LS Review
Math Questions

1. For a 2000-foot long closed traverse, the following have been computed:

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Sum of North Latitudes = 515.30' Sum of East Departures = 845.40'
Sum of South Latitudes = 515.00' Sum of West Departures = 845.00'
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The traverse closure precision is:

a. 1/6667
b. 1/2000
c. 1/5000
d. 1/4000
e. 1/1720

2. Section 18 of T21N, R6W, was subdivided for the first time about 20 years ago. You wish to retrace that survey. For the north line of the NW1/4 of the NW1/4 (also called Lot 1), what measurement should have been used if the official distance for the north line of Section 18, shown in government notes, is 78.39 chains?

a. 10.00 chains
b. 19.60 chains
c. 18.39 chains
d. 38.39 chains
e. 19.20 chains

3. In 1886 the magnetic bearing of a line was found to be N 87° 55' W when the declination was 4° 37' W. If today, the declination is 0° 12' E, what would the magnetic azimuth (from north) of the same line be?

a. 92° 20'
b. 276° 30'
c. 267° 16'
d. 276° 54'
e. 267° 40'

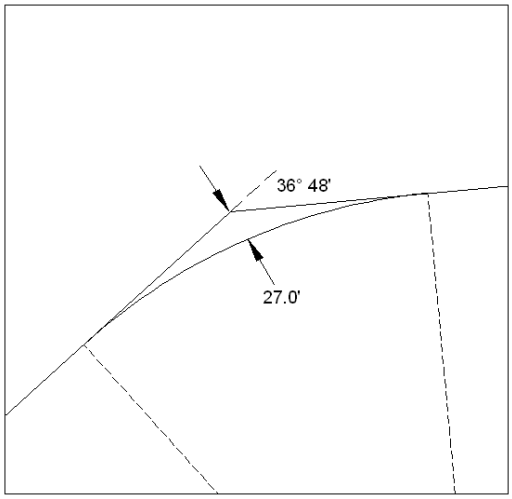
4. An aircraft carrying an aerial camera of focal length 6 inches flies over an area with average elevation of 3,000 feet above mean sea level (M.S.L.). What should be the height of the aircraft in feet above M.S.L. to obtain photography with an average scale of 1:30,000?

a. 12,000
b. 21,000
c. 15,000
d. 30,000
e. 18,000

5. In trying to find an old original land corner you find that the surveyor, in chaining out the line, crossed a stream at 45.6 chains and set the corner at 51.25 chains total measure. From other lines in the area, you find a very constant chaining factor of 100.00 feet of your measure equals 99.75 feet of the original surveyor's. How far beyond the same point in the stream would you measure to find the original corner today? Assume the stream has not shifted.

   a. 5.66 feet
   b. 372.90 feet
   c. 66.00 feet
   d. 373.84 feet
   e. 371.97 feet

6. What is the radius of the curve shown to the right?



   a. 501.07
   b. 501.09
   c. 501.11
   d. 501.13

7. What would the deflection angle be from Station 23+00 to 25+00 on the horizontal curve defined below? (Deflection angle means you are set on Station 23+00, you sight the BC of the curve, plunge the telescope and then turn to 25+00, assume it is a deflection right, unless told otherwise)

   STA_{PI} = 24+98.12 I = 23° 34′ 56″ R = 2500′

   a. 2° 17′ 30″
   b. 4° 35′ 01″
   c. 6° 00′ 06″
   d. 11° 47′ 28″
   e. 12° 00′ 12″

