TENNIS

CALIFORNIA BOARD OF REGISTRATION FOR CIVIL AND PROFESSIONAL ENGINEERS

1963 LAND SURVEYING EXAMINATION

LS PART I AM

Time Allowed - Four Hours

INSTRUCTIONS TO EXAMINEE:

The first day of the examination consists of two parts of four hours each. Each part has a grading weight of 50 points.

Part I consists of 75 multiple choice problems. Each problem has a grading weight of one point. You are to answer any 50 problems of your choice. Do not answer more than 50, as only the first 50 answers shown will be graded. Indicate the one answer of your choice for each of the problems you select by showing the letter A, B, C, D, or E in the space provided on the answer sheet. You may use any available space for computations; however, only the answer shown on your answer sheet will be graded. If you need scratch paper, the proctor will supply it.

Show your identification number in the space provided on the answer sheet. After you have completed Part I, return only your answer sheet to the proctor.

No text or reference material may be used in this part of the examination.

You may keep the examination questions.

SHOW YOUR ANSWERS ON THE ANSWER SHEET

1. Relative to the cosine of angle A, the cosine is equivalent to:

(A) $\sin (A - 90°)$

(B) $\sqrt{\frac{\tan A}{1 + \tan^2 A}}$

(C) $\sqrt{1 - \cos^2 A}$

(D) $\frac{\sin A}{\tan A}$

(E) $\frac{1}{\tan A}$

2. The coefficient of expansion of a steel tape is generally assumed to be

(A) 0.00000022 per 1°F
(B) 0.0000065 per 1°F
(C) 0.000022 per 1°F
(D) 0.01' per 100' per 30°F variation from 68°F
(E) Negligible between 40°F and 70°F

3. The geodimeter is a device which

(A) measures slope distances.
(B) measures horizontal angles.
(C) operates on the same electrical principles as radar.
(D) operates on the same electrical principles as the tellurometer.
(E) operates on the same electrical principles as the electrotape.

4. The corner common to Sections 7, 12, 13, and 18 has been declared lost. All other corners of the four sections have been located. Which of the following procedures is correct to re-establish the lost corner?

   ✓(A) Double proportion

   (B) Set at record distance from North one-quarter corner of Section 13

   (C) Set halfway between the North one-quarter corner of Section 13 and the North one-quarter of Section 18

   (D) Set halfway between the East one-quarter corner of Section 12 and the East one-quarter corner of Section 13

   (E) Set by single proportion on line between the one-quarter corner common to Sections 7 and 12, and the one-quarter corner common to Sections 13 and 18

5. For making a single measurement, accurate to $\pm$ 25 feet, between two mountain tops about 50 miles apart, a surveyor would use

   (A) a tellurometer.

   (B) a telemeter.

   (C) a tachometer.

   (D) a Model 4 geodimeter.

   (E) Loran equipment.

6. The central angle subtending a plane circular curve is

   ✓ (A) equal to the deflection angle between the tangents to the curve.

   (B) equal to one-half the deflection angle between the tangents to the curve.

   (C) two radians times the sine $\frac{R}{2}$.

   (D) equal to 360° minus the deflection per foot.

   (E) usually stated in $\frac{\text{radians}}{2}$.

7. Corrections are determined for a 300-foot tape to eliminate the effects of sag and stretch, and a curve is prepared showing the corrections to be applied. These corrections are determined for the tape when it is level and fully suspended in the air at standard temperature. During the course of a traverse, you slope chain, with the chain fully suspended, down a hillside one mile in length. All of the measurements were made on a slope of approximately minus 20°. In reducing your chained distances, you therefore

   (A) apply the sag and stretch corrections as taken from the curve.

   (B) multiply the correction, as taken from the curve, by the sine of the depression angle.

   (C) multiply the correction, as taken from the curve, by the cosine squared of the depression angle.

   ✓ (D) apply the formula: correction to distance = - (vers depression angle x total length of course).

8. In a regular four-sided figure (90° angles), which of the following contains exactly one acre of land in area?

   (A) 206.7 feet by 206.7 feet

   ✓ (B) 2 chains by 5 chains

   (C) 3.2 chains by 3.2 chains

   (D) 200 links by 495 links

   (E) 209.7 feet by 209.7 feet

9. The polar distance of the star Polaris is

   (A) about one degree.

   (B) about eighty-nine degrees.

   (C) about zero degrees.

   (D) two and one-half million miles, approximately.

   (E) about 30 minutes of arc.

10. Polaris, a star of the second magnitude, is located in the constellation

   (A) Ursa Major.

   (B) Cassiopeia.

   (C) Perseus.

   ✓ (D) Ursa Minor.

   (E) Draco.

11. The arc of a circle is measured, in degrees, by

(A) radial lines passing through the extremities of the arc.

(B) producing a chord between the two end points of the arc measuring the angle formed between the chord and a line tangent to the arc at the end of the arc.

✓(C) producing radial lines through the end points of the arc and measuring the angle formed at the vertex of these lines.

(D) producing lines tangent to the circle at the ends of the arc and measuring the interior angle formed at the intersection of these tangent lines.

12. The central meridian of the Pacific Standard Time Zone is

(A) 7 hours behind Greenwich Civil Time.

(B) 127° 30' West lingitude.

(C) 112° 30' West longitude.

(D) 8 hours ahead pf Greenwich Civil Time.

✓(E) 120° 00' West longitude.

13. The most simple and accurate method for determination of the true meridian would be

(A) from the coordinates of any two points on the State Plane Coordinate System.

(B) with a precise surveyor's compass.

✓(C) from the coordinates of any two points if the latitude and longitude of these points are known.

(D) if the State Plane Coordinates of two intervisible points and the mapping angle are known.

14. What is the geodetic azimuth (measured from South) of a line between two points based on the California State Plane Coordinate System if the grid bearing of the line is N 44° 23' 20" W? Θ = + 0° 15' 20". Neglect second term.

(A) 135° 36' 40"

(B) 315° 36' 40"

✓ (C) 135° 52' 00"

(D) 135° 21' 20"

(E) 315° 52' 00"

15. The equation of time is

✓(A) the difference between sidereal time and solar time.

(B) the difference between astronomical time and civil time.

(C) the difference in hour angle between the true sun and the mean sun.

(D) the difference between the sidereal year and the solar year.

(E) Never amounts to more than a minute.

16. A plane, perpendicular to the earth's axis, and equidistant from the poles, passing through the sphere, defines a line thereon, this line is more commonly called

(A) parallel of longitude.

(B) parallel of latitude.

(C) meridian.

✓(D) equator.

(E) horizon.

17. The most accurate method for determination of the true meridian involving the least amount of calculation is

(A) observation of sun.

(B) Polaris at elongation.

✓(C) Polaris at culmination.

(D) use of Burt Solar attachment.

(E) observation of celestial body by sextant.

18. A solar observation for meridian is generally considered

(A) more accurate than an observation for meridian on a circumpolar star.

✓(B) accurate within plus or minus three minutes of arc.

(C) less accurate than a meridian determination made with a good surveyor's compass.

(D) damaging to the observer's eyesight.

(E) poor practice for section line retracement in mountainous country.

19. Between latitude 30° North and latitude 40° North a solar observation to determine astronomic North is best made

(A) immediately after sunrise.

(B) within one-half hour prior to sunset.

(C) near noon.

(D) between the hours of 8 a.m. and 10 a.m. Standard Time, or between the hours of 2 p.m. and 4 p.m. Standard Time.

(E) during the vernal equinox.

20. One of the principal advantages to surveys based on the State Plane Coordinate System is:

(A) A lost property corner, the coordinates being known, may be replaced without regard to other physical evidence.

(B) The law permits any survey to be based on the coordinate system provided a record of such survey is filed with the County Surveyor.

(C) It is relatively easy to use with proper care and employing second order survey methods and procedures.

(D) The coordinates, if incorporated in a recorded document, take precedence over physical monuments.

(E) Permits extensive surveys to be performed, providing these surveys do not overlap zones.

21. Clarke's spheroid of 1866 has

(A) the equatorial axis smaller than the polar axis.

(B) a surface formed by ellipses revolved about both the equatorial and polar axes.

(C) a surface formed by revolving an ellipse about the polar axis.

(D) a surface formed by rotating a circle about the polar axis.

(E) a perfect spherical surface.

22. When determining the bearing of a line by solar observation using the altitude method,

? (A) the longitude of the station occupied must be known.

(B) the semidiameter of the sun must be known.

(C) on certain days of the year the time of the day need not be recorded other than to know that the altitude was determined somewhere between 8 a.m. to 10 a.m. or 2 p.m. to 4 p.m. on regular time.

✓(D) it is necessary to know Civil Time.

(E) temperature and altitude do not alter the results.

23. The accuracy of an angular measurement is not impaired by

(A) short sights.

(B) improper centering of instruments.

(C) extremely hot temperatures.

✓(D) sights of great length with well defined targets.

(E) improper focusing (parallax).

24. The sun and stars are located by the celestial coordinates

(A) right ascension and sidereal hour angle.

(B) prime vertical and hour circle.

(C) latitude and longitude.

(D) hour angle and equation of time.

(E) declination and right ascension.

25. You are determining the most probable value as based upon the theory of probability. Select the answer that is not true from the following:

(A) Small errors are more frequent than large ones.

(B) Errors are as likely to be positive as negative.

(C) The true value is the mean of an infinite number of observations.

✓(D) Systematic errors are included in the error analysis.

(E) Very large errors do not occur.

26. A rectangular piece of land is 12 chains 6 links in length by 10 chains 55 links in breadth. Its area is

(A) 10 square rods.

(B) 127.23 acres.

✓(C) 12.72 acres.

(D) 1.27 acres.

(E) 1/16 of a standard section.

27. Two points on opposite sides of a canyon (difference in elevation of rims more than 10 feet) were set at a distance of 300.00 feet apart with a 300-foot, 3-pound tape calibrated at 25-pound pull. Which of the following items contributed the greater error?

(A) Tape calibrated wrong by .028 feet.

(B) Temperature of tape 16°F in error from the recorded temperature.

(C) Pull is only 24 pounds instead of 25 pounds.

(D) Error in difference in elevation of the ends of the tape by 2.5 feet.

✓(E) When the tape is pulled at 25 pounds, the mid-point of the tape is resting on a limb so that the two ends and the center point form a straight line.

28. For a continuous direct current in any circuit, the total current in amperes is equal to the applied electromotive force in volts divided by the total resistance in ohms. This may be expressed by the formula

(A) $E = \frac{I}{R}$

(B) $W = Pt$

✓(C) $I = \frac{E}{R}$

(D) $W = EI$

(E) $I = \frac{KVA}{m}$

29. An electrical circuit has three resistances hocked up in parallel. The net total effect of the three resistances is

(A) $R = R_1 + R_2 + R_3$

(B) $R = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

(C) $R = \frac{R_1 + R_2 + R_3}{3}$

(D) $R = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$

(E) $R = R_1^2 + R_2^2 + R_3^2$

30. The acceleration of gravity on a freely falling object is

(A) 8.1 feet per second per second
(B) 16.16 ditto
(C) 32.2 "
(D) 48.0 "
(E) 100.0 "

31. One atmosphere of pressure is equivalent to

(A) 15 inches of mercury.
(B) 29 inches of mercury.
(C) 2 inches of water column.
(D) 14.7 lbs per sq inch.
(E) a vacuum of 2 inches.

32. In staking a point 300 feet from the transit, the instrumentman should have turned an angle of 90° 01' clockwise from the backsight. He mistakenly turned 90° 10'. The point he set is out of its correct position by approximately

(A) 0.08 foot.
(B) 8 feet.
(C) 1.80 feet.
(D) 0.008 foot.
✓(E) 0.80 foot.

33. Parallax

(A) correction is subtracted from the vertical angle to the sun during solar observations.

(B) difference for two points on a pair of overlapping aerial photographs is measured to obtain the difference in elevation between the points.

(C) in an instrument occurs when the cross hairs and the plane of the image coincide.

(D) causes light rays to bend.

(E) correction is necessary when light rays pass from a less dense medium into a more dense medium.

34. Light rays can be made to diverge with a

(A) plain convex lens.

(B) double convex lens.

(C) lens with thicker glass in the middle.

(D) double concave lens.

(E) concavo-convex lens.

