0.88

Example. Bar. Mean. Alt. = 30"; Bar. = 28 in. or Elev. 3000 ft.; Temp. 70° F.  
Reduction = 1.06' (0.88) (0.96) = 1.02'. Parallax = 0.13'.  
True Alt. = 30' (0.88) - 1.02' + 0.13' = 29' 50.73".

Example. Bar. Mean. Alt. = 30"; Bar. = 34.5 or Elev. 8818 ft.; Temp. 10° F.  
Reduction = 2.03' (0.87) (1.08) = 1.94'.  
True Alt. = 30' (0.87) - 1.94' = 28' 06.16".

**TABLE 3**  
**POLAR INSTANCES OF POLARIS, 1962**  
For CP Universal Time or Greenwich Civil Time

Polar Instance			Polar Instance		
1962	Angle	Correct	1962	Angle	Correct
Jan. 1	0 48 33	78.37	July 18	0 49 12	69.74
11	0 48 32	78.41	29	0 49 12	69.70
21	0 48 30	78.44	30	0 49 31	69.71
31	0 48 30	78.44			
Feb. 10	0 48 30	78.44	Aug. 9	0 49 29	69.72
20	0 48 32	78.41	19	0 49 13	69.70
			29	0 49 23	69.63
Mar. 3	0 48 33	78.37	Sept. 8	0 49 18	69.90
13	0 48 33	78.37	18	0 49 13	69.97
23	0 48 32	78.37	28	0 49 08	70.04
Apr. 1	0 48 31	78.39	Oct. 8	0 49 02	70.12
11	0 48 32	78.37	18	0 49 00	70.21
21	0 48 31	78.39	28	0 49 00	70.30
May 1	0 48 32	78.39	Nov. 7	0 48 53	70.40
11	0 48 31	78.39	17	0 48 47	70.48
21	0 48 29	78.41	27	0 48 41	70.57
31	0 48 29	78.41			
June 10	0 48 28	78.41	Dec. 7	0 48 36	70.64
20	0 48 30	78.37	17	0 48 31	70.72
30	0 48 32	78.37	27	0 48 27	70.77

See Example - 90° - Polar Instance

**TABLE 4**  
**THE SUN'S ALTITUDE AT 12 H, 1962**  
For CP Universal Time or Greenwich Civil Time

Date	Sun. Alt.	Date	Sun. Alt.	Date	Sun. Alt.
1962		1962		1962	
Jan. 1	16.74	May 1	15.94	Sept. 8	15.98
11	16.79	11	15.96	18	15.94
21	16.78	21	15.93	28	15.99
31	16.76	31	15.90		
Feb. 10	16.71	June 10	15.78	Nov. 8	16.03
20	16.70	20	15.76	18	16.08
		30	15.76	28	16.12
Mar. 3	16.16	July 10	15.70	Dec. 7	16.14
13	16.17	20	15.70	17	16.20
23	16.20	30	15.70	27	16.24
Apr. 1	16.83	Aug. 9	15.60	Dec. 7	16.24
11	15.94	19	15.61	17	16.29
21	15.94	29	15.66	27	16.29

Problem D-9 (5 Points)

REQUIRED

TABLE 8  
Increase in GHA for Elapsed Time.

