NCEES FS Practice Exam

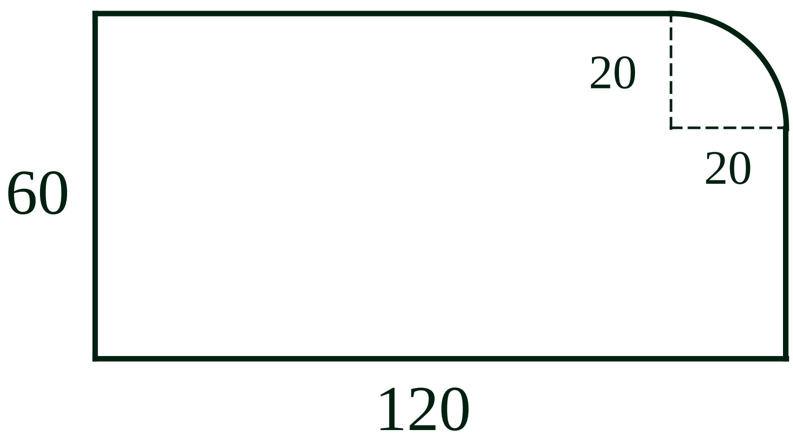
Terrametra Resources

Lynn Patten

- 1. One corner of a 60-ft. × 120-ft. lot, otherwise rectangular, is a curve with a radius of 20 ft. and a central angle of 90°.

- The area (ft.^{2}) of the lot is most nearly:

  A. 6,872
  B. 6,886
  C. 7,114
  D. 7,200



$$60 \times 120 = 7200$$

$$\underline{-\ 20 \times 20 = \ \ 400}$$

$$6800$$

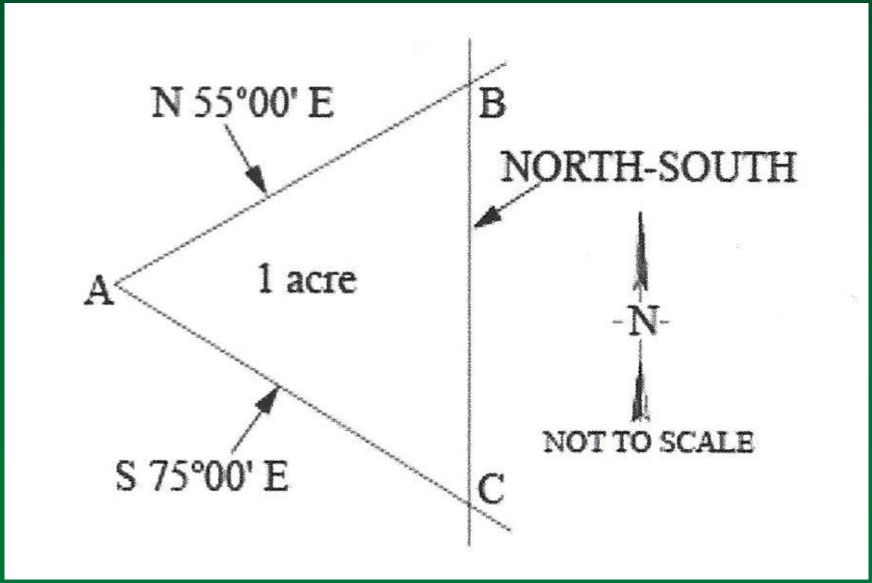
$$+ \quad \frac{\pi(20)^2}{4} = \ 314$$

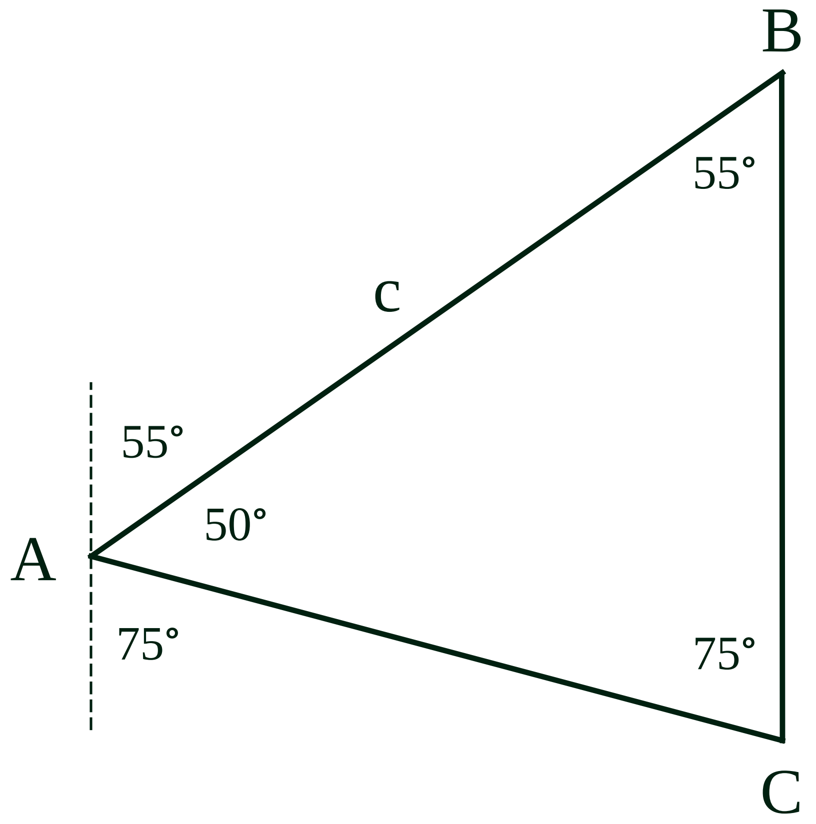
$$7114$$

- 2. A client wants to create a 1-acre parcel by establishing a North-South line, BC, as shown in the figure.