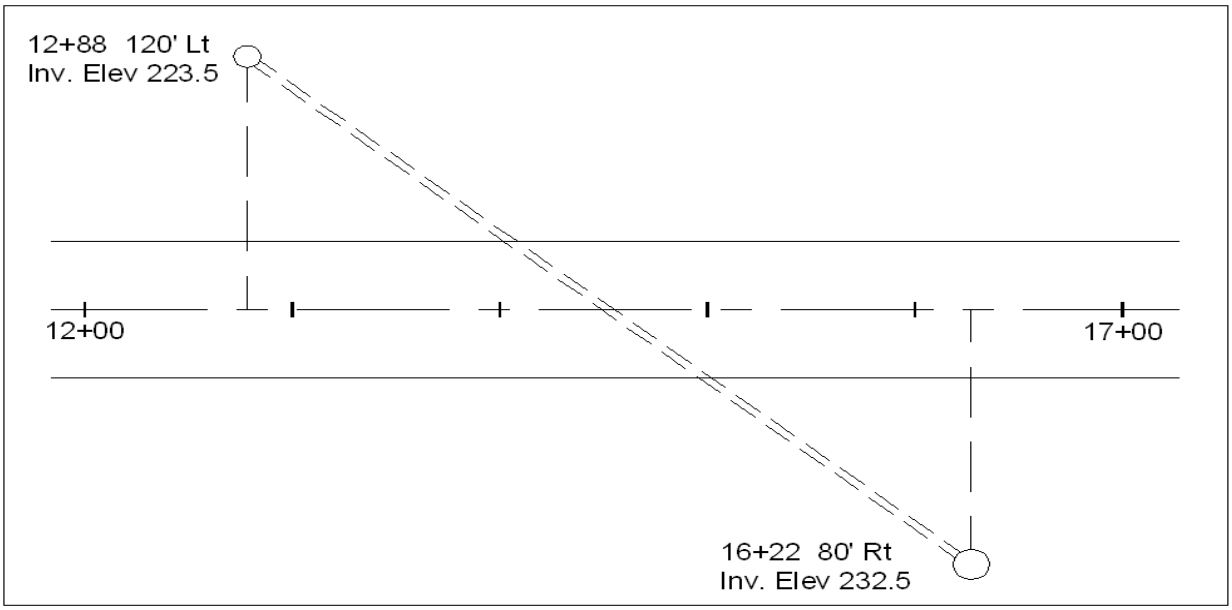
8. What would the chord distance be from station 25+00 to the EC based on the following horizontal curve?

   STAPI = 24+98.12 I = 23° 34′ 56″ R = 2500′

   a. 523.75
   b. 522.79
   c. 505.21
   d. 504.35
   e. 501.77

9. What is the Station and elevation of the Vertical point of intersection for a tangent that has a grade of -3.50% and an elevation of 352.56 at station 10+00; with a tangent that has a grade of + 4.25% and an elevation of 335.00 at station 20+00?

   a. 15+00 Elev.= 335.06
   b. 15+00 Elev.= 313.75
   c. **17+75** **Elev.= 325.43**
   d. 18+00 Elev.= 324.56
   e. 18+25 Elev. = 327.56



10. On the proposed road shown above, a vertical curve is designed based on the following criteria; STA_{VPI} = 11+00; $ELEV_{VP}I$ = 214.40 g1 = -2.50%; g2 = + 5.05%; Length = 1000 feet. The line crossing the road, as shown in the sketch above, is a 2 foot diameter sewer line. What is the approximate clearance from the top of the pipe to the finish grade at the centerline of the road?

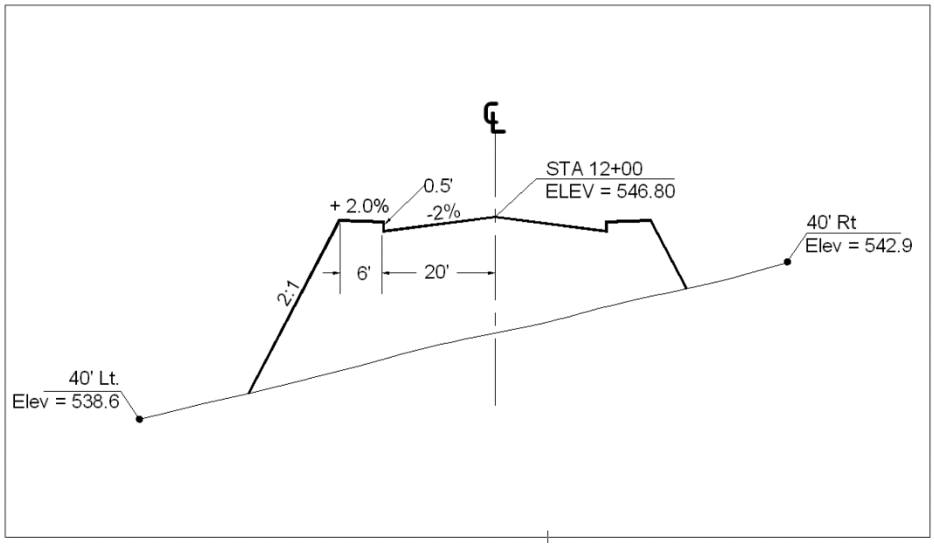
    a. 3.5'
    b. 4.0'
    c. 4.5'
    d. 5.0'
    e. 5.5'
    f. 6.0'

11. An area of a field is measured to be 4.245 In^2 on a photograph. The photo was taken at an elevation of 12,000' MSL with a camera that has a focal length of 6.000 inches. If the field is at an elevation of 3,500' MSL, what is the area of the field in acres?

    a. 19.6 acres
    b. 39.2 acres
    c. 196 acres
    d. 392 acres
    e. 1960 acres
    f. 3920 acres

12. Looking at the image below, if the grade of the road from station 12+00 to 24+00 is +2.45%, what is the elevation of the curb flow line at station 18+45?