35. Cromatic aberration in lenses may be almost eliminated by

(A) grinding a lens in a slightly nonspherical shape.

(B) omitting the objective lens.

(C) using a combination of flint glass and crown glass.

(D) using convex lenses.

(E) using concave lenses.

36. An optical instrument, usually precise, for measuring rectangular or polar coordinates of points on any plane surface is called a

(A) coordinatograph.

(B) stereoscopic plotter.

(C) stereometer.

(D) parallax bar.

(E) comparator.

53. Which of the following statements regarding trigonometric functions of an angle is true?

(A) The cosine is positive in the first and second quadrants.

(B) The tangent is positive in the first and second quadrants.

✓(C) The sine is negative in the third and fourth quadrants.

(D) The cotangent is negative in the third and fourth quadrants.

(E) The secant is positive in the second and third quadrants.

54. The magnetic declination

(A) is East of true North within the United States.

✓(B) has a daily variation of about 28 minutes.

(C) is constantly changing in the same direction.

(D) is shown on an isogonic chart where lines of equal declination are called agonic lines and the line of zero declination is known as the isogonic line.

(E) has a daily variation of less than 8 minutes; within California has an annual change of two to three minutes.

55. The azimuth, measured from geographic South, from C. & G.S. Station "Hall" to C. & G.S. Station "Dog" is 273° 10' 11", according to C. & G.S. published data. The back azimuth is published as 93° 15' 22". Station "Hall" is at 2000 feet elevation. Station "Dog" is at 8000 feet elevation. The azimuths do not differ by exactly 180° 00' 00"

(A) because of the difference in elevation between the stations.

(B) because Station "Dog" is further from the central meridian of the grid zone.

(C) because the θ angle (mapping angle) is applied to the back azimuth.

(D) because of the inclination of the line of sight.

✓(E) because of the convergence of the geographic meridians.

56. When using a magnetic compass

(A) the dip is at right angles to the meridian.

(B) east and west are in reversed positions on the plate.

(C) the north pole of the earth is a magnetic north pole.

(D) the direction of the needle may be accurately predicted within 5 minutes of arc.

(E) None of the above statements are correct.

57. One of the most useful attachments to the alidade for computing difference in elevation and reduction to horizontal distance is

(A) Cox's stadia reducer.

(B) Beaman's stadia arc.

(C) the right angle viewer.

(D) Lehmann's triangle.

(E) the altimeter.

58. The term "grad" is a unit of

(A) linear measure, English system.

(B) linear measure, metric system.

(C) linear measure, either English or metric system.

(D) arc measure, either degrees or radians.

(E) arc measure, metric system.

59. There are several methods employed in leveling. The most common method used is:

(A) Trigonometric leveling
(B) Indirect leveling
(C) Barometric leveling
✓(D) Direct or spirit leveling
(E) Transit leveling

60. In the use of Briggs or common Logarithms (logs),

(A) to find the product of any given numbers, add the numbers together.
(B) to find the square root of a number, divide the log of the number by 4.
(C) the log of the quotient is the difference of the dividend and the divisor.
(D) a number may be raised to any power by multiplying the log of the number by the exponent less one.
✓(E) the integer preceding the mantissa is called the index or characteristic.

61. To prolong a line, by plunging the telescope, using any ordinary transit,

(A) it is unnecessary to double center.
(B) accurate plumb of backsite may be ignored.
(C) the transit need not be centered exactly above the point.
✓(D) the transit need not be in perfect adjustment, if the instrument is double centered.
(E) turning on the horizon is recommended to verify results.

62. In the survey of a normal township, the excess and/or deficiency is generally placed in

(A) the North and East tier of sections.

(B) the South and East tier of sections.

(C) the South and West tier of sections.

✓(D) the North and West tier of sections.

(E) Is not considered.

63. One of the many advantages in the use of the three-wire leveling system is

(A) simplified reading of target.

(B) that by setting the target on the elevation of the originating bench mark no notes need be kept.

(C) double rodding may be ignored.

✓(D) it is fast, accurate, and self-checking.

(E) May be accomplished only with the use of a self-leveling level and yard rods.

64. The Coast and Geodetic Survey specifies that for Second Order triangulation work the average triangle closure shall not exceed

(A) 1 second.

(B) 8 seconds.

✓(C) 5 seconds.

(D) 3 seconds.

(E) 4 seconds.

65. In performing a traverse to Second Order specifications at an elevation of 2000 feet above sea level, a horizontal distance of 5000 feet was measured. The sea level distance on the State Plan Coordinate System is

(A) more than 5000 feet.

(B) the same as the measured distance.

(C) less than 5000 feet.

(D) within Second Order limits.

(E) approximately 4975 feet.

66. During the progress of the original survey of Township 10 North, Range 5 East, Mount Diablo Base and Meridian, in 1865, the surveyor finds that a portion of Rancho Del Paso, a Spanish grant, lies within the township. The township is otherwise regular. This portion of the Rancho will be designated on the Township Plat as

(A) Lot 100.

(B) Lot 1.

(C) Lot 10.

(D) Lot 50.

(E) Lot 37.

67. The legal center of a section is

✓(A) the point of intersection of a straight line run from the North quarter-section corner to the South quarter-section corner, with a straight line run from the West quarter-section corner to the East quarter-section corner.

(B) the mid-point of the section.

(C) a point 40 chains North and 40 chains East from the Southwest corner of the section.

(D) a point 40 chains South and 40 chains West from the Northeast corner of the section.

(E) the point of intersection of a straight line run from the Northwest corner of the section to the Southeast corner of the section with a straight line run from the Northeast corner of the section to the Southwest corner of the section.

68. The sudden removal, by the forces of nature, of a considerable quantity of soil from the land of one man and its deposit on, or annexation to, the land of another is termed:

(A) Reliction

(B) Dereliction

(C) Accretion

(D) Avulsion

(E) Flowage

69. The correction for tension in a steel tape is

(A) directly proportional to the cross-sectional area of the tape.

(B) directly proportional to the elastic modulus of steel.

(C) inversely proportional to the length of the tape.

(D) inversely proportional to the change in pull.

(E) not correctly expressed by A, B, C, or D.

70. The meridian of a legal description

(A) is true North.

(B) is magnetic North.

(C) is assumed.

(D) is stated in the description.

(E) is any reference line for the description.

71. When using the subtense bar

(A) the vertical angle to the bar must be measured to correct slope distance to horizontal distance.

(B) the error of measurement increases with the square of the distance.

(C) the accuracy obtained is 0.1 feet in 1000 feet.

✓(D) the angle measured need not be more accurate than 0° 00' 05".

(E) None of the above statements are correct.

72. One of the following factors need not be considered when conducting surveys based on the California State Plane Coordinate System:

(A) Height above sea level

(B) Scale factor

(C) Proper grid zone

✓(D) Mapping angle

(E) Latitude

73. The California State Plane Coordinate System is

(A) based on a conformal polyconic projection.

(B) broken into 5 zones.

✓(C) based on the Lambert Conformal Conic Projection.

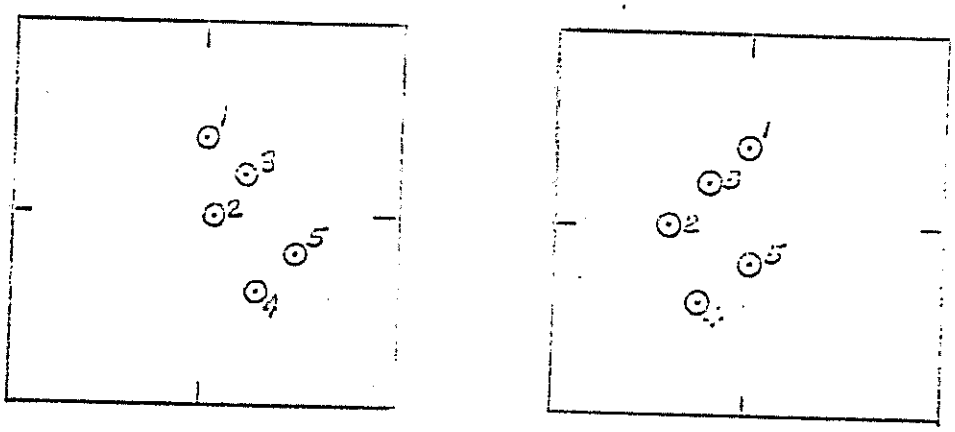
(D) based on a plane tangent to the sphere at the average elevation of the zone.

(E) based on the Transverse Mercator Projection.

74. The mapping angle (θ) of the California State Plane Coordinate System is affected directly by

(A) the convergence of the y axis.
(B) the latitude.
(C) the value of Y' on the central meridian.
(D) the longitude.
(E) Is always constant.

75.



In this stereogram, which is the highest point?

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

TENNIES

CALIFORNIA BOARD OF REGISTRATION FOR CIVIL AND PROFESSIONAL ENGINEERS

1963 LAND SURVEYING EXAMINATION

LS PART II PM

Time Allowed - Four Hours

INSTRUCTIONS TO EXAMINEE:

Part II consists of 20 problems for a total point value of 70. You are to work any combination of problems for a total point value of 50. The grading weight is shown with each problem. Do not work more than 50 points, since only the first 50 points that you attempt will be graded.

Work the problems on the grid sheets in the WORKBOOK. Do not put more than one problem on a sheet and use only one side of the paper. If you need more sheets of paper, the proctor will supply them.

ALL WORK TO BE EVALUATED MUST BE IN THE WORKBOOK.

Show your identification number in the space provided on each sheet of your workbook. After you have completed this part of the examination, check to insure that your calculation sheets are arranged in numerical sequence by problem number, and that all of your work is included.

If the meaning of a problem is not clear to you, or if it appears to be incomplete, note such assumptions as you think necessary and proceed with the problem solution.

Acceptable solutions for examination questions must show fundamental formulas and sufficient supporting calculations to enable the examiner to judge your method of solution. Solutions which are not presented in a readable manner may result in reduced grades. In discussion-type problems, neat long-hand writing will be just as acceptable as printing.

No text or reference material may be used in this part of the examination.

You may keep the examination questions,

Be sure to mark VOID any work you do not wish graded.

Problem 1 - Wt. 2

The arc of a curve of $\Delta = 80°$ is divided into 8 equal parts. You set up on Station 3. What should be the deflection angle from Station 2 to Station 8?

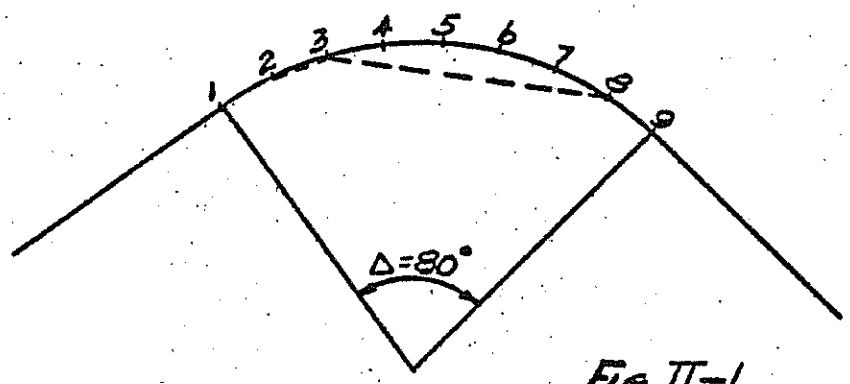


Fig. II-1

Problem 2 - Wt. 2

The length of the arc on a 1-foot radius circle is 1.5708 feet.

What is the central angle in degrees?

Problem 3 - Wt. 2

In a triangle with vertex angles A, B, and C and sides a, b, and c, the formula given is:

$$\frac{\text{Sin A}}{\text{sin a}} = \frac{\text{Sin B}}{\text{sin b}}$$

What kind of triangle is it, and what units may be used for A and a?

Problem 4 - Wt. 2

Tracing with the planimeter as shown below (drawing is 1/5 the size of the planimeter) and running around the area clockwise on a drawing of 1" = 200', your reading decreases from zero to 7.782. Running counterclockwise, your reading increases from zero to 2.218. The constants are:

Reading 1 = 10 square inches
Zero circle = 218.00 square inches
Scale of drawing 1" = 200'

What is the area in square feet represented by this portion of the drawing?