- The length (ft.) of Side AB is most nearly:

  A. 299.96
  B. 352.84
  C. 358.73
  D. 366.20





$$Area = \frac{c^2 \sin A \sin B}{2 \sin C}$$

$$43560 = \frac{c^2 \sin 50 \sin 55}{2 \sin 75}$$

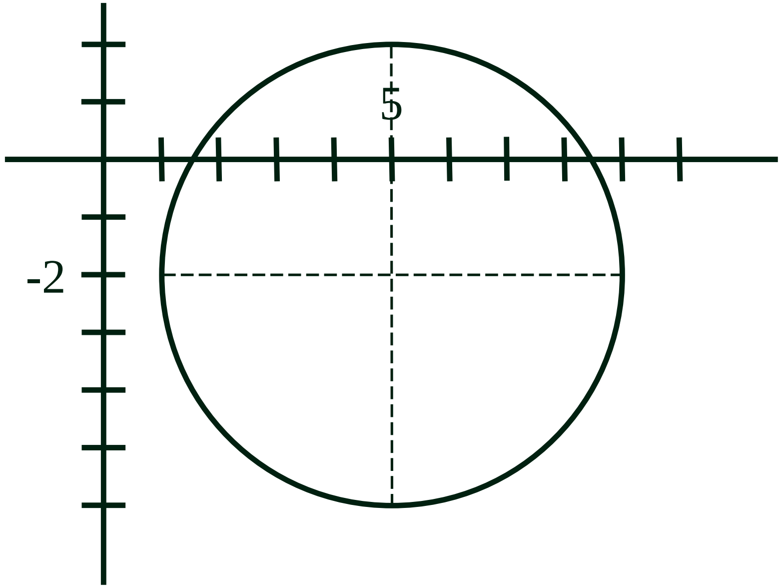
$$c^2 = \frac{2\,(43560) \sin 75}{\sin 50 \sin 55}$$

$$= 134{,}104.44$$

$$c = 366.20$$

- 3. The center of a circle with a radius of 4 is at $x = 5$, $y = -2$.
- The equation of the circle is:

  A. $(x - 5)^2 + (y - 2)^2 - 4 = 0$
  B. $(x + 5)^2 + (y + 2)^2 - 4 = 0$
  C. $(x - 5)^2 + (y + 2)^2 - 16 = 0$
  D. $(x - 5)^2 + (y + 2)^2 + 16 = 0$



$$\Delta x^2 + \Delta y^2 = r^2$$

$$\big(x - (5)\big)^2 + \big(y - (-2)\big)^2 = 4^2$$

$$(x - 5)^2 + (y + 2)^2 - 16 = 0$$

- 4. A thin-walled tank is constructed as a body of revolution of a parabola, as shown in the figure. The base diameter is 20 ft., and the height of the tank is 25 ft.

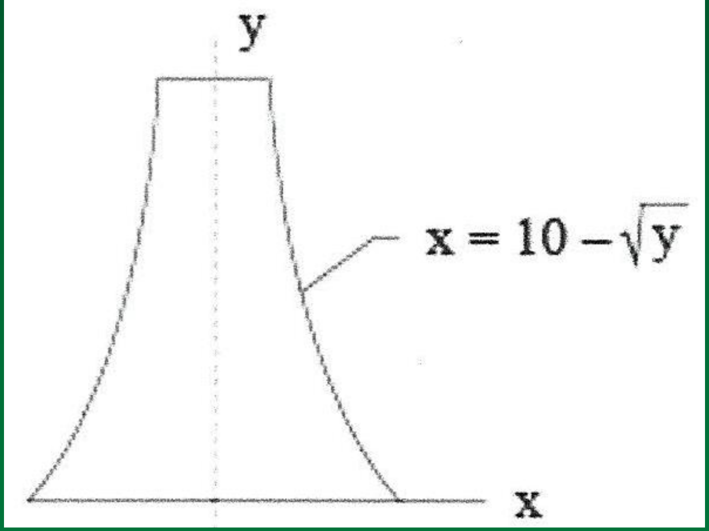
- The volume (ft.^{3}) of water in the tank when full is most nearly:

A. $\frac{500}{3}\pi$

B. $\frac{625}{2}\pi$

C. $\frac{625}{2}(9-4\sqrt{2})\pi$

D. $\frac{6875}{6}\pi$



TERRAMETRA

$$\pi\int_a^b R^2 dh = \pi\int_0^{25}(10-\sqrt{y})^2 dy = \pi\int_0^{25}(100-20\sqrt{y}+y)dy$$

$$= \pi\int_0^{25} 100\,dy - 20\,\pi\int_0^{25} y^{\frac{1}{2}}\,dy + \pi\int_0^{25} y\,dy$$

$$= 100\pi y\Big|_0^{25} - 20\pi\frac{y^{\frac{3}{2}}}{\frac{3}{2}}\Big|_0^{25} + \pi\frac{y^2}{2}\Big|_0^{25}$$

$$= 2500\pi - \frac{40}{3}\pi(125) + \frac{\pi}{2}(625) = \frac{15{,}000}{6}\pi - \frac{10{,}000}{6}\pi + \frac{1875}{6}\pi$$

$$= \frac{6875}{6}\pi$$

TERRAMETRA

- 5. Which object described below will subtend the greatest angle at your eye?

  A. A tree 18 feet tall at 100 yards away
  B. A house 12 feet tall at 180 feet away
  C. A 1/2-inch-diameter coin at 10 inches away
  D. The 2,170-mile-diameter moon at 240,000 miles away

$$\frac{18}{100(3)} = \frac{18}{300} = 0.0600$$

$$\frac{12}{180} = 0.0667$$

$$\frac{0.5}{10} = \frac{1}{20} = 0.0500$$

$$\frac{2,170}{240,000} = 0.0090$$

- 6. An island is formed by the intersections of Birch, Oak, and Ash Streets. Specific details of the intersection are shown in the figure below.

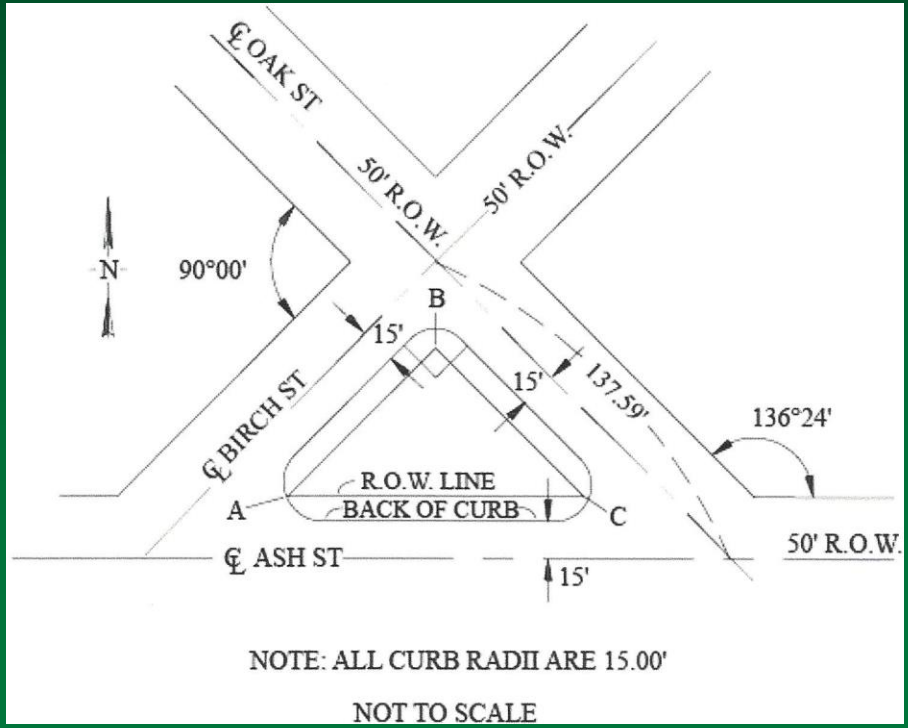
- The length (ft.) of the right-of-way line along the Birch Street side of the island is most nearly:

