LS-A

n0038

LAND SURVEYOR - 1986

Part A - Wt. 52.5

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 A is the first section of this two-part examination. ALL PROBLEMS IN PART A 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 A-1	12.5 points
Problem A-2	10.0 points
Problem A-3	10.0 points
Problem A-4	10.0 points
Problem A-5	10.0 points
TOTAL	52.5 points

ALL PROBLEMS IN PART A ARE REQUIRED.

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 A1 Wt. 12.5 points

PROBLEM STATEMENT

The following questions relating to subdivisions in California are based on the existing laws in effect January 1986. Answer each of the following questions and cite the appropriate references.

1. What conditions must exist in order to compile a map from recorded data?
2. What map can be compiled from record?
3. When a field survey is required for a subdivision, to what state standard must it conform?
4. Who can prepare a parcel or final map?
5. A final map is required for which subdivisions?
6. A parcel map is required for which subdivisions?
7. For what reasons are Certificate of Corrections or Amending Maps filed?
8. What does a local ordinance regulate regarding a parcel or final map?
9. When is it mandatory for local agencies to disapprove a Subdivision Map?
10. Who shall examine a parcel or final map?

The following questions relating to the California Land Surveyors Act are based on the existing laws in effect January 1986. Answer each of the following questions and cite the appropriate references.

11. What act or activities performed by a person constitutes the practice of land surveying within the meaning of the Land Surveyors Act?
12. On what items is it mandatory for a licensed Land Surveyor to place his signature and show his license number, or stamp his seal?
13. List those titles that are reserved to a licensed Land Surveyor by law.
14. Who is vested with the power to administer the provisions and requirements of the Land Surveyors Act?
15. When may a licensed Land Surveyor administer or certify oaths?
16. When is it mandatory for a surveyor to file a Record of Survey?
17. What are the mandatory requirements that outline the contents of a Record of Survey Map?

Problem A1 - continued:

18. What are the mandatory requirements that prescribe the form of a Record of Survey Map?

19. Whose signatures are required on a Record of Survey Map?

20. When is it mandatory for a surveyor to file a Corner Record?

The following questions relate to subdivisions in California. They are based on existing State laws in effect as of January 1986. State whether each statement is true or false. If false, explain why the portion is incorrect and cite applicable law and sections.

21. When there is sufficient survey information existing on a filed map and at least one of the boundary lines is monumented, a parcel map may be compiled as shown on record.

22. Only the County Surveyor may examine a Parcel Map.

23. A Parcel, Reversion to Acreage, or Final Map may be compiled from record.

24. By State law, a tentative map shall expire 18 months after approval.

25. A final map is required for all subdivisions of five or more parcels.

Problem A2 - Wt. 10.0 points

PROBLEM STATEMENT

The following page is reproduced data based upon the California Coordinate System - Zone V.

The drawing below shows a Section Corner with a reference to another station.

For △ TRANS

ϕ = 34°-13'-25".50161N

λ = 118°-50'-10".12362W

Elev = 509.8 metres

Constants for Zone V

Central Meridian = 118°00'

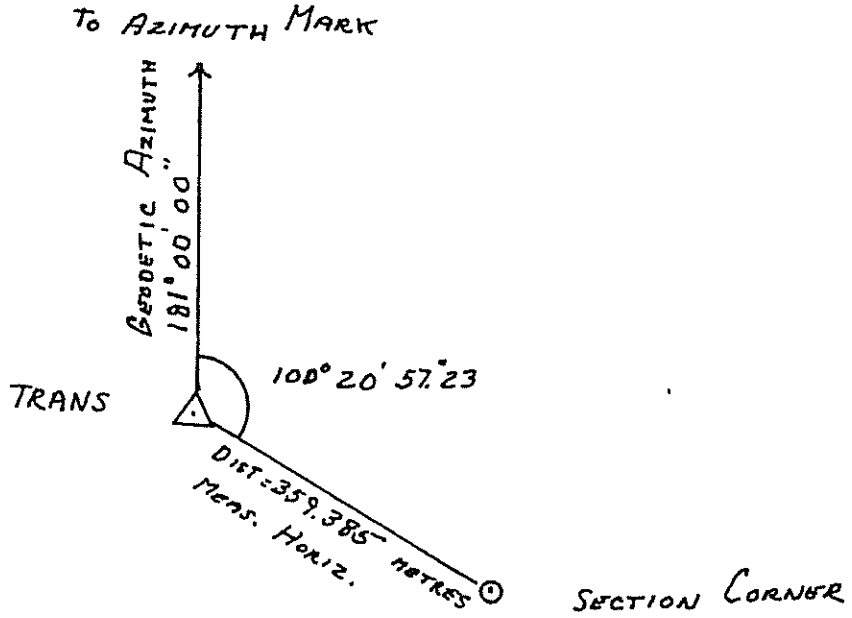
R_b = 30,649,424.27

C = 2,000,000.00

Mean radius of the earth = 20,945,000 ft.

REQUIRED:

Determine the coordinates (Northing & Easting) of the Section Corner in Zone V. Express final answer to the nearest 0.01 ft. Show all of your work.



Problem A2 - continued:

Lambert Projection for California V

Table I (Cont'd)

Lat.	R feet	Y' 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
34° 06'	30,431,073.26	218,351.01	101.08567	-59.9	0.9999862
07	30,425,008.12	224,416.15	101.08567	-73.9	0.9999830
08	30,418,942.98	230,481.29	101.08550	-87.6	0.9999798 -
09	30,412,877.85	236,546.42	101.08550	-100.9	0.9999768 -
10	30,406,812.72	242,611.55	101.08550	-113.9	0.9999738
34° 11'	30,400,747.59	248,676.68	101.08533	-126.5	0.9999709
12	30,394,682.47	254,741.80	101.08550	-138.7	0.9999681
13	30,388,617.34	260,806.93	101.08550	-150.6	0.9999653
14	30,382,552.21	266,872.06	101.08550	-162.1	0.9999627
15	30,376,487.08	272,937.19	101.08550	-173.2	0.9999601
34° 16'	30,370,421.95	279,002.32	101.08550	-184.0	0.9999576
17	30,364,356.82	285,067.45	101.08567	-194.4	0.9999552
18	30,358,291.68	291,132.59	101.08567	-204.5	0.9999529
19	30,352,226.54	297,197.73	101.08567	-214.2	0.9999507
20	30,346,161.40	303,262.87	101.08567	-223.5	0.9999485
34° 21'	30,340,096.26	309,328.01	101.08583	-232.5	0.9999465
22	30,334,031.11	315,393.16	101.08600	-241.0	0.9999445
23	30,327,965.95	321,458.32	101.08600	-249.3	0.9999426
24	30,321,900.79	327,523.48	101.08617	-257.2	0.9999408
25	30,315,835.62	333,588.65	101.08617	-264.6	0.9999391

Lambert Projection for California V

Table II (Cont'd)

1" of Long. = 0".57001192 of θ

Long.	θ	Long.	θ	Long.	θ
117° 31'	+0° 16' 31".8207	118° 06'	-0° 03' 25".2043	118° 41'	-0° 23' 22".2293
32	+0 15 57.6200	07	-0 03 59.4050	42	-0 23 56.4300
33	+0 15 23.4193	08	-0 04 33.6057	43	-0 24 30.6308
34	+0 14 49.2186	09	-0 05 07.8064	44	-0 25 04.8315
35	+0 14 15.0179	10	-0 05 42.0072	45	-0 25 39.0322
117° 36'	+0 13 40.8172	118° 11'	-0 06 16.2079	118° 46'	-0 26 13.2329
37	+0 13 06.6165	12	-0 06 50.4086	47	-0 26 47.4336
38	+0 12 32.4157	13	-0 07 24.6093	48	-0 27 21.6343
39	+0 11 58.2150	14	-0 07 58.8100	49	-0 27 55.8351
40	+0 11 24.0143	15	-0 08 33.0107	50	-0 28 30.0358
117° 41'	+0 10 49.8136	118° 16'	-0 09 07.2114	118° 51'	-0 29 04.2365
42	+0 10 15.6129	17	-0 09 41.4122	52	-0 29 38.4372
43	+0 09 41.4122	18	-0 10 15.6129	53	-0 30 12.6379
44	+0 09 07.2114	19	-0 10 49.8136	54	-0 30 46.8386
45	+0 08 33.0107	20	-0 11 24.0143	55	-0 31 21.0393
117° 46'	+0 07 58.8100	118° 21'	-0 11 58.2150	118° 56'	-0 31 55.2401
47	+0 07 24.6093	22	-0 12 32.4157	57	-0 32 29.4408
48	+0 06 50.4086	23	-0 13 06.6165	58	-0 33 03.6415
49	+0 06 16.2079	24	-0 13 40.8172	59	-0 33 37.8422
50	+0 05 42.0072	25	-0 14 15.0179	119° 00'	-0 34 12.0429

Problem A2 - continued:

O°

	Sine	Tab. diff.	Cosine	Tab diff.	Tangent	Tab. diff.
20 00	0.00581 77314	484 805	0.99998 30769	2833	0.00581 78398	484 830
10	.00586 62119	484 805	.99998 27936	2855	.00586 63128	484 831
20	.00591 46924	484 805	.99998 25081	2880	.00591 47959	484 831
30	.00596 31729	484 805	.99998 22201	2903	.00596 32790	484 831
40	.00601 16534	484 805	.99998 19298	2926	.00601 17621	484 831
50	.00606 01339	484 805	.99998 16372	2950	.00606 02452	484 832
21 00	.00610 86144	484 804	.99998 13422	2973	.00610 87284	484 832
10	.00615 70948	484 805	.99998 10449	2997	.00615 72116	484 832
20	.00620 55753	484 804	.99998 07452	3020	.00620 56948	484 832
30	.00625 40557	484 804	.99998 04432	3044	.00625 41780	484 833
40	.00630 25361	484 804	.99998 01388	3067	.00630 26613	484 833
50	.00635 10165	484 804	.99997 98321	3091	.00635 11446	484 834
22 00	.00639 94969	484 804	.99997 95230	3114	.00639 96280	484 833
10	.00644 79773	484 803	.99997 92116	3138	.00644 81113	484 834
20	.00649 64576	484 804	.99997 88978	3161	.00649 65947	484 835
30	.00654 49380	484 803	.99997 85817	3185	.00654 50782	484 834
40	.00659 34183	484 803	.99997 82632	3209	.00659 35616	484 835
50	.00664 18986	484 803	.99997 79423	3231	.00664 20451	484 835
23 00	.00669 03789	484 803	.99997 76192	3256	.00669 05286	484 836
10	.00673 88592	484 802	.99997 72936	3279	.00673 90122	484 836
20	.00678 73394	484 803	.99997 69657	3302	.00678 74958	484 836
30	.00683 58197	484 802	.99997 66355	3326	.00683 59794	484 836
40	.00688 42999	484 802	.99997 63029	3349	.00688 44630	484 837
50	.00693 27801	484 802	.99997 59680	3371	.00693 29467	484 837
24 00	.00698 12603	484 802	.99997 56307	3396	.00698 14304	484 838
10	.00702 97405	484 801	.99997 52911	3420	.00702 99142	484 838
20	.00707 82206	484 802	.99997 49491	3444	.00707 83980	484 838
30	.00712 67008	484 801	.99997 46047	3466	.00712 68818	484 838
40	.00717 51809	484 801	.99997 42581	3491	.00717 53656	484 839
50	.00722 36610	484 801	.99997 39090	3514	.00722 38495	484 839
25 00	.00727 21411	484 801	.99997 35576	3537	.00727 23334	484 840
10	.00732 06212	484 801	.99997 32039	3561	.00732 08174	484 839
20	.00736 91013	484 800	.99997 28478	3584	.00736 93013	484 841
30	.00741 75813	484 800	.99997 24894	3608	.00741 77854	484 840
40	.00746 60613	484 800	.99997 21286	3632	.00746 62694	484 841
50	.00751 45413	484 800	.99997 17654	3655	.00751 47535	484 841
26 00	.00756 30213	484 800	.99997 13999	3678	.00756 32376	484 842
10	.00761 15013	484 800	.99997 10321	3702	.00761 17218	484 842
20	.00765 99813	484 799	.99997 06619	3725	.00766 02060	484 842
30	.00770 84612	484 799	.99997 02894	3749	.00770 86902	484 843
40	.00775 69411	484 799	.99996 99145	3773	.00775 71745	484 843
50	.00780 54210	484 799	.99996 95372	3796	.00780 56588	484 843
27 00	.00785 39009	484 799	.99996 91576	3819	.00785 41431	484 844
10	.00790 23808	484 798	.99996 87757	3843	.00790 26275	484 844
20	.00795 08606	484 798	.99996 83914	3866	.00795 11119	484 845
30	.00799 93404	484 798	.99996 80048	3890	.00799 95964	484 845
40	.00804 78202	484 798	.99996 76158	3914	.00804 80809	484 845
50	.00809 63000	484 798	.99996 72244	3937	.00809 65654	484 846
28 00	.00814 47798	484 797	.99996 68307	3960	.00814 50500	484 846
10	.00819 32595	484 798	.99996 64347	3984	.00819 35346	484 846
20	.00824 17393	484 797	.99996 60363	4008	.00824 20192	484 847
30	.00829 02190	484 797	.99996 56355	4031	.00829 05039	484 847
40	.00833 86987	484 796	.99996 52324	4054	.00833 89886	484 848
50	.00838 71783	484 797	.99996 48270	4078	.00838 74734	484 848
29 00	.00843 56580	484 796	.99996 44192	4101	.00843 59582	484 848
10	.00848 41376	484 796	.99996 40091	4125	.00848 44430	484 849
20	.00853 26172	484 796	.99996 35966	4149	.00853 29279	484 849
30	.00858 10968	484 796	.99996 31817	4172	.00858 14128	484 850
40	.00862 95764	484 796	.99996 27645	4195	.00862 98978	484 850
50	.00867 80560	484 795	.99996 23450	4219	.00867 83828	484 850
30 00	.00872 65355		.99996 19231		.00872 68678	

Correction for Second Difference of Cosine

Seconds	Correction 10th Place
0 & 10	0
1 & 9	+1
2 & 8	+2
3 & 7	+3
4 & 6	+3
5 & 5	+4

Problem A2 – continued:

4

0°

	Sine	Tab. diff.	Cosine	Tab. diff.	Tangent	Tab. diff.
30'00"	0.00872 65355	484 795	0.99996 19831	4243	0.00872 68678	484 851
10	.00877 50150	484 795	.99996 14988	4266	.00877 53529	484 851
20	.00882 34945	484 795	.99996 10722	4289	.00882 38380	484 852
30	.00887 19740	484 794	.99996 06433	4313	.00887 23232	484 852
40	.00892 04534	484 795	.99996 02120	4337	.00892 08084	484 852
50	.00896 89329	484 794	.99995 97783	4360	.00896 92936	484 853
31 00	.00901 74123	484 793	.99995 93423	4383	.00901 77789	484 853
10	.00906 58916	484 794	.99995 89040	4407	.00906 62642	484 854
20	.00911 43710	484 794	.99995 84633	4431	.00911 47496	484 854
30	.00916 28504	484 793	.99995 80202	4454	.00916 32350	484 855
40	.00921 13297	484 793	.99995 75748	4478	.00921 17205	484 855
50	.00925 98090	484 793	.99995 71270	4501	.00926 02060	484 855
32 00	.00930 82883	484 792	.99995 66769	4524	.00930 86915	484 856
10	.00935 67675	484 792	.99995 62245	4548	.00935 71771	484 857
20	.00940 52467	484 793	.99995 57697	4572	.00940 56628	484 856
30	.00945 37260	484 791	.99995 53125	4595	.00945 41484	484 858
40	.00950 22051	484 792	.99995 48530	4618	.00950 26342	484 857
50	.00955 06843	484 792	.99995 43912	4642	.00955 11199	484 858
33 00	.00959 91635	484 791	.99995 39270	4666	.00959 96057	484 859
10	.00964 76426	484 791	.99995 34604	4689	.00964 80916	484 859
20	.00969 61217	484 791	.99995 29915	4712	.00969 65775	484 860
30	.00974 46008	484 790	.99995 25203	4737	.00974 50635	484 860
40	.00979 30798	484 791	.99995 20466	4759	.00979 35495	484 860
50	.00984 15589	484 790	.99995 15707	4783	.00984 20355	484 861
34 00	.00989 00379	484 789	.99995 10924	4807	.00989 05216	484 861
10	.00993 85168	484 790	.99995 06117	4830	.00993 90077	484 862
20	.00998 69958	484 789	.99995 01287	4853	.00998 74939	484 862
30	.01003 54747	484 790	.99994 96434	4878	.01003 59801	484 863
40	.01008 39537	484 789	.99994 91556	4900	.01008 44664	484 863
50	.01013 24326	484 788	.99994 86656	4924	.01013 29527	484 864
35 00	.01018 09114	484 789	.99994 81732	4948	.01018 14391	484 864
10	.01022 93903	484 788	.99994 76784	4971	.01022 99255	484 865
20	.01027 78691	484 788	.99994 71813	4995	.01027 84120	484 865
30	.01032 63479	484 787	.99994 66818	5018	.01032 68985	484 866
40	.01037 48266	484 788	.99994 61800	5041	.01037 53851	484 866
50	.01042 33054	484 787	.99994 56759	5065	.01042 38717	484 866
36 00	.01047 17841	484 787	.99994 51694	5089	.01047 23583	484 867
10	.01052 02628	484 787	.99994 46605	5112	.01052 08450	484 868
20	.01056 87415	484 786	.99994 41493	5136	.01056 93318	484 868
30	.01061 72201	484 787	.99994 36357	5159	.01061 78186	484 869
40	.01066 56988	484 786	.99994 31198	5182	.01066 63055	484 869
50	.01071 41774	484 785	.99994 26016	5207	.01071 47924	484 869
37 00	.01076 26559	484 786	.99994 20809	5229	.01076 32793	484 870
10	.01081 11345	484 785	.99994 15580	5253	.01081 17663	484 871
20	.01085 96130	484 785	.99994 10327	5277	.01086 02534	484 871
30	.01090 80915	484 785	.99994 05050	5300	.01090 87405	484 872
40	.01095 65700	484 784	.99993 99750	5324	.01095 72277	484 872
50	.01100 50484	484 784	.99993 94426	5347	.01100 57149	484 873
38 00	.01105 35268	484 784	.99993 89079	5371	.01105 42022	484 873
10	.01110 20052	484 784	.99993 83708	5394	.01110 26895	484 873
20	.01115 04836	484 783	.99993 78314	5417	.01115 11768	484 875
30	.01119 89619	484 783	.99993 72897	5442	.01119 96643	484 874
40	.01124 74402	484 783	.99993 67455	5464	.01124 81517	484 876
50	.01129 59185	484 783	.99993 61991	5488	.01129 66393	484 876
39 00	.01134 43968	484 782	.99993 56503	5512	.01134 51269	484 876
10	.01139 28750	484 782	.99993 50991	5535	.01139 36145	484 877
20	.01144 13532	484 782	.99993 45456	5559	.01144 21022	484 877
30	.01148 98314	484 782	.99993 39897	5582	.01149 05899	484 878
40	.01153 83096	484 781	.99993 34315	5606	.01153 90777	484 879
50	.01158 67877	484 781	.99993 28709	5629	.01158 75656	484 879
40 00	.01163 52658		.99993 23080		.01163 60535	

Correction for Second Difference of Cosine

Seconds	Correction (0th Place)
0 & 10	0
1 & 9	+1
2 & 8	+2
3 & 7	+3
4 & 6	+3
5 & 5	+3

Problem A3 - Wt. 10.0 points

PROBLEM STATEMENT

The sketch below shows Tentative Parcel Map Number 12687, based on record data, proposing the subdivision of Lot 18, Tract 400, into three parcels. The Tentative Map has been approved along with a waiver of Final Parcel Map. (No Parcel Map need be filed.)

In order to complete the subdivision process, the County requires that a Certificate of Compliance be prepared and recorded and that the 30.00 foot road easement be dedicated to the County by a separately recorded document. The bearings and dimensions shown are record or calculated from record per Tract 400 and are not the result of a survey.

