CALIFORNIA BOARD OF REGISTRATION FOR CIVIL AND PROFESSIONAL ENGINEERS

1962 LAND SURVEYING EXAMINATION

LS PART I AM

Time Allowed - Four Hours

INSTRUCTIONS TO EXAMINEE:

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ALL WORK TO BE EVALUATED MUST BE IN THE WORKBOOK. The answers to the multiple choice Problems 1 through 5 should be shown on the Answer Sheet provided in your workbook (Page 1). For ALL OTHER PROBLEMS, your work should be shown on the grid sheets in your 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.

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

You may keep the examination questions.

SHOW YOUR WORK IN THE WORKBOOK

DIRECTIONS: Indicate the one answer of your choice for each of the Problems 1 through 5 by showing the letter A, B, C, D, or E in the space provided on the answer sheet in your workbook. You may use any available space for computations. Only the answer shown on your answer sheet will be graded.

Problem 1 - Wt. 2

The cosine of an angle is minus in the

(A) first quadrant.

(B) second and fourth quadrant.

(C) second and third quadrant.

(D) second, third, and fourth quadrant.

(E) fourth quadrant.

Problem 2 - Wt. 2

$\text{Log}_{10} P (a + b)^n$ is equal to

(A) $\log_{10} P + n \log_{10} (a + b)$

(B) $n \log_{10} P + \log_{10} (a + b)$

(C) $n\left[\log_{10} P + \log_{10} (a + b)\right]$

(D) $n \log_{10} P - n \log_{10} (a + b)$

(E) $n \log_{10} P (a + b)$

Problem 3 - Wt. 2

Centrifugal force is a function of

(A) angular velocity, mass, moment of inertia, and radius.

(B) angular velocity, mass, and radius.

(C) mass and radius of curvature.

(D) speed, moment of inertia, gravity, and momentum.

(E) angular velocity and polar moment of inertia.

Problem 4 - Wt. 2

In order to determine the relative humidity of a sample of air, the easiest way to proceed would be to

(A) measure the wet bulb and dry bulb temperatures and divide the smaller value by the larger.

(B) measure the wet bulb and dry bulb temperatures and use a Mollier chart.

(C) measure the barometric pressure and use a psychrometric chart.

(D) measure the barometric pressure and dry bulb temperature and divide the smaller value by the larger.

(E) measure the wet bulb and dry bulb temperatures and use a psychrometric chart.

Problem 5 - Wt. 2

If a telescope is constructed with a convex lens for the eyepiece and a convex lens for the objective,

(A) the image will appear right side up.

(B) the magnifying power can be determined by dividing the focal length of the objective by the focal length of the eyepiece.

(C) the magnifying power can be determined by dividing the objective lens diameter by the eyepiece lens diameter.

(D) the field will increase as the diameter of the objective lens is increased.

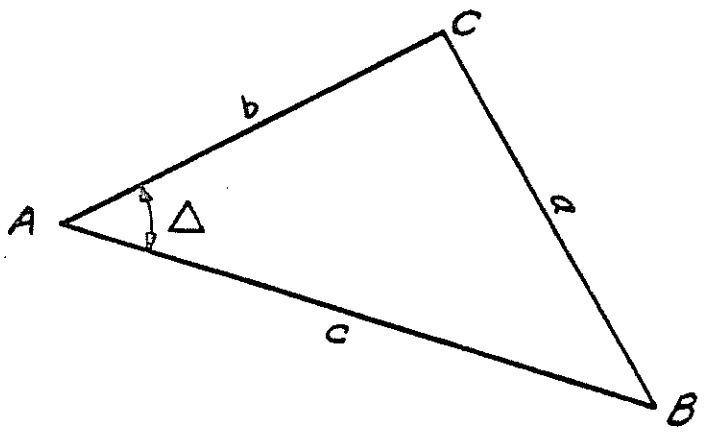
(E) the field will decrease as the diameter of the objective lens is increased.

Problem 6 - Wt. 2

The closure on a level circuit two miles long was 0.70 feet, with an average length of sight of 200 feet.

On a rerun of the same circuit under identical conditions, except that the average length of sight was reduced to 100 feet, what would be the probable error of closure?

Problem 7 - Wt. 2



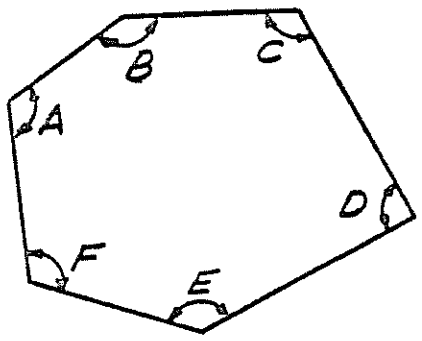
In the solution of a triangle with three known sides, the following may be used for solving the angles:

(a) $\sin \frac{1}{2}\Delta = \sqrt{\frac{(s-b)(s-c)}{bc}}$

(b) $\cos \frac{1}{2}\Delta = \sqrt{\frac{s(s-a)}{bc}}$

What are the limitation and disadvantage of each of the above formula?

Problem 8 - Wt. 2



Present proof by geometry that "the sum of the interior angles of a polygon equals the number of sides multiplied by 180° less 360°."