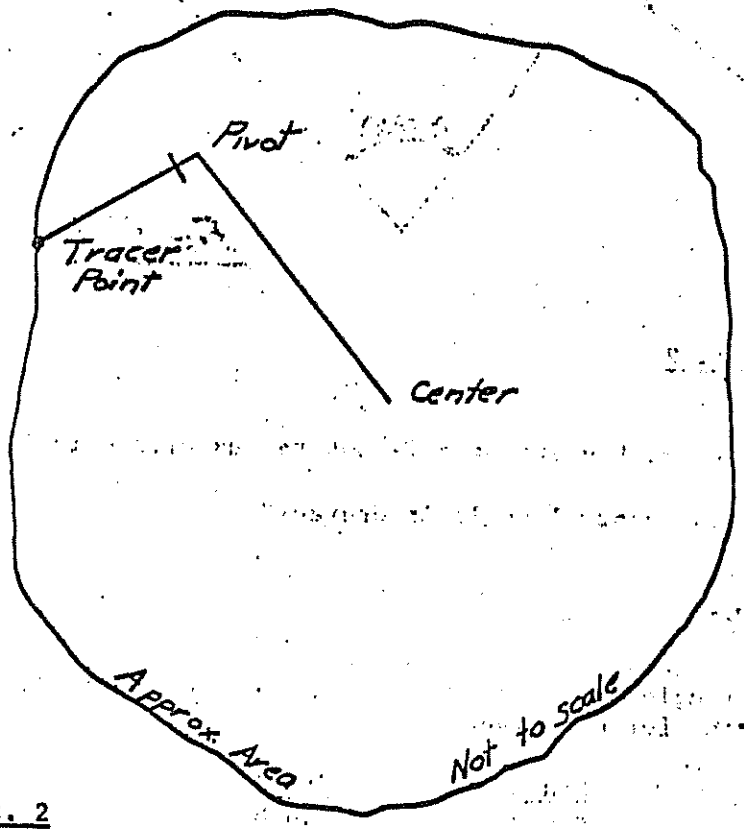


FIG. II-4

Problem 5 - Wt. 2

Compute the area in square feet of the following right triangle:

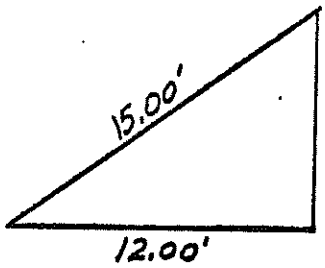


FIG. II-5

Problem 6 - Wt. 2

You are to measure the distance between two points "A" and "B" that are intervisible. The grade between these two points is constant. What is the horizontal length of the line A-B if the difference in elevation is 50.00 feet and the slope distance measured is 800.00 feet?

Problem 7 - Wt. 2

A base line is to be laid out with a 100-foot tape. The recorded measurement was 1965.23 feet. If the tape was later found to be short by 0.03 foot, what is the true length of the base line?

Problem 8 - Wt. 2

Your 100-foot steel tape is standardized at 68°F. At a tension of 25 lbs, there is no correction other than temperature to apply. With the temperature constant at 91°F, what distance would you measure to lay out exactly 100.00 feet?

Problem 9 - Wt. 2

If the radius of a curve is 600.00' and the central angle is 30° 00', compute the length of the long chord.

TRIGONOMETRIC FUNCTIONS

Angle	Sin	Tan	Cot	Cos
15° 00'	.25882	.26795	3.7321	.96593
30° 00'	.50000	.57735	1.7321	.86603
45° 00'	.70711	1.0000	1.0000	.70711
60° 00'	.86603	1.7321	.57735	.50000

Problem 10 - Wt. 3

The central meridian of Grid Zone 2 of the California Coordinate System is 122° 00' West longitude. At traverse point "A", located at 119° 30' West longitude, the grid bearing to traverse point "B" is North 0° 55' 28" West. The θ angle (mapping angle) is + 01° 34' 34.21", according to the projection tables.

What is the bearing (to the nearest second) of the line from traverse point "A" to traverse point "B", referred to astronomic North? Illustrate by a sketch.

Problem 11 - Wt. 3

What condition equations are necessary in adjusting a quadrilateral of a triangulation net so that the solution will be identical no matter which direction the computations are made, and the most probable measurement will be the result?

Problem 12 - Wt. 3

The chart shown below resulted from a large number of 100-foot measurements with a 100-foot steel tape. If you were to measure 2500 feet with the same tape under the same conditions, how would you expect the scale or scales on the drawing to change?

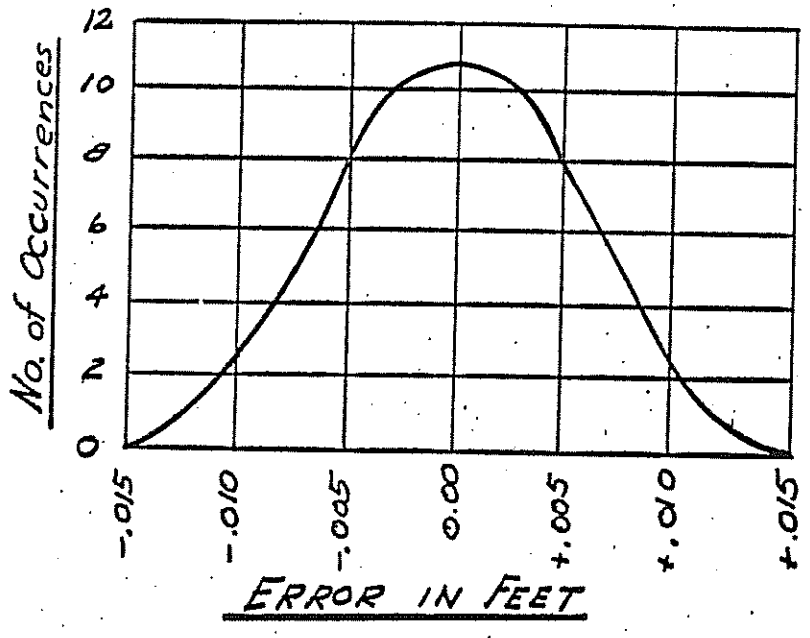


FIG. II-12

Problem 13 - Wt. 3

An aerial photo is taken from an altitude of 12,000 feet above the average ground. The camera has a focal length of 6 inches and uses a 9" x 9" negative.

What is the approximate size of the area photographed? Show your computations and a sketch.

Problem 14 - Wt. 5

Given the following information, compute (1) Greenwich Civil Time, and (2) the declination of the sun:

Longitude = 122° 30' 00" West

Pacific Standard Time of observation 10:30 A.M.

Date of observation May 5, 1962

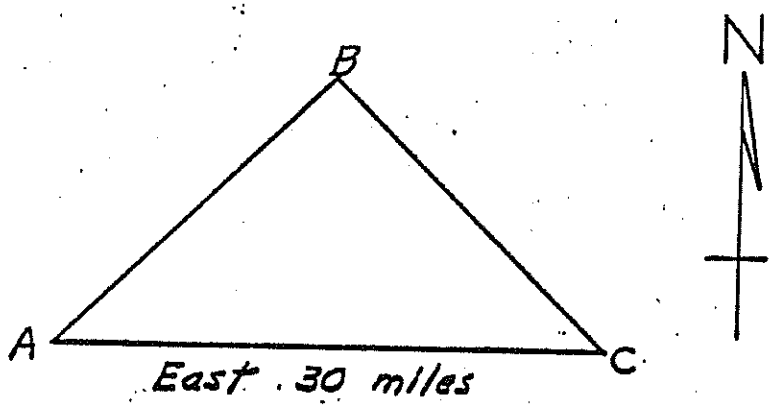
From the ephemeris for 0^h G.C.T. May 1962

0^h G.C.T. (midnight)

Date	Apparent Declination	Difference for 1 hour	Equation of Time
5	+ 16° 03' 00"	42.94"	$3^m\ 16.8^s$
6	+ 16° 20' 10"	42.26"	$3^m\ 22^s$

Problem 15 - Wt. 5

In a First Order triangulation scheme, the triangle pictured below was observed. The observed angles are as listed. Does the triangle close within Coast and Geodetic Survey specifications for the average triangle closure of a First Order scheme? Explain.



A = 44° 59' 01.6"

B = 89° 58' 11.2"

C = 45° 02' 49.8"

Fig II-15

Problem 16 - Wt. 5

A portion of the field notes of a traverse is shown on the next page. You have determined in the office that the angular closure is unsatisfactory.

Which of the entries in the notes appear to be in error? Explain.

Do not concern yourself with entries relating to measured distances.