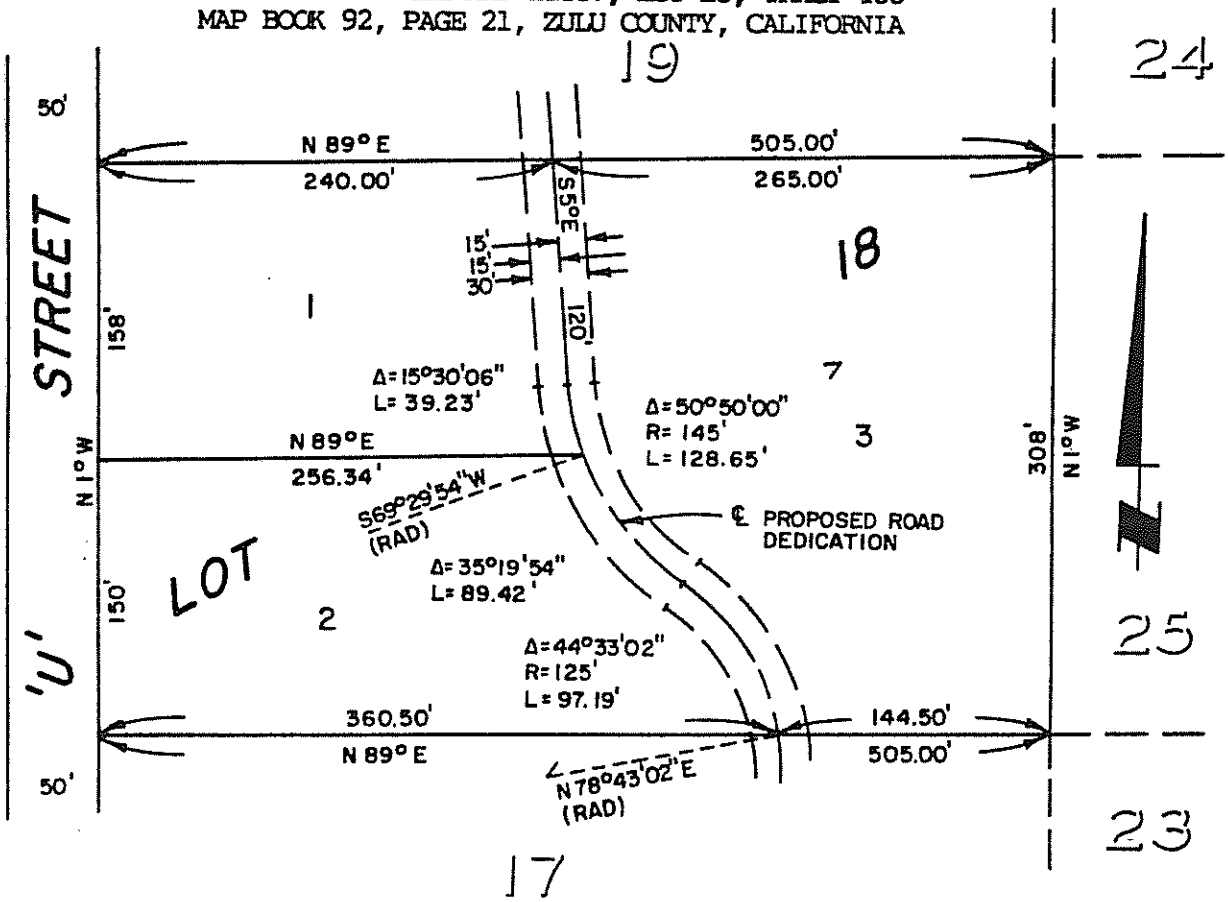
REQUIRED

(1) Prepare a Legal Description for the road easement. Include the caption.

(2) Prepare Legal Descriptions for proposed Parcels 1, 2 and 3 in such a way that if a survey reveals different bearings and dimensions from those shown on Tract 400, no gaps or overlaps will result. Include captions. Each description must stand alone. If reference is made to the road easement, the entire description need not be rewritten, just referred to.

NO CALCULATIONS ARE REQUIRED.

TENTATIVE PARCEL MAP 12687, LOT 18, TRACT 400
MAP BOOK 92, PAGE 21, ZULU COUNTY, CALIFORNIA



Problem A4 - Wt. 10.0 points

PROBLEM STATEMENT

The sketch below shows portions of two townships surveyed in 1886 and some subsequent surveys.

You may assume the original government notes and plat are in agreement.

All dimensions shown are record, except those followed with an M, which designate those measured in 1986.

All corners normally set by the GLO surveyors were found, except the following:

N 1/4 corner Sec. 7 SW Corner Sec. 7

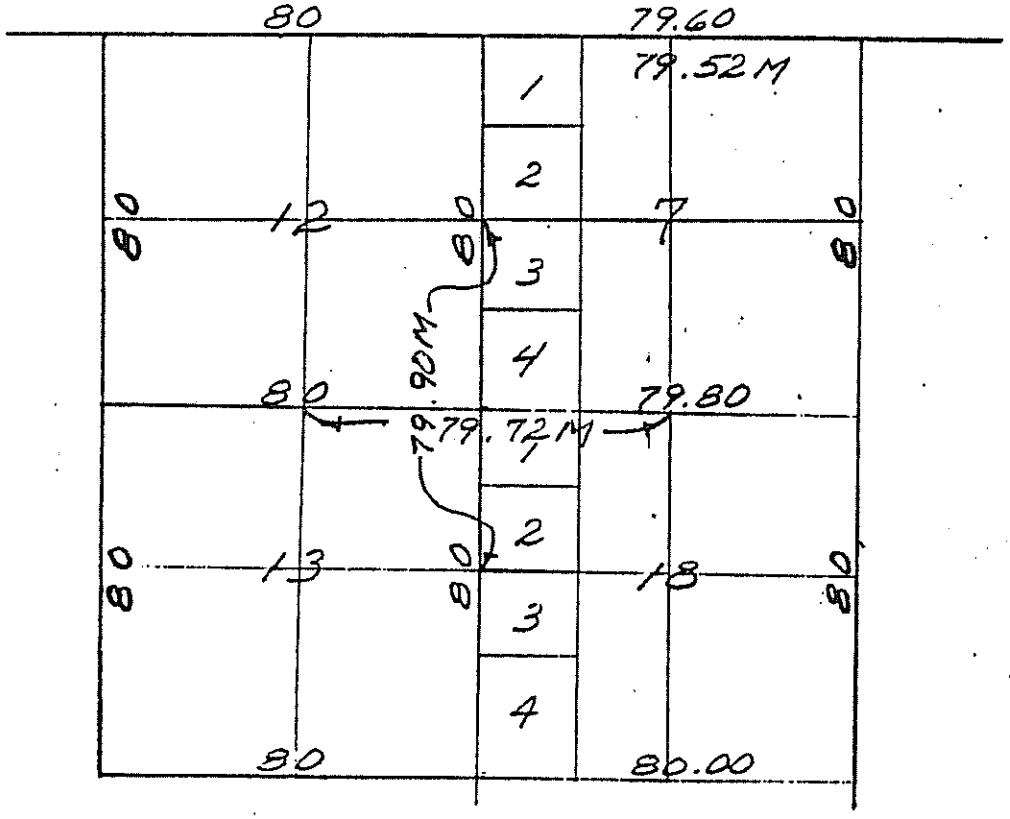
These are to be regarded as being lost corners.

Your client has title to the NE 1/4 of the SW 1/4 of Sec. 7. He asks you to survey and monument his property.

REQUIRED

1. Describe what you would do.
2. What monuments would you set?
3. What surveying and mapping requirements of the State of California would you comply with?

In particular, few calculations are needed to answer this problem, but method of establishment must be mentioned. If any proportioning is used, show the elements of the proportion.



Problem A5 - Wt. 10.0 points

PROBLEM STATEMENT

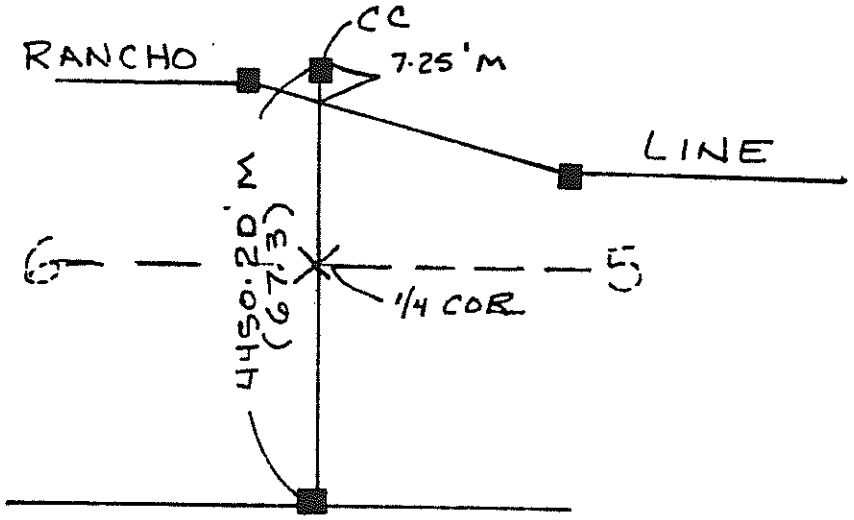
Questions 1 through 8 refer to the U.S. Public Lands Survey System.

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.

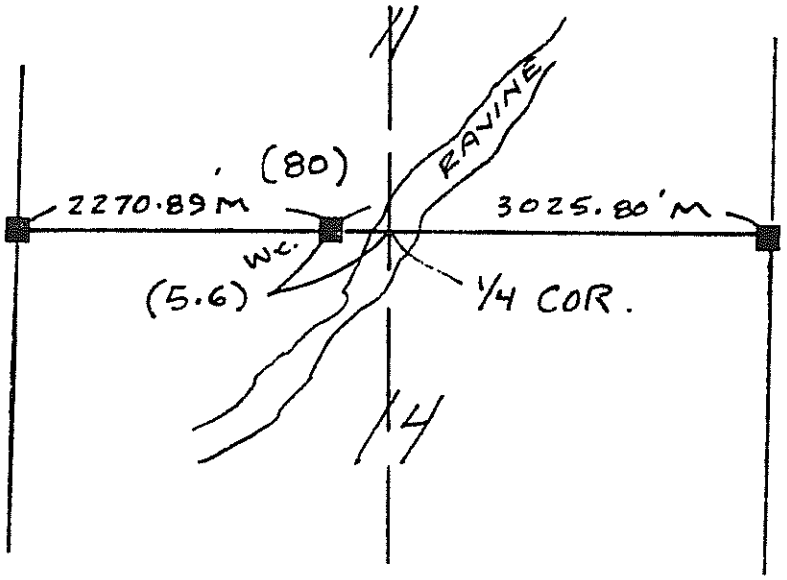
Your answer may be shown in feet or chains. Show all calculations.

REQUIRED

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

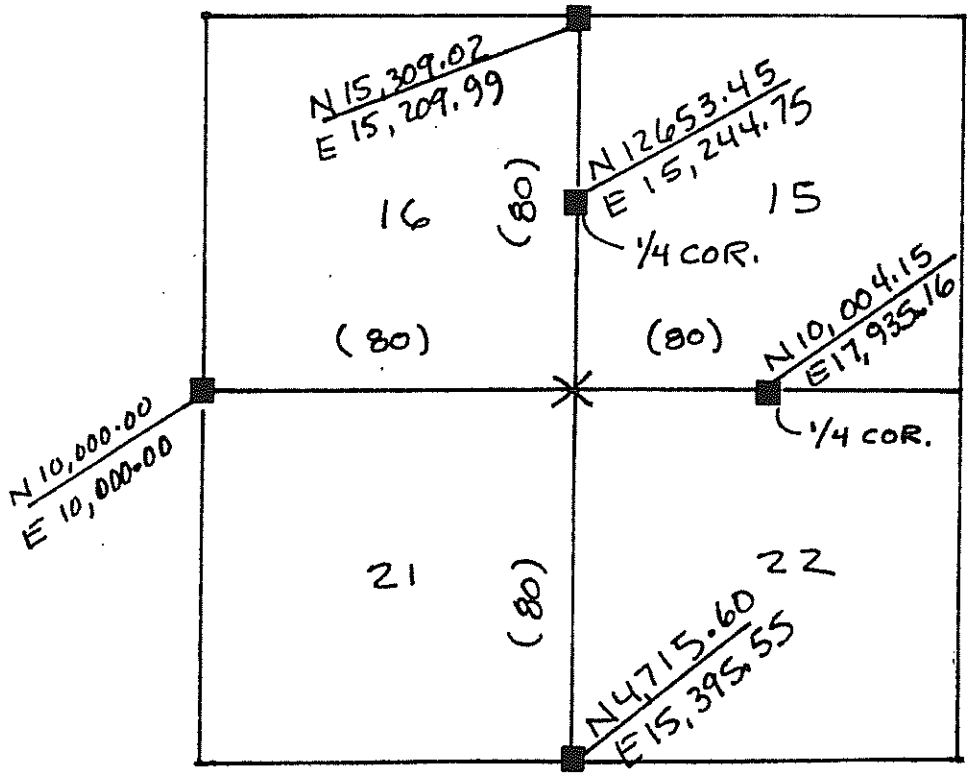


(2) Where would you position the missing 1/4 corner?

