L S - A

LAND SURVEYOR - 1973

PART A - Wt. 50

CLOSED BOOK

Time Allowed - Four Hours

INSTRUCTIONS TO EXAMINEE:

The first day of this examination consists of two parts of four hours each (Part A and Part B). Each part has a total weighted score of 50 points. The maximum possible score for the first day is 100 points.

Part A consists of 75 problems. All problems are required. Each problem has a weighted value of 2/3.

Detach the last sheet from this booklet - this is your Answer Sheet for Part A. Show the appropriate answer in the space provided on the Answer Sheet. For multiple choice problems, enter the appropriate identifying letter in the space provided. Your score for Part A of this examination will be based only on the answers shown on your Answer Sheet. You may use any available space in this booklet for computations. When you have completed Part A, return only the Answer Sheet to the proctor. Be sure that your identification number is shown.

No texts, notes, or any other reference materials are permitted in this part of the examination. Calculators or computers of any type are prohibited in this part of the examination. Slide rules are permitted. No work will be accepted after you have turned in your paper to the proctor, or after the close of this examination period.

You may keep the examination questions.

SHOW YOUR ANSWERS ON THE ANSWER SHEET

+ (A1) Determine the area of the trapezoid shown in square feet.

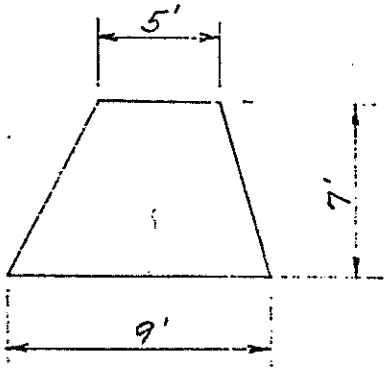
A 45 sq. ft.

B 48 sq. ft.

C 52 sq. ft.

(D) 49 sq. ft.

E 56 sq. ft.



+ (A2) A property line which bears S 60°00' W can also be identified, when measured from North, as a course of

A 030°

B 060°

C 120°

(D) 240°

E 300°

(A3) If the function $y = 2 \cos \frac{x}{2}$ is plotted on a graph it will pass through the point whose coordinates are (with x in radians)

A $(\pi, -2)$

B $(2\pi, -2)$

C $(2\pi, 2)$

D $(\pi, 2)$

E $(\pi, 1)$

A4 The log sin 2x is equal to which of the following?

A log 2x + log sin x

B 2 log sin x

C log 2 + log sin x

D log 2 + log sin x + log cos x

E log 2x + log sin x + log cos x

A5 The cosine of an angle will have a minus (—) value in the

A first and third quadrants

B second and third quadrants

C second and fourth quadrants

D third and fourth quadrants

E second, third and fourth quadrants

A6 The number of standard sections included within a standard township is

A 6

B 36

C 160

D 640

E 40

A7 In the system of public land surveys the various ranges are separated by range lines. In a similar relationship the East-West lines that separate townships

A are called township lines

B are called closing lines

C are called base lines

D have no assigned names

E have numerical designations

A8 The scale of a map was shown in the Legend to be $\frac{1}{25000}$. This means that

A one inch on the map equals 25000 inches on the ground

B one inch on the map equals 25000 feet on the ground

C one inch on the map equals 25000 meters on the ground

D the least squares factor approaches zero

E the plotting fraction is known

A9 A steel tape that is supported at its two ends will assume the shape of a

A parabola

B circular arc

C catenary

D ellipse

E hyperbola

A10 The secant of a given angle in a right triangle is equal to the

A $\frac{\text{opposite side}}{\text{hypotenuse}}$

B $\frac{\text{adjacent side}}{\text{opposite}}$

C $\frac{\text{hypotenuse}}{\text{adjacent side}}$

D $\frac{\text{hypotenuse}}{\text{opposite side}}$

E $\frac{\text{adjacent side}}{\text{hypotenuse}}$

A11 The three sides of a triangular land parcel were measured in the field as

252.79, 453.67, and 389.06 feet

The interior angles can be computed from this information by making use of

A Burke's Law

B the transit rule

C the Prismoidal Formula

D the Three Point Method

E the Law of Cosines

A12 The figure shows a sector of a circle. The area within the sector is

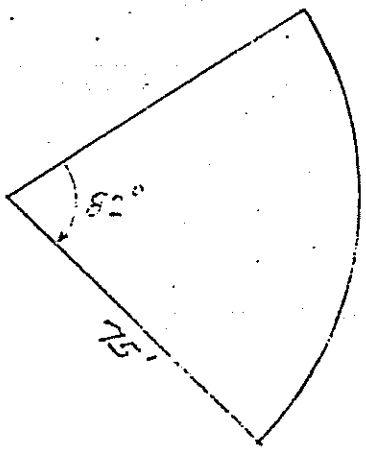
A 0.079 acres

B 0.083 acres

C 0.092 acres

D 0.105 acres

E 0.121 acres



A13 A distance in the field can be measured very carefully with a tape, and the significant figures recorded to 1/1000 foot. Such a measurement would be

A absolutely accurate

B absolutely precise

C precise but not accurate

D accurate but not precise

E approximate

A14 A distance in the field was very carefully measured twice and two distinctly separate readings were recorded in the field book. Later in the office the two readings were shown to be slightly different. This difference is called a

A discrepancy

B accidental error

C systematic error

D resultant error

E degree of refinement

A15 When three sides of a triangle are given, the three interior angles can be determined by using the law of cosines. For the triangle shown, which of the following expresses the law of cosines?

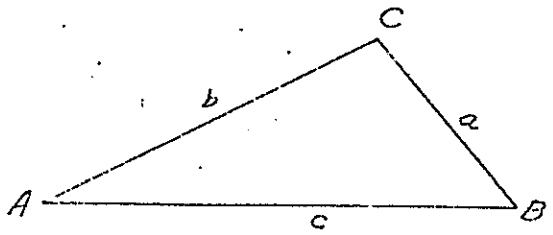
A $B = \frac{a}{2 \sin a}$

B $A = \sqrt{s(s-a)(s-b)(s-c)}$

C $\cos A = \frac{9}{c}$

D $a^2 = b^2 + c^2 + 2bc \cos A$

E $\sin A = \frac{a \sin B}{b}$



A16 The legal value for the number of inches in a meter is

A 39.00

B 39.3333----

C 39.44

D 39.30

E 39.37

A17 A measurement reported as 39.68 chains would mean that the

A length was equal to 39.68 x 16.5 feet

B distance was the same as 39.68 surveyor's points

C length was equal to 100 meters

D distance measured was 2618.88 feet

E measurement was on a grant line

A18 In the formula used for reduction of stadia the value of (f + c)

A increases with an increase in the length of the sight

B decreases with an increase in the length of the sight

C increases with an increase in the angle of slope

D varies slightly so that the variation may be ignored

E may be adjusted by the instrument man

A19 The stadia method of surveying is based upon

A the Law of Sines

B the principle that horizontal distance is equal to a rod intercept multiplied by a constant factor

C the principle that the horizontal distance can be read directly from the face of the stadia rod

D the theory that similar triangles have proportionate sides

E the principle that elevations can be easily determined by adding the rod reading to the HI.

A20 A variable systematic error

A is constantly in the same direction but the direction is unknown

B has an unknown magnitude of known direction

C varies as the square root of the number of opportunities for the error

D can be predicted as to magnitude

E is the same in its net effect as a discrepancy

A21 The theory of errors in surveying also includes the assumptions that

A large errors will occur frequently

B large errors will be more numerous than small errors

C true values can be determined by no less than 5 readings

D small errors are more numerous than large errors

E errors are much more likely to be negative than positive

A22 The length of a circular curve when measured along the arc is equivalent to

A $\frac{2\pi R\Delta}{360°}$

B 2π radians

C $RL/2$

D $2R \sin \frac{\Delta}{2}$

E $\frac{R^2}{2}(Q - \sin \Delta)$ where Δ in radians = Q

A23 A star can be positioned on the celestial sphere by using the coordinates of

A latitude and longitude

B hour angle and principal meridian

C latitude and true bearing

D right ascension and declination

E sidereal hour angle and zenith distance

A24 Research of the maps of record show that an owner's land parcel was recorded in various ways. Which of the listed measurements will identify exactly one acre of land?

A 490 links x 220 links

B 209.73 feet x 209.73 feet

C 2 chains x 5 chains

D $16\frac{1}{5}$ rods x $16\frac{1}{2}$ rods

E 4 chains x 3 chains

A25 A stadia intercept of 5.30 together with a Beaman Arc reading of 55 results in a

A horizontal correction of -2.65 feet

B vertical difference of +2.65 feet

C vertical difference of -2.65 feet

D vertical difference of + 26.5 feet

E horizontal distance of 281.5 feet

A26 Having a fully equipped survey party you are instructed to determine the true meridian. You have no Ephemeris. Which of the following observing programs would you select as the most accurate?

A sun by equal altitude

B Polaris at elongation

C Polaris at culmination

D sun at Greenwich apparent noon

✓ E star by equal altitude

A27 A grad is equal to

A 1/500th part of the total angle around a point

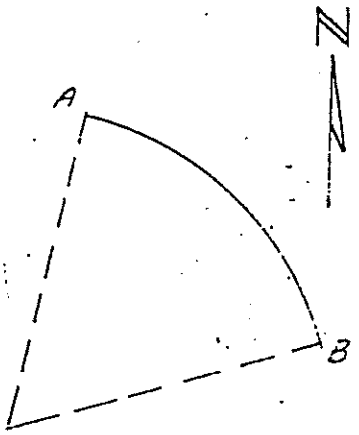
B 1/6400th part of the total angle around a point

C a part of the total angle around a point of 1/2 TT

✓ D nine-tenths of one degree of angle

E one micron

A28 The curve A-B would be described as being



A concave to the Northeast

B convex to the Northeast

C concave to the Southeast

D concave to the Southwest

E convex to the Southwest

A29 A base line for a geodetic triangulation is usually measured in

A chains

B feet

C rods

D meters

E microns

A30 The correction for slope, for a difference in elevation of 1.50 meters in a tape length of 50 meters, is most nearly

A minus 30 mm

B plus 30 mm

C minus 22 mm

D plus 22 mm

E depends on sign of the slope

(A31) The approximate angular error of 20" corresponds to a linear error that will produce a relative error of

A 1 : 5,000

B 1 : 10,000

C 1 : 15,000

D 1 : 20,000

E 1 : 100,000

(A32) The limit of closure for the perimeter of a normal township in the subdivision of public lands shall not exceed

A 50 links

B 175 links

C 300 links

D 425 links

E 500 links

(A33) The latitude of a certain place in the Northern Hemisphere may readily be determined by a direct observation on Polaris at upper or lower culmination. One of the following items may be neglected without any appreciable effect on the determination.

A refraction

B index correction

C polar distance

D parallax

E vertical angle

A34 With respect to Clarks spheroid

A the north end of Lake Tahoe has the same elevation above the datum as does the south end.

B the surface of the ocean is computable from a mathematical figure.

C the elevation as determined between two points with about 5000 feet difference in elevation will be the same (ignoring measurement errors) regardless of the route run in determining the difference in elevation.

D a level line is everywhere normal to the direction of gravity.

(E) none of the above are true.

A35 A point of beginning which is used in a metes and bounds description is

A referenced to a standard one-quarter corner

B given greater standing as a control point than any other point identified in the description

(C) referenced to a standard base line

D referenced to a standard section corner

(E) selected because of its certainty of identity and its facility of location

A36 The difference as measured from the hour angle of the true sun to the hour angle of the mean sun is called the

A right ascension

B equation of time

C sidereal hour angle

D azimuth

E longitude

(A37) To obtain an accurate average tide height at a given location, it is necessary to record tide readings for

A 51 years

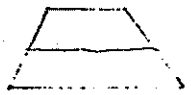
B 19 years

C 5 years

D 1 year

E 1 month

(A38) A parcel of land may be trapezoidal in shape such as that indicated by the figure



If the present owner conveys the North one-half to another party, this means that

A a line is drawn which connects the mid points of the two opposite sides

B a line parallel with the two parallel sides cuts the total area into t. equal areas

C the conveyance is based on a consideration other than area

D a title insurance company's record must be researched to obtain the basic starting information

E the true dividing line must be determined by double proportionate measurement

(A39) Contours which are closely spaced on a contour map will indicate

A a steep slope

B a flat slope

C a change in slope

D a uniform slope

E no slope -- a nearly level surface

(A40) Which of the following methods of levelling is deemed the most accurate?