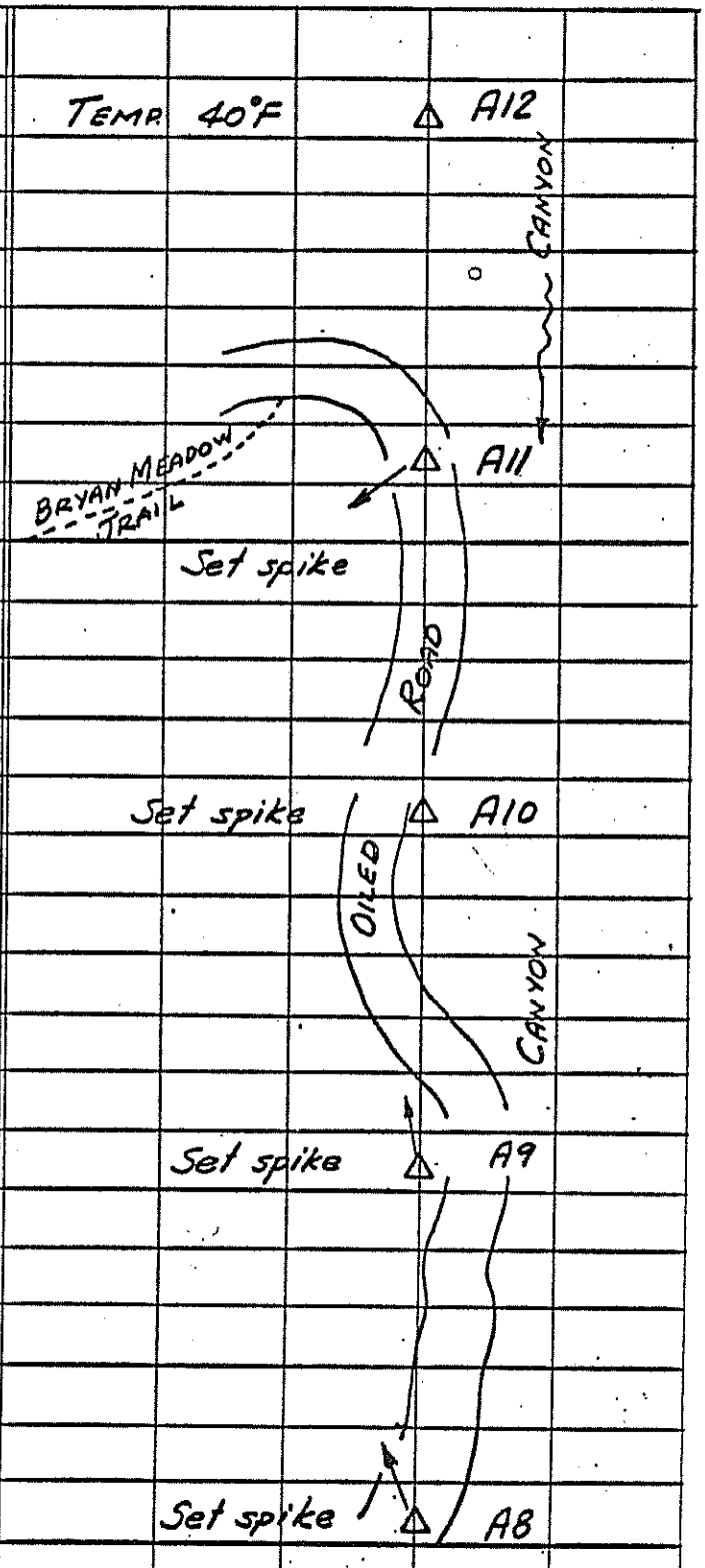
Prob. 16 contd on next page

FIELD NOTES

ACCOMPANYING PROBLEM NO. 16

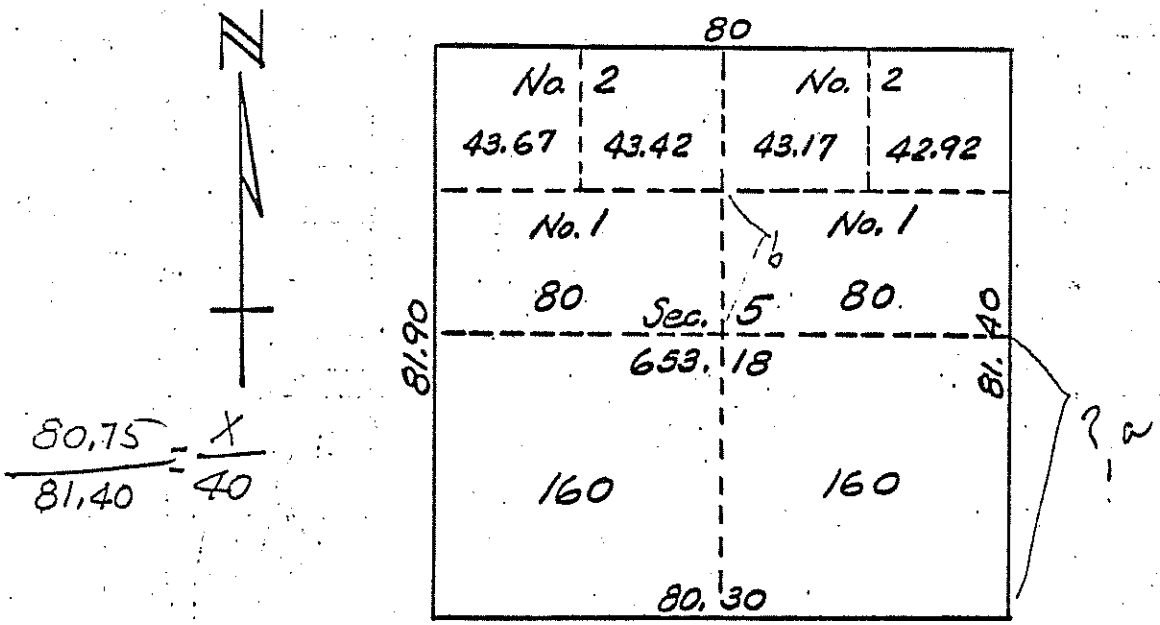
NOTES READ
UP THE PAGE

	Slope Dist.		Rt. Azim. ∠	Mag.
A12				
	(213.00 +05°08')	4'		
	(212.91 +04°52')	3'	1) 45°58'40"	
			2) 96°57'40"	N33°45'E
A11	H.I. 5 16		M) 48°28'50"	
				N12°30'W
	(168.56 +05°51')	4'		
	(168.44 +05°31')	3'	1) 179°49'40"	
			2) 359°40'00"	S2°30'E
A10	H.I. 5 22		M) 179°50'00"	
				N2°00'W
	(281.24 +04°34')	4'		
	(281.18 +04°22')	3'	1) 179°57'00"	
			2) 359°54'00"	S12°00'E
A9	H.I. 5 12		M) 179°57'00"	
				N12°15'W
	(173.47 +07°24')	4'		
	(173.34 +07°04')	3'	1) 163°14'00"	
			2) 326°28'30"	S12° 15'E
A8	H.I. 5 36		M) 163°14'15"	

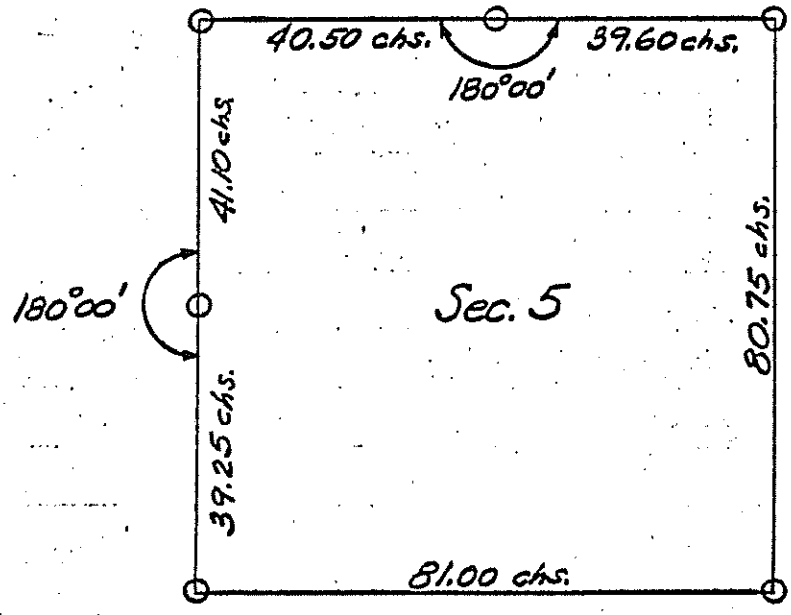


Problem 17 - Wt. 10

Shown below is a copy of a portion of the Map of Township 3 North, Range 9 East, Mount Diablo Base and Meridian, as prepared by the General Land Office in 1883.



Your measurements between original corners are as shown below.



○ Denotes original corner found.

FIG. II-17

Prob. 17 contd on next page

Problem 17 (contd)

You are unable to find the East 1/4 corner or the South 1/4 corner. The field notes of the General Land Office do not include any calls to topographic features, line trees, or other objects along the South line or along the East line of the section.

(a) At what distance do you set the East 1/4 corner from the Southeast corner of the section?

(b) At what distance do you set the Northwest corner of Lot No. 1, in the Northeast 1/4 of the section, from the center 1/4 corner of the section?

Assume the N-S centerline is the average of the East and West lines of the section.

Show your computations, and explain how you determined your answers to both "a" and "b", above.

TENNIES

CALIFORNIA BOARD OF REGISTRATION FOR CIVIL AND PROFESSIONAL ENGINEERS

1963 LAND SURVEYING EXAMINATION

LS PART III LSM

Time Allowed - Four Hours

INSTRUCTIONS TO EXAMINEE:

Part III of this examination consists of [illegible] problems. You are required to work Problems 1, 2, and 3, plus any two of the remaining problems. The grading weight is given with each problem. Part III will be graded on the basis of 50 points.

Work the problems on the grid sheets in the WORKBOOK. Do not put more than one problem on a sheet and use only one side of the paper. If you need more sheets of paper, the proctor will supply them.

ALL WORK TO BE EVALUATED MUST BE IN THE WORKBOOK.

Show your identification number in the space provided on each sheet of your workbook. After you have completed this part of the examination, check to insure that your calculation sheets are arranged in numerical sequence by problem number, and that all of your work is included.

If the meaning of a problem is not clear to you, or if it appears to be incomplete, note such assumptions as you think necessary and proceed with the problem solution.

Acceptable solutions for examination questions must show fundamental formulae and sufficient supporting calculations to enable the examiner to judge your method of solution. Solutions which are not presented in a readable manner may result in reduced grades. Neat long-hand writing will be just as acceptable as printing in discussion-type problems.

You are allowed to use any text or reference book in this part of the examination. At the conclusion of each answer, list those reference books which are used. Where diagrams or tables are used or where constants and formulae are employed, the reference book and page number should be given.

You may keep the examination questions.

Be sure to mark VOID any work you do not wish graded.

Problem 1 - Wt. 14 (Required)

You are to locate Parcel A shown in Figure III-1. The essential parts of the adjoiners are:

> Newlin's deed, dated December 16, 1908, reads, "Commencing at a stone mound marking the Southwesterly corner of Johnson's land; thence South 26½° West, 5280 feet; thence, etc." No other monuments were called for, but the deed did clearly indicate that the basis of bearings was magnetic.
>
> Henderson's deed (1924) reads: "Commencing at a blazed pine tree marking the Northeasterly corner of Smith's land; thence South 80° 21' East to the Westerly line of Newlin's land . . ., etc." No basis of bearings was called for.
>
> Jones' deed reads, "Commencing at USC&GS station 'Black' from which station High Point bears South 85° 27' 33.2" West; thence South 81° 00' 20" East to the Westerly line of the land of Newlin; thence, etc.

Figure III-1 shows the evidence uncovered. List the steps and procedures you would use to locate and survey the direction of the boundary lines of Parcel A?

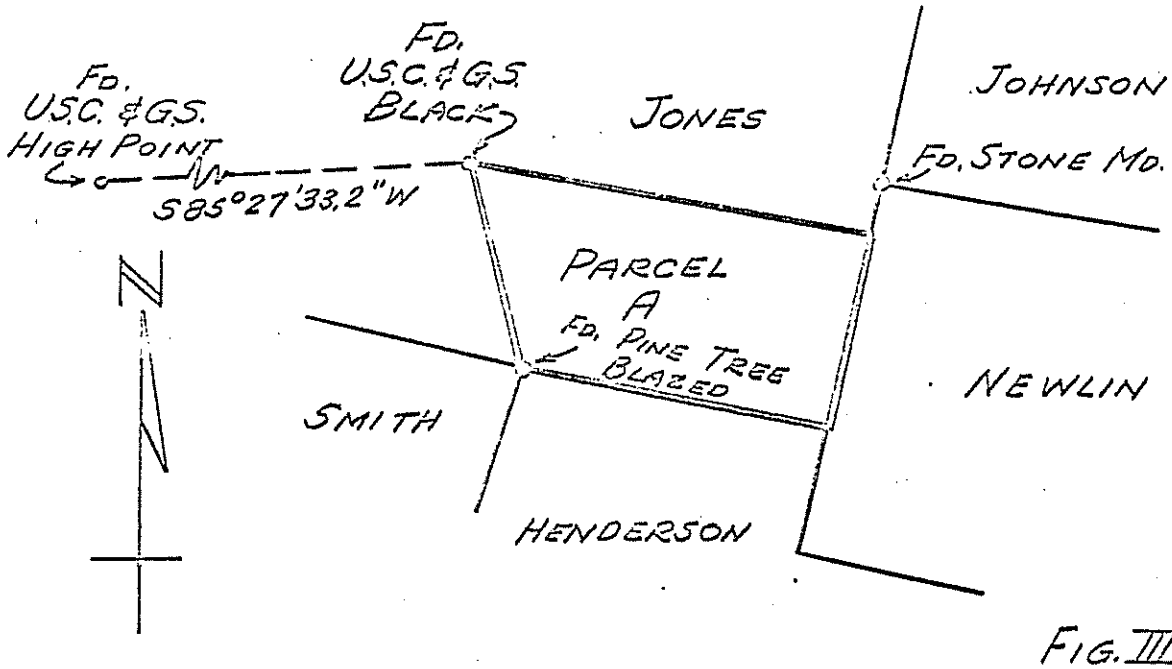


FIG. III-1

Problem 2 - Wt. 6 (Required)

At Point A (latitude 41° 30' N and longitude 121° 00' West in Modoc County) you accurately determine astronomic North. You turn exactly 90° and run out 16,000 feet and set Point B. On the way, you leave temporary points at 4,000, 8,000, and 12,000 feet. What is the bearing of Line BA at Point B relative to astronomic North (nearest second)? How far north would you have to move each point (B and the 3 temporary points) to have a due east west line from Point A? Give answer to nearest 0.01 feet.

Problem 3 - Wt. 10 (Required)

Compute distance AB, bearing of CD, and Δ at C.