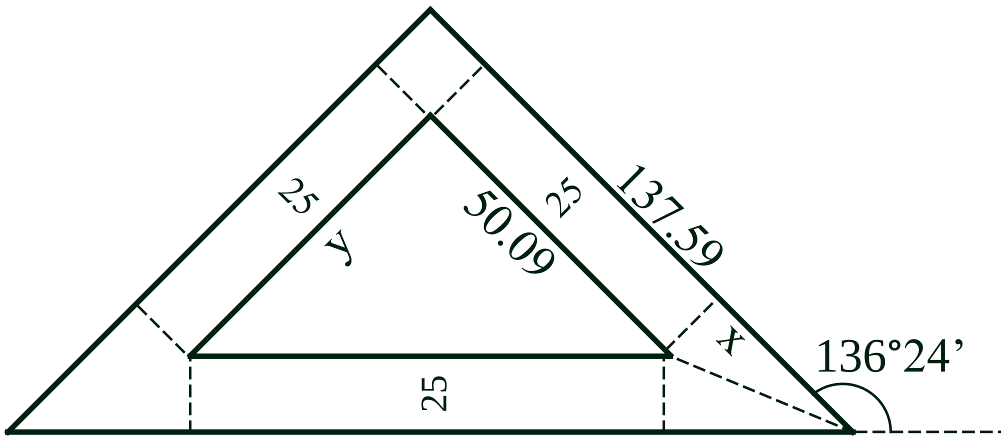
  A. 46.95

  B. 47.35

  C. 47.70

  D. 47.90





$$180° - 136°24' = 43°36'$$

$$\frac{43°36'}{2} = 21°48'$$

$$\tan 21°48' = \frac{25}{x}$$

$$x = 62.50$$

$$137.59 - 25.00 - 62.50$$
$$= 50.09$$

$$\tan 43°36' = \frac{y}{50.09}$$

$$y = 47.70$$

- 7. A thermometer, which is also known to read 3°F too high, records a temperature of 46°F.

- The correct temperature is most nearly:

  A. 6.1°C
  B. 7.8°C
  C. 9.4°C
  D. 25.2°C

$$C = \frac{5}{9}(F - 32)$$

$$C = \frac{5}{9}(43 - 32) = \frac{5}{9}(11) = \frac{55}{9} = 6.1°\mathrm{C}$$

- 8. Two brass monuments set on a shady sidewalk have a known, verified horizontal separation of 99.96 ft. A surveyor measures between the monuments with a tape and reads 99.99 ft. at a temperature of 83°F, holding a tension of 15 lb. while the tape is fully supported.

- The length (ft.) of the surveyor's tape between the 0 and 100 marks while the temperature remains at 83°F is most nearly:

  A. 99.95
  B. 99.97
  C. 100.03
  D. The question cannot be answered with the information given.

$$\frac{99.96\text{' true}}{99.99\text{' measured}}$$

$$\frac{x\text{' true}}{100.00\text{' measured}}$$

$$\frac{99.96}{99.99} = \frac{x}{100.00}$$

$$x = 99.97$$

- 9. Direct and reverse zenith angles to a point are read as follows:

  D = 36°12'18"

  R = 323°47'36"

- The vertical circle reading that must be set in the instrument to produce a vertical angle of 12°16'12" is most nearly:

  A. 77°43'45"

  B. 77°43'48"

  C. 77°43'51"

  D. 77°43'54"

raw zenith angles	adjusted zenith angles	true vertical 12-16-12
36-12-18 + 323-47-36 359-59-54	36-12-21 + 323-47-39 359-59-60	true zenith 77-43-48
6” short	check	actual zenith 77-43-45

- 10. The elevation of BM A is 644.00 ft. A level in perfect adjustment is set midway between BM A and BM B. The backsight reading is 8.76 ft. and the foresight reading is 3.21 ft.

- If the level rod at BM B is held at an angle of 10° to the vertical, then the correct elevation (ft.) of BM B is:

  A. 638.40

  B. 649.50

  C. 649.55

  D. 649.60

$$\cos 10° = \frac{h}{3.21}$$

$$h = 3.21 \cos 10°$$

$$= 3.16$$

$$\begin{array}{r} 644.00 \\ +\quad 8.76 \\ \hline 652.76 \\ -\quad 3.16 \\ \hline 649.60 \end{array}$$

- 11. Consider the following

  $$A = B*C + D/C\^2$$

  Where: B = 2 C = 0.5 D = 127

  The following notation applies to this question:

  * = multiply / = divide ^ = raise to exponent

- If the question were executed by a spreadsheet or computer, the value of A would be most nearly:

  A. 509
  B. 512
  C. 130,050
  D. 299,081

$$A = \quad B * C \quad + \quad D/C\hat{}2$$

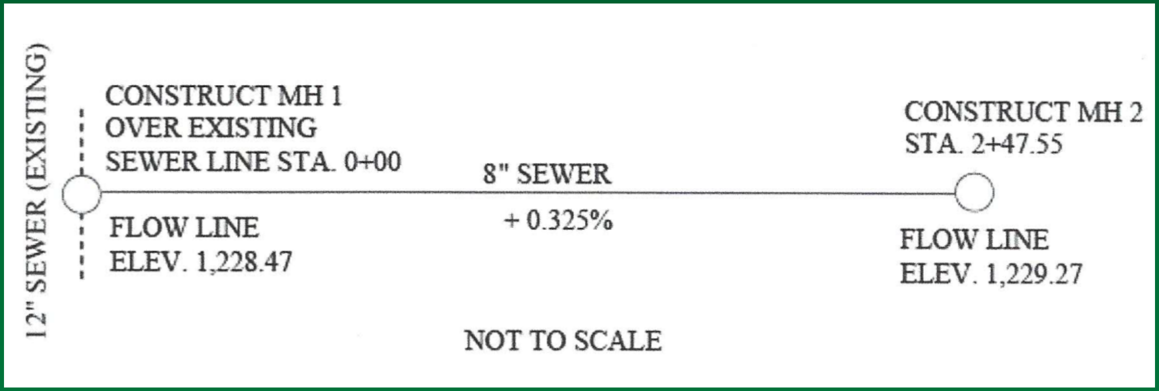
$$= (2) \cdot (0.5) + 127/(0.5)^2$$

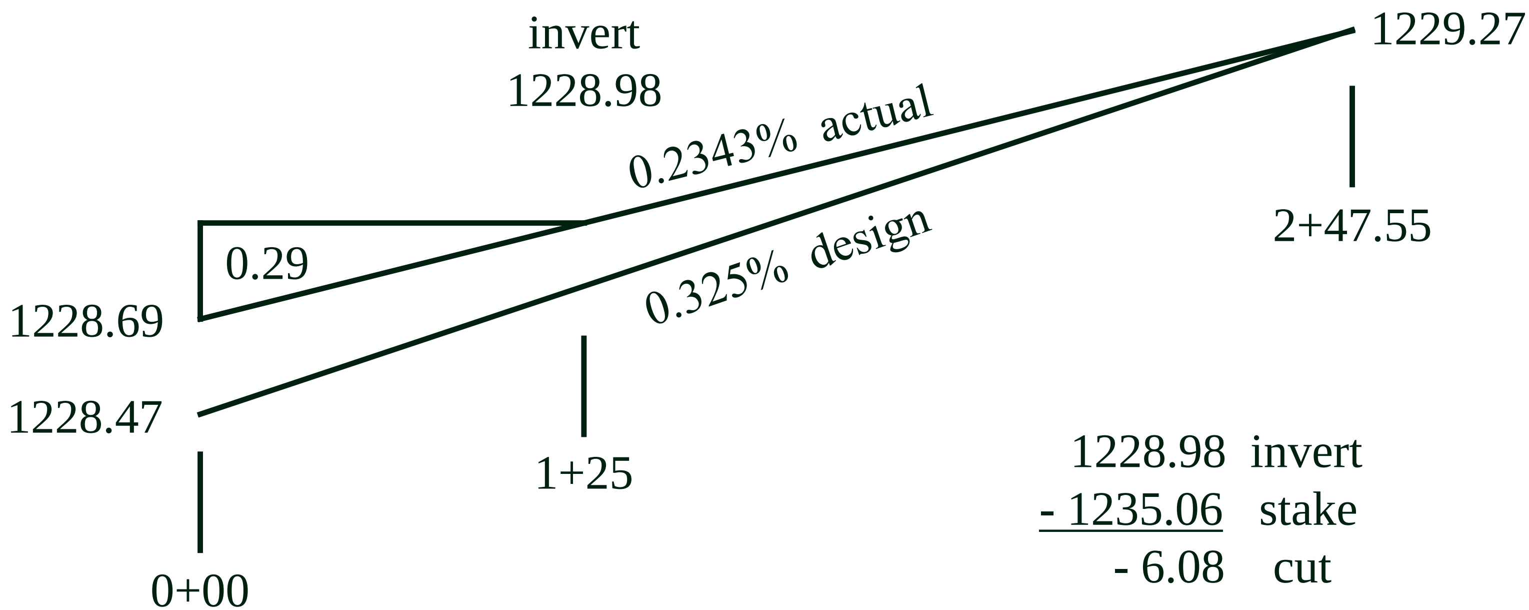
$$= 1 + \frac{127}{0.25} \; = 1 + 127(4)$$

$$= 1 + 508 \; = \; 509$$

- 12. A survey party has set offset stakes for construction of an 8-in. sewer shown in the design plan. When the existing 12-in. sewer line is uncovered for the construction of Maintenance Hole (MH) 1, it is found that the actual flow line elevation is 1,228.69 ft. rather than the design elevation of 1,228.47 ft. The gradient must be revised, holding the flow line elevation of 1,229.27 ft. at MH 2. If the elevation of the grade stake is 1,235.06 ft., the cut (ft.) to the flow line that you would mark on the stake at Station 1+25 is most nearly:

  A. 5.98
  B. 6.08
  C. 6.18
  D. 6.25




invert
1228.98
1229.27
0.2343% actual
0.29
0.325% design
2+47.55
1228.69
1228.47
1+25
0+00
1228.98 invert
- 1235.06 stake
- 6.08 cut

- 13. A traverse was run from Point A to Point E, and the coordinates of each point were computed with the following results:

Point	X Coordinate	Y Coordinate
A	100.00	100.00
B	250.55	232.66
C	388.26	95.98
D	466.15	2.15
E	609.50	-11.92

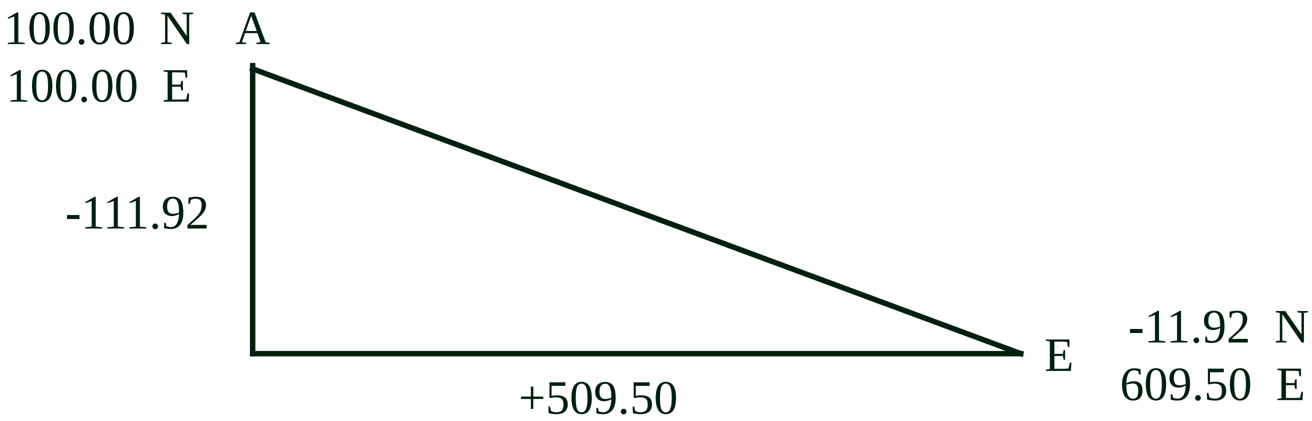
- The distance and bearing, respectively, of a straight line from Point A to Point E are most nearly:

A. 517.06 ft., S 09°54’ E

B. 517.06 ft., S 80°06’ E

C. 521.65 ft., S 12°23’ E

D. 521.65 ft., S 77°37’ E



$$\text{Angle} = \text{atan}\left(\frac{509.50}{111.92}\right) = \text{S } 77\text{-}36\text{-}39 \text{ E}$$

$$\text{Distance} = \sqrt{(509.50)^2 + (111.92)^2} = 521.65$$

- 14. The coordinates of Point Q on a highway spiral relative to the TS are:

  X = 200, Y = 5.