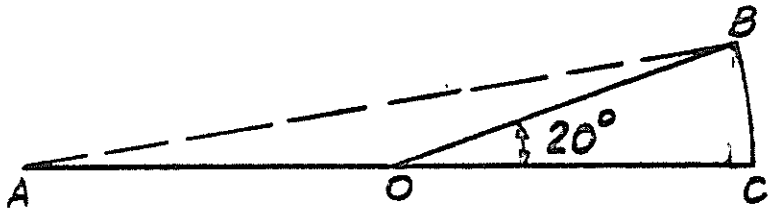
$$(A + B + C + D + E + F = 6 \times 180° - 360°)$$

Problem 9 - Wt. 4

A surveyor runs a line AC = 380 feet, with the center O at the midpoint of AC, he lays out a curve CB having a central angle of 20°.

(a) What is the distance AB?

(b) What is the length of the curve CB?



Problem 10 - Wt. 5

(a) What type of curve is normally used as the vertical curve at the change of grade of a highway? What is the mathematical equation for this curve?

(b) What is the purpose of a spiral transition curve in a highway alignment?

(c) What is the difference between accuracy and precision as applied to measurements?

(d) In measuring horizontal angles, what is the fundamental difference in procedure with a repeating instrument and a direction instrument?

(e) Why are the angles doubled in an ordinary deflection angle traverse?

Problem 11 - Wt. 4

Compared to the error in measurement due to a 0.01 foot error in the length of an ordinary 100-foot steel tape, would the error due to the following causes be approximately the same amount, more, or less? (Answer each part.)

(a) One end of the tape is held one foot higher than the other end.

(b) One end of the tape is 1½ feet off line.

(c) Average temperature of the tape is 30°F off standard.

(d) Tension used is 5 pounds off standard.

Problem 12 - Wt. 5

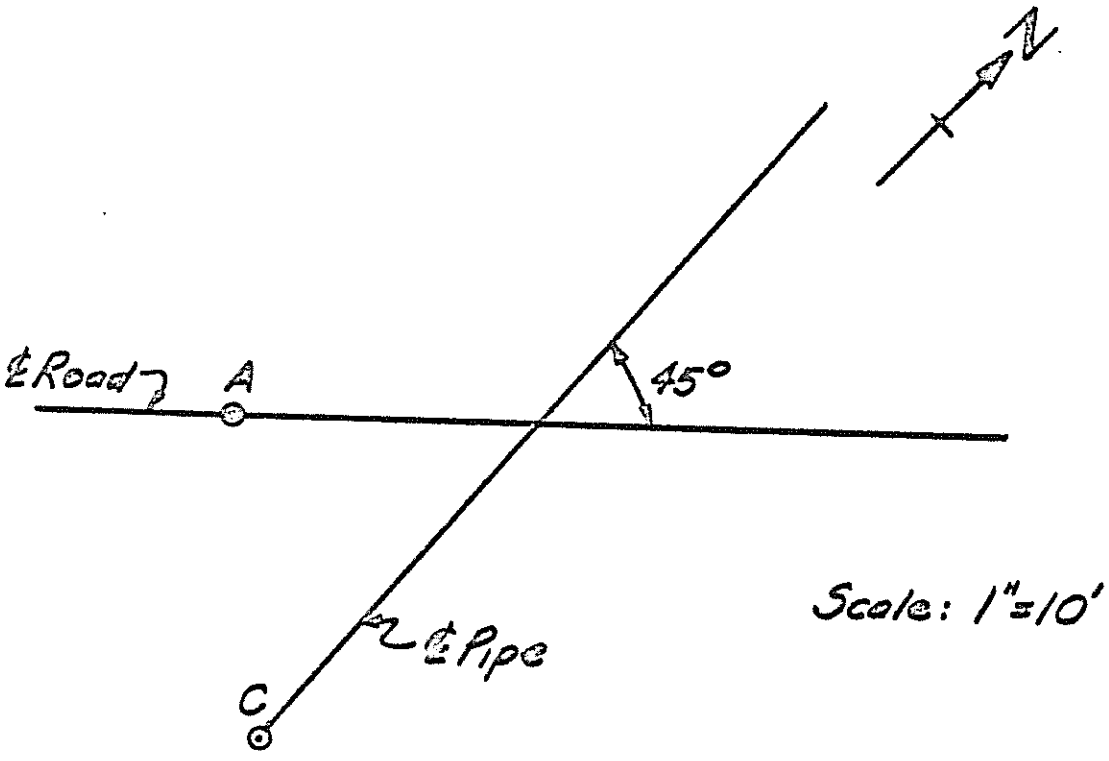
Shown below is an enlarged view of a portion of the plan view of a roadway centerline, with a pipe passing under the roadway.

The road grade is + 5% from A to the northeast

The pipe grade is - 20% from C to the north

The elevation of A is 120 feet and the elevation of C is 116 feet.

Draw the figure in your workbook, and graphically determine the vertical distance from the road centerline to the pipe centerline.



Problem 14 - Pt. 4

The following statements are either true or false. If they are true, so state; and if they are false, give the correct statement.

(a) Sound travels faster in a solid than in a fluid, such as air.

(b) When light passes from a less dense medium to a more dense medium, the angle of refraction is always less than the angle of incidence.

(c) If the intensity of an electric light signal is not sufficient, and an extra electric battery is available, the second battery should be connected in parallel with the first battery.

(d) In order to charge a storage battery, the positive terminal of the generator is connected to the positive terminal of the battery, and the negative terminal of the generator is connected to the negative terminal of the battery.

Problem 15 - Wt. 8

The following statements are either true or false. If they are true, so state; and if they are false, give the correct statement.

(a) In the California State Coordinate System, the mapping angle for any position of longitude is always more than the difference in longitude between this position and the central meridian.

(b) To reduce a California State Coordinate grid length of a line to ground length, the approximate average elevation and approximate average longitude of the line must be known.