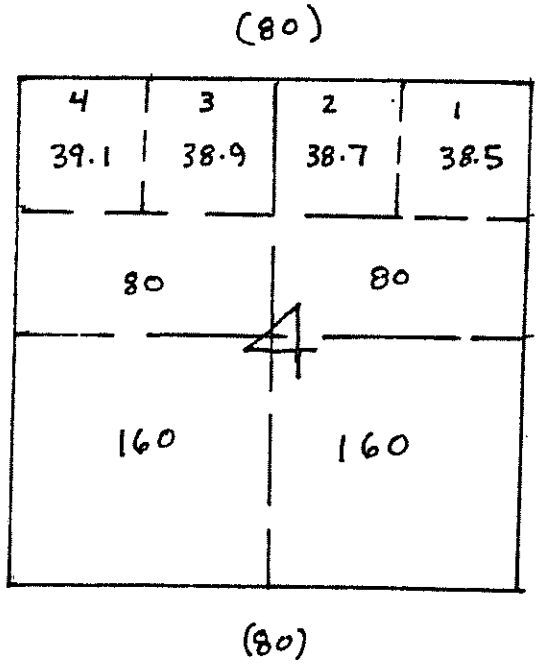


Problem A5 - continued:

(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 A5 - continued:

(5) What is the difference between a lost corner and an obliterated corner?

(6) What is the legal status of a found original closing corner?

(7) Define "subdivision by protraction"?

(8) Of the three methods used to establish a base line or standard parallel, which one is the most preferred and why?

LS-1B

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

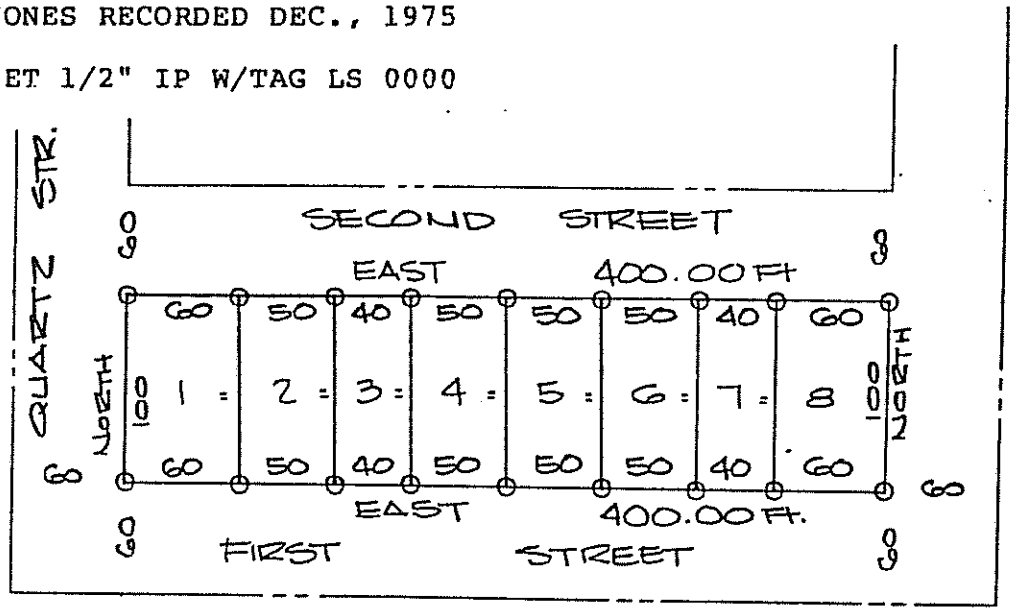
Problem B1 - Wt. 10.0 points

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

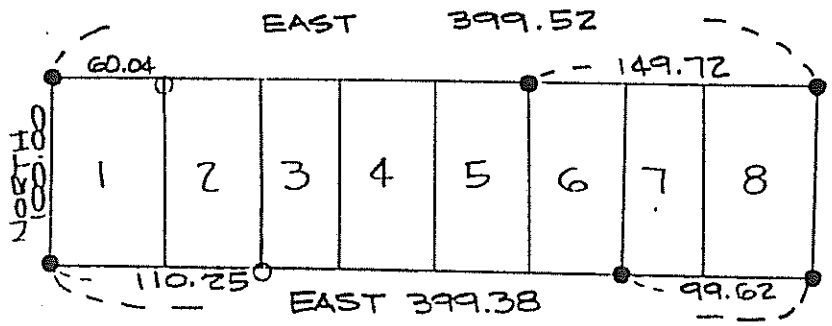


CHAIN OF TITLE

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.

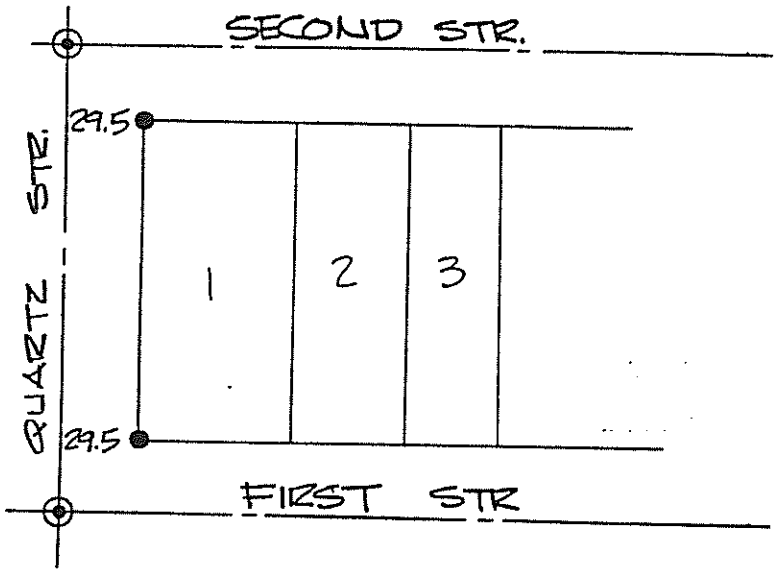
2) Show all calculations necessary and provide a brief narrative about your method and reasoning.

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

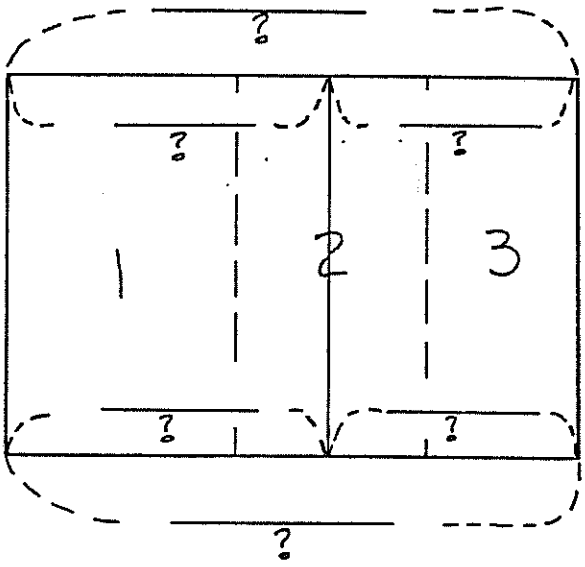
REQUIRED ITEM 4 IS A SEPARATE PART OF THIS PROBLEM AND INFORMATION GIVEN BELOW IS FOR ITEM 4 ONLY

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



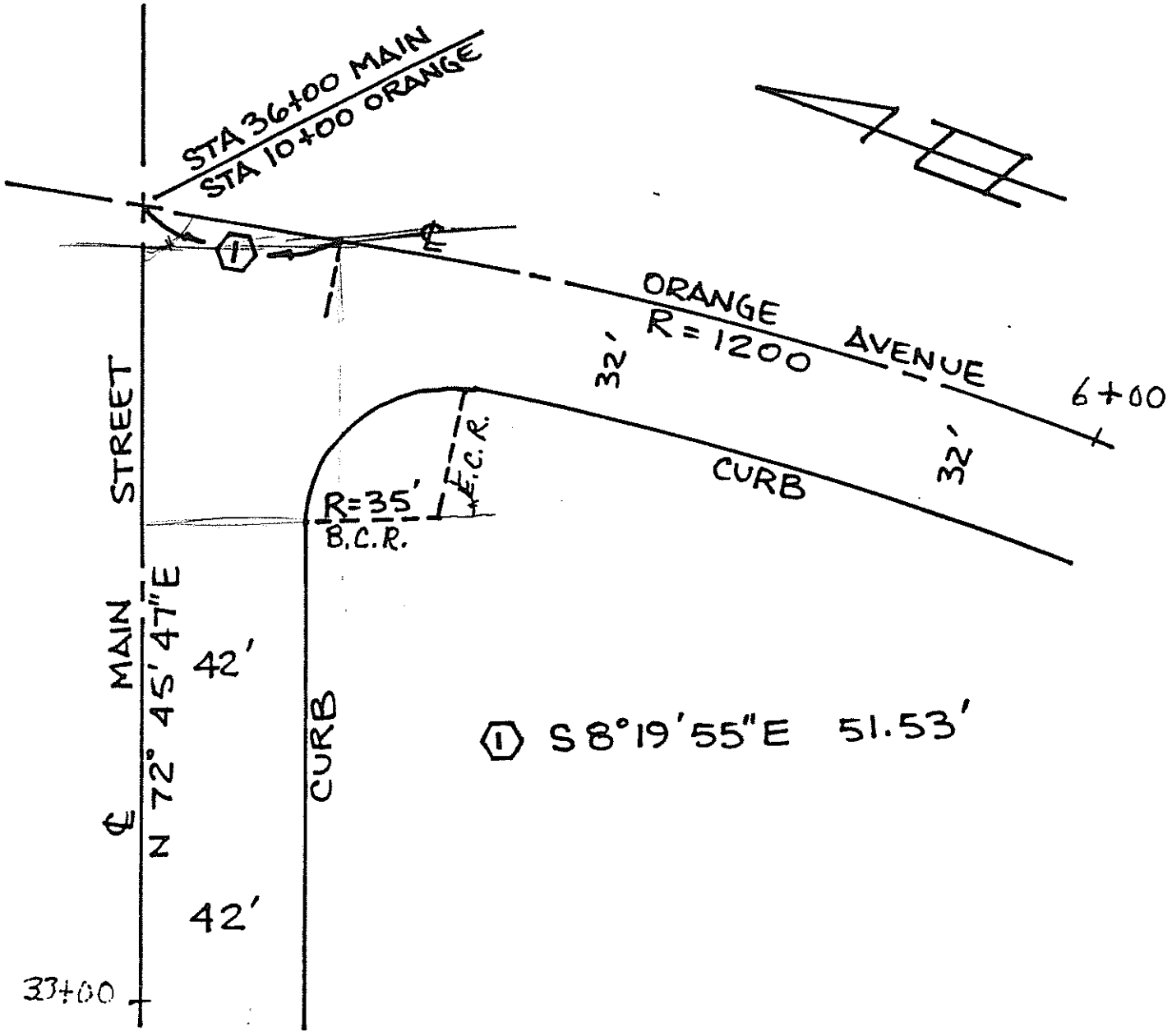
Problem B1 - continued:



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

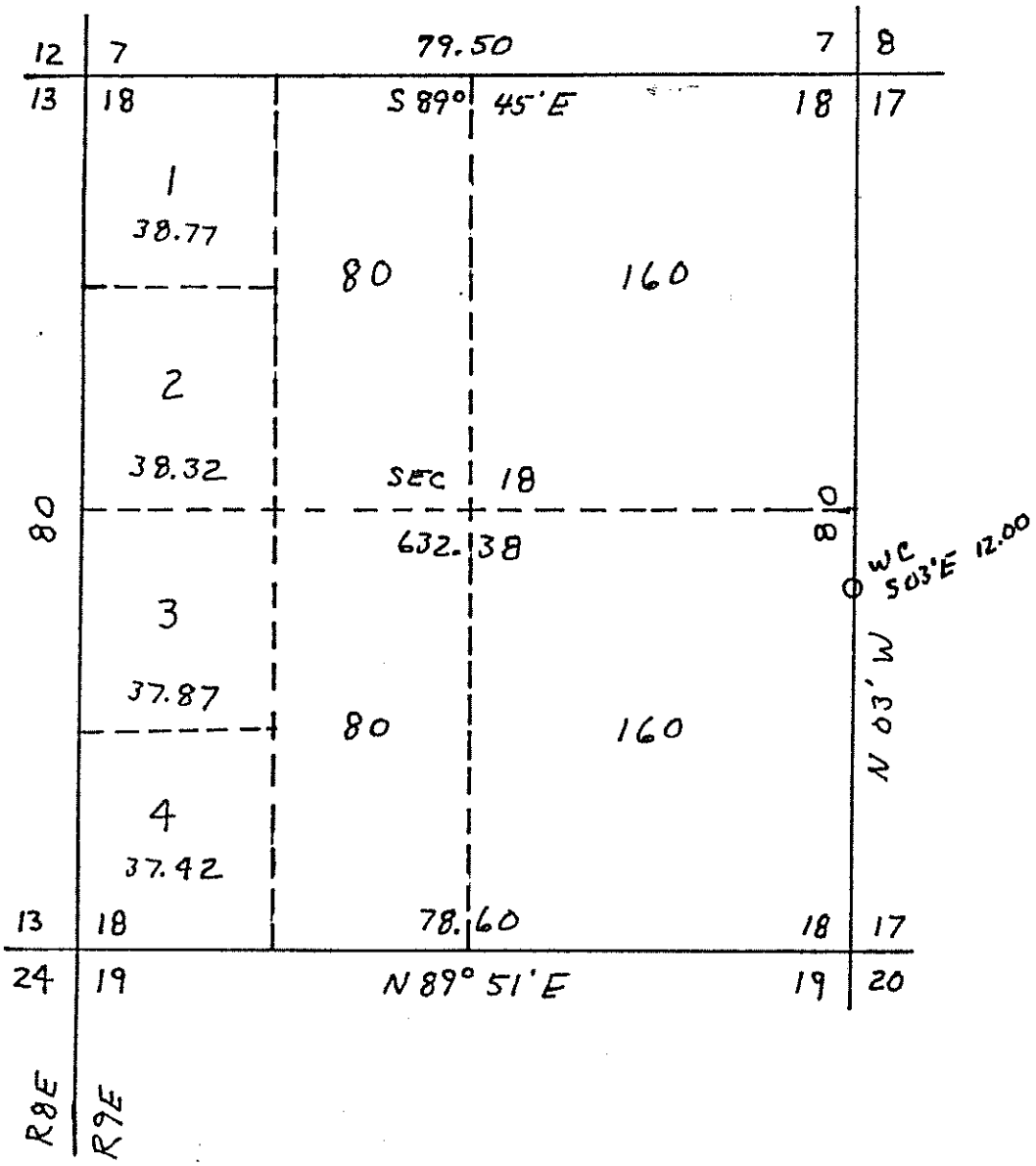
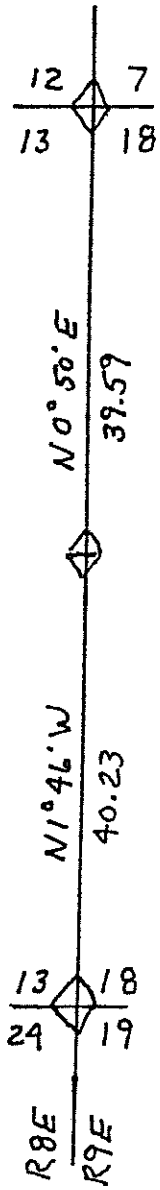


Diagram 2:
Portion of 1920
GLO Plat - Dependent
resurvey of Range
Line.



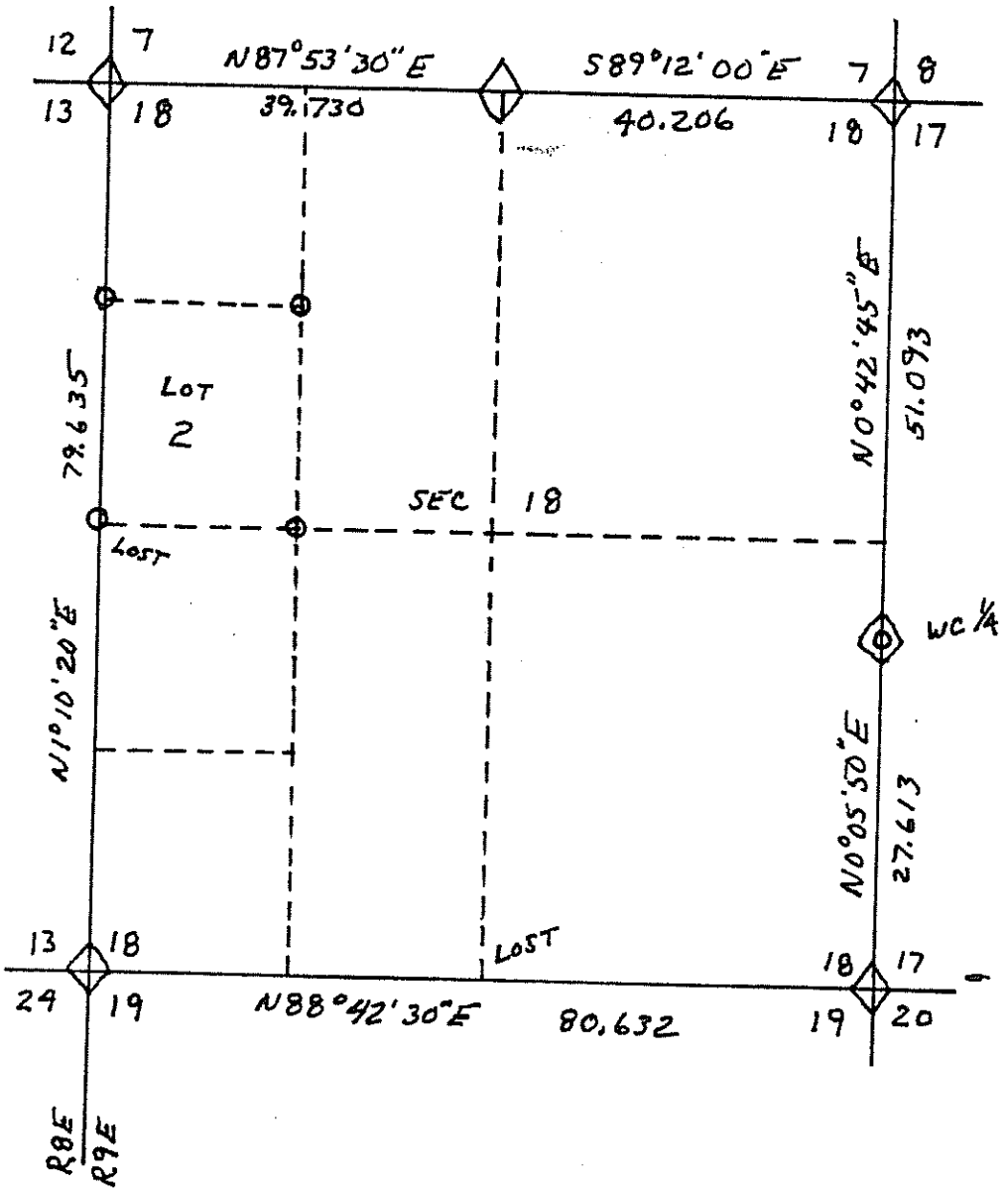
Legend
◇ Found Original Corner
○ Corner to be set

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 B4 - continued:

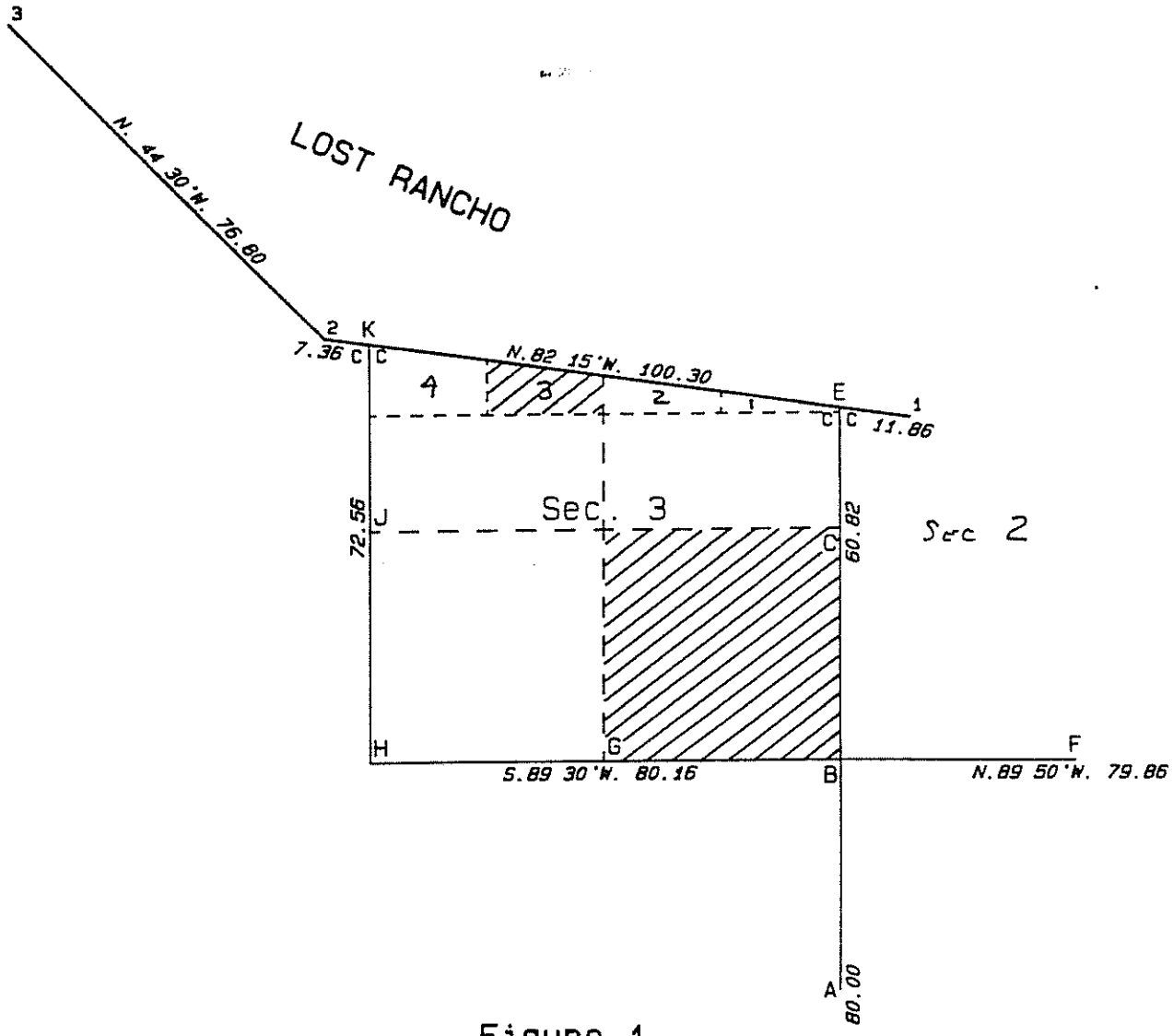


Figure 1

Problem B4 - continued:

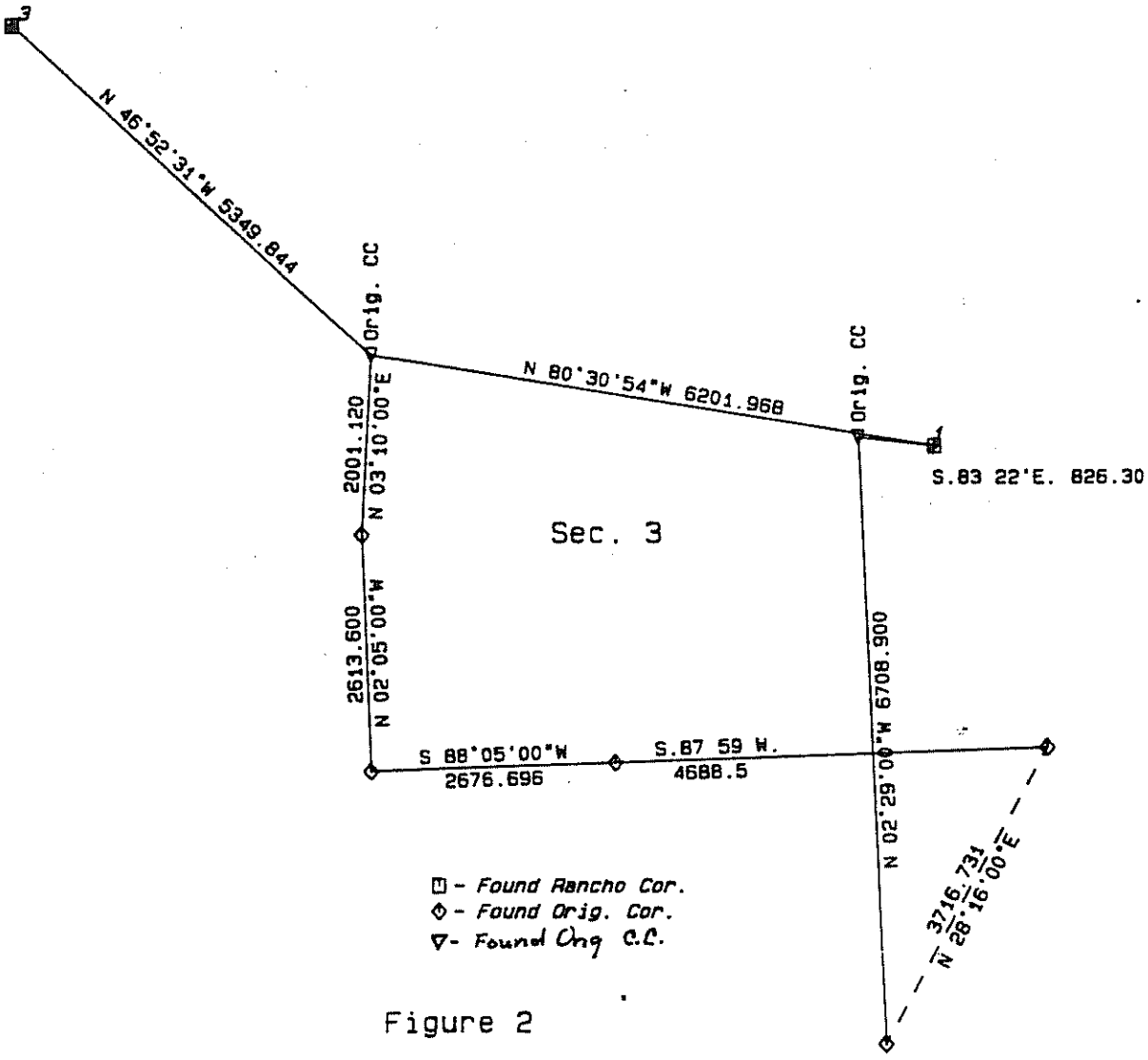


Figure 2

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.

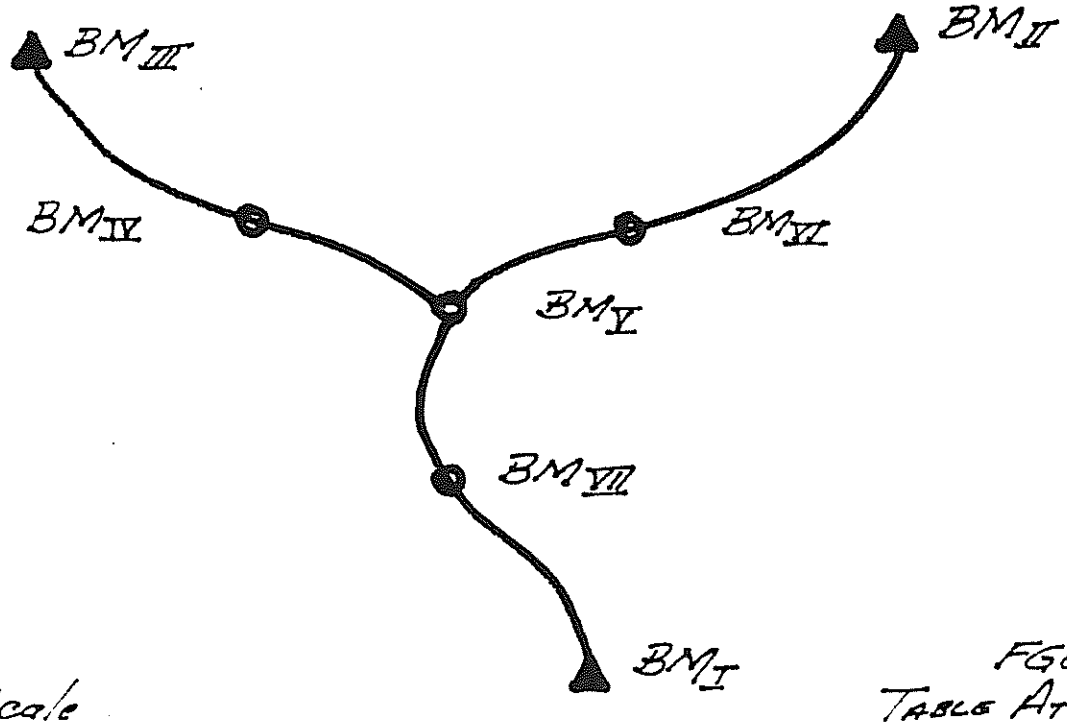
CRITERIA

	(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.

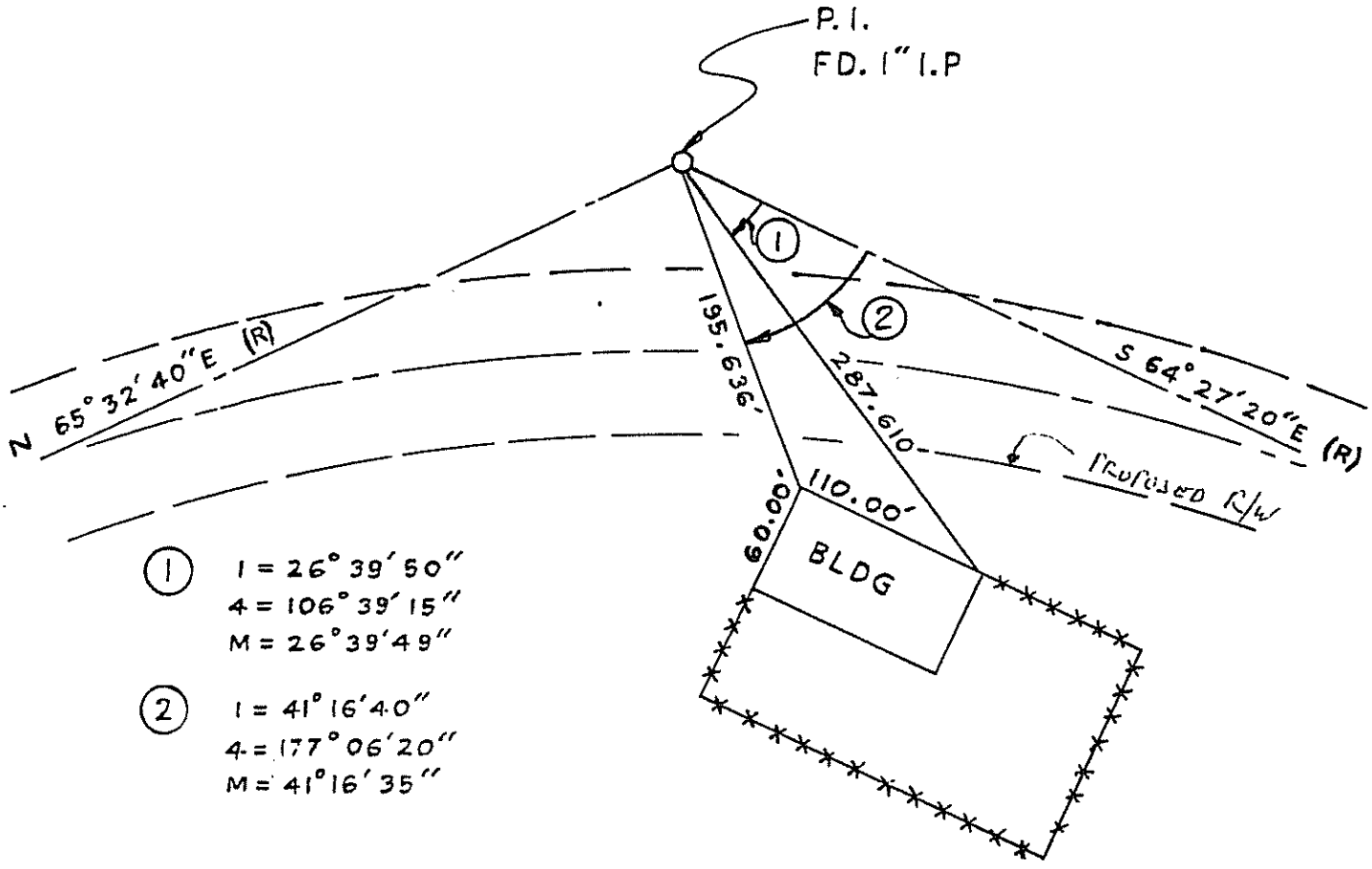
REQUIRED

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.