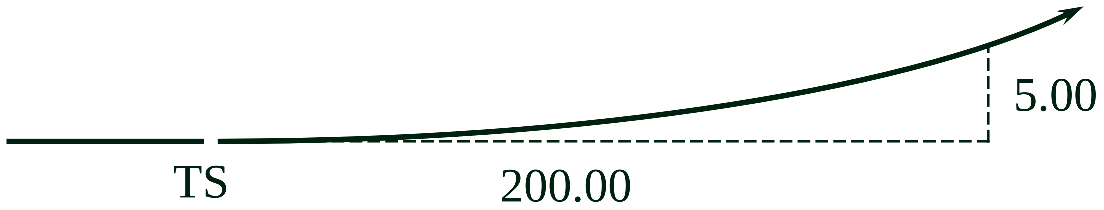
- The deflection angle from the TS to Point Q is most nearly:

A. 0°28’38”

B. 1°25’55”

C. 2°50’00”

D. 4°05’02”



$$\text{Deflection} = \text{atan}\left(\frac{5.00}{200.00}\right) = 01\text{-}25\text{-}56$$

- 15. The following deflection angles were measured in a closed traverse:

  P: 92°24' R

  Q: 150°42' R

  R: 15°37' L

  S: 132°35' R

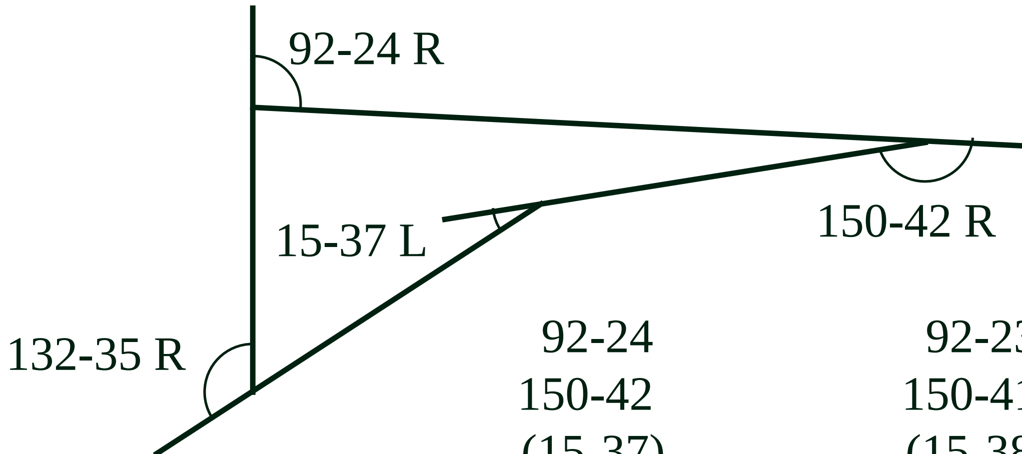
- The balanced deflection angle at R is most nearly:

  A. 15°36' L

  B. 15°37' L

  C. 15°38' L

  D. 15°39' L

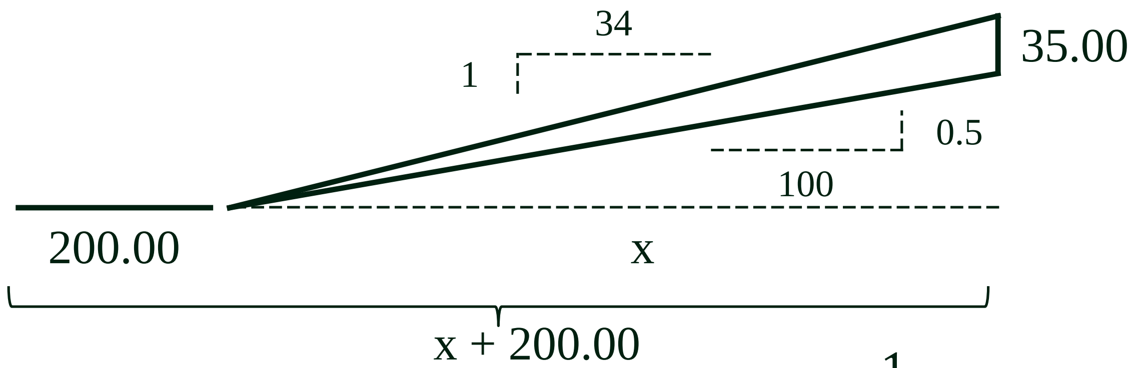


92-24	92-23	
150-42	150-41	
-(15-37)	-(15-38)	= 15-38 L
137-35	137-34	
360-04	360-00	
4 minutes too much	check	

- 16. A clear zone avigation easement with a 34:1 slope begins at ground level 200 ft. from the end of an active airport runway. The natural ground slope moving away from a point 200 ft. from the end of the runway is 0.5% in an uphill direction.

- At what distance (ft.) from the end of the runway can a 35-ft-tall structure be located and not violate the clear zone easement?

  A. 1,434
  B. 1,593
  C. 1,634
  D. 1,675



$$\frac{1}{34}x - 35 = \frac{0.5}{100}x$$

$$\frac{1}{34}x - \frac{1}{200}x = 35$$

$$\frac{200 - 34}{6800}x = 35$$

$x = 1434$ (200’ from runway)

$$x + 200 = 1634$$

- 17. The sum of the exterior angles of an eight-sided figure is most nearly:

  A. 1,800°
  B. 1,440°
  C. 1,080°
  D. none of the above

exterior angles

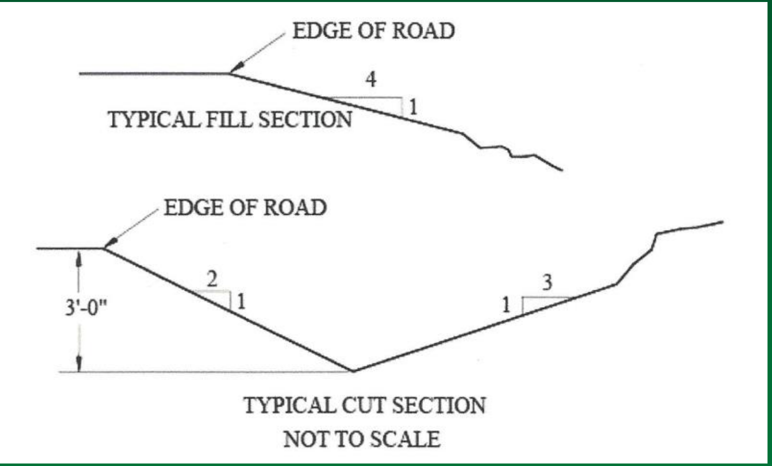
$$= 180(n + 2)$$

$$= 180(8 + 2)$$

$$= 180\ (10)$$

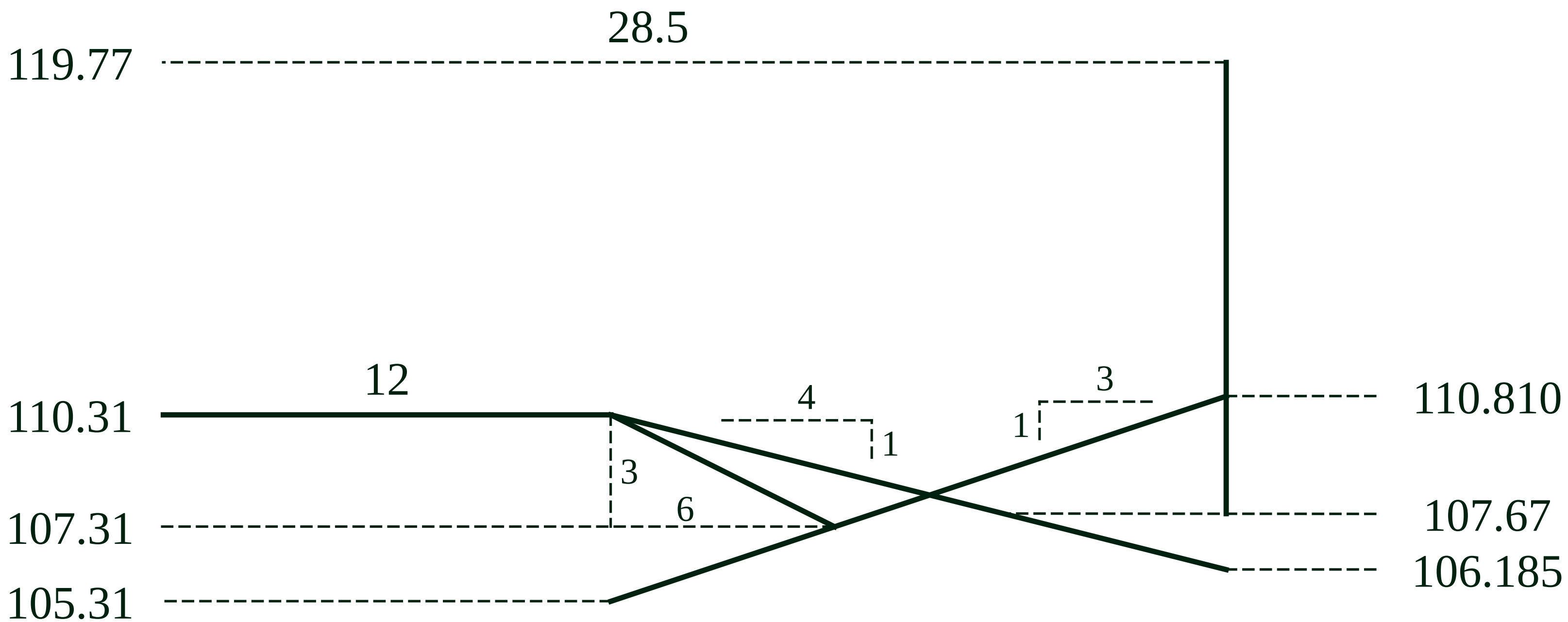
$$= 1800°$$

- 18. You are to set slope stakes along the roads within a subdivision. At Station 2+00 the finish grade elevation is 110.31 at the edge of the road, and the distance from the centerline to the edge of the road is 12.0 ft. The rod is being held at a distance of 28.5 ft. from the centerline and the rod reading is 12.1 ft. while the H.I. is 119.77 ft. Typical cut and fill sections are shown below.



- Your next step would be to:

  A. move in about 6 ft. and try again
  B. move in about 10 ft. and try again
  C. move out about 6 ft. and try again
  D. drive in a stake since you are at the slope stake



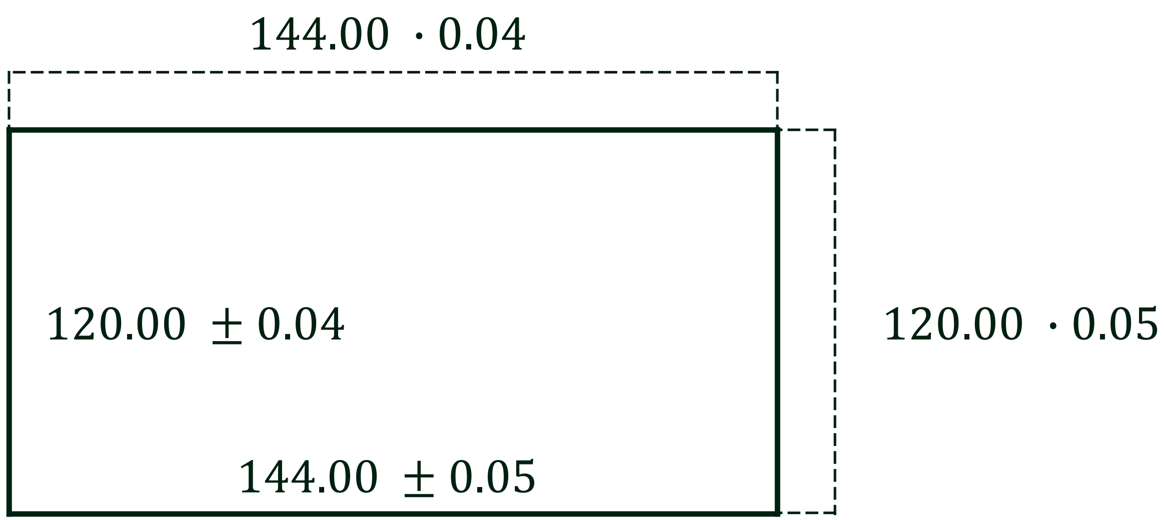
ground elevation (bottom of rod) is below edge of road -- use typical fill section

$12 + 4 \cdot (110.31 - 107.67) - 28.5 = -5.94$ move in about 6 feet

$4 \cdot (106.185 - 107.67) = -5.94$ (check)

- 19. A small rectangular lot measures 120.00 $\pm$ 0.04 ft. by 144.00 $\pm$ 0.05 ft.
- The area (ft.^{2}) of the lot is best stated as:

  A. 17,280 $\pm$ 4.7
  B. 17,280 $\pm$ 8.3
  C. 17,280 $\pm$ 49.7
  D. 17,280 $\pm$ 87



$$144 \cdot 120 = 17{,}280$$

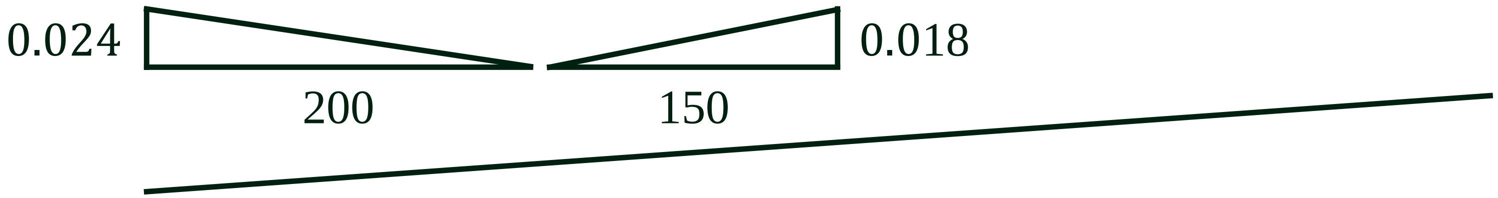
$$\sqrt{(144 \cdot 0.04)^2 + (120 \cdot 0.05)^2} = 8.3$$

$$17{,}280 \pm 8.3$$

- 20. After leveling up a hill where backsight distances were taken at 200 ft. and foresight distances at 150 ft. you discovered that the line of sight was inclined upward at 0.012 ft. per 100-ft. sight distance. The difference in elevation between the starting BM A and ending BM B was +50.035 ft. There were 20 instrument setups.

- The adjusted elevation difference (ft.) after correcting for line of sight inclination is most nearly:

  A. 49.915
  B. 50.023
  C. 50.029
  D. 50.155



$$
\begin{array}{r}
0.024 \\
\underline{-\ 0.018} \\
0.006
\end{array}
$$
too much per setup

$$
\begin{array}{r}
\underline{\times\ \ 20} \\
0.12
\end{array}
$$
too much overall

$$
\begin{array}{r}
50.035 \\
\underline{-\ \ 0.12} \\
49.915
\end{array}
$$

- 21. An angle is measured with a 1” theodolite twelve times with the following results:

223°14’56”	223°14’53”	223°14’58”
223°14’52”	223°14’55”	223°14’59”
223°14’58”	223°15’02”	223°14’55”
223°14’59”	223°15’00”	223°14’54”

- The standard deviation of the **mean** is most nearly:

A. $\pm$0.9”
B. $\pm$1.5”
C. $\pm$2.8”
D. $\pm$3.3”

Average = 223-14-56.75

$$\begin{matrix} +0.75 & +3.75 & -1.25 \\ +4.75 & +1.75 & -2.25 \\ -1.25 & -5.25 & +1.75 \\ -2.25 & -3.25 & +2.75 \end{matrix}$$

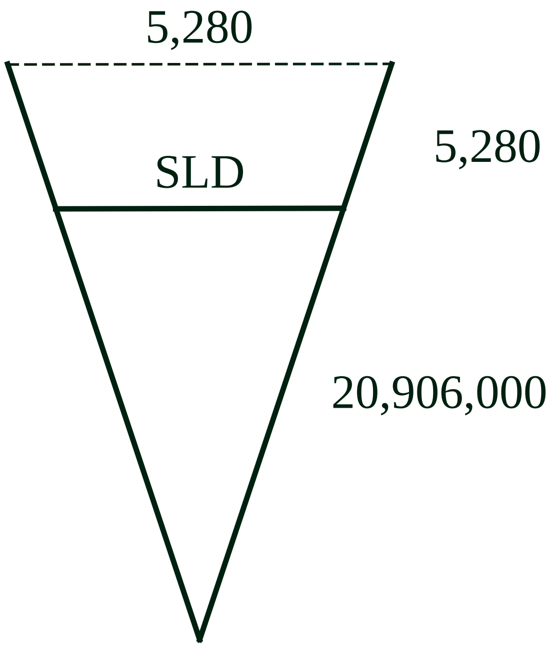
$$\sum v^2 = 102.25$$
$$\sigma = 3.0488$$

Standard deviation of the mean: ~~$\frac{\sigma}{\sqrt{12}} = 0.88$~~

Population over 10 : $\frac{\sigma}{\sqrt{11}} = 0.92$

- 22. An EDM distance of 1 mile is measured at an elevation of 1 mile. The earth's radius R is assumed to be 20,906,000 ft.
- The sea level distance (ft.) is most nearly:

A. 5,270.02
B. 5,278.67
C. 5,280.00
D. 5,281.33



$$\mathrm{SLF} = \frac{R}{R+H} = \frac{20{,}906{,}000}{20{,}911{,}280} = 0.9997$$

$$\mathrm{SLD} = 5{,}280 \cdot \frac{R}{R+H} = 5{,}280 \cdot 0.9997 = 5{,}278.67$$

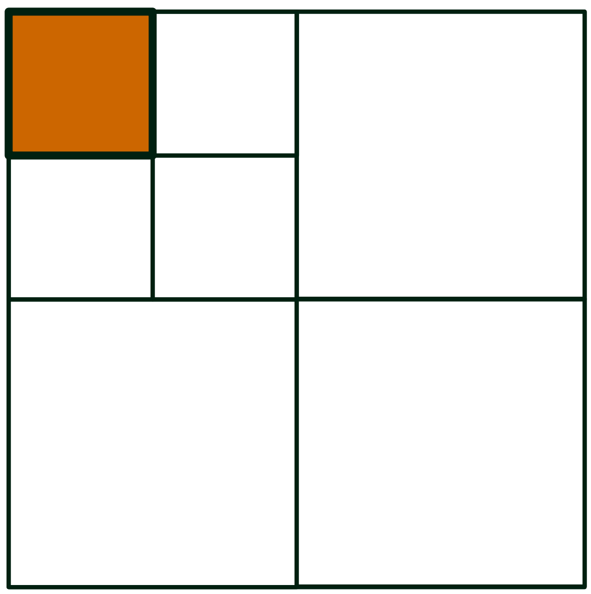
- 23. The original government record of a fractional lot in the northwest quarter of Section 5 shows the following dimensions in chains:

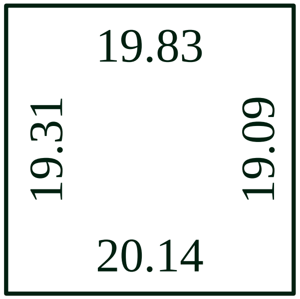
north side	19.83
east side	19.09
west side	19.31
south side	20.14

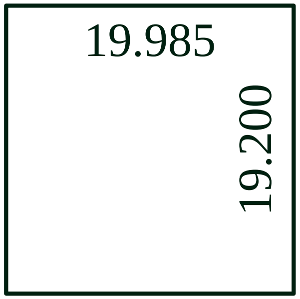
- The area (acres) of the lot on the original township plat would be most nearly:

A. 38.33
B. 38.35
C. 38.37
D. 38.39

TERRAMETRA



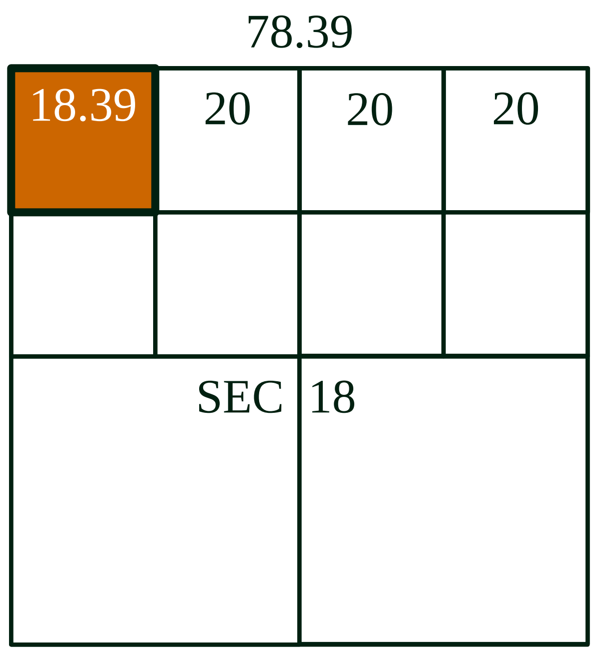




$$19.985 \cdot 19.200$$
$$= 383.712\ sq.chains$$
$$= 38.37 \text{ acres}$$

- 24. Section 18 of T21N, R6W, was subdivided for the first time about 20 years ago. You wish to retrace that survey. The official distance shown in government notes for the north line of Section 18 is 78.39 chains.
- The measurement (chains) that should have been used for the north line of the NW 1/4 of the NW 1/4 (also called Lot 1) is most nearly:

A. 18.39
B. 19.20
C. 19.60
D. 38.39


78.39
18.39
20
20
20
SEC 18

- 25. The distance on a vertical aerial photograph between two east-west hedge lines is measured and found to be 7.96 in. The hedge lines are approximately the north and south section lines of Section 16, which is regular. The terrain is approximately level.

- What is the approximate photo scale in the area between the two hedges?

  A. 1:663
  B. 1:24,000
  C. 1 in. = 663 ft.
  D. 1 in. = 7,960 ft.

7.96”
5,280’

$$\frac{5{,}280}{7.96} = 663\ \frac{ft.}{in}$$

$$1\ in. = 663\ ft.$$

- 26. You plan to plot the following traverse on a sheet with dimensions of 18 in. wide x 24 in. long.

AB:	S 0° 25’ E,	1,380.02 ft.
BC:	N 88°31’W,	2,495.00 ft.
CD:	N 0°25’W,	1,380.02 ft.
DA:	S 88°31’ E,	2,495.00 ft.

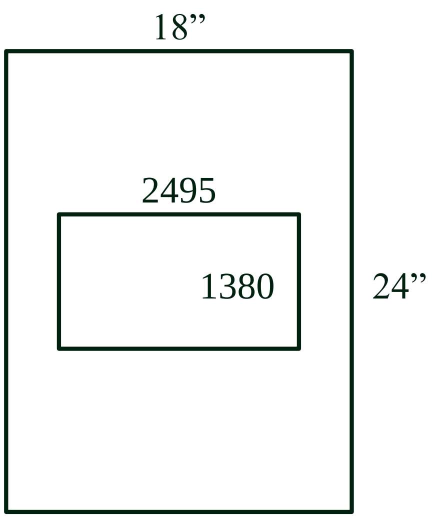
- The scale best suited to show maximum detail and to allow for a 1/2-in. margin is:

  A. 1:1,440

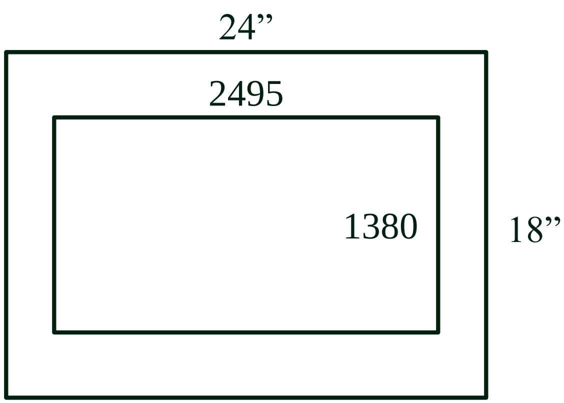
  B. 1:1,200

  C. 1:960

  D. 1:600



not good



good

use scale of 1:1440

$$\frac{2495}{1440} = 1.73' = \quad 21''$$

$$\frac{2495}{1200} = 2.08' = \quad 25''$$

$$\frac{1380}{1440} = 0.96' = \ 11.5''$$

$$\frac{1380}{1200} = 1.15' = \ 13.8''$$

$$\frac{1380}{960} = 1.44' = 17.25''$$

- 27. The area of a lake is obtained by planimeter as 10 $in.^2$ on a map at scale 1:50,000.
- The area (sq. mi.) covered by the lake is most nearly:

A. 6.23
B. 7.89
C. 9.47
D. 10.00

$$1:50{,}000$$

$$1\ in. =\ 4{,}166.67\ ft.$$

$$1\ in. =\ 0.79\ mi.$$

$$1\ sq.in. = 0.623\ sq.mi.$$

$$10\ sq.in. = 6.23\ sq.mi.$$

- 28. On an aerial photograph, the measured distance between two points is 5.134 in. On a 7.5-min topographic map (1:24,000 scale), the measured distance between these same two points is 1.689 in.
- The nominal scale ratio of the photo is most nearly:

  A. 1:658

  B. 1:7,896

  C. 1:7,920

  D. 1:24,000

$$1{:}\,24{,}000$$

$$1.689 \cdot 24{,}000 = 40{,}536$$

$$\frac{40{,}536}{5.134} = 7{,}896$$

$$1{:}\,7{,}896$$