A reciprocal

B barometric

C profile

D differential

E refraction

(A41) The unit of time known as a sidereal day is the same as that required for

A the sun to move one complete revolution around the ecliptic

B the sun to move from the Eastern horizon to the Western horizon

C the vernal equinox to move through one apparent revolution

D the sun to move from nadir to zenith

E Polaris to move from lower culmination to Eastern elongation

(A42) The least count of a retrograde vernier is

A a variable depending upon the length of the graduation on the main scale

B the least reading that can be read on the vernier

C equal to the difference between the number of main scale graduations and the number of vernier graduations

D equal to the number of main scale graduations divided by the corresponding number of vernier graduations

E equal to the value obtained by dividing the length of the smallest division on the main scale by the number of divisions on the vernier scale.

(A43) A line of levels which is double rodded is one which

A uses two targets on a Philadelphia rod

B is run in both directions using one rod

C uses two turning points for each instrument set up

D is run twice in the same direction using one rod

E uses two rods on each turning point and a dual set of parallel notes

(A44) A line of constant true bearing is referred to as a rhumb line, and it is one which crosses all meridians at a constant angle. The type of map projection which will accommodate the rhumb line is

A orthographic

B Mercator

C Lambert Conformal Conic

D gnomonic

E stereographic

(A45) When using the Lambert Conformal Conic projection

A all land parcels will appear in correct shape

B all land parcels will be distorted in area in proportion to their distance away from the center of projection

C all land parcels can be measured as true areas without distortion

D all azimuths run from one central point will show true direction

E all measured bearings will be true bearings

(A46) The horizontal distance between two adjacent contours

A is usually shown by hachure lines

B is equal to the slope of the ground

C is equal to the contour interval

D is inversely proportioned to the slope of the ground

E is directly proportioned to the slope of the ground

(A47) One of the following statements is generally <u>not</u> true when balancing a survey.

A In many cases a careful arbitrary distribution of errors on the basis of a knowledge of the field conditions is the best that can be made.

B If systematic errors are believed to be present in the linear measurements, they can be eliminated only by applying proper computed corrections to the field measurements before any rules for balancing the survey can be applied.

C Systematic errors are not subject to distribution by any general rule.

D If the error of closure is subject to accidental errors affecting angular and linear measurements equally, the "Compass Rule" is valid.

E If the accidental errors in linear measurement are assumed to be much larger than those in angles, the "Transit Method" is valid.

(A48) The effect of refraction and parallax in determining azimuths by solar observation is

A equal to the measured altitude minus refraction plus parallax

B equal to the measured altitude plus refraction minus parallax

C equal to the measured altitude plus refraction plus parallax

D in most cases negligible and therefore not necessary to correct the measured altitude

E not considered unless the measured altitude exceeds 40°

(A49) That point at which a vertical line through the perspective center of the camera lens pierces the plane of the photograph is called the

A principal point

B isocenter

C nadir point

D principal line

E zenith

(A50) $y = ax^2$ is the general equation of a

A parabola

B hyperbola

C circle

D ellipse

E line

(A51) A person does <u>not</u> practice land surveying within the meaning of the Land Surveyors Act who

A. makes any survey for the subdivision or resubdivision of any tract of land

B is engaged in geodetic or cadastral surveying

C performs surveys exclusively for geological or landscaping purposes, which do not involve the determination of any property line

D procures or offers to procure land surveying work for himself or others

E manages, or conducts as manager, proprietor, or agent, any place of business from which land surveying work is solicited, performed or practiced

(A52) The Greenwich Civil Time (G.C.T.) is 5:00 A.M. April 4, 1971. What is the Local Civil Time (L.C.T.) at longitude 121°30' at the same instant?

A 1:00 P.M. L.C.T. April 4, 1971

B 1:06 P.M. L.C.T. April 4, 1971

C 8:54 P.M. L.C.T. April 3, 1971

D 9:00 P.M. L.C.T. April 3, 1971

E 9:06 P.M. L.C.T. April 3, 1971

(A53) By limiting the north-south length of the zones in the California Coordinate System, the limit of error due to distortion is confined to

A 1 in 5,000

B 1 in 7,500

(C) 1 in 10,000

D 1 in 15,000

E 1 in 20,000

(A54) The magnetic bearing of a line was recorded as S 80°30' W in 1900 at a location which had a declination of 15° E in that year. What is the magnetic bearing at present if the declination is now 4°15' E?

A S 69° 45' W no correct answer

B N 80° 15' W

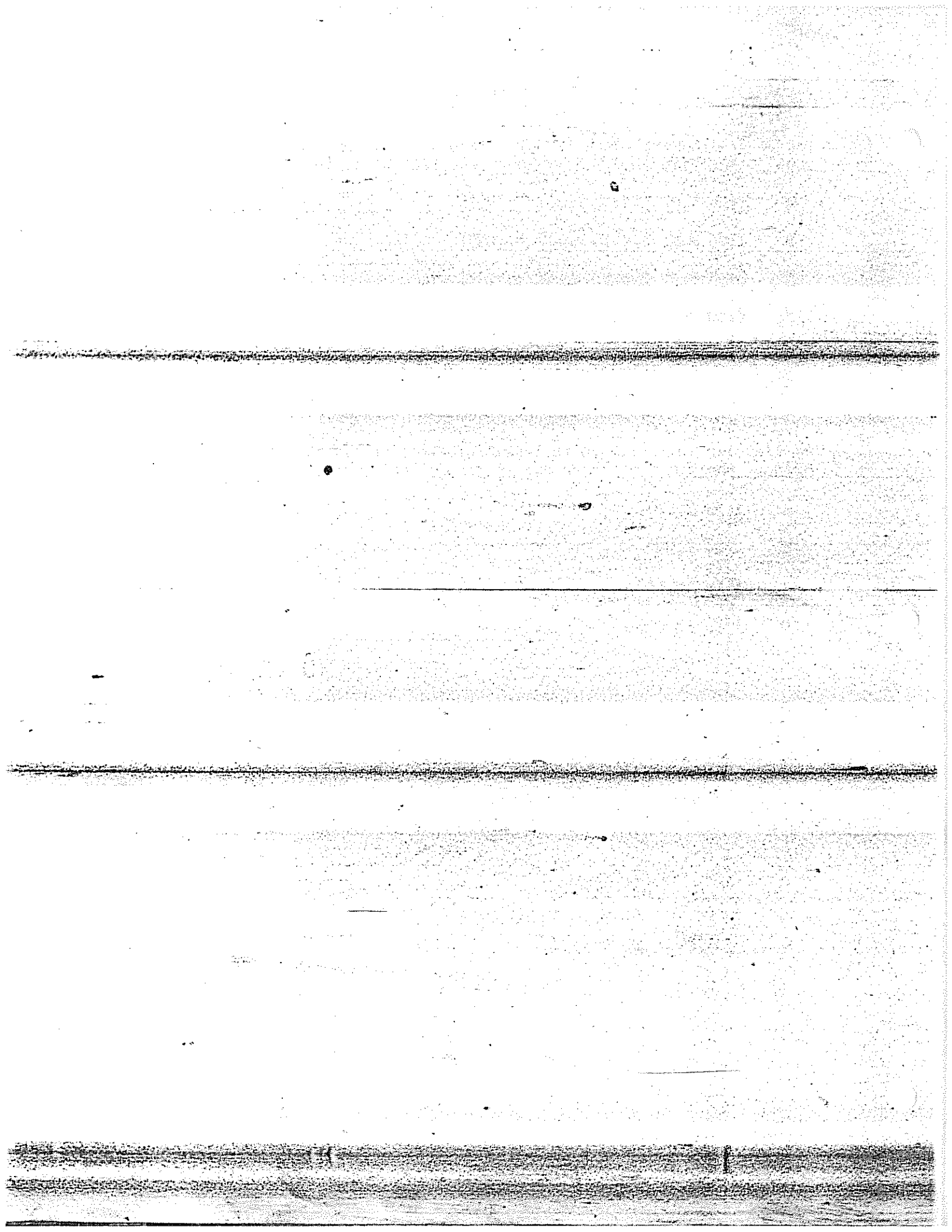
C S 61° 15' W

D N 89° 15' W

E S 69° 45' E

14 60 — 4 15 — 10 45

9 — 80 90 — 10 45 — 69 45



(A55) In a triangle with three angles marked a, b, and c the sin of a is equivalent to which of the following?

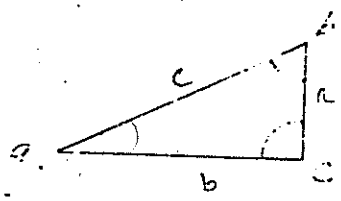
A $1 / \tan a$

B $1 / \sec a$

C $\pm \sqrt{1 - \cos^2 a}$

D $\dfrac{1}{\pm \sqrt{1 - \cos^2 a}}$

E $\cos a$



$\sin A = \frac{a}{c}$

(A56) Errors in horizontal angle measurement are experienced when sighting upon a target with unequal illumination. These are called errors due to

A refraction

B parallax

C phase

D abberation

E eccentricity

(A57) Precise levels sometimes use an "Optical Flat" in order to

A reduce glare from the sun

B observe both ends of bubble simultaneously

C move line of sight up or down

D focus on close shots

E level the instrument

(A58) The angle between a horizontal plane and the natural slope assumed by a loosely placed embnakment material is called the

A angle of incidence

B angle of refraction

C dip angle

D angle of repose

E angle of strike

(A59) When a circular curve is constructed using the railway definition it will be

A the same as the mathematical path of a parabola

B the same as the mathematical path of a catenary

C a series of connected chords made successively shorter so that they collectively approximate a true circular arc

D a part of a true circular arc defined by a series of 100-foot chords and a degree of curve D

E equivalent to a 10-chord spiral

(A60) The average closure of the main scheme triangles in a Second Order triangulation should not exceed

A 1 second

B 3 seconds

C 5 seconds

D 10 seconds

E 1 minute

(A61) Strength of figure in triangulation is dependent on the strength of the best chain of triangles through the system, hence

A the smaller the "R Factor" the smaller the strength of figure

B the smaller the "R Factor" the greater the strength of figure

C the greater the "R Factor" the greater the strength of figure

D the strongest figure will have R = 0

E the strongest figure will have R = ∞

(A62) Aerial mapping photos were taken from an average flight altitude of 4800 feet above the ground. The overlap along the flight line is 65%. Topographic maps are to be prepared from diapositives prepared from the negatives of these photos. The contour interval will be 5 feet. The "C" factor is

A 1200

B 960

C 1000

D 2000

E 1500

(A63) The 9" x 9" glass diapositives of a stereo-pair of aerial photos are printed at a contact scale of 1" = 1000'. When these diapositives are used in a standard Kelsh Plotter the resulting horizontal scale of the manuscript will be

A 1" = 1000'

B 1" = 2000'

C 1" = 100'

D 1" = 200'

E 1" = 500'

A64 Which of the following is equivalent to the numerical value of $\cos \frac{4\pi}{3}$?

A $+\frac{1}{2}$

B 1.3333

C 0

D $-\frac{1}{2}$

E $\sqrt{3}/2$

A65 A deed can also be defined as

A an instrument demonstrating proof of ownership

✓ B an instrument of conveyance

C a mortgage encumbrance

D a release of mortgage encumbrance

E a policy of title insurance

A66 If the calls in a deed are given a relative weight, the least weight would be assigned to

✓ A quantity calls

B calls to adjoiner

C course and distance calls

D natural monuments

E. artificial monuments

A67 The legal shore line of a lake will be marked by a meander post

A if the water level does not go down

B in all instances

C if the original monuments can be checked by a resurvey

D in no instances

E when it coincides with the thread of the lake

A68 A land parcel is found to have two descriptions contained in old deeds which are somewhat inconsistent. If both of them appear to have equal weight then

A the shorter of the two would be adopted

B the longer of the two would be adopted

C the averaged value of the two would be adopted

D they must both be discarded

E some additional evidence must be found

A69 The procedure called reciprocal levelling may be used when

A a series of elevations is desired along a defined accessible line

B it is necessary to correct for refraction and curvature

C a line of levels can be run in one direction only and an accuracy check is prohibited

D the level cannot be set up between two intervisible points which are a considerable distance apart such that FS and BS cannot be balanced

E the difference in elevation between two known points is desired

A70 The boundaries of the U.S. Public Lands, when approved and accepted by the proper U.S. Government agency, are generally unchangeable except in which of the following cases?