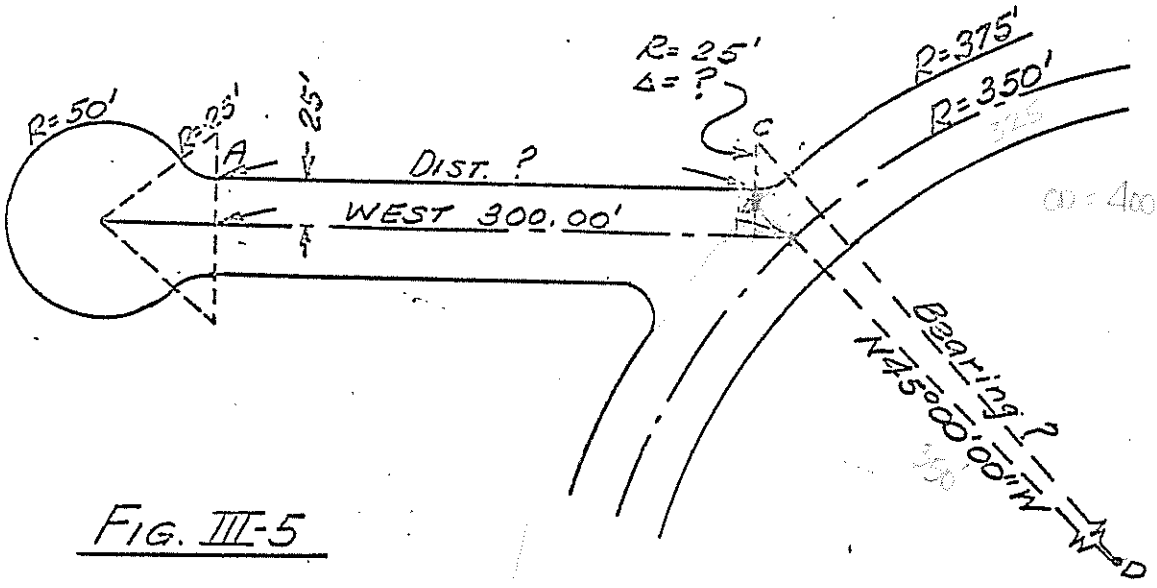


FIG. III-5

INSTRUCTIONS: You are to answer any two problems selected from the following five problems (Problems 4, 5, 6, 7, or 8). Only the first two problems answered will be graded.

Problem 4 - Wt. 10 (Optional)

A steel piano wire is to be stretched across a canyon to determine the distance between points on each side of a dam site. Two marks were made on the wire 1320.00 feet apart. When the wire was measured to scribe the marks, the wire was fully supported at 70°F and stretched by a 10-lb pull. Two feet of wire was left beyond each end mark. The wire weighed 1.779 lbs total weight.

After pulling the wire across the canyon, one end was securely fastened to an immovable object; the other end was run over a pulley and a 22-lb weight attached to the wire.

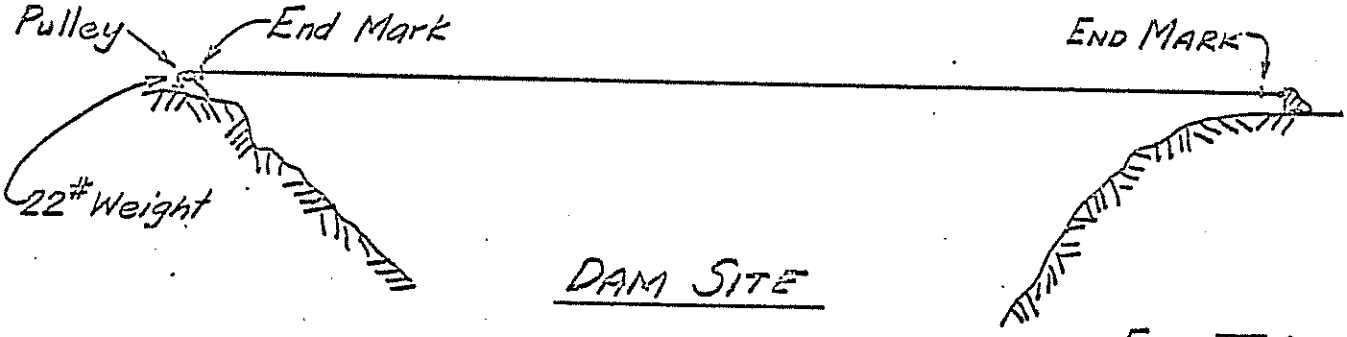


FIG. III-3

Wt.

5 (a) When the temperature is 34°F, what would be the distance between the end marks? (E = 30,000,000 pounds per square inch, and density of steel is 0.2800 pounds per cubic inch.)

5 (b) If the elastic limit of the wire is 110,000 pounds per square inch, what is the maximum weight that can be used to put tension on the wire?

Problem 5 - Wt. 10 (Optional)

At Point A (latitude 32° 50', longitude 116° 49' 20") on 5/14/63 you take the following observations on the sun by turning a horizontal angle clockwise from the sun to Point B. The elevation is 1000 feet, the temperature 68°F, and time was by a watch 02" slow. Each pair below was in opposite quadrants of the cross hairs.

	Horiz. Angle	Vert. Angle	Civil Time
(D	105° 25' 00"	56° 20'	4:02
(D	103° 36' 40"	54° 57'	4:06
(R	102° 26' 20"	53° 45'	4:12:40
(R	102° 43' 40"	53° 41'	4:14:30
(D	101° 06' 00"	52° 00'	4:23:40
(D	99° 47' 10"	50° 57'	4:26:15
(R	98° 48' 20"	50° 23' 30"	4:32:30
(R	99° 08' 40"	49° 19'	4:34:14

What is the bearing of line AB? Express your results to the degree of accuracy that could be expected.

Problem 6 - Wt. 10 (Optional) (Work both sections)

SECTION A - Wt. 5

The distance between points A and B was measured nine times with the following results: 2620.05, 2620.50, 2619.60, 2620.25, 2620.15, 2619.85, 2619.75, 2619.50, 2620.35. Determine the following and express each as a ratio $\frac{1}{?\text{ thousand}}$:

(1) Probable error of a single measurement.

(2) Standard error.

(3) 90% error.

(4) Probable error of the mean.

SECTION B - Wt. 5

What data should be shown on a Record of Survey map?

Problem 7 - Wt. 10 (Optional)

The topographic map in Figure III-7 covers a stereomodel area formed by a Kelsh-type plotter. The manuscript scale is 1" = 50'. The aerial photography was taken with a camera having a focal length of 152.00 mm, but the principal distance setting in the plotter was inadvertently left at 153.54 mm from a previous project. The four corner points (W, X, Y, Z) show the location and values of vertical control points used to level the model. The tracing table was geared to read in feet.

Wt.

5 (a) What is the probable vertical scale of the model? (Assume photography virtually tilt free.)

4 (b) Determine the residual vertical errors at each of the four points, and the distribution of these errors in the leveling solution.

1 (c) Before distribution of the residual errors point A was read as 304.3. By how much would it have appeared in error if its field value had been known?

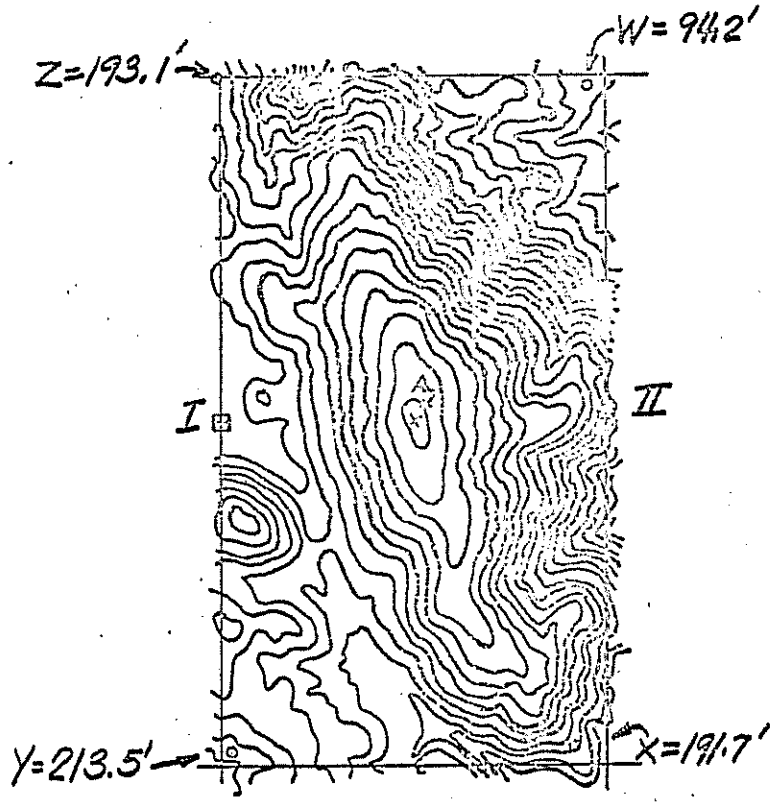


FIG. III-7

Problem 8 - Wt. 10 (Optional)

A photo-control line for reconnaissance mapping was being surveyed by stadia methods, and it became necessary to jump a long distance with a level sight at a target. The notes were as follows:

Stadia Dist. Feet	Angle ° '	Rod Feet	Photo Point	Eleva. Feet	Remarks
			A	3609.8	Photo 1-13
335	−4 24	+ 11.2			
410	+3 17	− 5.3			Left target here 8.4' high
					Level on target from 2.4 miles
275	+2 27	− 4.8			
355	−3 51	+ 8.9			
320	+1 08	− 4.9	B		Photo 1-14

What is the elevation of photo-point B?

Problem 18 - Wt. 5

Wt.

2 (a) If the shutter speed of an aerial camera is set at $\frac{1}{500}$ of a second and the velocity of the airplane is 130 mph, what distance will the camera be moved during the period of one exposure?

3 (b) If the camera in (a) had a 6-inch focal length, and the altitude of the airplane above mean ground was 1650 feet, compute the dimensions on the photograph of the image of a target centered on a survey monument. Target detail is given in the following sketch:

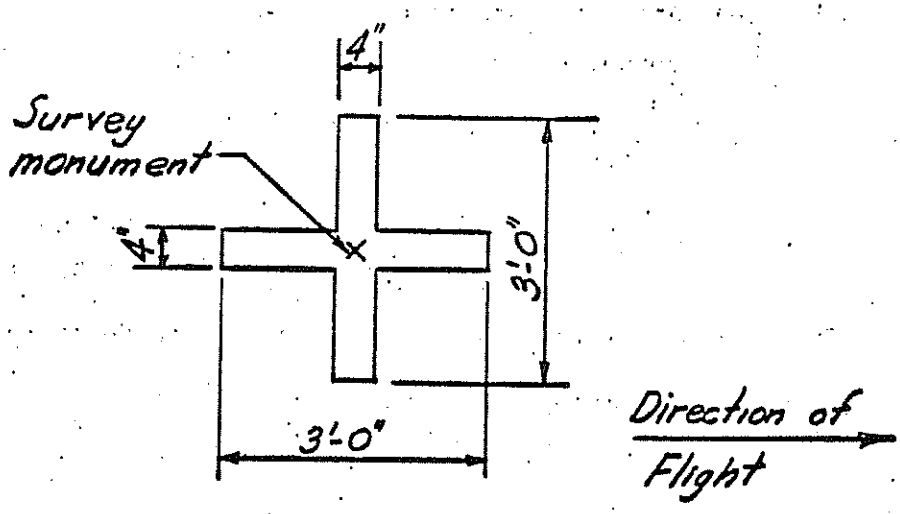


Fig II-18

Problem 19 - Wt. 5

Figure II - 19 represents a photograph which has been reduced from the standard 9" x 9" format size for which the resulting focal length is 3". If the approximate flying height is 4000', which point will exhibit the greater displacement? Plot their displacements on the figure in your workbook, and show calculations.