(c) In barometric leveling, it is customary to use at least one barometer for control and at least one roving barometer.

(d) The geodimeter converts time of travel of radio-frequency signals between two points into distance between the two points.

(e) The accuracy of measurements with the tellurometer or electrotape depends on the distance measured.

(f) It is legal for any engineer registered in California to practice land surveying.

(g) Unlike the measurement of distance with stadia, in the subtense-bar method the horizontal distance is always obtained directly, even though an inclined line of sight is taken.

(h) The purpose in using reciprocal leveling to cross a canyon is to compensate for curvature and refraction as well as instrumental error.

Markham

CALIFORNIA BOARD OF REGISTRATION FOR CIVIL AND PROFESSIONAL ENGINEERS

1982 LAND SURVEYING EXAMINATION

LS PART II PM

Time Allowed - Four Hours

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SHOW YOUR WORK IN THE WORKBOOK

Problem 1 - Wt. 3

The following questions are with reference to the telescope of a surveying instrument:

(a) What is a reticule?

(b) Why do some eyepiece assemblies have four lenses rather than two?

(c) What is the purpose in using an achromatic doublet?

(d) Where are these achromatic lenses used?

(e) How is an achromatic lens constructed?

(f) Are the stationary lenses in the eyepiece concave or convex?

Problem 2 - Wt. 3

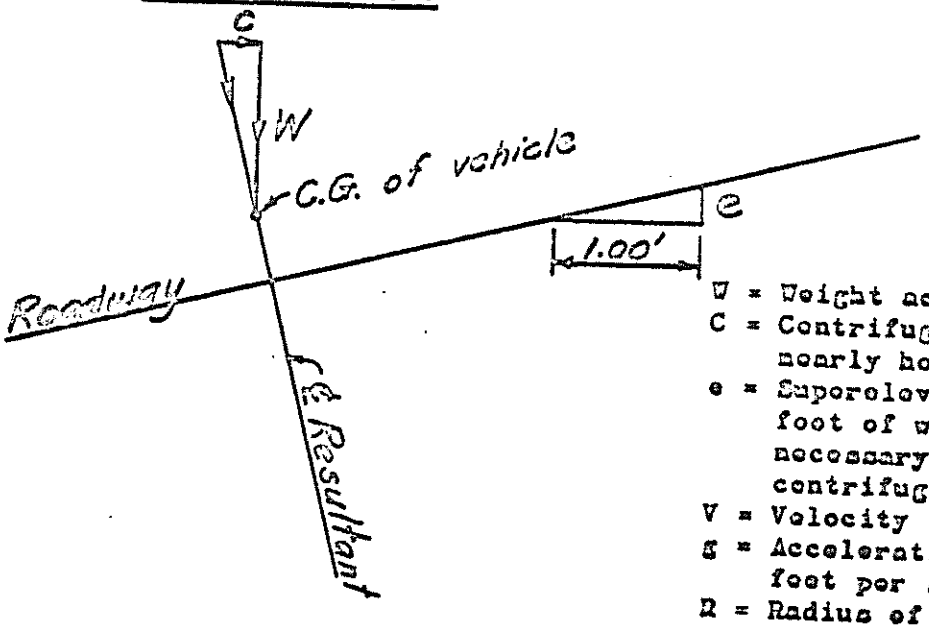
The sensitivity of the level vial on an engineer's level is 20 seconds per 0.01 foot division.

(a) What is the radius of curvature of the vial in feet?

(b) If the bubble in this level vial is 2 divisions off center when a rod reading is taken on a rod 300 feet from the level, what error in reading will result?

(c) Would a 30-second bubble be more or less sensitive than this 20-second bubble?

Problem 3 - Wt. 6



W = Weight acting vertically.
C = Centrifugal force acting nearly horizontally.
e = Superelevation in feet per foot of width of roadway, necessary to balance centrifugal force.
V = Velocity in feet per second.
g = Acceleration of gravity in feet per second per second.
R = Radius of curve in feet.

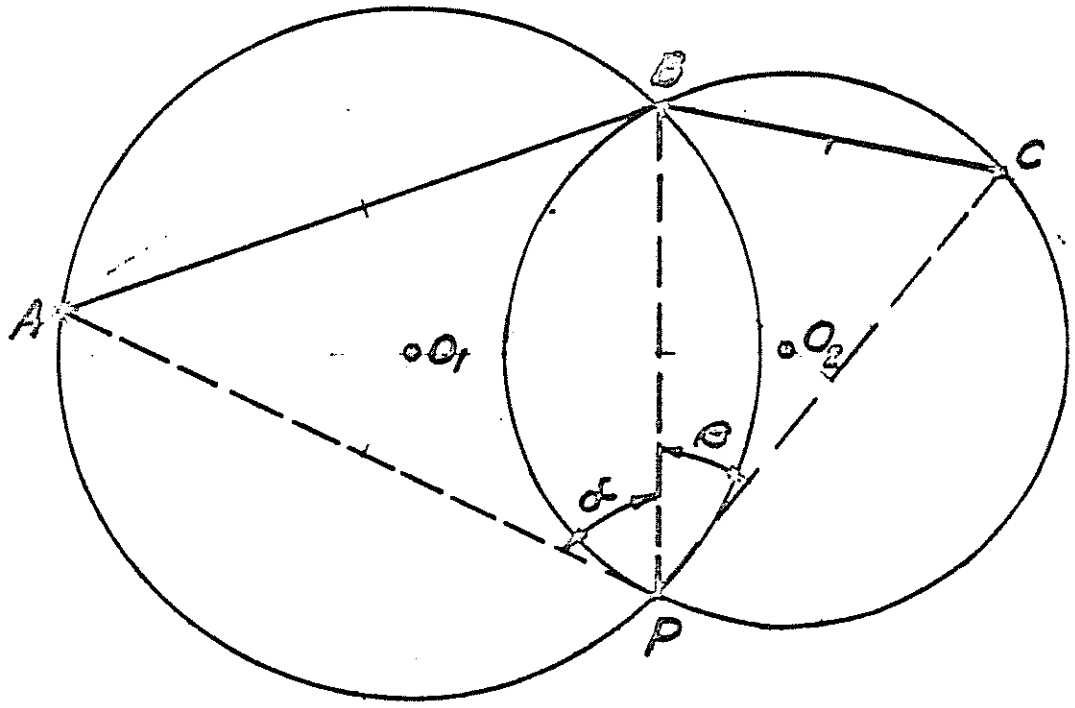
(a) If $C = \frac{WV^2}{gR}$ (approximately)