A junior rights are interfered with

B adjacent property owners file suit against the government

C Mexican Rancho Land Grants are interfered with

D when the statutory period of compliance has elapsed

E when a private surveyor remeasures 81 chains between standard section corners

A71 Double proportionate measurement is used to replace lost corners of

A four townships and lost interior corners of four sections

B four townships and lost exterior corners of four sections

C northwest sections of the townships

D section corners on standard parallels

E mineral survey and meander corners

A72 A quitclaim deed

A conveys an interest that the maker may have in the property described

B is an action in law to remove an adverse claim or cloud on the title of property

C is evidence in writing of an executed and delivered contract for sale of land

D conveys the fee title of the land described and owned by the grantee

E conveys an easement

A73 Record monuments exist because of reference to them in a deed or legal description. Which one of the following is a true statement regarding record monuments?

A Record monuments are always marked upon the ground.

B National Geodetic Survey concrete monuments are always record monuments.

C Artificial monuments can never be record monuments.

D Streets and fence lines can never be examples of record monuments.

E "..to Calistoga's property as described in..." is an example of record monument.

A74 Parcels of land, or lots drawn upon a subdivision map, but not monumented on the ground are said to be created by which of the following:

A Deflection

B Protraction

C Reliction

D Contraction

E Parcel resection

A75 A metes and bounds description which in part reads, "All that land designated as Parcel XX on the map of John Pleasants property, as recorded in Book 2 of Maps, in Concord County,....." would suggest which of the following to you?

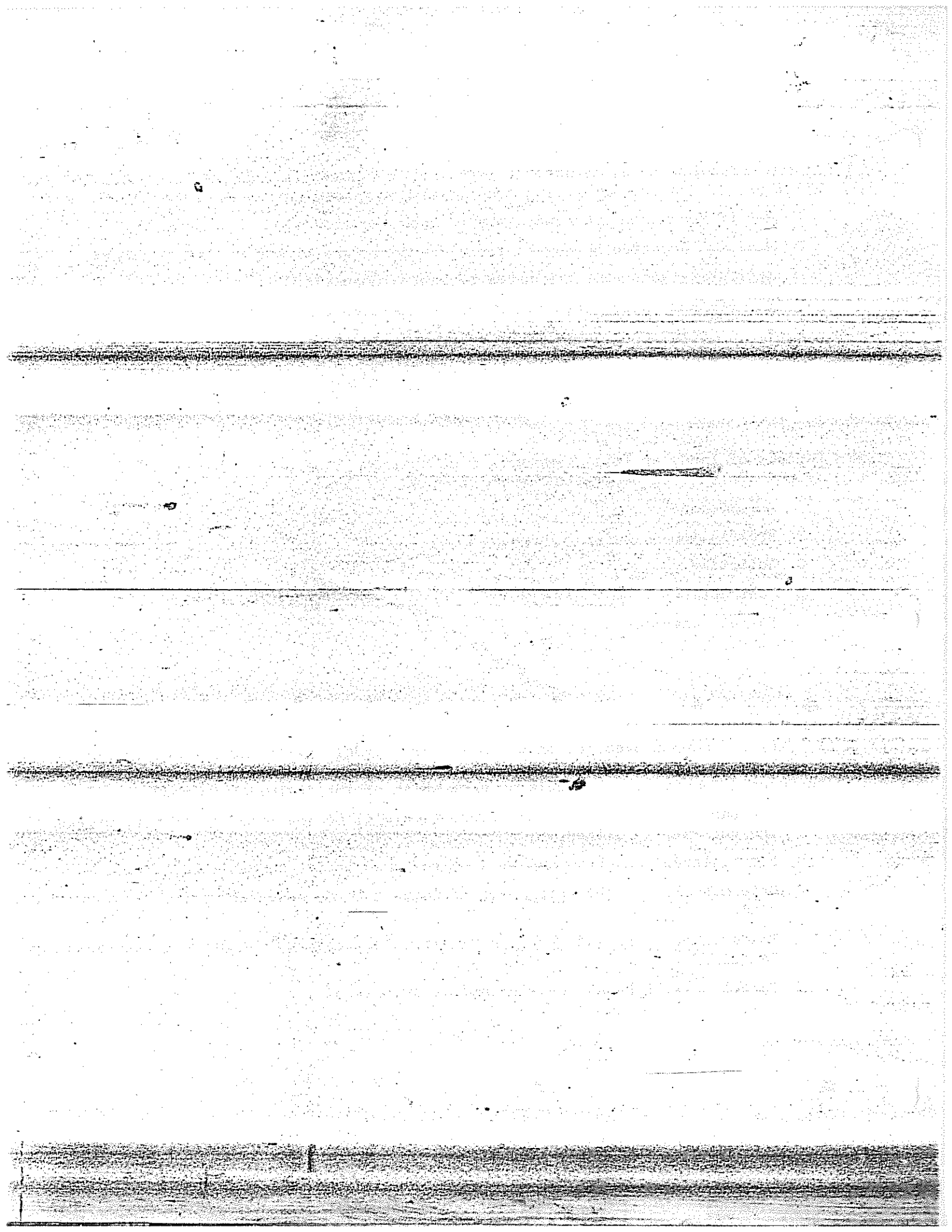
A The basis of bearing of the description will be the same as the map, unless the contrary is stated.

B All distances and bearings will be referred to the magnetic meridian.

C Determination of the astronomic meridian will be necessary for comparison of data.

D The original line will have to be determined between the land of Pleasants and Parcel XX.

E Parcel XX will have junior rights of ownership.



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LAND SURVEYOR - 1973

B

PART B - Wt. 50

This booklet contains the problems for Part B of this examination.

The general instructions are shown on the cover page of the workbook which you have already received. Please read them.

All of the work which will be scored must be included in your workbook. No work will be accepted that is not in the hands of the proctor at the close of the examination period.

No books, notes, or reference material may be used in this part of the examination. Slide rules and minor drafting aids - such as triangles, scales, french curves and compasses - are permitted.

You may keep this set of examination questions.

Work any combination of problems for a total of 50 points.

5

Problem B1 - Wt. 2

In the equation $5x + 6x^2 = 201.96$ what is the value of x?

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$ax^2 + bx + c = 0$$

$a = 6$
$b = 5$
$c = -201.96$

$$x = \frac{-5 \pm \sqrt{5^2 - 4 \times 6 \times (-201.96)}}{2 \times 6}$$

$$x = \frac{\sqrt{5^2 - 4847.04}}{25}$$

$$6 \times (64.44^2) + 5 \times 64.44 = 201.96$$

$$6 \times (-74.44^2) + 5 \times -74.44 =$$

$$6 \times (5.37^2) + 5 \times 5.37 =$$

$$6 \times (5.78)^2 + 5 \times 5.78 - 201.96 = 0$$

$$6 \times 33.40 + 28.90 - 201.96 =$$

$$200.40 + 28.90$$

Problem B2 - Wt. 3

A triangular shaped parcel of land was measured and the sides were recorded as 45 ft., 53 ft. and 62 ft. What is the area of the parcel to the nearest 0.1 square foot?

$$a = \sqrt{s(s-a)(s-b)(s-c)}$$

5

Problem B1 - Wt. 2

In the equation $5x + 6x^2 = 201.96$ what is the value of x?

$a = 6$
$b = 5$
$c = -201.96$

$ay^2 + by + c = 0$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \frac{-5 \pm \sqrt{5^2 - 4 \times 6 \times (-201.96)}}{2 \times 6}$

$x = \frac{\sqrt{5^2 - 4847.04}}{25}$

$6 \times (64.44^2) + 5 \times 64.44 = 201.96$

$6 \times (-74.44^2) + 5 \times -74.44 =$

$6 \times (5.37^2) + 5 \times 5.37 =$

$6 \times (5.78)^2 + 5 \times 5.78 - 201.96 = 0$

$6 \times 33.40 + 28.90 - 201.96 =$

$200.40 + 28.90$

Problem B2 - Wt. 3

A triangular shaped parcel of land was measured and the sides were recorded as 45 ft., 53 ft. and 62 ft. What is the area of the parcel to the nearest 0.1 square foot?

$a = \sqrt{s(s-a)(s-b)(s-c)}$

$\sqrt{80(80-45)(80-53)(80-62)}$

$35 \quad 27 \quad 18$

1166.5 ft^2

Problem B3 - Wt. 3

Two sides of a triangular land parcel were measured as 130 ft. and 50 ft. The included angle between the two sides is 30°. What is the length of the third side?

Problem B4 - Wt. 3

2:13 x 12 2:25

A small tract of land in the foothills was measured, and found to contain 197.38 acres. Later the 100' steel tape used for this work was standardized and was found to be 0.18' too long. What is the correct area contained within the tract?

$C_T = .0000065 (T_m - T_s)$

.18'

~~197.02~~ Ac

100 = 100.18'

43,560 sq ft/acre

197.38

Acq.
99.72 SAID 10

Problem B5 - Wt. 3

Some monuments will provide stronger evidence of boundary location than others. In the event of a disaccord one monument may be presumed to control over others that are deemed inferior. What are three necessary characteristics for one monument to prevail over others in such an instance?

Problem B6 - Wt. 3

An electronic distance measuring device is accurate to within 2cm + 1 ppm. The following formula may be used to determine the minimum distance that is to be measured in order to obtain a desired order of accuracy:

$$\frac{1}{PP} = \frac{0.02 + (S \times 10^{-6})}{S}$$, where S = the distance in meters, and PP = the proportional part desired.

If the order of accuracy of a survey is to be $\frac{1}{5,000}$,

a. What is the minimum distance that should be measured with the measuring device?

b. What is the maximum error permissible in angular observations?

Problem B7 - Wt. 3

The true bearing of a line AB is S40°30'W. The magnetic declination is determined to be 03°30'E. The magnetic bearing of AB was read in the field as S41°30'W. It was further determined that no errors had been made in the readings. Explain in detail the condition that exists in this case.

LOCAL ATTRACTION

41 30

Problem B8 - Wt. 4

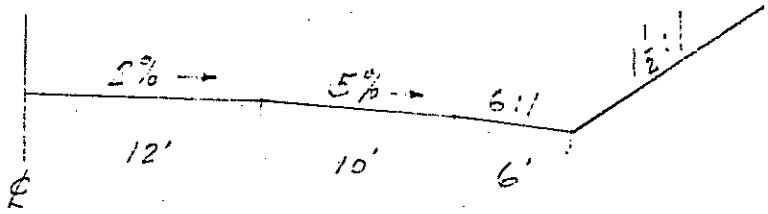
A tract of land lies adjacent to the bank of a small lake. A transit line was run approximately parallel to the lake shore. Offsets were then run at regular intervals of 15 feet with the offsets recorded in order as follows:

22.2, 16.9, 16.5, 30.5, 28.1, 19.9, 16.3, 20.7

What is the total area within the measured tract?

Problem B9 - Wt. 4

A road with a cross-section as shown below is to be constructed on a uniform grade of + 3.20 percent. The profile grade (centerline) at Station 11 + 25.78 is 890.22. If the ground elevation at the right slope stake at Station 13 + 15 is 913.2', how far is this slope stake from centerline?



Problem B10 - Wt. 4 (Answer all parts)

a. How does the reference to coordinates based on the California Coordinate System affect the title to real property on a map or a deed?

b. A map based on the California Coordinate System must show references to at least two known stations. What are the requirements for these stations?

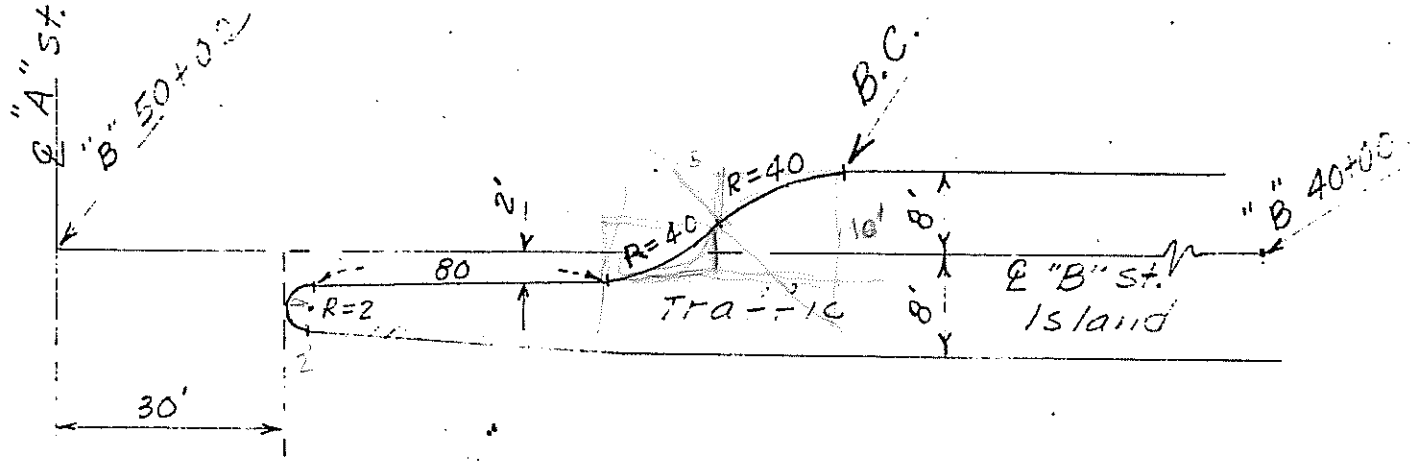
c. The State Legislature divided California into grid zones which follow county boundaries rather than mathematical rules. What was the purpose for this action?

d. In each grid zone, sea level distances are equal to ground distances at all points along two lines of exact scale which are called _____. At all other points, either a negative or a positive correction must be applied. Explain, or use a sketch, to show where, in each zone, the correction would be negative or positive.