(1) I = 26° 39' 50"
Δ = 106° 39' 15"
M = 26° 39' 49"

(2) I = 41° 16' 40"
Δ = 177° 06' 20"
M = 41° 16' 35"

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.

Problem B8 - continued:

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	6.62	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	2.62	0.14
8 30	6.13	0.15	21 00	2.48	0.14
8 40	6.02	0.15	22 00	2.36	0.14
8 50	5.92	0.15	23 00	2.25	0.14
9 00	5.82	0.15	24 00	2.15	0.14
9 10	5.72	0.15	25 00	2.05	0.14
9 20	5.63	0.15	26 00	1.96	0.13
9 30	5.53	0.15	27 00	1.88	0.13
9 40	5.43	0.15	28 00	1.80	0.13
9 50	5.34	0.15	29 00	1.73	0.13
10 00	5.26	0.15	30 00	1.66	0.13
10 20	5.10	0.15	32 00	1.53	0.13
10 40	4.95	0.14	34 00	1.42	0.12
11 00	4.81	0.14	36 00	1.32	0.12
11 20	4.67	0.14	38 00	1.23	0.12
11 40	4.54	0.14	40 00	1.15	0.11
12 00	4.42	0.14	42 00	1.07	0.11
12 30	4.25	0.14	44 00	1.00	0.11
13 00	4.09	0.14	46 00	0.93	0.10
13 30	3.93	0.14	48 00	0.86	0.10
14 00	3.78	0.14	50 00	0.80	0.09
14 30	3.65	0.14	55 00	0.67	0.08
15 00	3.53	0.14	60 00	0.55	0.07
15 30	3.42	0.14	65 00	0.45	0.06
16 00	3.32	0.14	70 00	0.35	0.05
16 30	3.22	0.14	80 00	0.17	0.03
17 00	3.12	0.14	90 00	0.00	0.00

The refraction values in Table 2 are corrected by multiplying them by the multipliers in Table 2a 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 2a. Otherwise the elevations are disregarded.

TABLE 2a

To correct Table 2. See Examples below.

MULTIPLIERS FOR OBSERVED BAROMETRIC PRESSURE OR ELEVATION

Bar. (Inches)	Elev. (Feet)	Multiplier	Bar. (Inches)	Elev. (Feet)	Multiplier
30.5	− 451	1.03	23.9	+ 6194	0.81
30.2	− 181	1.02	23.6	6538	0.80
30.0	00	1.01	23.3	6887	0.79
			23.0	7239	0.78
29.9	+ 91	1.01			
29.6	366	1.00	22.7	7597	0.77
29.3	643	0.99	22.4	7960	0.76
29.0	924	0.98	22.1	8327	0.75
28.7	1207	0.97	21.8	8700	0.74
28.4	1493	0.96	21.5	9077	0.73
28.1	1783	0.95	21.2	9460	0.72
27.8	2075	0.94	20.9	9848	0.71
27.5	2371	0.93	20.6	10242	0.70
27.2	2670	0.92	20.3	10642	0.69
			20.0	11047	0.68
26.9	2972	0.91			
26.6	3277	0.90	19.7	11458	0.67
26.3	3586	0.89	19.4	11875	0.66
26.0	3899	0.88	19.1	12299	0.65
25.7	4215	0.87	18.8	12729	0.64
25.4	4535	0.86	18.5	13165	0.63
25.1	4859	0.85	18.2	13608	0.62
24.8	5186	0.84	17.9	14058	0.61
24.5	5518	0.83			
24.2	5854	0.82			

MULTIPLIERS FOR TEMPERATURE

Temp. Deg. F	Multiplier	Temp. Deg. F	Multiplier	Temp. Deg. F	Multiplier
− 20	1.16	+ 30	1.04	+ 80	0.94
− 10	1.13	+ 40	1.02	+ 90	0.93
0	1.11	+ 50	1.00	+100	0.91
+ 10	1.08	+ 60	0.98	+110	0.90
+ 20	1.06	+ 70	0.96	+120	0.88

Example. Sun: Meas. Alt. = 30°; Bar. = 26 in. or Elev. 3900 ft.; Temp. 70° F.
Refraction = 1.66′ (0.88) (0.96) = 1.40′. Parallax = 0.13′.
True Alt. = 30° 00.00′ − 1.40′ + 0.13′ = 29° 58.73′.

Example. Star: Meas. Alt. = 25°; Bar. = 24.5 or Elev. 5518 ft.; Temp. 10° F.
Refraction = 2.05′ (0.83) (1.08) = 1.84′.
True Alt. = 25° 00.00′ − 1.84′ = 24° 58.16′.

Problem B8 - continued:

TABLE 5

Increase in GHA for Elapsed Time.

Min.	Hours of Greenwich Civil Time 0h		1h		2h		3h	
	°	′	°	′	°	′	°	′
0	0	0.0	15	2.5	30	4.9	45	7.4
1	0	15.0	15	17.5	30	19.9	45	22.4
2	0	30.1	15	32.5	30	35.0	45	37.5
3	0	45.1	15	47.6	30	50.1	45	52.6
4	1	0.2	16	2.6	31	5.1	46	7.6
5	1	15.2	16	17.7	31	20.1	46	22.6
6	1	30.2	16	32.7	31	35.2	46	37.6
7	1	45.3	16	47.8	31	50.2	46	52.7
8	2	0.3	17	2.8	32	5.3	47	7.7
9	2	15.4	17	17.8	32	20.3	47	22.8
10	2	30.4	17	32.9	32	35.3	47	37.8
11	2	45.5	17	47.9	32	50.4	47	52.8
12	3	0.5	18	3.0	33	5.4	48	7.9
13	3	15.5	18	18.0	33	20.5	48	22.9
14	3	30.6	18	33.0	33	35.5	48	38.0
15	3	45.6	18	48.1	33	50.5	48	53.0
16	4	0.7	19	3.1	34	5.6	49	8.0
17	4	15.7	19	18.2	34	20.6	49	23.1
18	4	30.7	19	33.2	34	35.7	49	38.1
19	4	45.8	19	48.2	34	50.7	49	53.2
20	5	0.8	20	3.3	35	5.7	50	8.2
21	5	15.9	20	18.3	35	20.8	50	23.3
22	5	30.9	20	33.4	35	35.8	50	38.3
23	5	45.9	20	48.4	35	50.9	50	53.3
24	6	1.0	21	3.4	36	5.9	51	8.4
25	6	16.0	21	18.5	36	21.0	51	23.4
26	6	31.1	21	33.5	36	36.0	51	38.5
27	6	46.1	21	48.6	36	51.0	51	53.5
28	7	1.1	22	3.6	37	6.1	52	8.6
29	7	16.2	22	18.7	37	21.1	52	23.6
30	7	31.2	22	33.7	37	36.2	52	38.6
31	7	46.3	22	48.7	37	51.2	52	53.7
32	8	1.3	23	3.8	38	6.2	53	8.7
33	8	16.4	23	18.8	38	21.3	53	23.7
34	8	31.4	23	33.9	38	36.3	53	38.8
35	8	46.4	23	48.9	38	51.4	53	53.8
36	9	1.5	24	3.9	39	6.4	54	8.9
37	9	16.5	24	19.0	39	21.4	54	23.9
38	9	31.6	24	34.0	39	36.5	54	39.0
39	9	46.6	24	49.1	39	51.5	54	54.0
40	10	1.6	25	4.1	40	6.6	55	9.0
41	10	16.7	25	19.1	40	21.6	55	24.1
42	10	31.7	25	34.2	40	36.7	55	39.1
43	10	46.8	25	49.2	40	51.7	55	54.2
44	11	1.8	26	4.3	41	6.7	56	9.2
45	11	16.8	26	19.3	41	21.8	56	24.2
46	11	31.9	26	34.4	41	36.8	56	39.3
47	11	46.9	26	49.4	41	51.9	56	54.3
48	12	2.0	27	4.4	42	6.9	57	9.4
49	12	17.0	27	19.5	42	21.9	57	24.4
50	12	32.1	27	34.5	42	37.0	57	39.4
51	12	47.1	27	49.6	42	52.0	57	54.5
52	13	2.1	28	4.6	43	7.1	58	9.5
53	13	17.2	28	19.6	43	22.1	58	24.6
54	13	32.2	28	34.7	43	37.1	58	39.6
55	13	47.3	28	49.7	43	52.2	58	54.6
56	14	2.3	29	4.8	44	7.2	59	9.7
57	14	17.3	29	19.8	44	22.3	59	24.7
58	14	32.4	29	34.8	44	37.3	59	39.8
59	14	47.4	29	49.9	44	52.4	59	54.8
60	15	2.5	30	4.9	45	7.4	60	9.9

Sec.	Corr.
	′
0	0.0
1	0.3
2	0.5
3	0.8
4	1.0
5	1.3
6	1.5
7	1.8
8	2.0
9	2.3
10	2.5
11	2.8
12	3.0
13	3.3
14	3.5
15	3.8
16	4.0
17	4.3
18	4.5
19	4.8
20	5.0
21	5.3
22	5.5
23	5.8
24	6.0
25	6.3
26	6.5
27	6.8
28	7.0
29	7.3
30	7.5
31	7.8
32	8.0
33	8.3
34	8.5
35	8.8
36	9.0
37	9.3
38	9.5
39	9.8
40	10.0
41	10.3
42	10.5
43	10.8
44	11.0
45	11.3
46	11.5
47	11.8
48	12.0
49	12.3
50	12.5
51	12.8
52	13.0
53	13.3
54	13.5
55	13.8
56	14.0
57	14.3
58	14.5
59	14.8
60	15.0

TABLE 5—(Continued)

Increase in GHA for Elapsed Time.