    a. 562.60
    b. 562.20
    c. 562.82
    d. 567.50
    e. 567.10
    f. 567.72



13. Looking at the image above, what is the distance from centerline to the right catch point?

    a. 8.3
    b. 8.8
    c. 9.3
    d. 34.3
    e. 34.8
    f. 35.3

14. The east line of Section 1, shows a record dimension of 78.90 chains. What would the length of the east line of Lot 1, in section 1 be?

    a. 20 chains
    b. 19.16 chains
    c. 19.73 chains
    d. 19.45 chains
    e. 18.90 chains

15. If in the above question, you measured the east line of Section 1 to be 80 chains, what would the measured length of the east line of Lot 1 be?

    a. 20 chains
    b. 19.16 chains
    c. 19.73 chains
    d. 19.45 chains
    e. 18.90 chains

16. A project that is 8000 feet by 4000 feet, is to be mapped at a 1 foot contour interval, using a camera with a 6 in focal length and standard 9" x 9" negatives. It will be plotted on a plotter with a C-factor of 2000. Assuming standard 60% forward overlap and 30% side overlap, how many flight lines and photos will be required? (assume the standard neat model size)

    a. One Flight line 4 photos
    b. Two Flight lines 4 photos
    c. Two Flight lines 8 photos
    d. Two Flight lines 14 photos
    e. Two flight lines 16 photos

17. What maximum uncertainty in measuring a vertical angle of 5° 00' 00" will result in a precision of at least 1:20,000 for the derived horizontal distance when the slope distance is 5000.00 feet? (Neglect curvature and refraction)

    a. 0° 00' 10"
    b. 0° 13' 05"
    c. 0° 00' 01"
    d. 0° 04' 03"
    e. 0° 01' 58"

18. You are set on Pt "Monterey", backsight Pt "KVEC" and turn a clockwise angle to Point "Hill" of 321° 58' 47.26". Using the following information shown on the data sheet for Pt. "Monterey", determine the Grid Azimuth from "Monterey" to "Hill".

    Geodetic Azimuth to "KVEC" = 234° 12' 56.02"
    Convergence angle = -1° 15' 25.6"
    Laplace correction = 12.25"

    a. 194° 56' 17.68"
    b. 196° 11' 43.28"
    c. 197° 27' 08.88"
    d. 197° 27' 21.13"
    e. 272° 14' 08.76"

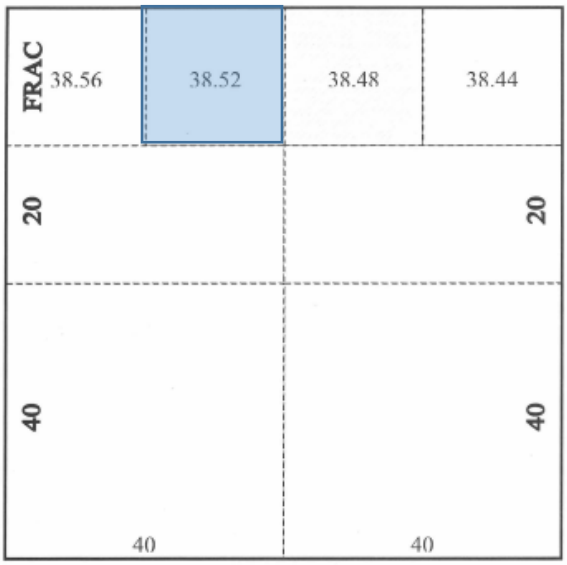
19. You have a map that shows the grid bearing and grid distance between Point "Alpha" and Point "Dog" to be N 01° 14' 56" W 4,560.234 meters. On the map there is a statement that the combined scale factor is 0.99985623 and the convergence angle is -1° 31' 55". The elevation at "Alpha" is 2345.67 feet, and the elevation at "Dog" is 1299.032 feet. What is the geodetic azimuth and ground distance in U.S. survey feet?

    a. 0° 16' 59" 14959.22 sFt.
    b. 0° 16' 59" 14,963.51 sFt.
    c. 2° 46' 51" 14959.22 sFt.
    d. 357° 13' 09" 14,963.52 sFt.
    e. 358° 45' 04" 14,961.37 sFt.