12'
2:40 2:52

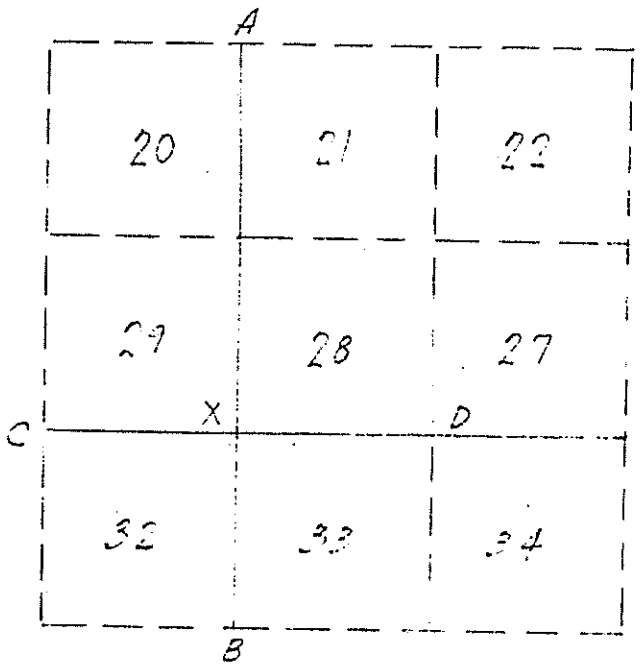
Problem B11 - Wt. 4

Calculate the B.C. station of the traffic island shown to the nearest foot.



Problem B12 - Wt. 4

The plat shown represents a group of standard sections in the township. The Section corner 28 - 29 - 32 - 33 is presumed as lost. Explain how you would restore this corner if the Section corners marked A, B, C and D are known and found in the field.



Problem B13 - Wt. 4

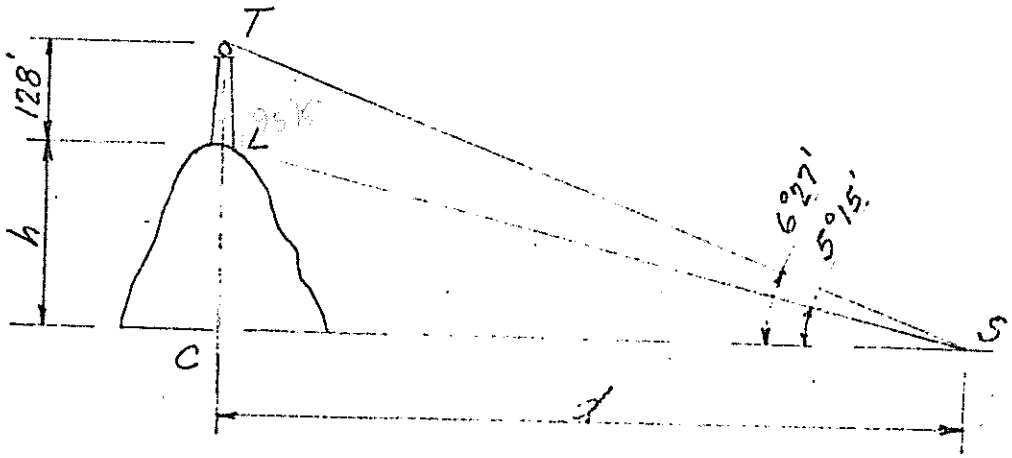
In the restoration of lost interior section corners, Section 370 of the 1947 Manual of Surveying Instructions states "A lost interior corner of four sections will be restored by double proportionate measurement." Explain "double proportionate measurement" in your own words or by a diagram.

Problem B14 - Wt. 4

Sights to an observation tower are shown in the following sketch:

a. Determine h.

b. Determine d.

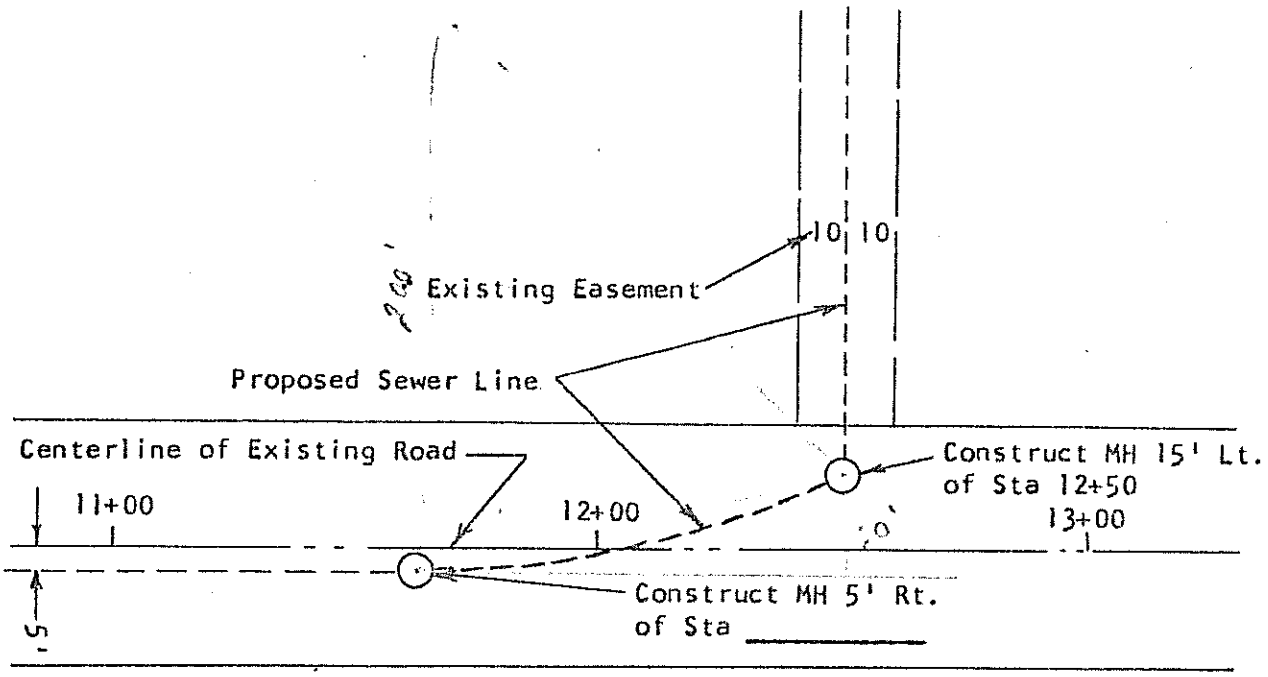


2:52 - 3:04

Problem B15- Wt. 4

A future sewer line which services an existing easement is to be constructed as shown in the diagram below. The radius of curvature connecting the manholes is to be R = 200'.

Assuming the center of the MH to be at the B.C. of the 200' radius curve which is tangent at that point, determine the centerline stationing for the B.C. (slide rule accuracy is sufficient).



NOT TO SCALE

3:04 - 3:16

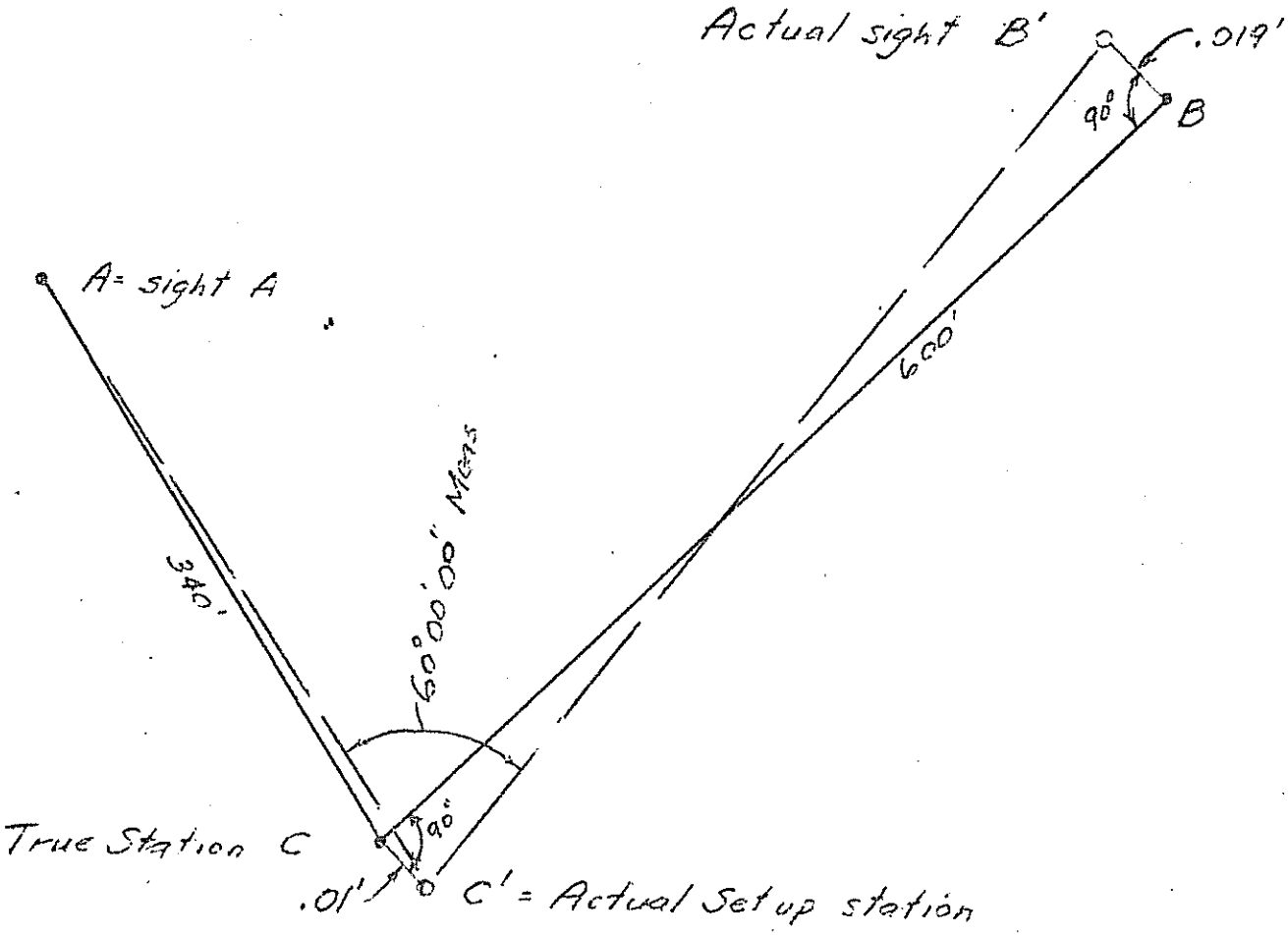
Problem B16 - Wt. 4

Knowing the information tabulated below, how many feet is the street above (or below) the high water level?

Elev. of high water level = 18.93' (Flood Control District's datum)
Elev. of the street = 17.85' (City's datum)
Elev. 0.00' (Flood Control District's datum) = Elev. 2.30' (SLD - 1929 datum)
Elev. -1.23' (City's datum) = Elev. 0.00' (SLD - 1929 datum)

Problem B17 - Wt. 4

An angle was determined to be 60° 00' 00". Upon completion of the measurement one of the sights was found to have been displaced by 0.019' and the actual set-up was in error by 0.01' as shown in the figure. What is the correction to be applied to the measurement? (Give answer to nearest second.)