Prob. 19 contd on next page

Problem 19 (contd)

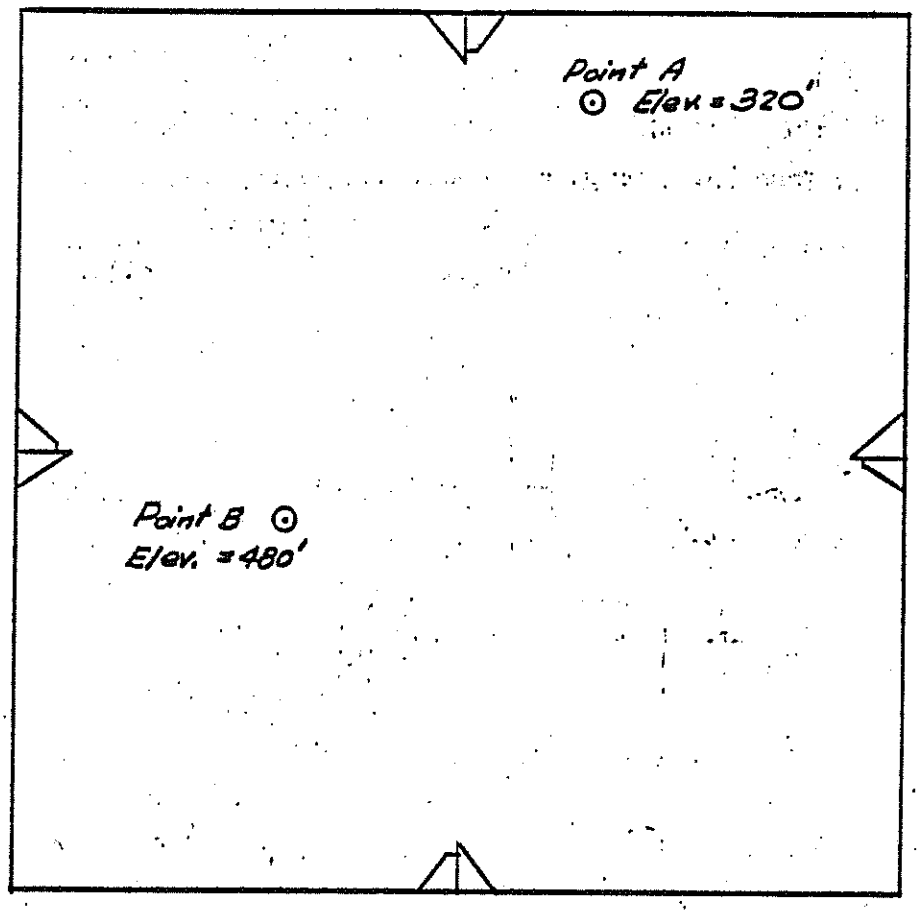


FIGURE II - 19

Problem 20 - Wt. 5

Figure II - 20 represents two photographs oriented on the flight line. The photographs have been reduced from the standard 9" x 9" format size for which the resulting focal length is 3 inches. The ground distance between points "a" and "b" is 1800 feet. Calculate the approximate difference in elevation between the two points, and state which is the higher.

Prob. 20 contd on next page

Problem 20

(contd)

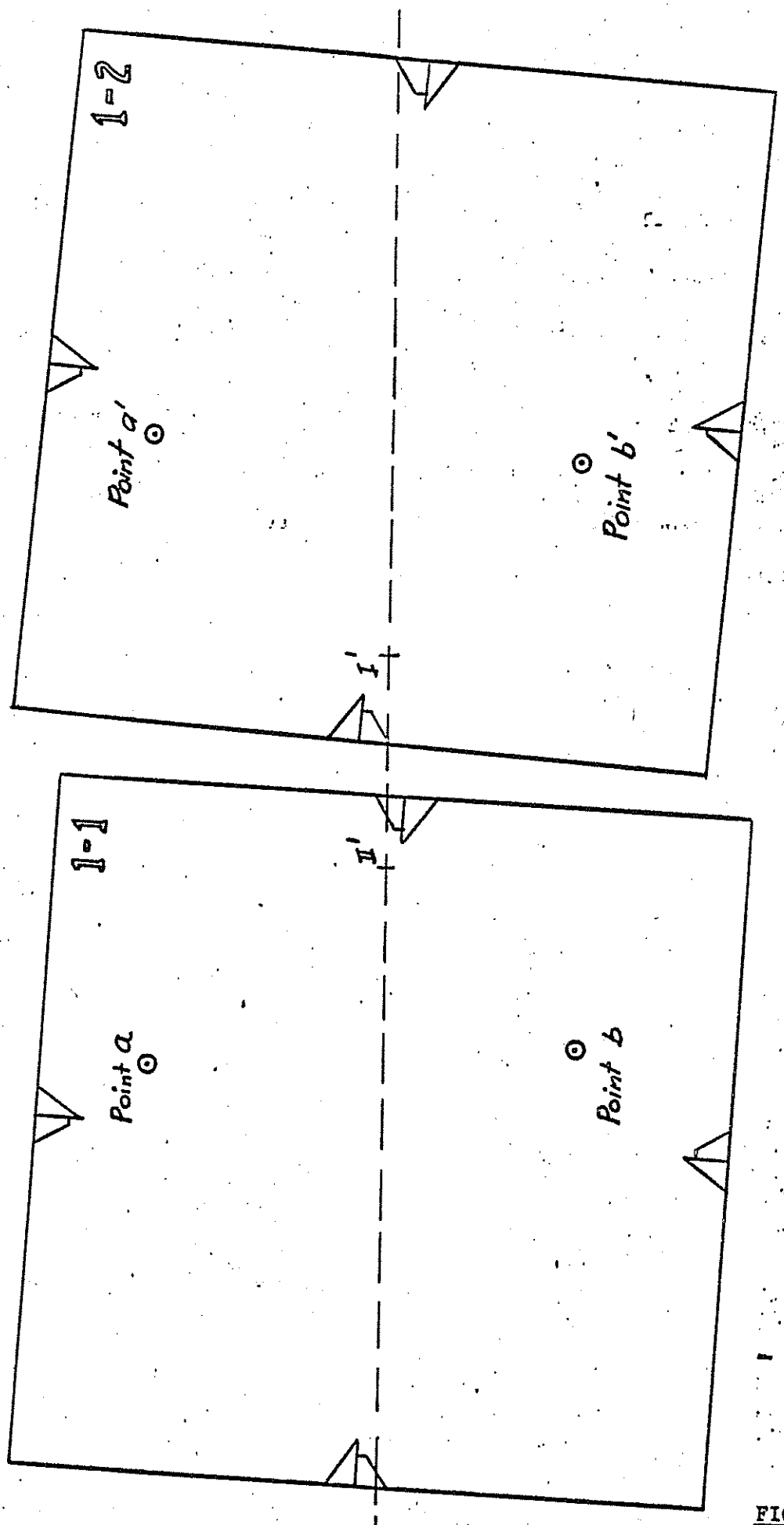


FIGURE II - 20

37. Assume that the magnetic declination in a particular area is 18° East. A surveyor, using a transit having a compass which has no means of setting off the declination, reads the bearing of a course as South 73° 30' West. The bearing, referred to astronomic North, is

(A) South 73° 30' West.

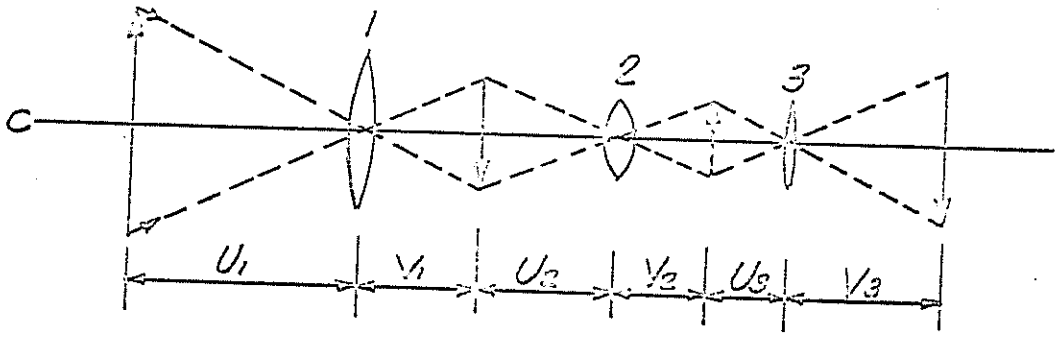
(B) N. 89° 00' W.

(C) South 55° 30' West.

(D) North 88° 30' West.

(E) South 88° 30' West.

38.



The total magnification of the series of lenses centered on the common axis is

(A) $\frac{U_1}{V_1} + \frac{U_2}{V_2} + \frac{U_3}{V_3}$

(B) $f_1 \times f_2 \times f_3$

(C) $m_1 + m_2 + m_3$

(D) $m_1 \times m_2 \times m_3$

(E) $\frac{V_1}{U_1} + \frac{V_2}{U_2} + \frac{V_3}{U_3}$

39. Relief displacement in a vertical photograph is a function of

(A) elevation of point and flying height.

(B) focal length and flying height.

(C) radial distance of point on photo, elevation, and flying height.

(D) radial distance of point on photo, focal length, and flying height.

✓ (E) radial distance on photo, elevation of point, focal length, and flying height.

40. When calibrating the projectors of a Kelsh plotter, it is assumed that the

(A) mechanical axis of rotation is coincident with the optical axis.

(B) lens is distortion-free.

(C) fiducial marks on the plate holders are fixed in the factory.

(D) optical axis is normal to the plane of the plate holder.

(E) cam follower is centered on the cam.

41. The size of the model formed by a Kelsh-type plotter depends essentially on the

✓ (A) scale of photography.

(B) amount of relief in the model.

(C) scale of the manuscript.

(D) base-height ratio.

(E) plotting ratio.

42. The distance measured along the lens axis from the rear nodal point to the plane of best average definition over the entire field used in the aerial camera defines

(A) focal length.

(B) equivalent focal length.

(C) calibrated focal length.

(D) back focal distance.

(E) principal distance.

43. The c-factor is a term used to relate the contour interval to the

(A) projection distance of the plotter.

(B) flight altitude above sea level.

(C) range of relief to be accommodated.

(D) flight altitude above average ground.

(E) flight altitude above lowest ground.

44. The nadir point of an aerial photograph

(A) is located at the intersection of lines formed by connecting opposite fiducial marks.

(B) is the vanishing point of the images of vertical objects.

(C) corresponds to the principal point in a tilted photograph.

(D) is identical with the zenith of the exposure station.

(E) is halfway between the isocenter and the principal point.

45. When plotting a point by means of a double-projection plotter, the position of the point in the model

(A) is transferred to the map sheet by perspective projection.

(B) is transferred to the map sheet by orthographic projection.

(C) depends essentially upon the coordinate grid system used, such as the California Coordinate System.

(D) is essentially influenced by distortion of the camera lens.

(E) is essentially dependent upon the relationship between the horizontal and vertical scale of the model.

46. In the United States, the aerial camera used most often for mapping photography has a

(A) 7" x 9" format and a 6" focal length.

(B) 9" x 9" format and a 210^{mm} focal length.

(C) 15^{cm} x 15^{cm} format and a 153^{mm} focal length.

✓ (D) 9" x 9" format and a 6" focal length.

(E) 9" x 9" format and a 8¼ focal length.

47. Photogrammetrically determined, spot elevations are

✓ (A) more accurate than photogrammetrically determined contours.

(B) less accurate than photogrammetrically determined contours.

(C) about as accurate as photogrammetrically determined contours.

(D) not generally required in flat country.

(E) generally shown on the sides of hills having slopes exceeding 10%.

48. For photogrammetrically prepared maps of open country, having a contour interval of two feet and a horizontal scale of one inch equals fifty feet, it is usually specified that

(A) all contours shall be correct vertically within 0.2 foot.

(B) all contours shall be correct vertically within one foot.

(C) all contours shall be correct vertically within 0.1 foot.

✓ (D) at least 90% of all contours shall be correct vertically within one foot.

(E) all contours shall be 100% accurate.

49. A scale check of a strip of vertical photographs indicates an average scale of 1" = 860'. The photographs will probably be stamped with which one of the following scale ratio:

(A) 1:7500

(B) 1:11000

(C) 1:7200

(D) 1:7000

✓(E) 1:10000

50. In triangulation, reduction to center is necessary

(A) to determine spherical excess.

(B) to determine if the theodolite is directly over the point.

(C) to adjust wild sights.

(D) to compensate for convergence of meridians.

✓(E) when an eccentric station is occupied.

51. Graphical triangulation is most frequently used

(A) in surveys of third order.

(B) in the drafting room.

✓(C) to determine position from quad maps.

(D) in plane table surveys.

(E) in hydrographic surveys.

52. In calculating a traverse, which of the following formulae would you select to compute the departure of the course? Let L equal length of course, B equal bearing of course, and d equal departure of course.

(A) $\cos B = \frac{d}{L}$

(B) $\tan B = \frac{d}{L}$

(C) $\cos B = \frac{L}{d}$

✓(D) $\sin B = \frac{d}{L}$

(E) $\sin B = \frac{L}{d}$

TENNIES

CALIFORNIA BOARD OF REGISTRATION FOR CIVIL AND PROFESSIONAL ENGINEERS

1963 LAND SURVEYING EXAMINATION

L S PART IV P M

Time Allowed - Four Hours

INSTRUCTIONS TO EXAMINEE:

Part IV of this examination consists of five problems. You are required to work Problem 1, plus either one of Problems 2 or 3, plus either one of Problems 4 or 5. The grading weight is given with each problem. Part IV will be graded on the basis of 50 points.