20. In trying to find an old original land corner you find that the surveyor crossed a stream at 45.6 chains and set the corner at 51.25 chains total measure. From other lines in the area, you find a very constant chaining factor of 100.00 feet of your measure equals 99.75 feet of the original surveyors. How far beyond the same point in the stream would you measure to find the original corner today? Assume the stream has not shifted.

    a. 5.66 feet
    b. 66.00 feet
    c. 371.97feet
    d. 372.90 feet
    e. 373.84 feet

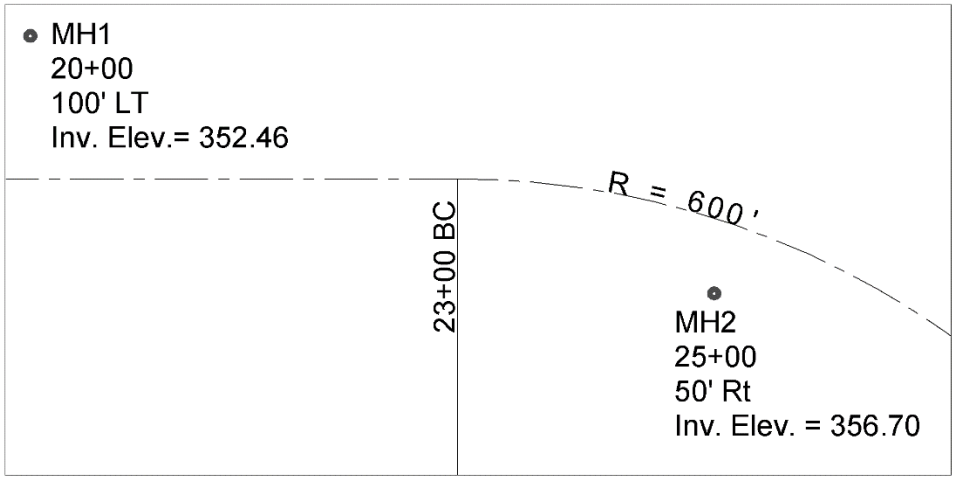
    This is the same as #5!



Sec. 1 T9N, R1E, SBM
Per Government Survey 1876

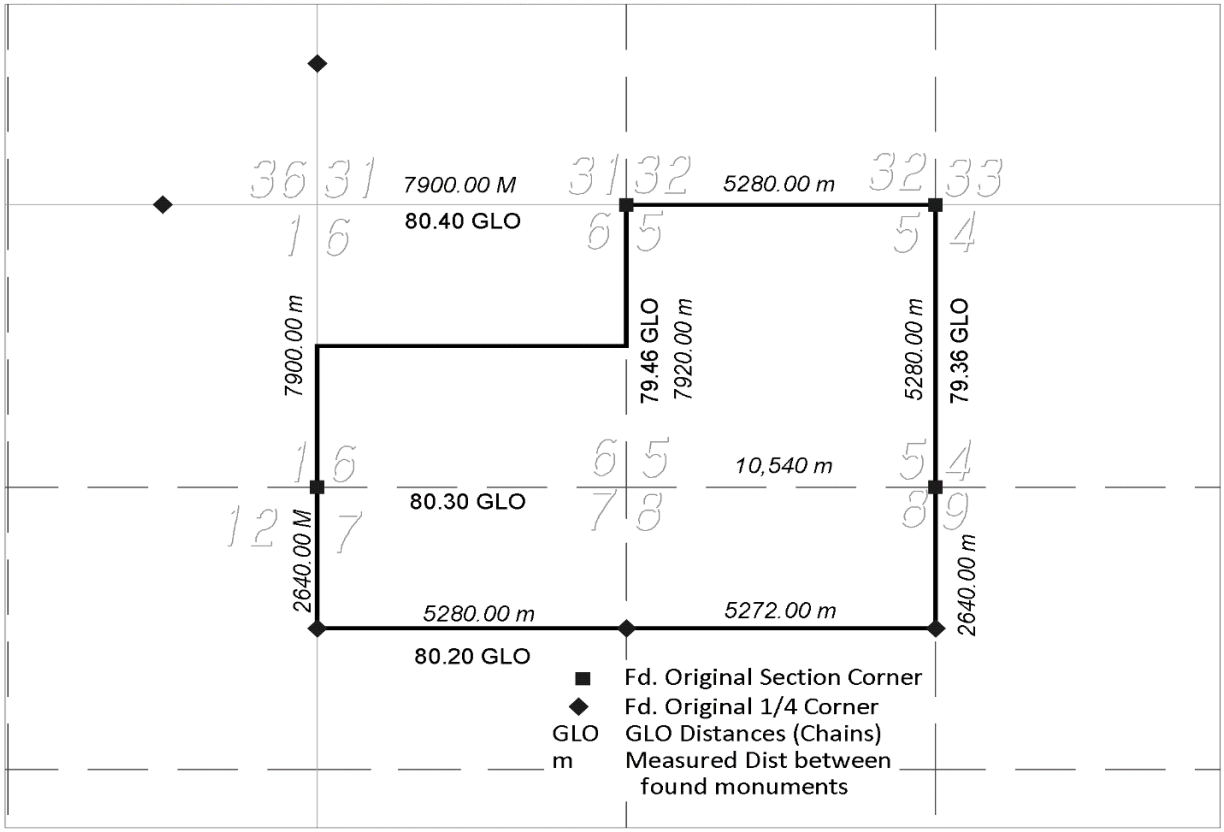
21. Dimension all four sides of the shaded area shown in the above sketch as per Public Land Surveys