derive an equation for e (approx.) in terms of velocity in miles per hour and radius of curve in feet.

Reduce the equation to its simplest terms.

(b) What superelevation would be required to balance centrifugal force on a 1000-foot radius curve in a roadway designed for 60 miles per hour speed of travel?

Problem 4 - Wt. 6



Sighting fixed points A, B, and C from an unknown position P, angles α and β are observed.

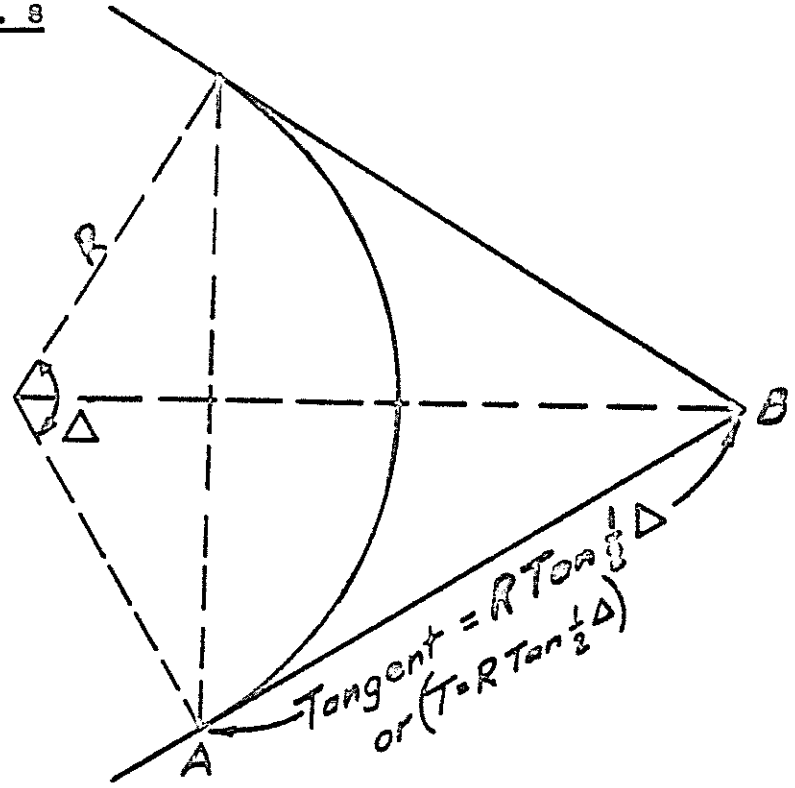
If A, B, and C are plotted in their correct relative positions and two arcs with chords AB and BC are properly constructed, the correct plotted position of P will be at the intersection of the two arcs.

How are the two centers O_1 and O_2 located?

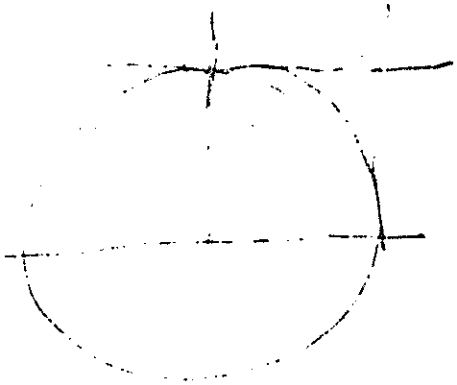
Show by sketch and trigonometric equations.

State any geometrical theorems used.

Problem 5 - Wt. 8



The above figure represents a circular curve of given Radius "R" and central angle of "Δ". The value of "Δ" in radians is "Q". For each of the following formula, illustrate on a similar figure (in the workbook) where it is applicable, and state its common name (if it has one). For example, the formula "R tan 1/2Δ" is commonly known as the "tangent". Along line AB would be written "tangent (T = R tan 1/2Δ)" and arrows would be drawn to indicate the limits of the tangent as illustrated.