Work the problems on the grid sheets in the WORKBOOK. Do not put more than one problem on a sheet and use only one side of the paper. If you need more sheets of paper, the proctor will supply them.

ALL WORK TO BE EVALUATED MUST BE IN THE WORKBOOK.

Show your identification number in the space provided on each sheet of your workbook. After you have completed this part of the examination, check to insure that your calculation sheets are arranged in numerical sequence by problem number, and that all of your work is included.

If the meaning of a problem is not clear to you, or if it appears to be incomplete, note such assumptions as you think necessary and proceed with the problem solution.

Acceptable solutions for examination questions must show fundamental formulae and sufficient supporting calculations to enable the examiner to judge your method of solution. Solutions which are not presented in a readable manner may result in reduced grades. Neat long-hand writing will be just as acceptable as printing in discussion-type problems.

You are allowed to use any text or reference book in this part of the examination. At the conclusion of each answer, list those reference books which are used. Where diagrams or tables are used or where constants and formulae are employed, the reference book and page number should be given.

You may keep the examination questions.

Be sure to mark VOID any work you do not wish graded.

Problem 1 - Wt. 15 (Required)

Figure IV-1a shows a part of the original township plat. Figure IV-1b shows the results of a resurvey.

What are the bearings and distances of the boundary of the NW ¼ of NW ¼ (Lot 4), Section 6, T. 16 S., R. 7 E.?

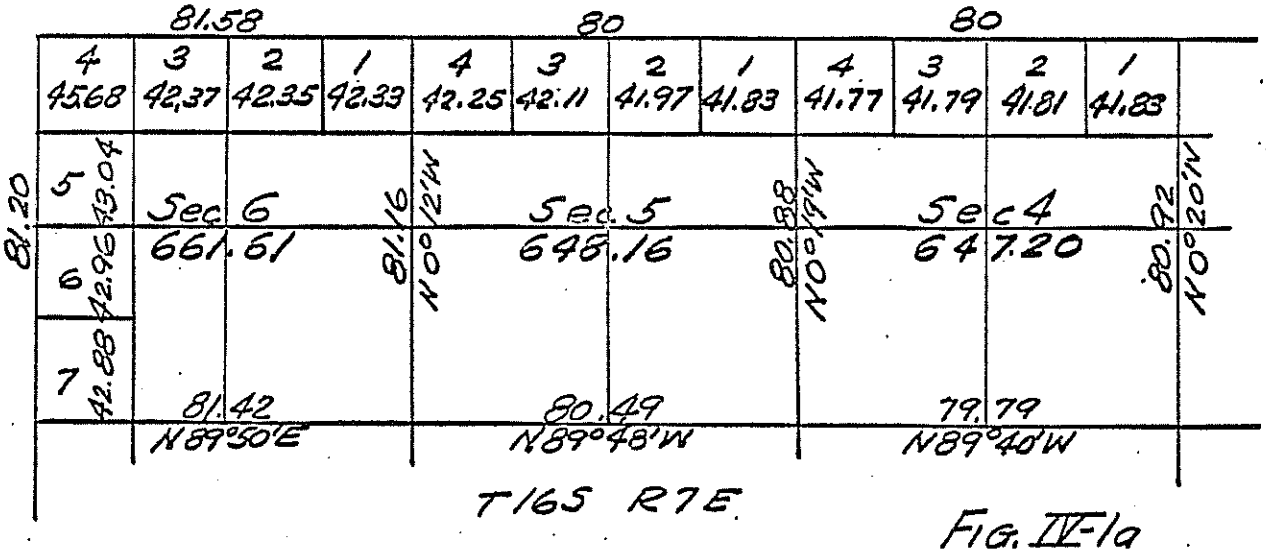


FIG. IV-1a

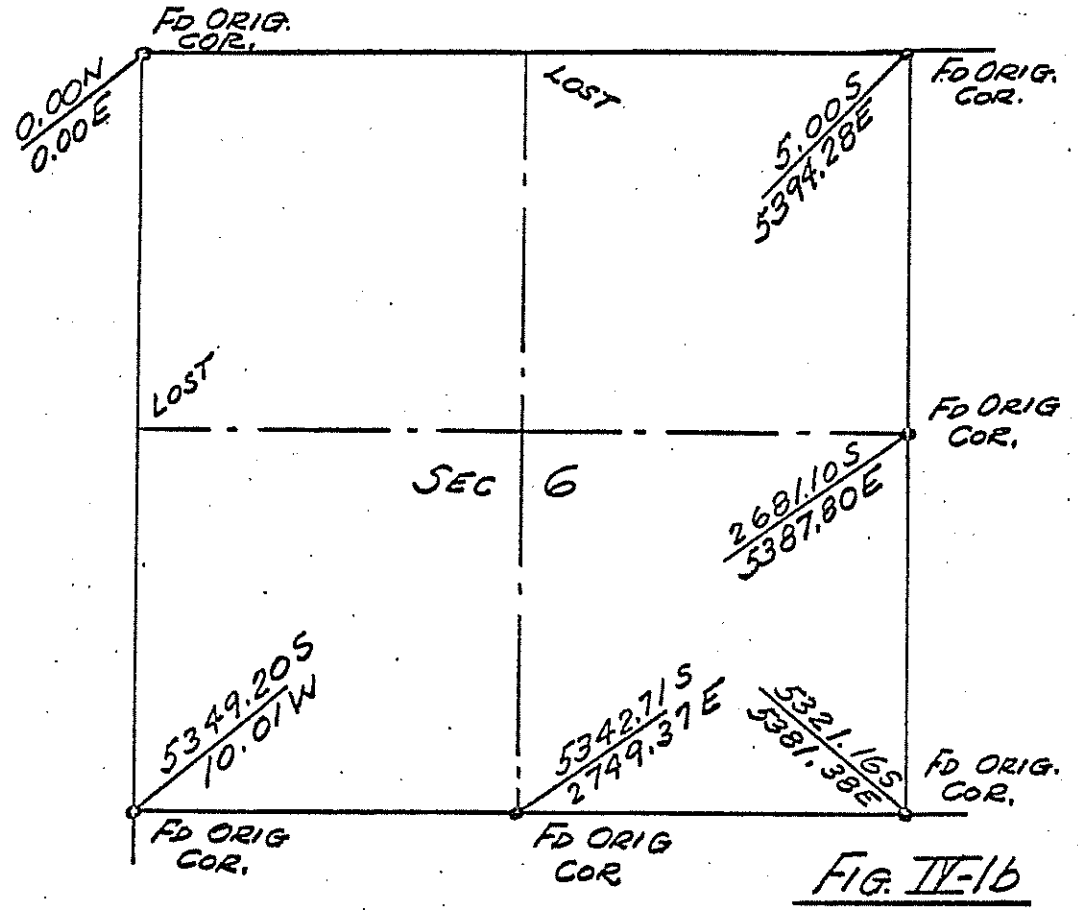


FIG. IV-1b

INSTRUCTIONS: You are to work either Problem 2 or Problem 3. Do not work both.

Problem 2 - Wt. 10

SECTION A - Wt. 5

Given three sides and three angles of triangle A B C. You have set up at point D and measured the angles to A, B, and C. By the principles of Geometry and Trigonometry, prove how you would calculate the length and direction of A D.

A D B (given) is to be called Δ_1; angle A D C is called Δ_2; and angle B D C is called Δ_3. Use the construction lines in your proof.

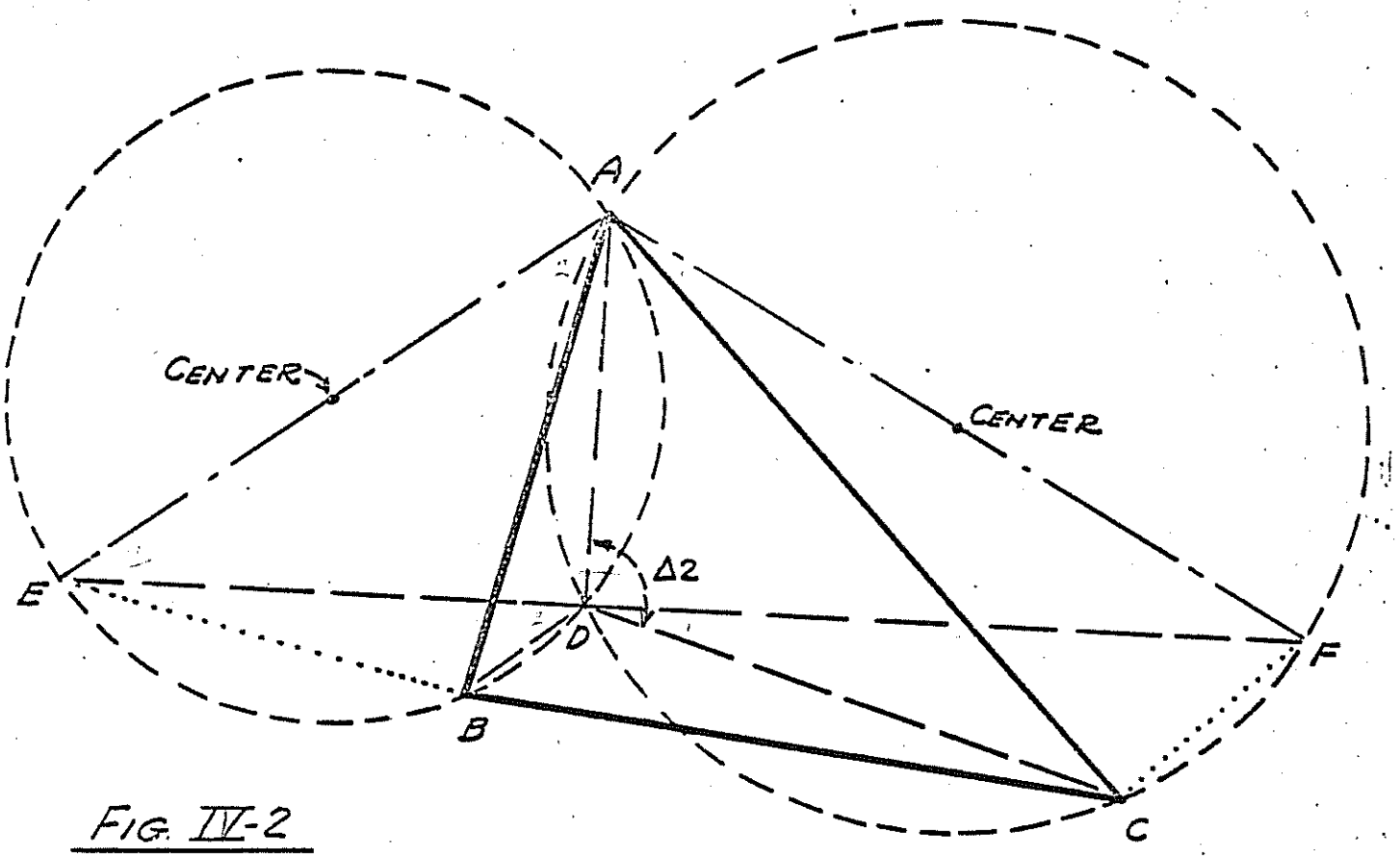


FIG. IV-2

SECTION B - Wt. 5

The elevation of the high point on an island is 82.66 feet above mean sea level. On the mainland 25 miles away is a building whose roof elevation is 100.00 feet. What is the maximum amount of the building that can be seen from the island at elevation 82.66 when the water level is at mean sea level?

INSTRUCTIONS: You are to work either Problem 2 or Problem 3. Do not work both.

Problem 3 - Wt. 10

SECTION A - Wt. 8

When applying the following legal description to the ground some of the calls may be in conflict with other terms of the description. List the terms that might be in conflict with one another, and state which call is controlling. FOR EXAMPLE: If the description wording is, ". . . 200.00 feet to the centerline of Valley Boulevard; thence, etc.", the termination of the 200.00-foot course may not be in the centerline of Valley Boulevard. If it is not, which call is controlling?