Problem B18 - Wt. 4

Discuss the principles of "intersection" and "resection" as they are used in plane table survey work. Illustrate each with a suitable sketch.

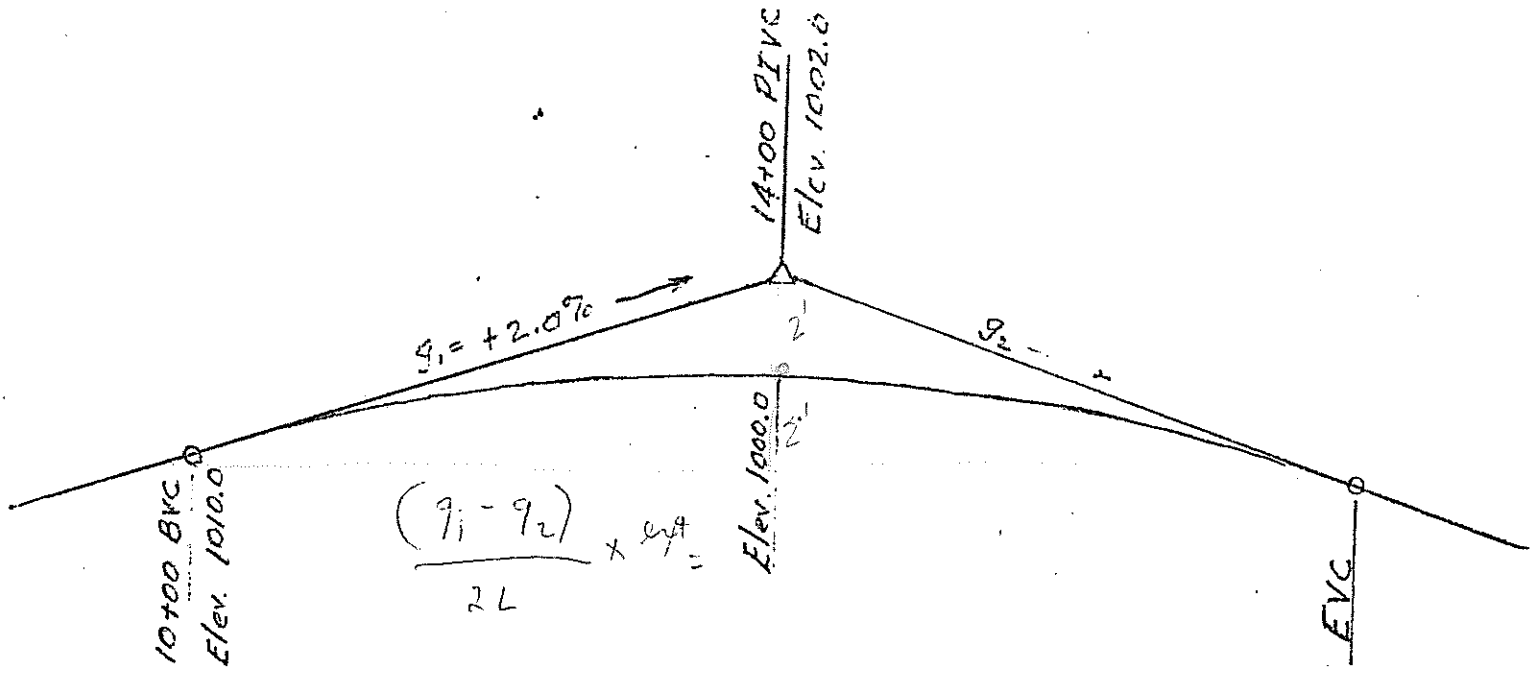
Problem B19 - Wt. 4

Given the following data:

a the grade $g_1 = +2.0\%$
b BVC at station 10+00 has elevation of 1010.0
c PIVC at station 14+00 has elevation of 1002.0.

It is desired to pass a vertical curve through elevation 1000.0 at station 14+00. Determine the following:

a station and elevation at the EVC
b the grade g_2
c the elevation on the curve at station 16+33



Problem B20 - Wt. 3

The magnetic bearing of a property line was determined to be N88°20'E. At the time the survey was made the magnetic declination was 14°30'E. If the magnetic declination is now 16°20'E what is the

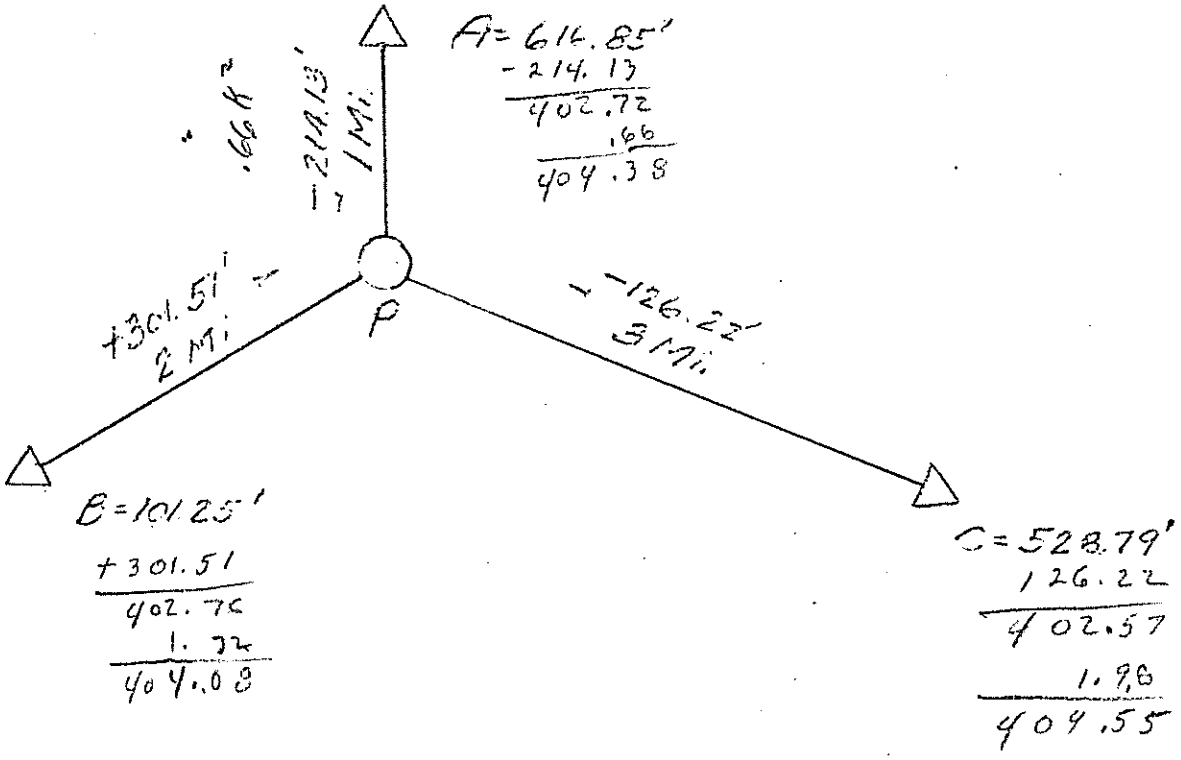
a present magnetic bearing of the line?
b present true bearing of the line?

Problem B21 - Wt. 5

A series of levels was run to a common bench mark identified as P in the plat shown. The accepted elevations of adjacent bench marks A, B and C are shown along with the observed elevation differences and the various distances between bench marks.

a. What is the most probable value for the bench mark P?

b. What conclusions would you draw from the results?



Problem B22 - Wt. 4

A large pile of wood chips was measured as 85 feet square at its base and 33 feet square at its top. It is 56 feet high.

a. What is the volume by average end areas?

b. What is the volume by the prismoidal method?

Give volumes in cubic feet and in cubic yards for each part.

Problem B23 - Wt. 5

The following information is known about a horizontal curve: R = 2292.53', ∠ = 16°22', D°arc = 2°30', P.I. Station = 24+89.60 and T = 329.69'.

Station 22+59.91 must be set. The B.C. of the curve was set from the P.I. However, the B.C. falls inches away from a wall and the instrument cannot be setup over it. By setting a point on the tangent, normal to Station 22+59.91 the station can be set.

a. What is this method called? tangent offset

b. Give the equation for computing the distance along the tangent from the B.C. to a point normal to Station 22+59.91.

c. Give the equation for computing the distance normal to the tangent at Station 22+59.91.

NOTE: Assume that a book of Trig functions for Sine and Cosine is in your possession.

Problem B24 - Wt. 4

a. What is meant by closing the horizon? Can this be done with a Wild-T2?

b. Is there an advantage to closing the horizon? Explain

3.24 - 3.36

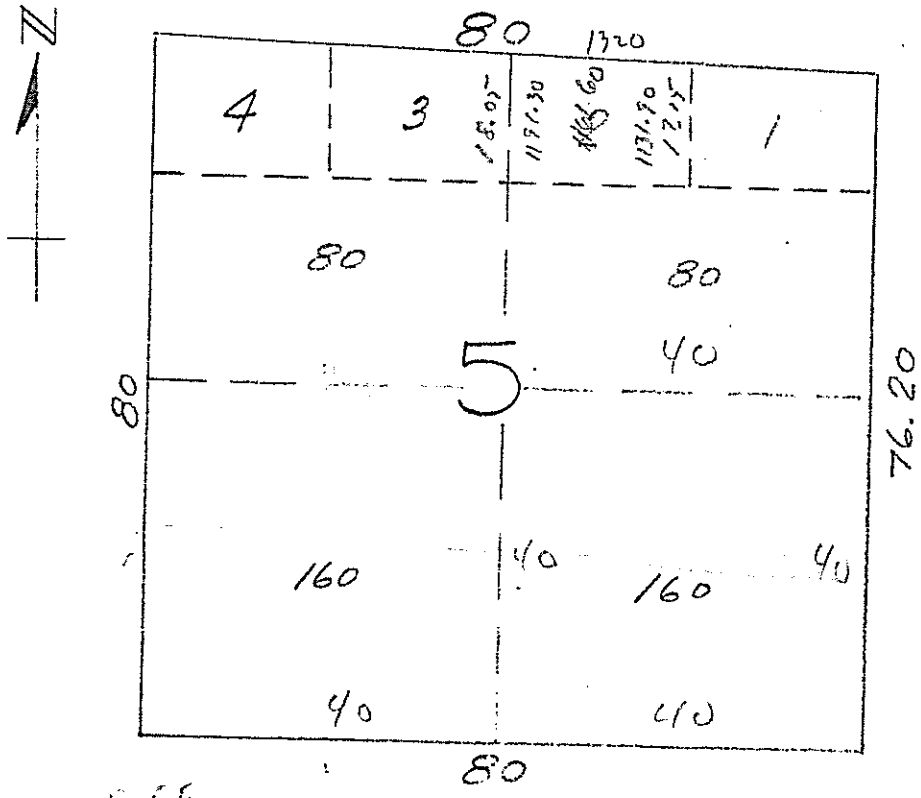
Problem B25 - Wt. 4

The diagram below is copied from an official survey of U.S. Public Domain Lands.

a. Calculate the dimensions of each fractional lot closing on the township exterior.

b. Calculate the area of each lot to the nearest one-hundredth acre.

c. Show mathematically how the area of each lot may also be determined by adding the side dimensions of each lot.

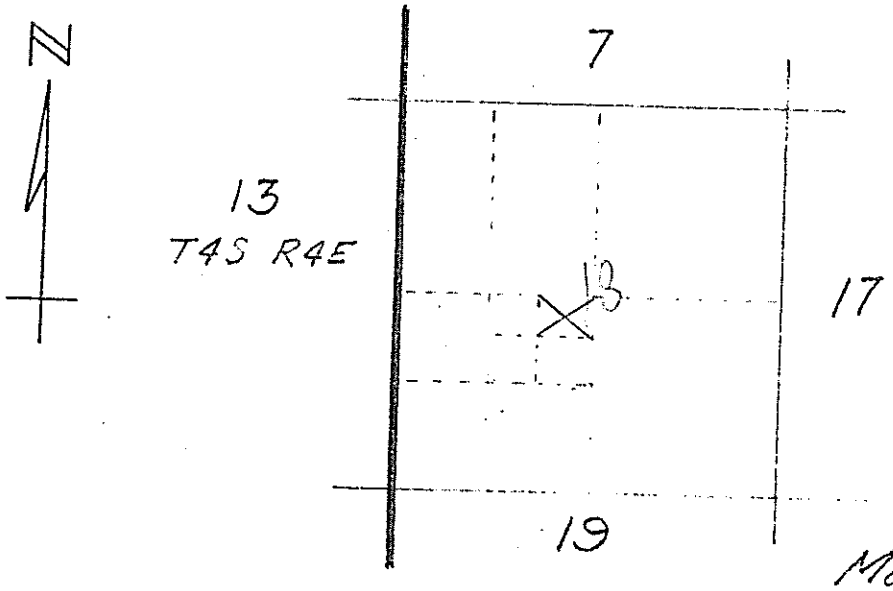


Problem B26 - Wt. 4

R 5 E

4.04 - 4.16

Prepare a sufficient description of the area indicated by the "X" in the following sketch.