(a) $2 R \sin \frac{1}{2}\Delta$

(b) $R \operatorname{Vers} \frac{1}{2}\Delta$

(c) QR

(d) $R \operatorname{Exsec} \frac{1}{2}\Delta$

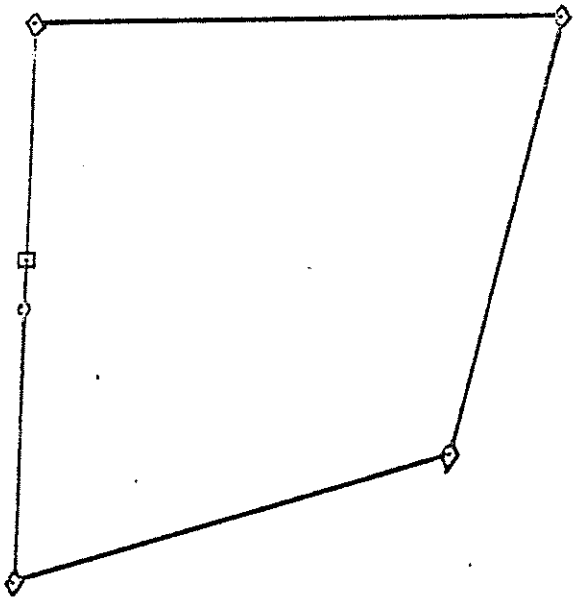
(e) $2 \pi R \frac{\Delta}{360°}$

(f) $\frac{1}{2} LR$

(g) $R\left(\frac{2T - L}{2}\right)$

(h) $\frac{R^2}{2}(Q - \sin\Delta)$

Problem 6 - Wt. 14



In retracing the exterior boundaries of a regular interior section (80 chains record length of each side) in preparation for subdivision of the section, all four original section corners were found. The west quarter corner was found on line between the NW and SW corners, but 500 feet north of its theoretical position. No other quarter corners were found.

All found corners were tied into the California State Coordinate System with the following results:

Corner	Y	X
NW corner	305,102.67	1,450,047.72
NE corner	305,297.33	1,455,552.28
SE corner	300,702.67	1,454,447.72
SW corner	299,297.33	1,449,052.28
W¼ corner	302,700.00	1,450,000.00

(a) Using methods of analytical geometry, calculate the coordinates of the center of the section.

(b) From the coordinates of the four section corners only, determine the grid area of this section.

(c) If the scale factor is 0.999967 and the reduction to sea level factor is 0.999928, what is the ground area of this section?

NOTE: Calculate areas to nearest .01 acre.

Problem 7 - Wt. 3

A vertical aerial photograph is taken with a 6.00-inch focal length camera from a height of 5650 feet above sea level. Two points of equal elevation of 850 feet above sea level appear on the photograph at a distance of 2.02 inches apart.

(a) What is the scale of the photograph at these points?

(b) What is the ground distance in feet between these two points?

Problem 8 - Wt. 3

The image of a ground point on a vertical aerial photograph may be displaced due to ground relief. How does this displacement vary with:

(a) the distance of the point from the principal point of the photograph?

(b) change in elevation of the point?

(c) change in flying height?

Problem 9 - Wt. 4

In measuring distance between points A and B with a tellurometer,

(a) what measurement is made and indicated on the master unit?

(b) what other data is necessary to obtain a geodetic distance between A and B, and how is this data secured?

Type Exam

CALIFORNIA BOARD OF REGISTRATION FOR CIVIL AND PROFESSIONAL ENGINEERS

1982 LAND SURVEYING EXAMINATION

LS PART III AM

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CHECK YOUR WORK IN THE WORKBOOK

Problem 1 - Wt. 18

From Lot 7 (Map 213) as shown on Page 2, the following parcels were sold:

(1) The North 1/2 of Lot 7,

(2) The Easterly 100 feet of the South 1/2 of Lot 7 (672/32 Official Records on 6/5/40).

From Lot 6 (Map 811) as shown on Page 2, the following parcels were sold:

(1) Everything south of the north line of Horne Street.

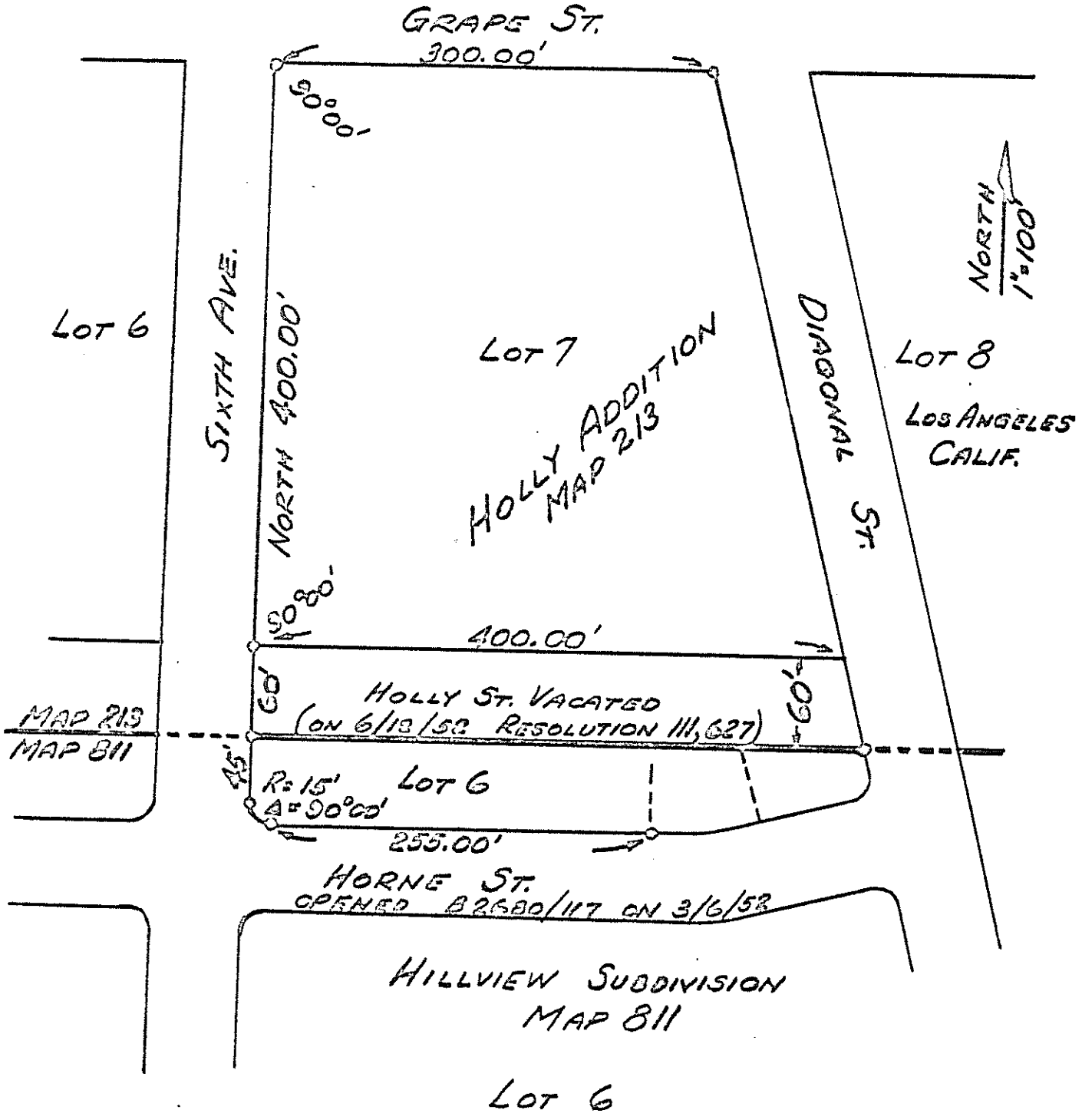
(2) Lot 6, except the westerly 200 feet (4/2/52, 2680/228 Official Records).