See work sheet



22. Based on the information given in the sketch above, what is the distance from MH1 to MH2?

a. 486.62’
b. 497.41’
c. 512.70’
d. 522.02’



The following two questions pertain to the sketch above.
These two are the same questions from State Lays #7 & #8

23. The agreement requires that Aerial mapping on the project be done with 2 foot contours. You Photogrammetrist indicates that they will be using a plotter with a C-Factor of 2000, A focal Length of 6", the negative size of 9" x 9" and the neat model covers 40% in the direction of the flight and 70% on the sides. The average Terrain elevation is 1250 feet. Minimizing the number of flight lines, what is the number of photos that will be required to complete the aerial mapping.

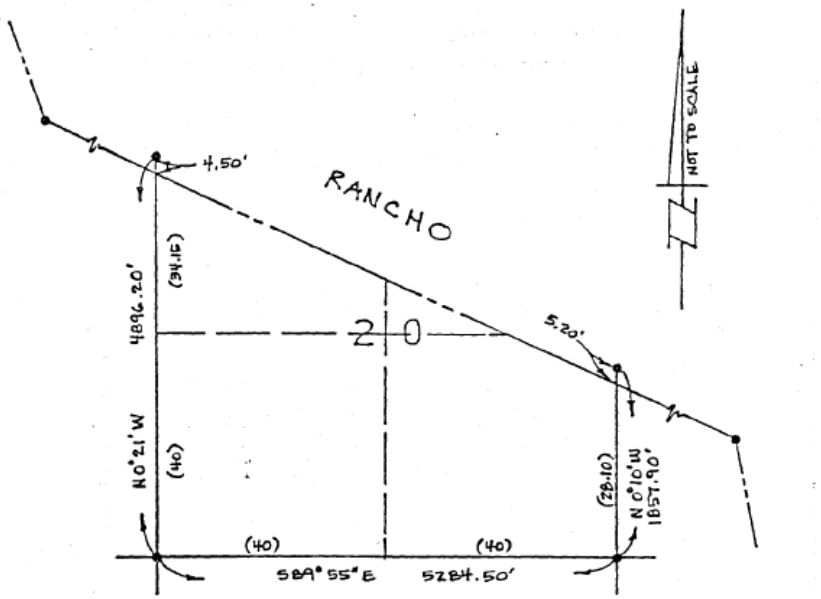
    a. 9
    b. 10
    c. 11
    d. 12
    e. 13

24. All GLO bearings shown on the Plat were Cardinal, and all the measured directions were close to cardinal. What would be the approximate distance from the NW cor. of Sec. 5 to the west ¼ cor. of Sec. 5?

    a. 2586 feet
    b. 2604 feet
    c. 2616 feet
    d. 2640 feet
    e. 2676 feet
    f. 761.58'

The next three questions are based on the information below.

The plat shown below shows fractional Section 20. The meridian and range are not identified. The bearings and distances given in feet are the results of your survey. The information in parentheses is record per the Government Plat.



25. The west ¼ corner of Section 20 would be set:

    a. 2638.81 feet north of the SW Section corner
    b. 2639.12 feet north of the SW Section corner
    c. 2640.00 feet north of the SW Section corner
    d. 2640.88 feet north of the SW Section corner
    e. Cannot be determined based on the information given

I get 2641.24feet per Sec 7.45 of Manual 2009.> I don't know if I am missing something obvious, but it seems like an easy question

26. The NE corner of Section 20 would be set

    a. 1854.60 feet north along the line between found monuments from the SE corner
    b. 1852.70 feet north along the line between found monuments from the SE corner
    c. 1851.30 feet north along the line between found monuments from the SE corner
    d. Cardinal north from the SE corner to the intersection of the Rancho Line
    e. The corner exist as shown on the plat