Mount Diablo Meridian

L S

LAND SURVEYOR - 1973

C

Part C - Weight 50

This booklet contains the problems for Part C of this examination.

The general instructions are shown on the cover page of your workbook. Please read them.

When you have completed Part C arrange the problems in your workbook in proper sequence, and check your workbook to see that it is complete. No work will be accepted that is not turned in to the proctor at the close of the examination period.

You are to work the problems that are given in the examination booklet. You may make appropriate assumptions where they are asked for, or if a problem is incomplete, or if a problem is obviously in error. If an assumption is necessary, you should provide sufficient explanation so that the examiner can judge the reasons therefor. Assumptions must generally follow the logic and the requirements of the problem statement.

At the end of each problem, list any reference book, diagram or tables which you have used. Give book title, edition and page number.

You may use a self-contained, mechanical calculator in this part of the examination. This means a hand operated type, or a battery operated type. Proctors are instructed to prohibit the use of any machine which requires a plug-in type power source.

You may keep this set of examination questions.

You are required to work Problems C1, C2, and C3, plus a choice of one.

Problem C1 - Wt. 12.5 (Required)

A careful and extensive search in the field has failed to reveal the southwest corner of Section 10, T17N R9E MDBM, and it is concluded that the section corner is obliterated.

A local resident who has lived nearby for many years has come forward and has volunteered the information that he remembers the corner and two bearing trees as having been destroyed some years before due to land levelling operations. He is fairly sure that the corner was once located in a field some twenty feet from his chicken house and on a line extended from a fence located some distance away.

REQUIRED:

a. What is the authority of a land surveyor to receive testimony from a local resident such as that described above? Under what conditions may this be done? What is this kind of evidence called? 2-45
PAROLE EVIDENCE

b. If you were to receive testimony from such local resident what facts would you seek to include in his statement relative to the corner identified? What form would you follow to receive such testimony?

c. How much weight, or validity, should be assigned to the man's statement, and how would it affect the restoration of the corner?

d. After you receive a statement from the local resident suppose he were to pass away. How would this event affect the relocation of the corner?

L.S. Act Sect 8760
Brown & Eldridge
Evidence & procedures - sect 2-45

Problem C2 - Wt. 12.5 (Required)

The sketch on the following page represents a section of land located in the foothills. The information of record is taken from the General Land Office notes and the township plat -- this information is shown in parentheses ( ). All other information shown is to be accepted as correct for this problem. The figure at the bottom of the following page is an enlarged plat of the SW$\frac{1}{4}$ of the section.

The recorded chain of titles is as follows and only the body of descriptions is used:

United States to Smith -- being the East $\frac{1}{2}$ of the Southwest $\frac{1}{4}$, and Lots 3 and 4 of Section 7, T 9 N, R 7 E, MDB & M -- Patent No. 1021, dated September 1887 (found in Book 7 of Deeds, page 42).

Smith to Black -- being the Northeast $\frac{1}{4}$ of the Southwest $\frac{1}{4}$ and Lot 3 of Section 7, T 9 N, R 7 E, MDB & M (found in Book 27 of Deeds, page 24), dated October 1929.

Black to White -- being all that portion of the North $\frac{1}{2}$ of the Southwest $\frac{1}{4}$ of Section 7, T 9 N, R 7 E, MDB & M, more particularly described as: Beginning at the West $\frac{1}{4}$ corner of Section 7, thence East 1320 feet to the true point of beginning, thence South 1320 feet, thence East 1320 feet, thence North 1320 feet, thence West 1320 feet to the true point of beginning (found in Book 99 of Deeds, page 37), dated July 1932.

White to Green -- being the Northwest $\frac{1}{4}$ of the Southwest $\frac{1}{4}$ (Lot 3) of Section 7, T 9 N, R 7 E (found in Book 101 of Deeds, page 105), dated June 1949.

Title to the balance of land remaining in Section 7 lies with the U.S. Government and was never patented.

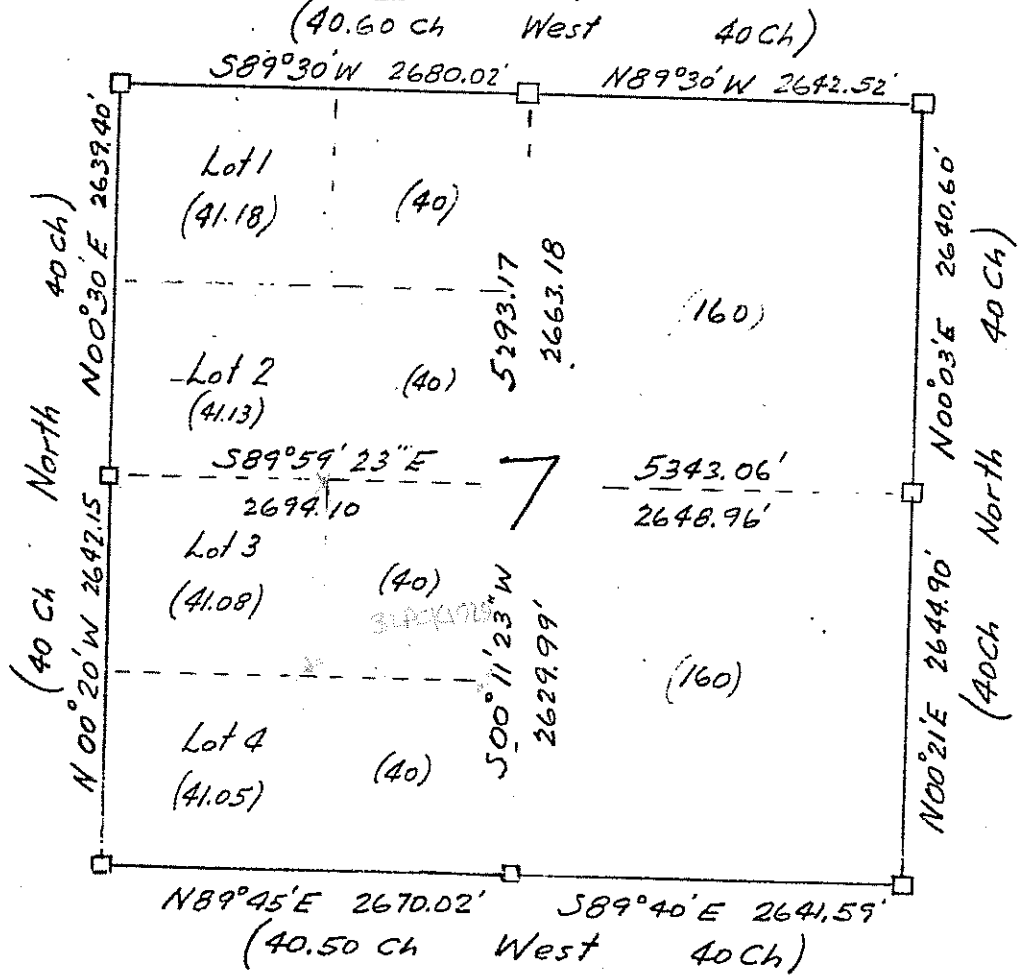
REQUIRED:

a. In your workbook draw a sketch similar to that shown on bottom of following page approximately twice the scale of the Southwest $\frac{1}{4}$ of Section 7 and show the ownerships as derived from the chain of titles given above.

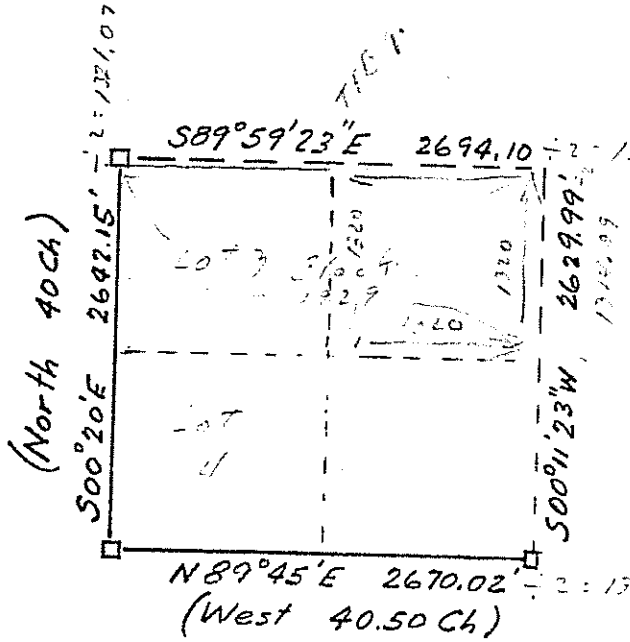
b. Draw the lines of apparent ownership and show the relationship of White's property to the adjoining parcels.

c. Explain your findings following the analysis above, and explain briefly what action you would take.

Problem C2 - Wt. 12.5 (Cont'd) (Required)



Red
Check To White



LEGEND

□ Found original corner

( ) Record per G.L.O.

All distances and bearings are measured unless otherwise noted

PLAT OF SW 1/4 SEC. 7

Problem C3 - Wt. 12.5 (Required)

The California Coordinate System was established by statute law primarily for use by land surveyors, title people, and any others interested in location on the ground.

In this question you are required to present a unified single discussion covering at least the following points:

a. How is the system constructed?
Upon what projection is it based?
What are the characteristics of this projection, and why was it chosen for California?

b. What is the basis for the primary control?
What corrections must be applied to raw data to comply with the projection?

c. What is the relationship of coordinates to land title?
What are the requirements of the Land Surveyors Act regarding coordinates?

d. What are the advantages in using the coordinate system in California?
What are the disadvantages of use?
What trends do you predict as to the use of the system in California in the future?

Problem C4 - Wt. 12.5

A land parcel identified as Lot 1 was divided into three parcels by deeds recorded in the following sequence:

Morgan to Johnson - Sept. 8, 1942 - East 330 ft. of the West 1630 ft. of Lot 1

Morgan to Smith - Jan. 27, 1943 - East 1000 ft. of Lot 1

Estate of Morgan to Brown - March 24, 1966 - West $\frac{1}{2}$ of Lot 1

A field survey made in September 1972 discloses that there are old existing fences located 1281 ft. and 1611 ft. Easterly of and parallel to the West boundary of Lot 1. The land between the fences contains a heavily laden grove of mature apple trees.

The original corners of Lot 1 were steel wagon axles set in 1915. All of these corner monuments are still in place.

Johnson, Smith and Brown have paid all taxes due on the various portions of Lot 1 since they became owners of their respective parcels.

In the plat below the distances (R) are the record distances shown on the original plat where bearings were all cardinal. The distances marked (M) are from your closed traverse around the lot as are the bearings which are shown in degrees, minutes, and seconds.

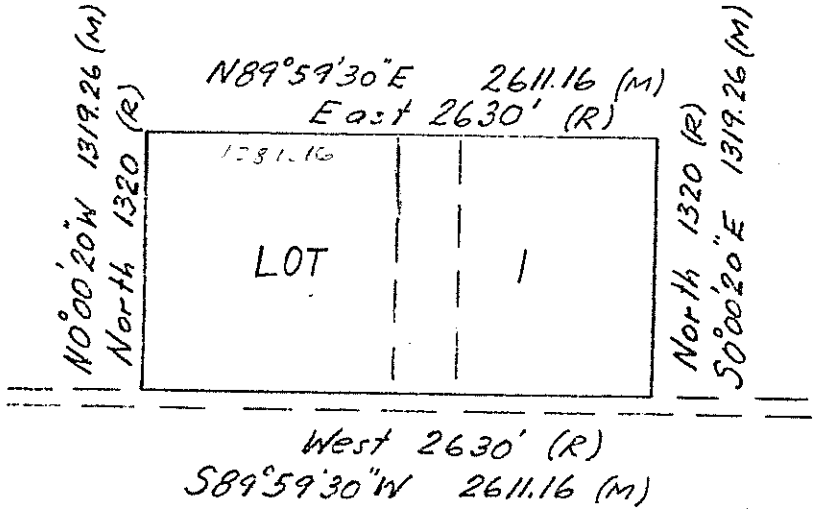
REQUIRED:

a. Prepare a sketch showing the dimensions of each parcel, and explain how you arrived at your conclusions. Prepare a sketch in your workbook to a scale approximately twice the size of the sketch shown.

b. Where would you set the NW and the SW corners of the land deeded to Johnson?

c. How can you explain the locations of the fences?

d. When you file your Record of Survey what would you do about the fences? Explain.