The small circles represent found original positions, and the dimensions are both record and measured.

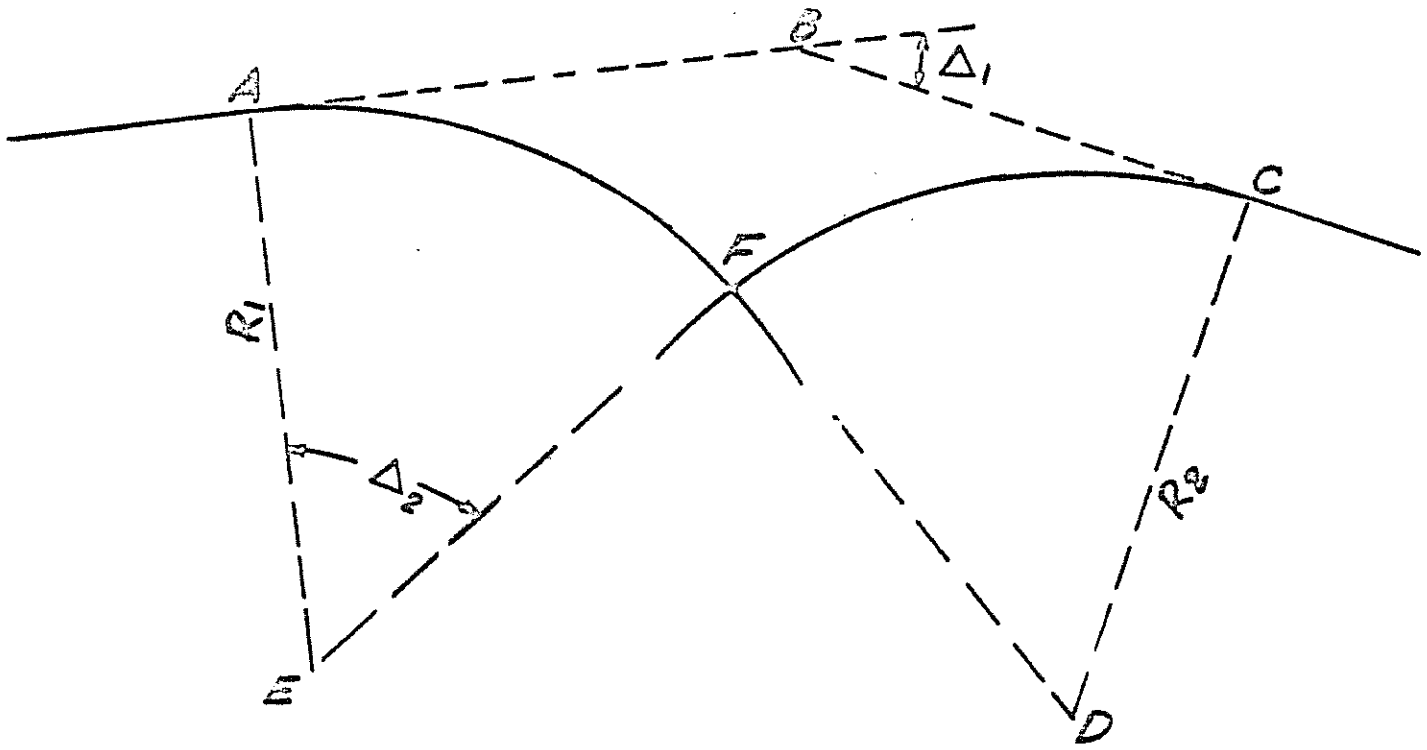
Write a perimeter description of the remaining land between Horne Street, Grape Street, Sixth Avenue, and Diagonal Street. Give the correct bearing and distance on every line along with any other calls you deem necessary. Since insufficient data is given, you will assume necessary facts not in evidence.