Min.	Hours of Greenwich Civil Time					Dec	Corr.
	0h	1h	2h	3h	4h		
00	00	00	00	00	00	00	00
01	00	00	00	00	00	00	00
02	00	00	00	00	00	00	00
03	00	00	00	00	00	00	00
04	00	00	00	00	00	00	00
05	00	00	00	00	00	00	00
06	00	00	00	00	00	00	00
07	00	00	00	00	00	00	00
08	00	00	00	00	00	00	00
09	00	00	00	00	00	00	00
10	00	00	00	00	00	00	00
11	00	00	00	00	00	00	00
12	00	00	00	00	00	00	00
13	00	00	00	00	00	00	00
14	00	00	00	00	00	00	00
15	00	00	00	00	00	00	00
16	00	00	00	00	00	00	00
17	00	00	00	00	00	00	00
18	00	00	00	00	00	00	00
19	00	00	00	00	00	00	00
20	00	00	00	00	00	00	00
21	00	00	00	00	00	00	00
22	00	00	00	00	00	00	00
23	00	00	00	00	00	00	00
24	00	00	00	00	00	00	00
25	00	00	00	00	00	00	00
26	00	00	00	00	00	00	00
27	00	00	00	00	00	00	00
28	00	00	00	00	00	00	00
29	00	00	00	00	00	00	00
30	00	00	00	00	00	00	00
31	00	00	00	00	00	00	00
32	00	00	00	00	00	00	00
33	00	00	00	00	00	00	00
34	00	00	00	00	00	00	00
35	00	00	00	00	00	00	00
36	00	00	00	00	00	00	00
37	00	00	00	00	00	00	00
38	00	00	00	00	00	00	00
39	00	00	00	00	00	00	00
40	00	00	00	00	00	00	00
41	00	00	00	00	00	00	00
42	00	00	00	00	00	00	00
43	00	00	00	00	00	00	00
44	00	00	00	00	00	00	00
45	00	00	00	00	00	00	00
46	00	00	00	00	00	00	00
47	00	00	00	00	00	00	00
48	00	00	00	00	00	00	00
49	00	00	00	00	00	00	00
50	00	00	00	00	00	00	00
51	00	00	00	00	00	00	00
52	00	00	00	00	00	00	00
53	00	00	00	00	00	00	00
54	00	00	00	00	00	00	00
55	00	00	00	00	00	00	00
56	00	00	00	00	00	00	00
57	00	00	00	00	00	00	00
58	00	00	00	00	00	00	00
59	00	00	00	00	00	00	00
60	00	00	00	00	00	00	00

TABLE 8--(Continued)  
Increase in GHA for Elapsed Time.

Min.	Hours of Greenwich Civil Time					Dec	Corr.
	0h	1h	2h	3h	4h		
00	00	00	00	00	00	00	00
01	00	00	00	00	00	00	00
02	00	00	00	00	00	00	00
03	00	00	00	00	00	00	00
04	00	00	00	00	00	00	00
05	00	00	00	00	00	00	00
06	00	00	00	00	00	00	00
07	00	00	00	00	00	00	00
08	00	00	00	00	00	00	00
09	00	00	00	00	00	00	00
10	00	00	00	00	00	00	00
11	00	00	00	00	00	00	00
12	00	00	00	00	00	00	00
13	00	00	00	00	00	00	00
14	00	00	00	00	00	00	00
15	00	00	00	00	00	00	00
16	00	00	00	00	00	00	00
17	00	00	00	00	00	00	00
18	00	00	00	00	00	00	00
19	00	00	00	00	00	00	00
20	00	00	00	00	00	00	00
21	00	00	00	00	00	00	00
22	00	00	00	00	00	00	00
23	00	00	00	00	00	00	00
24	00	00	00	00	00	00	00
25	00	00	00	00	00	00	00
26	00	00	00	00	00	00	00
27	00	00	00	00	00	00	00
28	00	00	00	00	00	00	00
29	00	00	00	00	00	00	00
30	00	00	00	00	00	00	00
31	00	00	00	00	00	00	00
32	00	00	00	00	00	00	00
33	00	00	00	00	00	00	00
34	00	00	00	00	00	00	00
35	00	00	00	00	00	00	00
36	00	00	00	00	00	00	00
37	00	00	00	00	00	00	00
38	00	00	00	00	00	00	00
39	00	00	00	00	00	00	00
40	00	00	00	00	00	00	00
41	00	00	00	00	00	00	00
42	00	00	00	00	00	00	00
43	00	00	00	00	00	00	00
44	00	00	00	00	00	00	00
45	00	00	00	00	00	00	00
46	00	00	00	00	00	00	00
47	00	00	00	00	00	00	00
48	00	00	00	00	00	00	00
49	00	00	00	00	00	00	00
50	00	00	00	00	00	00	00
51	00	00	00	00	00	00	00
52	00	00	00	00	00	00	00
53	00	00	00	00	00	00	00
54	00	00	00	00	00	00	00
55	00	00	00	00	00	00	00
56	00	00	00	00	00	00	00
57	00	00	00	00	00	00	00
58	00	00	00	00	00	00	00
59	00	00	00	00	00	00	00
60	00	00	00	00	00	00	00