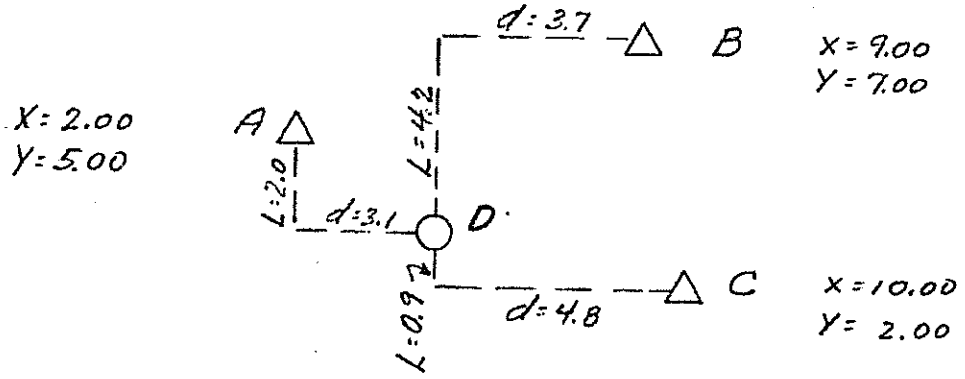
1281
330
1611
1281.16
1330
2611.16

Problem C5 - Wt. 12.5

Traverse lines have been run from three known points A, B and C to a point D. The plat drawn below shows the latitude and departure for each of the traverse routes and the relative position of each of the points identified.

REQUIRED:

Calculate the most probable position of point D. Compute the several positions, weigh these positions proportionally to the length of the latitude and departure of the traverse.



L S

LAND SURVEYOR - 1973

D

Part D - Weight 50

This booklet contains the problems for Part D of this examination.

The general instructions are shown on the cover page of your workbook. Please read them.

When you have completed your work for Part D arrange the problems in your workbook in proper sequence, and check your workbook to see that it is complete. No work will be accepted that is not turned in to the proctor at the close of the examination period.

You are to work the problems that are given in the examination booklet. You may make appropriate assumptions where they are asked for, or if a problem is incomplete, or is obviously in error. If an assumption is necessary, you should provide sufficient explanation so that the examiner can judge the reasons therefor. Assumptions must generally follow the logic and the requirements of the problem.

At the end of each problem, list any reference book, diagram, or tables which you have used. Give book title, edition and page number. You may use a self-contained mechanical calculator in this part of the examination. This means a hand operated type, or a battery operated type. Proctors are instructed to prohibit the use of any machine which requires a plug-in type power source.

You may keep this set of examination questions.

Choose any 50 points.

Problem D1 - Wt. 12.5

A land surveyor may be called to testify in court about his work. When called to serve in this capacity he is accepted as an expert witness. In this question you are to explain the position of the land surveyor when serving as an expert witness. You are to discuss the following points, but are not limited thereby.

a. What is an expert witness?
How does an expert witness differ from an ordinary witness?

b. When a surveyor appears in court what are his duties?
What kind of evidence may he present?
What kind of findings may he make?

c. Discuss the relationship between the surveyor, the attorney, the client, and the court.

Problem D2 - Wt. 12.5

A newly planned right-of-way is found to encroach upon a small cemetery as shown in the plat below. The cemetery is located at the midpoint of the curve and the encroachment involves 5.00 feet at the midpoint of the curve. Your assignment is to hold the position of the PI, and lay out a new curve which will shift the right-of-way southerly so that it eliminates the cemetery encroachment (just miss the cemetery to the south).

REQUIRED:

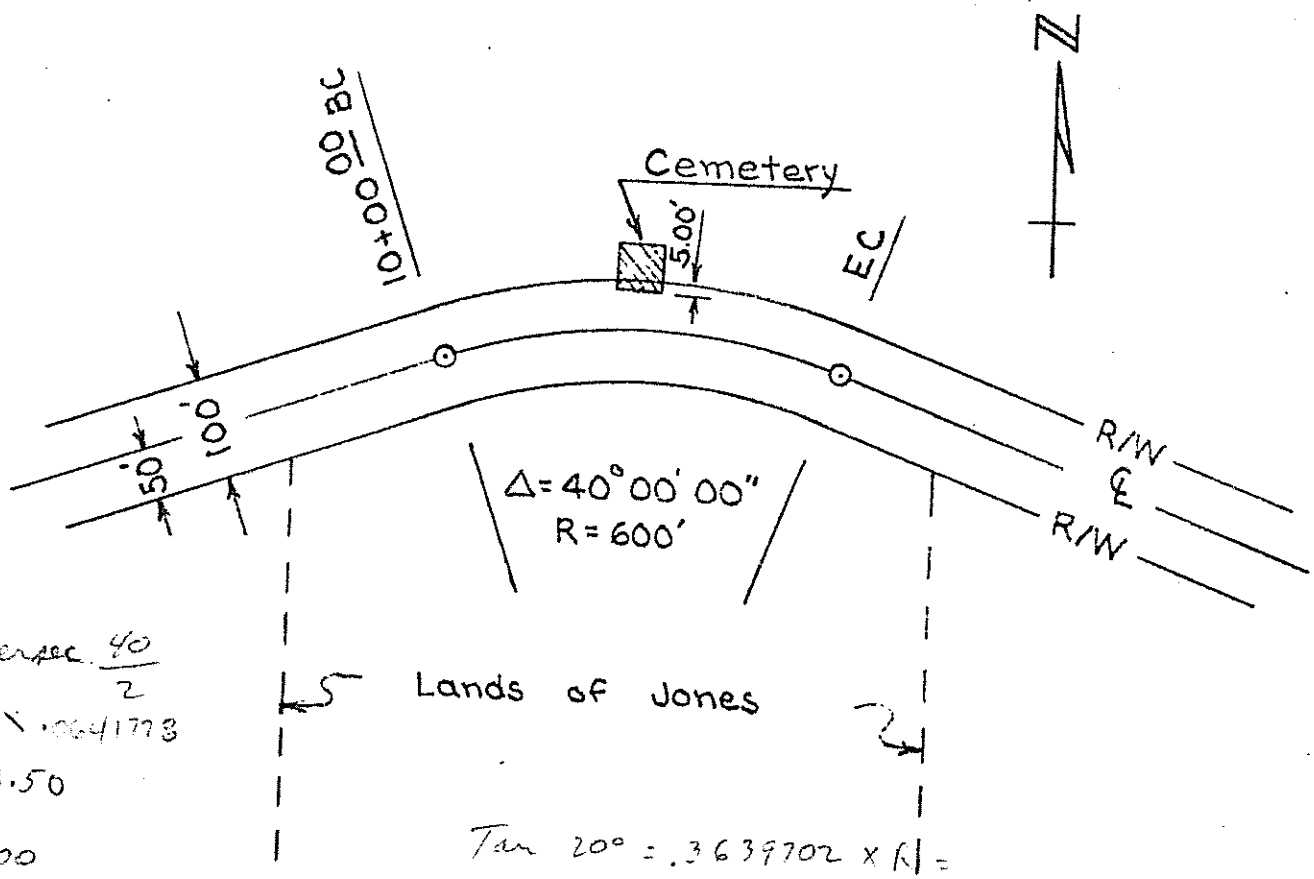
a. What is the radius of the new curve (to the nearest foot)? 522'

b. What is the station of the BC of the new curve? 104 28.38

c. What is the equation between the old alignment and the new alignment at the EC of the new curve?

d. What is the additional land area which must be purchased from Jones to accommodate the new alignment (to the nearest square foot)? 30549 SF

NOTE: The northerly boundary of the lands of Jones may be assumed as the southerly right-of-way line as shown on the plat.



$E = R \operatorname{exsec} \frac{40}{2}$

$E_1 = 200 \times .0641778$

$= 38.50$

$= 33.00$

$= \frac{33}{.0641778}$

$= 514.19$ 521.98 = 522

Tan 20° = .3639702 × R =

Problem D3 - Wt. 12.5

You are given the following description from which you are to survey and monument an owner's property:

> The North 100.00 feet of the South 435.00 feet of the East 200.00 feet of the North ten acres of that portion of the 632.54 acre parcel of land decreed to Senor Or de Mar at page 345 in Book 4 of Judgements of the 12th Judicial District Court in the County of Malaya, State of California, described as follows:
>
> Beginning at a point on the northerly prolongation of the westerly line of Lot 15 of the Mayo Tract as per map recorded in Book 10, page 30, of Maps in the office of the County Recorder of said County, distant North 7.52 chains from the northwest corner of said Lot: thence West 17.03 chains to the east bank of the Rio Grande River; thence North 9° 15' East 12.67 chains to the south line of the land of Henry Watson: thence along said south line East 15 chains; thence South 12.50 chains to the point of beginning.

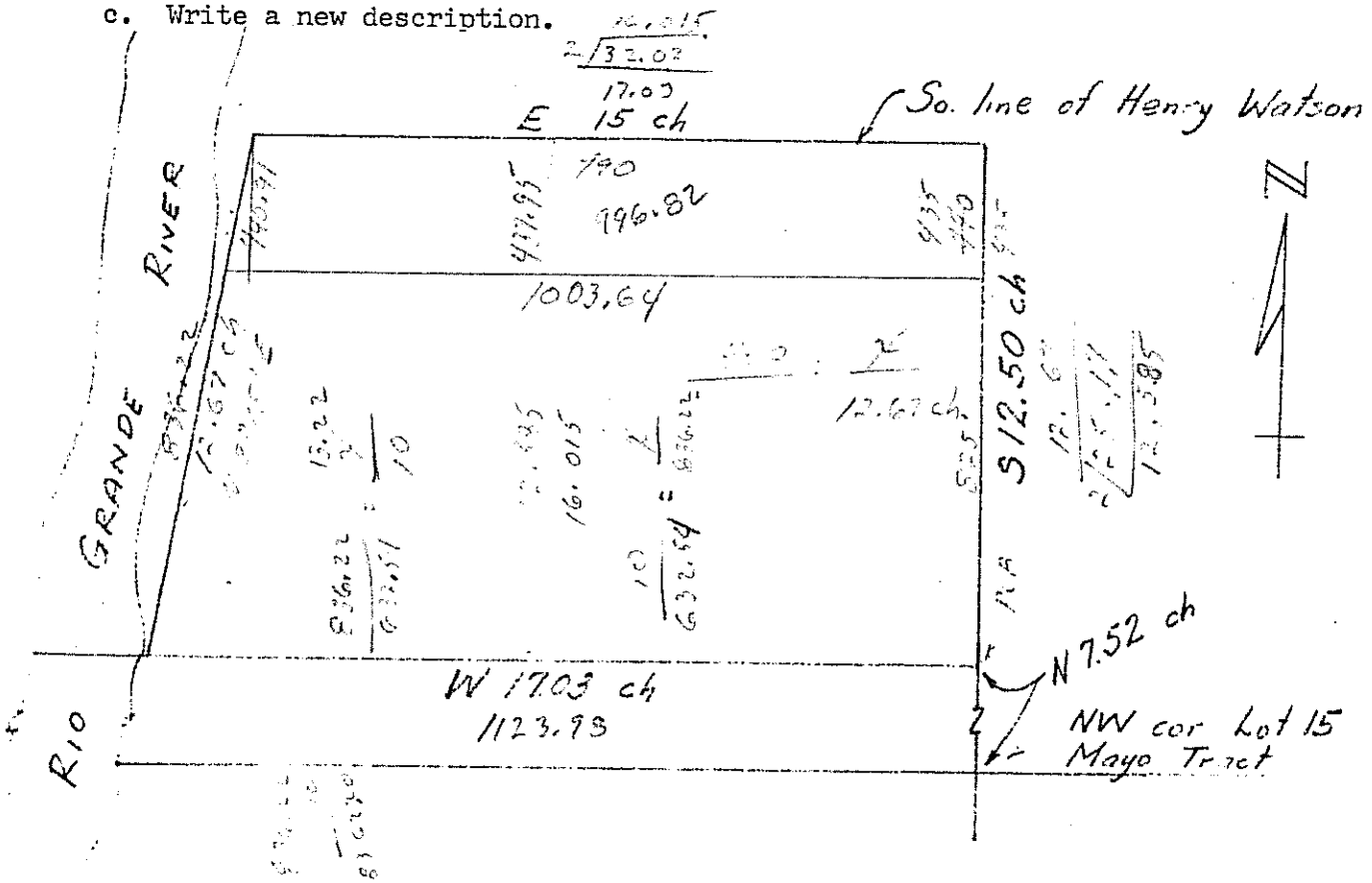
The plat below shows the controls as per map reference. Draw the owner's parcel in relation to these controls.