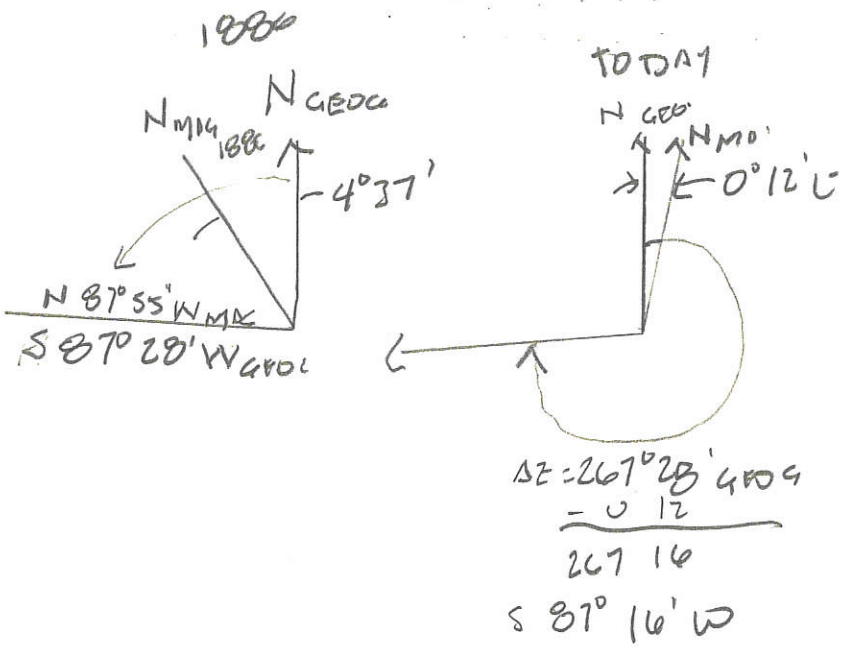
27. The center ¼ corner for Section 20 would be set by:

    a. Holding cardinal directions between the South and West ¼ corners
    b. Prorating along the Rancho line to determine the North and East ¼ corners and then intersection of ¼ corners
    c. Holding record distances from the South and West ¼ corners on cardinal direction and then double proportioning in the center ¼ corner
    d. Holding record distance from the south ¼ corner on a bearing of N 0° 15' 30" W
    e. Holding a bearing of N 0° 15' 30" W from the south ¼ corner and a cardinal bearing from the West ¼ corner

1. $E.O.C = \sqrt{0.30^2 + 0.40^2} - 0.50$

$R.L^s = \frac{0.50}{2000} = \frac{1}{4000}$

3.



4. $SCALE = \frac{f}{H - h}$

$\frac{1}{30,000} = \frac{0.5'}{H - 3000'}$

$H = \frac{0.50' \times 30,000}{} + 3000'$

$= 18,000'$

5. $51.25_{GN} - 45.6_{GN} = 5.65_{GN} = 372.90$ ft

$\frac{DIST_{MEAS}}{372.90} = \frac{100.00}{99.75'}$

$DIST_{MEAS} = \frac{100.00 \times 372.90}{99.75} = 373.83$

6. $L_{EXTERNAL} = R\left(\frac{1}{\cos(\Delta/2)} - 1\right)$

$$R = \frac{E}{\frac{1}{\cos \Delta/2} - 1}$$

$$12 = \frac{27.0}{\frac{1}{\cos 1.8°24'} + 1} = \frac{27.0}{0.053818} = 501.13'$$