Min.	Hours of Greenwich Civil Time 4h		5h		6h		7h		8h		9h	
	°	′	°	′	°	′	°	′	°	′	°	′
0	60	9.9	75	12.3	90	14.8	105	17.2	120	19.7	135	22.2
1	60	24.9	75	27.4	90	29.8	105	32.3	120	34.8	135	37.2
2	60	39.9	75	42.4	90	44.9	105	47.3	120	49.8	135	52.3
3	60	55.0	75	57.4	90	59.9	106	2.4	121	4.8	136	7.3
4	61	10.0	76	12.5	91	14.9	106	17.4	121	19.9	136	22.3
5	61	25.1	76	27.5	91	30.0	106	32.5	121	34.9	136	37.4
6	61	40.1	76	42.6	91	45.0	106	47.5	121	50.0	136	52.4
7	61	55.1	76	57.6	92	0.1	107	2.5	122	5.0	137	7.5
8	62	10.2	77	12.6	92	15.1	107	17.6	122	20.0	137	22.5
9	62	25.2	77	27.7	92	30.2	107	32.6	122	35.1	137	37.6
10	62	40.3	77	42.7	92	45.2	107	47.7	122	50.1	137	52.6
11	62	55.3	77	57.8	93	0.2	108	2.7	123	5.2	138	7.6
12	63	10.3	78	12.8	93	15.3	108	17.7	123	20.2	138	22.7
13	63	25.4	78	27.9	93	30.3	108	32.8	123	35.2	138	37.7
14	63	40.4	78	42.9	93	45.4	108	47.8	123	50.3	138	52.8
15	63	55.5	78	57.9	94	0.4	109	2.9	124	5.3	139	7.8
16	64	10.5	79	13.0	94	15.4	109	17.9	124	20.4	139	22.8
17	64	25.6	79	28.0	94	30.5	109	32.9	124	35.4	139	37.9
18	64	40.6	79	43.1	94	45.5	109	48.0	124	50.4	139	52.9
19	64	55.6	79	58.1	95	0.6	110	3.0	125	5.5	140	8.0
20	65	10.7	80	13.1	95	15.6	110	18.1	125	20.5	140	23.0
21	65	25.7	80	28.2	95	30.6	110	33.1	125	35.6	140	38.0
22	65	40.8	80	43.2	95	45.7	110	48.2	125	50.6	140	53.1
23	65	55.8	80	58.3	96	0.7	111	3.2	126	5.7	141	8.1
24	66	10.8	81	13.3	96	15.8	111	18.2	126	20.7	141	23.2
25	66	25.9	81	28.3	96	30.8	111	33.3	126	35.7	141	38.2
26	66	40.9	81	43.4	96	45.8	111	48.3	126	50.8	141	53.2
27	66	56.0	81	58.4	97	0.9	112	3.4	127	5.8	142	8.3
28	67	11.0	82	13.5	97	15.9	112	18.4	127	20.9	142	23.3
29	67	26.0	82	28.5	97	31.0	112	33.4	127	35.9	142	38.4
30	67	41.1	82	43.6	97	46.0	112	48.5	127	50.9	142	53.4
31	67	56.1	82	58.6	98	1.1	113	3.5	128	6.0	143	8.4
32	68	11.2	83	13.6	98	16.1	113	18.6	128	21.0	143	23.5
33	68	26.2	83	28.7	98	31.1	113	33.6	128	36.1	143	38.5
34	68	41.2	83	43.7	98	46.2	113	48.6	128	51.1	143	53.6
35	68	56.3	83	58.8	99	1.2	114	3.7	129	6.1	144	8.6
36	69	11.3	84	13.8	99	16.3	114	18.7	129	21.2	144	23.7
37	69	26.4	84	28.8	99	31.3	114	33.8	129	36.2	144	38.7
38	69	41.4	84	43.9	99	46.3	114	48.8	129	51.3	144	53.7
39	69	56.5	84	58.9	100	1.4	115	3.9	130	6.3	145	8.8
40	70	11.5	85	14.0	100	16.4	115	18.9	130	21.4	145	23.8
41	70	26.5	85	29.0	100	31.5	115	33.9	130	36.4	145	38.9
42	70	41.6	85	44.0	100	46.5	115	49.0	130	51.4	145	53.9
43	70	56.6	85	59.1	101	1.5	116	4.0	131	6.5	146	8.9
44	71	11.7	86	14.1	101	16.6	116	19.1	131	21.5	146	24.0
45	71	26.7	86	29.2	101	31.6	116	34.1	131	36.6	146	39.0
46	71	41.7	86	44.2	101	46.7	116	49.1	131	51.6	146	54.1
47	71	56.8	86	59.2	102	1.7	117	4.2	132	6.6	147	9.1
48	72	11.8	87	14.3	102	16.8	117	19.2	132	21.7	147	24.1
49	72	26.9	87	29.3	102	31.8	117	34.3	132	36.7	147	39.2
50	72	41.9	87	44.4	102	46.8	117	49.3	132	51.8	147	54.2
51	72	56.9	87	59.4	103	1.9	118	4.3	133	6.8	148	9.3
52	73	12.0	88	14.5	103	16.9	118	19.4	133	21.8	148	24.3
53	73	27.0	88	29.5	103	32.0	118	34.4	133	36.9	148	39.3
54	73	42.1	88	44.5	103	47.0	118	49.5	133	51.9	148	54.4
55	73	57.1	88	59.6	104	2.0	119	4.5	134	7.0	149	9.4
56	74	12.2	89	14.6	104	17.1	119	19.5	134	22.0	149	24.5
57	74	27.2	89	29.7	104	32.1	119	34.6	134	37.0	149	39.5
58	74	42.2	89	44.7	104	47.2	119	49.6	134	52.1	149	54.6
59	74	57.3	89	59.7	105	2.2	120	4.7	135	7.1	150	9.6
60	75	12.3	90	14.8	105	17.2	120	19.7	135	22.2	150	24.6

Problem B8 - continued:

APPARENT PLACE OF POLARIS AND APPARENT SIDEREAL TIME 0 HOUR UT
APRIL 1986

GCD	RIGHT ASCENSION			DECLINATION			SIDEREAL TIME		
1.0	2	15	27.843	89	12	17.217	12	36	14.042
2.0	2	15	27.419	89	12	16.977	12	40	10.603
3.0	2	15	26.901	89	12	16.737	12	44	7.163
4.0	2	15	26.302	89	12	16.487	12	48	3.720
5.0	2	15	25.658	89	12	16.220	12	52	0.273
6.0	2	15	25.015	89	12	15.931	12	55	56.824
7.0	2	15	24.420	89	12	15.621	12	59	53.373
8.0	2	15	23.910	89	12	15.293	13	3	49.920
9.0	2	15	23.510	89	12	14.954	13	7	46.468
10.0	2	15	23.226	89	12	14.611	13	11	43.017
11.0	2	15	23.050	89	12	14.271	13	15	39.567
12.0	2	15	22.962	89	12	13.940	13	19	36.121
13.0	2	15	22.932	89	12	13.623	13	23	32.676
14.0	2	15	22.929	89	12	13.320	13	27	29.234
15.0	2	15	22.922	89	12	13.032	13	31	25.792

APRIL 1986

GREENWICH HOUR ANGLE FOR THE SUN AND POLARIS FOR 0 HOUR UNIVERSAL TIME

SUN, POLARIS

DAY	GHA (SUN)	DECLINATION	EQ. OF TIME APPT-MEAN	SEMI-DIAM.	GHA (POLARIS)	DECLINATION	GREENWICH TRANSIT
	° ′ ″	° ′ ″	M S	′ ″	° ′ ″	° ′ ″	H M S
1 TU	178 58 30.9	4 20 29.7	-04 05.94	16 01.9	155 11 32.5	89 12 17.24	13 37 00.
2 W	179 02 59.6	4 43 39.0	-03 48.03	16 01.7	156 10 47.3	89 12 17.01	13 33 03.
3 TH	179 07 26.3	5 06 43.5	-03 30.25	16 01.4	157 10 03.6	89 12 16.77	13 29 07.
4 F	179 11 50.7	5 29 42.6	-03 12.62	16 01.1	158 09 21.3	89 12 16.53	13 25 10.
5 SA	179 16 12.5	5 52 36.1	-02 55.16	16 00.8	159 08 39.7	89 12 16.26	13 21 14.
6 SU	179 20 31.6	6 15 23.6	-02 37.90	15 00.5	160 07 58.1	89 12 15.97	13 17 17.
7 M	179 24 47.6	6 38 04.6	-02 20.83	16 00.2	161 07 15.7	89 12 15.66	13 13 21.
8 TU	179 29 00.3	7 00 38.9	-02 03.98	16 00.0	162 06 31.8	89 12 15.32	13 09 24.
9 W	179 33 09.6	7 23 06.0	-01 47.36	15 59.7	163 05 46.1	89 12 14.98	13 05 28.
10 TH	179 37 15.1	7 45 25.7	-01 30.99	15 59.4	164 04 58.6	89 12 14.63	13 01 32.
11 F	179 41 16.8	8 07 37.5	-01 14.88	15 59.1	165 04 09.4	89 12 14.28	12 57 36.
12 SA	179 45 14.3	8 29 41.1	-00 59.05	15 58.9	166 03 18.8	89 12 13.95	12 53 40.
13 SU	179 49 07.5	8 51 36.2	-00 43.50	15 58.6	167 02 27.2	89 12 13.63	12 49 44.
14 M	179 52 56.1	9 13 22.3	-00 28.26	15 58.3	168 01 35.3	89 12 13.32	12 45 48.
15 TU	179 56 40.0	9 34 59.1	-00 13.33	15 58.1	169 00 43.5	89 12 13.03	12 41 52.
16 W	180 00 19.0	9 56 26.3	00 01.26	15 57.8	169 59 52.2	89 12 12.76	12 37 56.
17 TH	180 03 52.7	10 17 43.6	00 15.52	15 57.6	170 59 01.6	89 12 12.49	12 34 00.
18 F	180 07 21.1	10 38 50.5	00 29.41	15 57.3	171 58 12.0	89 12 12.23	12 30 04.
19 SA	180 10 44.0	10 59 46.7	00 42.93	15 57.0	172 57 23.2	89 12 11.96	12 26 08.
20 SU	180 14 01.0	11 20 31.9	00 56.07	15 56.8	173 56 34.9	89 12 11.67	12 22 12.
21 M	180 17 12.0	11 41 05.6	01 08.80	15 56.5	174 55 46.5	89 12 11.37	12 18 16.
22 TU	180 20 16.8	12 01 28.1	01 21.12	15 56.3	175 54 57.1	89 12 11.05	12 14 20.
23 W	180 23 15.1	12 21 38.4	01 33.01	15 56.0	176 54 05.8	89 12 10.70	12 10 24.
24 TH	180 26 06.7	12 41 36.4	01 44.45	15 55.8	177 53 11.8	89 12 10.35	12 06 28.
25 F	180 28 51.4	13 01 21.9	01 55.42	15 55.5	178 52 15.2	89 12 10.01	12 02 32.
26 SA	180 31 28.8	13 20 54.7	02 05.92	15 55.2	179 51 16.6	89 12 09.68	11 58 37.
27 SU	180 33 58.8	13 40 14.3	02 15.92	15 55.0	180 50 17.0	89 12 09.39	11 54 41.
28 M	180 36 21.2	13 59 20.6	02 25.41	15 54.7	181 49 17.8	89 12 09.13	11 50 46.
29 TU	180 38 35.7	14 18 13.2	02 34.38	15 54.5	182 48 19.9	89 12 08.88	11 46 51.
30 W	180 40 42.3	14 36 51.7	02 42.82	15 54.2	183 47 23.9	89 12 08.65	11 42 55.