(1) All of that parcel of land surveyed by Henry Johnson on 7/16/58 and located in Lot 6, Map 2790, Culver Heights Addition (dated 7/13/21), City of Los Alamos, California, said land being more particularly described as follows:

(2) Beginning at the Southwest corner of Lot 6 as marked by a 3/4" iron pipe and disc stamped LS 5261; (3) thence along the South line of Lot 6 and along Maple Avenue, S. 89° 59' E., 122.03 feet to the Southwest corner of the land conveyed to Helen Angel and recorded in Book 1242, page 1632 of Official Records; (4) thence N. 1° 03' E., along the Westerly line of said Angel's land, 150.02 feet to the Northerly line of Lot 6; (5) thence N. 89° 57' W., 122.03 feet to the Northwesterly corner of Lot 6 as marked by a 3/4" pipe stamped LS 5261; (6) thence S. 1° 03' W., along the Westerly line of Lot 6, a distance of 150.02 feet to the point of beginning.

SECTION B - Wt. 2

What is the intent of the conveyance in Section A above, and can the intent be modified or changed because of discovery of conflicting evidence (measurements, testimony, possession or monuments) on the ground?

INSTRUCTIONS: You are to work either Problem 4 or Problem 5. Do not work both.

Problem 4 - Wt. 25

For the purposes of this problem, assume that you are a licensed surveyor by the name of John Doe (do not use your own name) with a license number the same as your examination identification number. Be sure to put that number on the drawing.

You have surveyed the following parcels for the people indicated:

Parcel 1. The East 200' of Lot 27 of Home Acres, owned by James Jones, acquired 5/14/42, and recorded in Book 2708, Page 16, Official Records.

Parcel 2. The North 100' of the Westerly 100' of Lot 27, Home Acres, owned by Earl Brown, acquired 6/6/45, and recorded in Book 2903, Page 40 of Official Records.

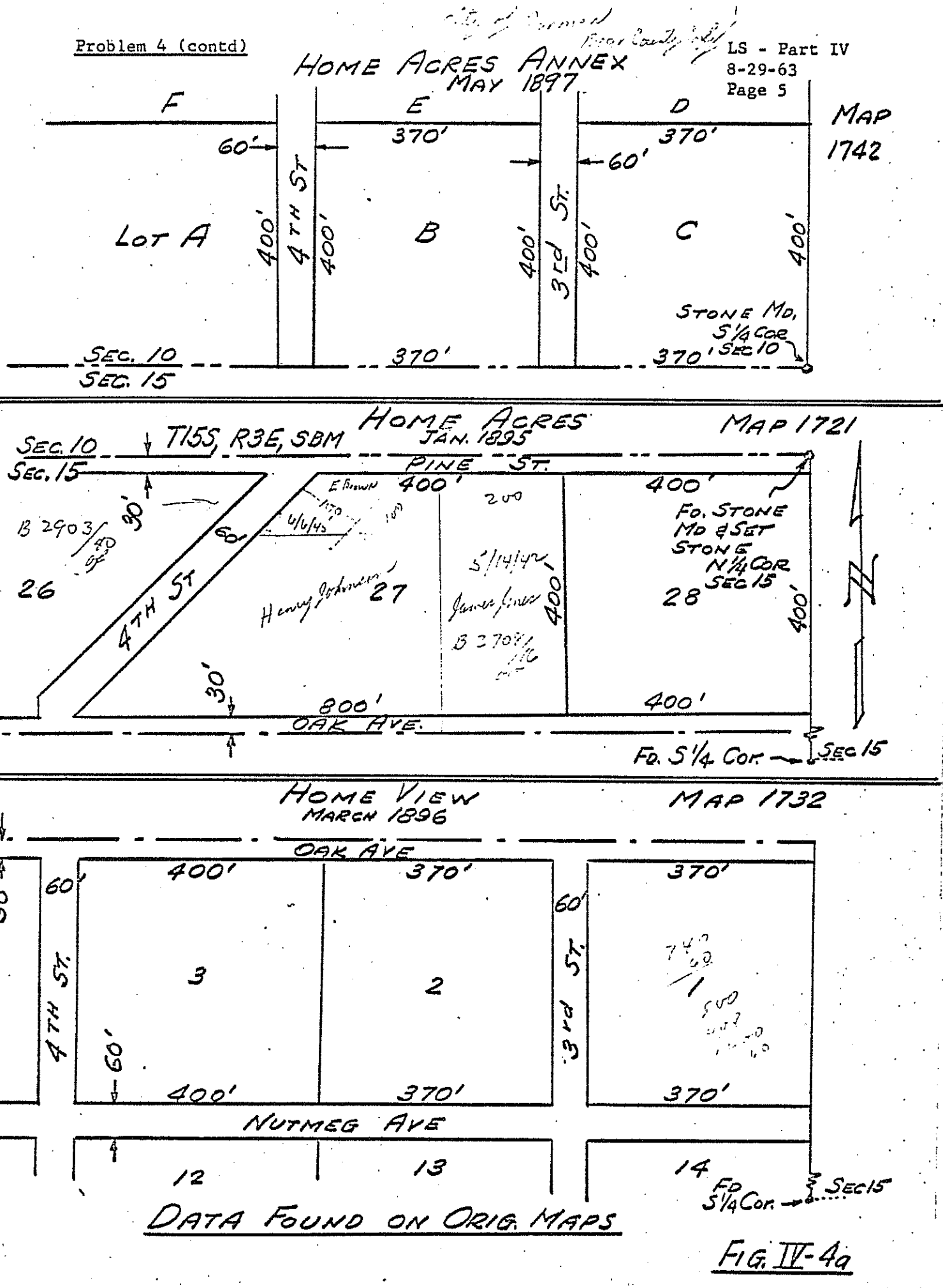
Parcel 3. The remainder of Lot 27, Home Acres, as owned by Henry Johnson.

The land is located in fictitious City of Carmen, Bear County, California.

Figure IV-4a shows the record size of Lot 27, Home Acres, and the adjoining subdivisions.

Figure IV-4b shows the results of research and your retracement of Block 27.

You are to make a drawing, in pencil, on the 18" x 13" sheet furnished (scale 1" = 100') showing the correct location for the above three parcels as you would survey them. Show everything on the sheet that would be required on a drawing presented for recordation. You will be graded on neatness, correctness of showing the position of each parcel, and on compliance with the record of survey law. (While the record of survey law requires an ink drawing on tracing cloth, you are excused from this requirement.) You may leave light weight guide lines on the drawing.



DATA FOUND ON ORIG. MAPS

FIG. IV-4a

Problem 4 (contd)

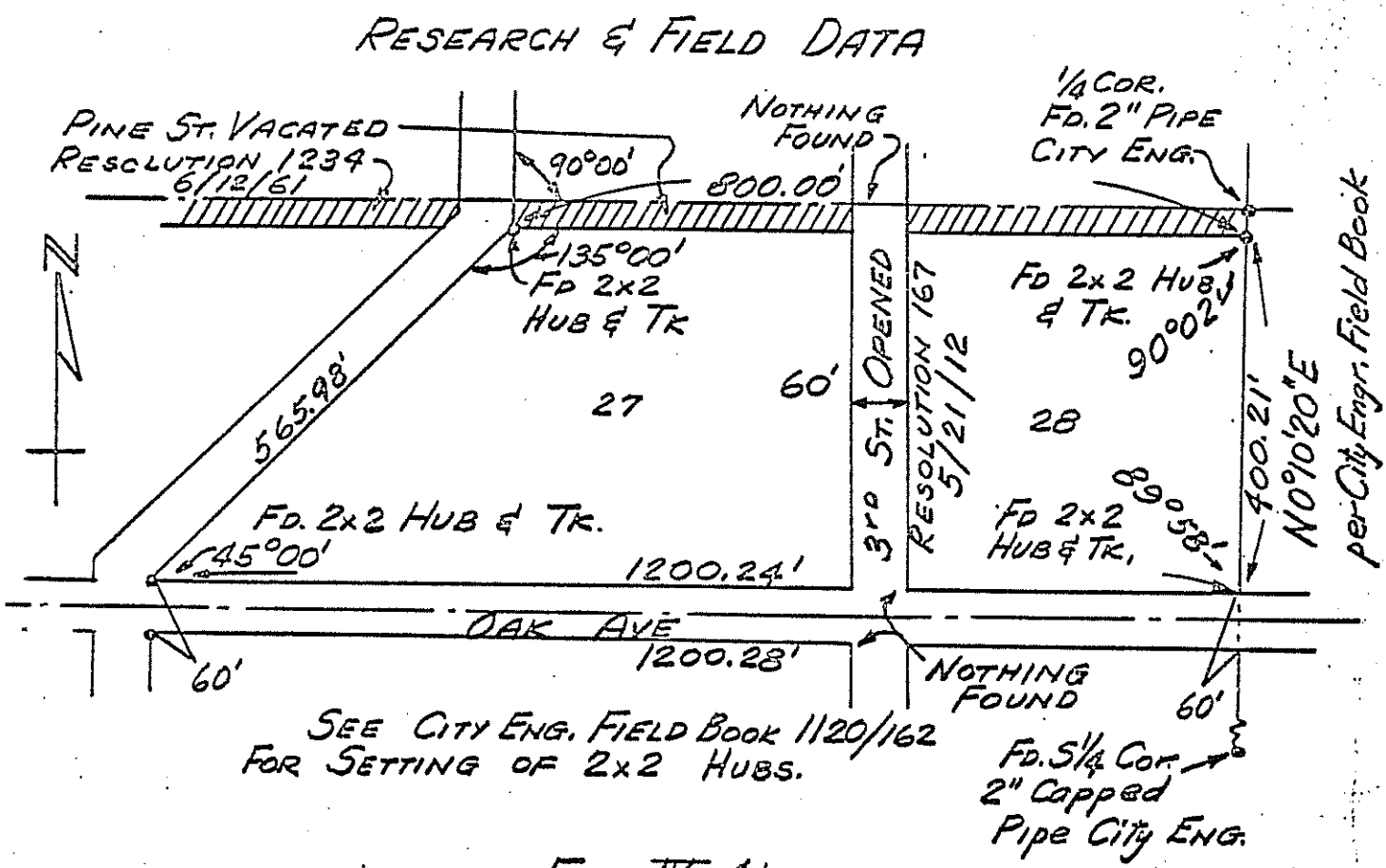


FIG. IV-4b

INSTRUCTIONS: You are to work either Problem 4 or Problem 5. Do not work both.

Problem 5 - Wt. 25

Large scale mapping is required for a highway relocation study as shown on the portion of a 7½-minute quadrangle map. The new maps will be used for location of centerline, design, preliminary earthwork quantities, and estimates of rights of way.

You have been retained to make the survey according to the following specifications:

1. Map scale: 1" = 100'
2. Contour interval: 5' with spot elevations on saddles, tops, benches, and where contours are more than 2" apart at map scale.
3. Accuracy: Refer to National Map Accuracy Standards (Federal Board of Surveys and Maps, Bureau of the Budget), with the additional requirement that all spot elevations shall be correct within 1.0 foot.
4. Planning C-factor shall not exceed 600.
5. Horizontal datum: California Coordinate System.
6. Vertical datum: 1929 Sea Level Datum.
7. Found section corners shall be located on maps in their correct map positions.

You have available a standard Kelsh Plotter with 1:5 plotting ratio, an electronic distance measuring instrument, theodolite, and related field equipment. You will have to order photography from a qualified aerial photographer.

REQUIRED

Wt.

12 (a) Prepare a flight plan, and draw flight lines on the quad map with their respective altitudes.

Show calculations, and specify camera type to be used and flight tolerances.

Prob. 5 contd on next page

Problem 5 (contd)

REQUIRED (contd)

Wt.		
2	(b)	How many models would you expect to set?
2	(c)	How many horizontal and how many vertical photo-control points per model would you recommend?
2	(d)	To what accuracy should the horizontal photo-control and the vertical photo-control be?
2	(e)	Briefly state National Map Accuracy Standards.
2	(f)	Describe how you would locate the found corners on the maps.
3	(g)	If you made an electronic distance determination between CANE and BM 721, and reduced it to a horizontal distance of 8103.37 feet at BM 721, what would it measure on the California Coordinate System?

Prob. 5 contd on next page

Problem 5 (contd)