7. $T = R \times \tan \Delta/2$

$T = 2500 \times \tan(11°47'28") = 521.87$

$STA_{BC} = 2498.12 - 521.87 = 19+76^{25}$

$L_{BC\ TO\ 25+00} = 2500 - 1976^{25} = 523.75$

$L_{FULL\ CURVE} = 2500 \times 0.411587 = 1028.97$

$$\frac{\Delta/2_{(25+00)}}{11°47'28"} = \frac{523.75}{1028.97}$$

$$\Delta/2_{(25+00)} = \frac{523.75 \times 11°47'28"}{1028.97} = 6°00'00"$$

8 $EC_{STA} = 1976.25 + 1028.97 = 30+05^{22}$

$L = 25+00\ TO\ EC = 505.22$

$$\frac{\Delta/2_{25-EC}}{11°47'28"} = \frac{505.22}{1028.97} = 5°47'22"$$

$Ch = 2 \cdot R \cdot \sin(\Delta/2)$

$= 2 \cdot 2500 \cdot \sin(5°47'22") = 504.36$

LS MATH

#9 USE EQUATION OF LINE $y = bx + c$

$y = -0.035x + 352.56$ X = HOR DIST FROM 10+00
y = ELEV AT INTERSECTION

$y = -0.0425(1000 - x) + 335.00$ CHANG. DIR. OF SLOPE

$-0.035x + 352.56 = -0.0425(1000 - x) + 335.00$

$-0.035x + 352.56 = 0.0425x + 292.50$

$-0.0775x = -60.00$

$x = 774.97$

$y = -0.035 \cdot 774.97 + 352.56 = 325.43$

C 17+74.97 325.43

#10 STATION AT INTERSECTION: $\frac{x}{334.00} = \frac{120}{200}$

$x = 200.40$ STA = $14+88^{40}$

Road ℄ $y = ax^2 + bx + c$ $a = \frac{g_2 - g_1}{L \cdot 2} = 0.000038$

$y = 29.79 + -22.21 + 226.90$ $b = -0.025$

$y = 234.48$ $c = 226.90$

$x = 1488^{40} - 600 = 888^{40}$

INV ELEV AT INTERSECTION

$\frac{x}{9.0} = \frac{120}{200}$ $x = 5.4$

ELEV INV AT INT = 223.5 + 5.4 = 228.9

TOP PIPE 228.9 + 2.0 + PIPE THICK = 230.9 + THICK

CLEARANCE = 4.5'

#11 $\text{SCALE} = \frac{f}{H-h} = \frac{0.50'}{12000-3500} = \frac{1}{17,000}$

$\text{AREA}_{\text{GROUND}} = \text{AREA}_{\text{MAP}} \times \left(\frac{1}{\text{SCALE}}\right)^2$

$= 4.245\ \text{IN}^2 \times 17{,}000^2 \times \frac{1\ \text{SQ FT}}{144\ \text{SQ IN}} \times \frac{1\ \text{ACRE}}{43{,}560\ \text{SQ FT}}$

$= 195.58\ \text{AC}$

#12.

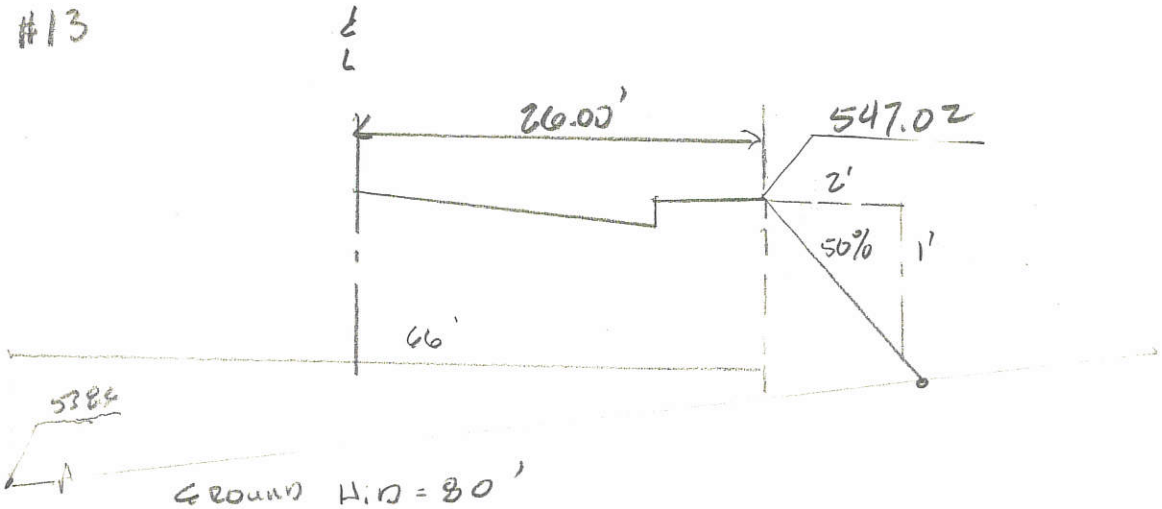
1845 - 1200 = 645.00'