REQUIRED:

a. How do you determine the position of the south line of the "North ten acres"?

b. How would you rewrite the description?
Could it be more definitive under the circumstances?

c. Write a new description.



Problem D4 - Wt. 12.5

The plat on the following page shows Lot 212 for which a boundary survey and a topographic map have been requested. It is expected that the lot will be subdivided in the near future in a pattern similar to that shown for the existing lots in the adjoining property lying to the West. Lot 25 is one of the lots in the tract that was previously subdivided.

Your research discloses that the land owner acquired one of several adjoining parcels which were created by a 1910 Decree of Distribution. The original parcels were 910 feet square. The plat is drawn with cardinal directions shown for all lines other than diagonals, and with a 20 ft. right of way along the South boundary. The 20 ft. was designated to the County for a road.

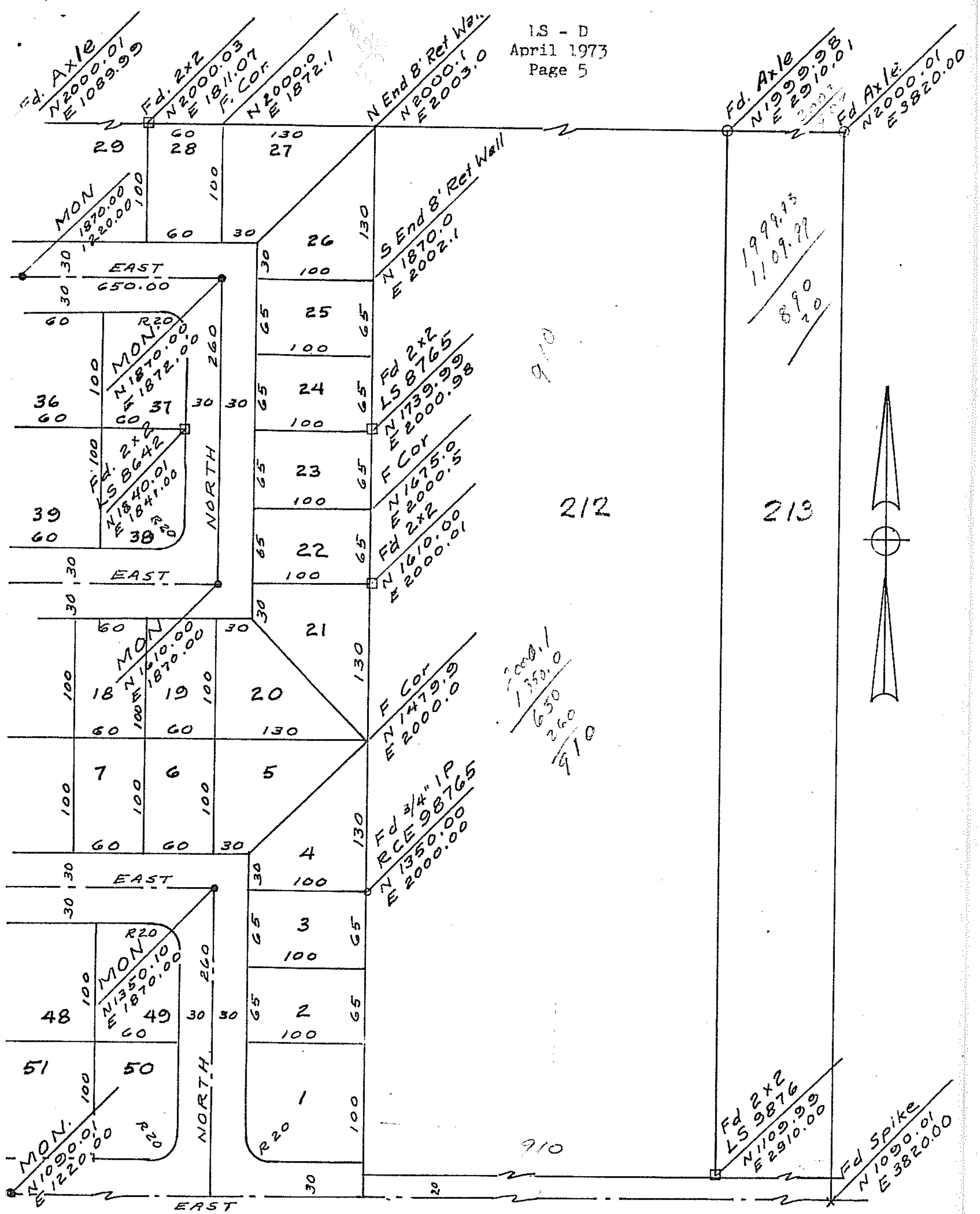
The results of your field work are shown by the coordinates noted on the plat. All other dimensions are taken from the adjacent subdivision map recorded in 1950. To the West of the existing subdivision you have found physical evidence of monuments and lot corners which mark boundaries that are consistent with the map of the existing subdivisions.

REQUIRED:

a. Prepare a written report to the owner regarding his boundary. Where would you place his corners? Identify any problems that may exist, or that could be anticipated, and your proposed solution to them.

b. Describe the procedure you would use to set the corners of Lot 25. How would you evaluate the correctness of your corners for this lot?

c. Describe the method you would use to obtain the topography for Lot 212. What equipment is necessary? What obstacles would you expect? What contour interval and scale would you recommend consistent with anticipated use and economic efficiency?

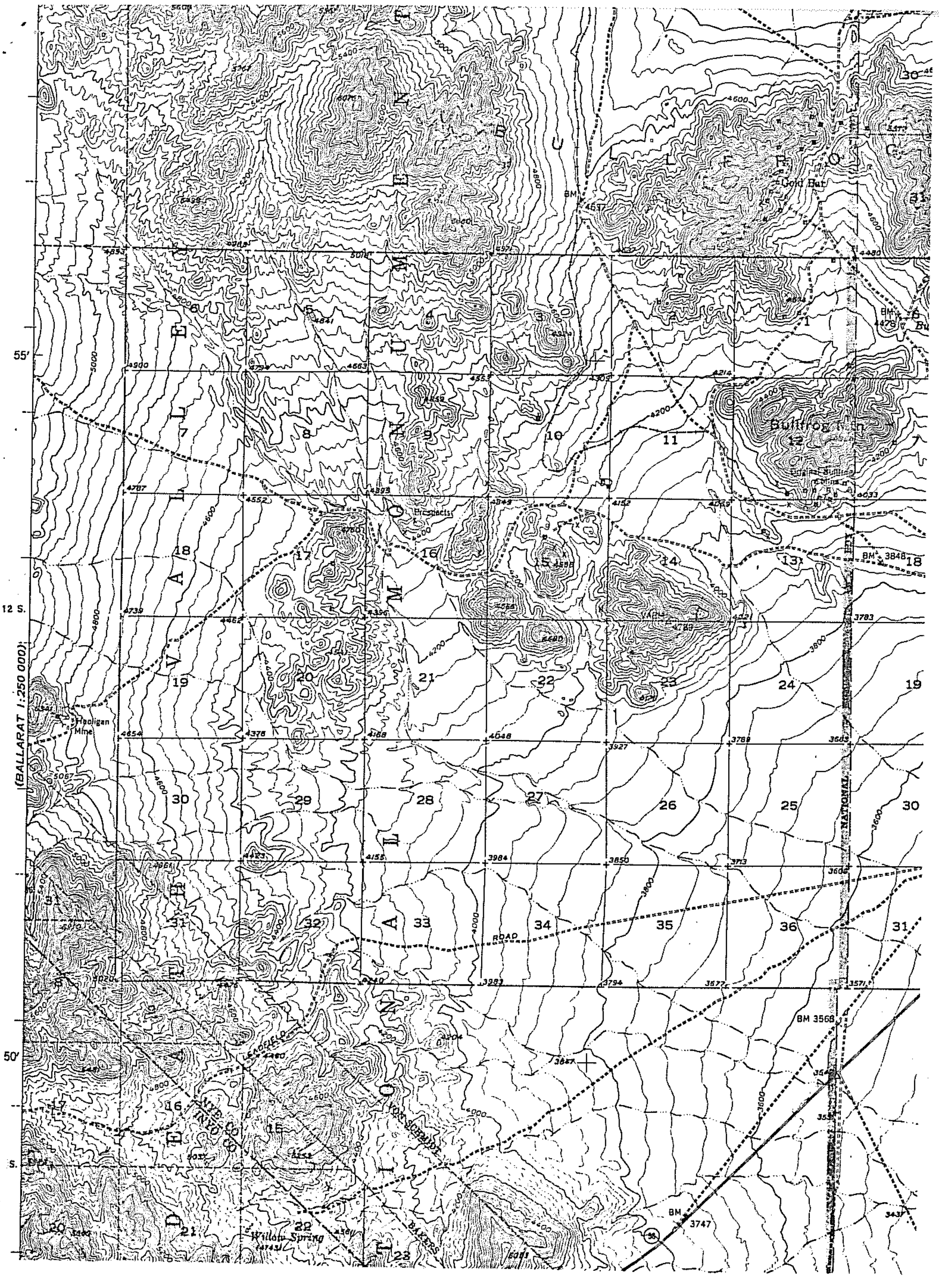

Fd. Axle
N2000.01
E1089.99
Fd. 2x2
N2000.03
E1811.07
F. Cor.
N2000.0
E1872.1
N End 8' Ret Wall
N2000.1
E2003.0
Fd. Axle
N1999.98
E2910.01
Fd Axle
N2000.01
E3820.00
29
28
27
26
25
24
23
22
21
20
19
18
7
6
5
4
3
2
1
36
37
39
38
48
49
51
50
212
213
MON
1870.00
1220.00
S End 8' Ret Wall
N1870.0
E2002.1
EAST
650.00
MON.
N1870.00
E1872.00
R20
Fd 2x2
LS 8765
N1739.99
E2000.98
Fd. 2x2
LS 8642
N1840.01
E1841.00
F Cor
N1675.0
E2000.5
NORTH
Fd 2x2
N1610.00
E2000.01
MON
N1610.00
E1870.00
F Cor
N1479.9
E2000.0
Fd 3/4" IP
RCE 98765
N1350.00
E2000.00
MON
N1350.10
E1870.00
MON.
N1090.01
E1220.00
Fd 2x2
LS 9876
N1109.99
E2910.00
Fd Spike
N1090.01
E3820.00
910
1999.95
1109.99
890
2000.1
1350.0
650
260
910

Problem D5 - Wt. 12.5

Photogrammetric procedures are to be used to establish State Plane Coordinates on the section corners of the N/2 of the township shown on the attached map. All corners have been found in the field except for the NW corner of Section 1 and the SW corner of Section 15. The root mean square error of the coordinate positions shall not exceed 0.6 feet.

REQUIRED:

Prepare a proposal on how to accomplish this job. The proposal must be complete with a flight plan and control requirements (which are to be plotted on the attached map) and a discussion of field and photogrammetric procedures recommended to position all of the existing corners and the two missing corners within the specified tolerance.



55'
T. 12 S.
(BALLARAT 1:250 000)
50'
Gold Bar
Bullfrog Mtn
Prospects
Hooligan Mine
Willow Spring
ROAD
NATIONAL
BM 3568
BM 3747

Problem D6 - Wt. 12.5

From station "C" (121°30'-West), the following observations are made:

At 20.00 h GCT the sun's lower limb was observed at altitude +69°13.7'
Ephemeris data for observation: Sun's diameter = 31.8'
parallax & refraction = 0.6'
declination = +16°18.8'
rate of change = +0.71'

Observed distances: Point "C" to point "A" (1°04' North latitude of point "C") = 386,200 ft.
Point "C" to point "B" (00°48' North latitude of point "C") - 440,570 ft.

Observed angle: Angle ACB = 51°22'55"

REQUIRED:

a. What are the geodetic coordinates of point "C"? 36° 48.6 N
121° 30' W

b. What is the final corrected horizontal angle ACB? 51 - 22 - 55