Prob. 1 contd on next page

Problem 1 (contd)



Problem 2 - Wt. 5



GIVEN:

R_1 and R_2, distances AB and BC, and angle Δ_1.

REQUIRED:

How would you determine Δ_2?

Problem 3 - Wt. 5

The following parcels of land were all conveyed by Moore (an absentee owner who had not looked at the property for 15 years) to the following parties as follows:

To Inyo County on 5/13/48 for road purposes only: The Westerly 30 feet of Lot 11 according to map . . .

To Smith on 5/28/52: The Westerly 200 feet of the Southerly 200 feet of Lot 11 according to map . . .

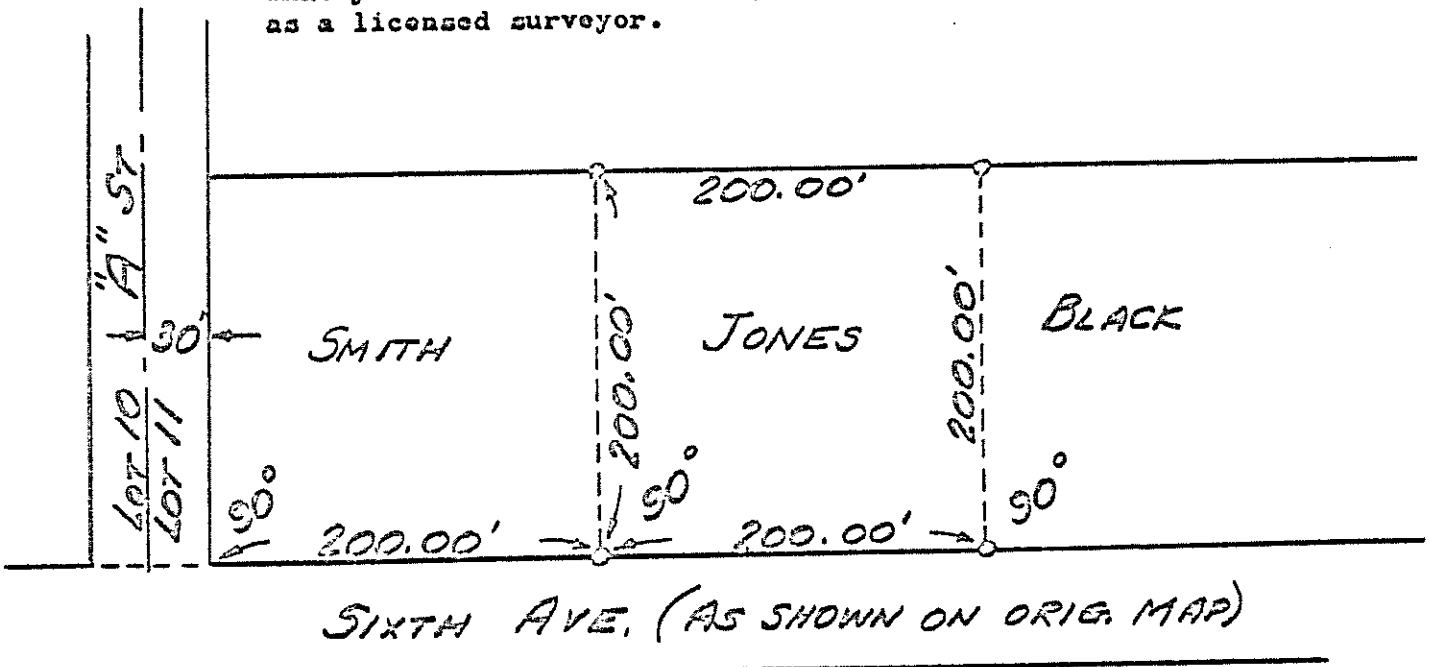
To Black on 8/27/56: The Easterly 200 feet of the Westerly 600 feet of the Southerly 200 feet of Lot 11 according to . . .

To Jones on 6/15/54 the following: All that portion of Lot 11 as surveyed and marked by Surveyor Johnson with 3/4" iron pipes and tags stamped LS 6027 and described as follows:

The Easterly 200 feet of the Westerly 400 feet of the Southerly 200 feet of Lot 11 in accordance with map . . .

You are to locate Black's land and you discover the 3/4" pipes with tags as described in Jones deed and as shown above. Witnesses testify that they saw Johnson set them.

Assuming that the facts as stated are correct, state what you would do and where you would set your monuments as a licensed surveyor.



Problem 4 - Wt. 6

You have turned 90° from a given line and have measured 2,500 feet with a 100 foot tape, and have set a point. In analyzing your errors, you have come to the conclusion that the following represents the probable error for each item of measurement. All other errors are negligible.

Angular measurement	0° 00' 20" ±
Error due to plumb bob swing	.010' ±
Tape out of level	.005'
Error in temperature of tape	5° F ±
Error due to tension of the tape	.005' ±

(a) What is the probable error due to taping?