645.00 × 0.0245 = 15.80

546.80 + 15.80 = 562.60

562.60 + -0.02 × 20 = 562.20

#13



Ground Hor = 80'
Ver = 4.3'
Slope = 5.375%

$y = bx + c$

$y = 0.0537x + 538.6$

$y = -0.50(x-66) + 547.02$

$0.0537x + 538.6 = -0.50x + 33 + 547.02$

$0.5537x = 41.42$

$x = 74.80$

From ℄ 74.80 - 40 = 34.80

#15

$$\frac{18.90}{78.90} = \frac{x}{80.00}$$

$$x = 80.00 \times \frac{18.90}{78.90} = 19.16$$

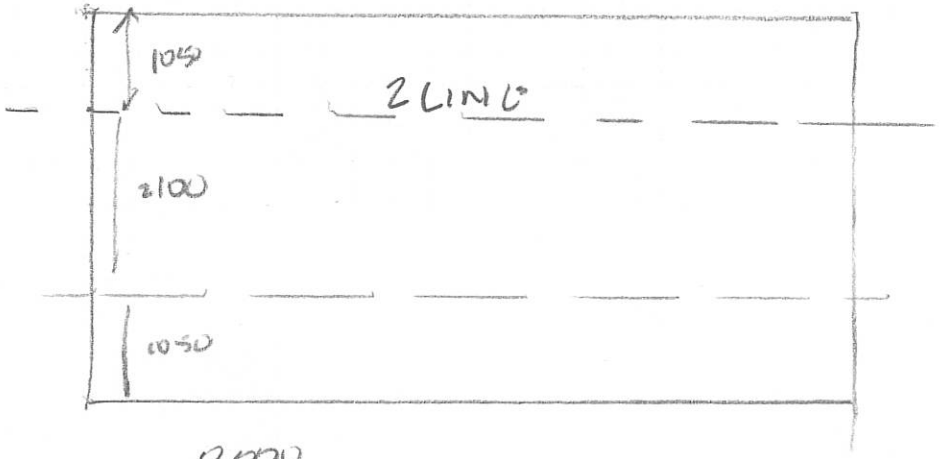
#16

NEAT MODEL = 6.3" x 3.6"

$$\text{SCALE} = \frac{0.5}{2000} = \frac{1}{4000}$$

$$\text{NEAT MODEL GR} = \frac{6.3 \times 4000}{12} = 2100'$$

$$\frac{3.6 \times 4000}{12} = 1200'$$



$$\frac{8000}{1200} = 6.66 = 7 \text{ NEAT MODEL PER LINE}$$

$$= 8 \text{ PHOTOS PER LINE}$$

#17

$$HD = \cos(5^\circ) \times 5000 \qquad 4980.97$$

$$1:20000 \text{ @ } 5000' = 0.25' \qquad -0.25$$

$$4980.72$$

$$\cos^{-1}\left(\frac{4980.72}{5000}\right) = 5^\circ 01' 58''$$

#18 GEOD MONT @ HIL → 234 12 56.02
+321 58 47.26
556-11-43.28
-360
196-11-43.28
- -1 15 25.60
197-27-08.88

Grid = Geod - Conv

#19 GRD DIST = Ground × C.S.F

$$\text{Ground} = \frac{\text{Grid Dist}}{\text{C.S.F}}$$

$$= \frac{4560.234}{0.99985623} \times \frac{39.37}{12}$$

$$= 14,963.52$$

Grid Az = Geod Az − Conv ∠

Geod Az = Grid + Conv

= 358 45 04 + -1°31'55"

= 357° 13' 09"

#21 DIMENSION BASED ON AREA

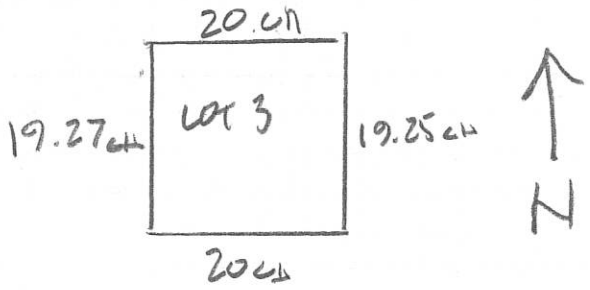
AREA OF ALL 4 LOTS = 154.00

NORTH + SOUTH LINE = 80CH

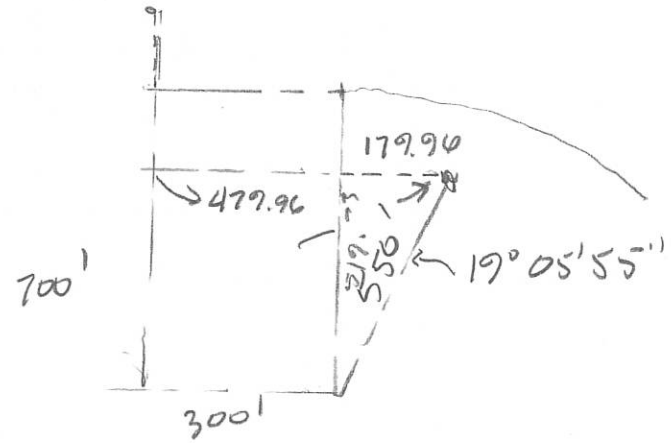
MID DIST IN CH = $\frac{80 \cdot DIST}{10} = 154.00$

DIST = $\frac{154.00 \times 10}{80} = 19.25$ CH

38.52 - 19.25 = 19.27



#22



$L = R \Delta_{RAD}$

$\Delta_{RAD} = \frac{200}{600} = 0.3333_{RAD} = 19°05'55"$

OPP = 550 · SIN(19°05'55") = 179.96

ADJ = 550 · COS(19°05'55") = 519.73

DIST = $\sqrt{479.96^2 + 180.27^2}$ = 512.70'

#25 $\frac{40}{74.15} = \frac{x}{4896.20}$

$x = \frac{40 \times 4896.20}{74.15} = 2641.24$