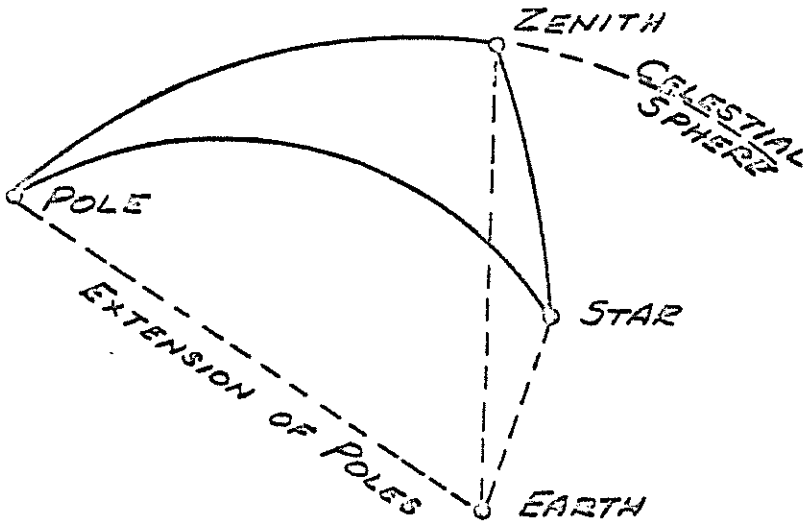
(b) What is the probable error due to angle?

(c) What is the probable error due to both angle and distance?

(d) What is the probable length of the line?

Do not express your answers as an error ratio.

Problem 5 - Wt. 9



In the spherical triangle in the celestial sphere as shown above "P" represents the extension of the earth's pole, "Z" the observer's zenith, and "S" the star being observed (sun or polaris). In the celestial triangle (P, Z, and S) there are six parts to the triangle(3 angles and 3 sides).

State which parts of the triangle can be determined by the surveyor (by tables, maps or observations), and how they can be determined. Also state which part of the triangle is the object of the computation, and which part of the triangle is never used.

Problem 6 - Wt. 7

Discuss the method of Three-wire Leveling (3 cross hairs in the level), state how readings are made on a rod calibrated in yards, how the notes are recorded, how the H. I. is determined, and the advantages over the single cross hair and target method.

CALIFORNIA BOARD OF REGISTRATION FOR CIVIL AND PROFESSIONAL ENGINEERS

1962 LAND SURVEYING EXAMINATION

L S PART IV P M

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SHOW YOUR WORK IN THE WORKBOOK

Problem 1 - Wt. 25

You are asked to locate by survey the N.E. 1/4 of Section One, T. 13 S., R. 2 E., of a given meridian according to a given township plat surveyed in 1902. Explain all of the necessary steps you would do or should investigate from the start to finish of the assignment. Exclude from the discussion questions of costs, business arrangements, contracts, or liability. The explanation is to include what you would do from research to delivery of finished drawing. In answering, neat long-hand writing will be just as acceptable as printing, and diagrams may be helpful. Assume that the section of land was originally surveyed in accordance with the normal manual of instructions of the time; that no land grants, rivers, lakes, or other objects caused exclusions of any portion of the section; and that standard parallels were every fourth township.

Note: This is a 25-point question (2 hours time) and requires a complete discussion.

Problem 2 - Wt. 5

In many court cases the rule is often applied that original monument positions, as called for in a conveyance, control the location of the described land; that is, original monuments called for in a conveyance control over distance, direction, and area. The courts, in deciding the location of an ownership, have at times rejected the position occupied by an original undisturbed monument, and have decreed another position to be the limits of ownership.

Of the five general types of conditions that cause the courts to reject an original monument position, name three, and describe an application of each.

Problem 3 - Wt. 10

You have carefully measured from point "A" to point "B" and have found it to be 2562.31 feet. You calibrated your steel tape, which weighs 2 pounds, by comparison with an accurate standard at 68°F, and found it to be 100.015 foot long (unsupported) for a pull of 20#. During the measurement, the temperature rose from 70° to 83°F at a uniform rate. You used plumb bobs and a hand level. For a distance of 1000 feet you had to break chain at the 50 foot point. No wind velocity was present, a transit was used for accurate alignment, and you pulled 28# for each distance measured.

(a) What is the length of the line from A to B after corrections are computed from the above data?

(b) No survey measurement is absolutely accurate due to errors. List the items that would contribute to the uncertainty of the measurement as made.

Problem 4 - Wt. 5

Define each of the following words or phrases:

(a) declination of a star

(b) diapositive (photogrammetry)

(c) focal point of a lens

(d) tilt (as applied to photogrammetry)

(e) probable error

(f) spherical excess

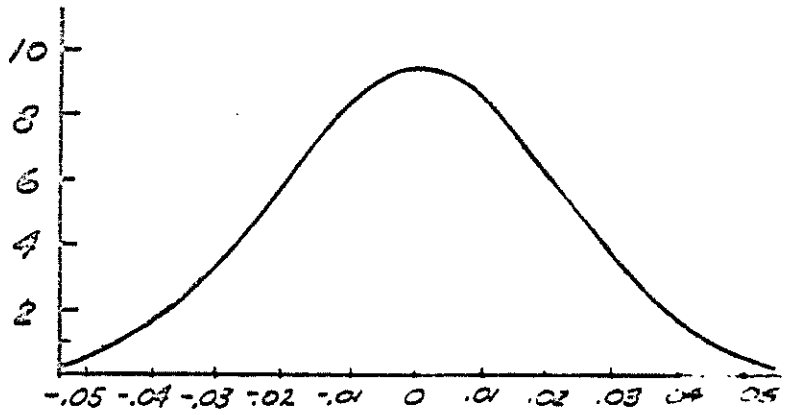
(g) riparian rights

(h) memorial (public land survey)

(i) elastic modulus

(j) spherical aberration

Problem 5 - Wt. 5



(a) In the above figure, showing a graph of the results of a large number of measurements of the same distance, what does the horizontal scale represent?

(b) What does the vertical scale represent?

(c) Using this graph, state how you would graphically determine the probable error for one measurement of distance.