

NAME \_\_\_\_\_

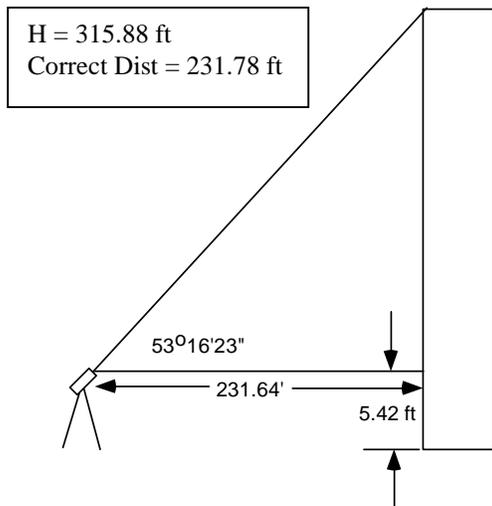
Score \_\_\_\_\_

CEEN 113-1 Engineering Measurements  
 Closed Book, Calculator Required  
**3 Hour** Time Limit

Final Exam

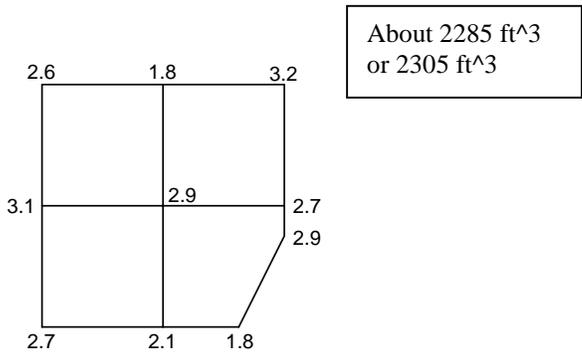
Fall 2001

- (10 pts) You are interested in determining the height of a building. You are unable to place a prism on top of the building and measure slope distance so instead you use a 100 foot steel tape to measure the distance (231.64 feet) from where you have set up a total station to the building. You then turn a vertical angle ( $53^{\circ}16'23''$ ) from this point to the top of building. a) What is the height of the building? b) If the tape measure you are using is actually 100.06 feet, what is the corrected horizontal distance measured? (You should use the uncorrected distance of 231.64 feet for the calculation in part a) (2.1.2)



H = 315.88 ft  
 Correct Dist = 231.78 ft

- (10 pts) The following diagram represents a small portion of a borrow pit. The squares are 15 feet on a side and the numbers represent the differences (cuts) in feet at the various points from one survey to the next. The two points not on 15 foot corners are located as follows: the 2.9 cut is 5.0 feet down from its nearest corner (the 2.7 cut) and the 1.8 cut is 10.0 feet over from its nearest corner (the 2.1 cut). Estimate the volume ( $\text{ft}^3$ ) that has been removed from the borrow pit. (7.4)



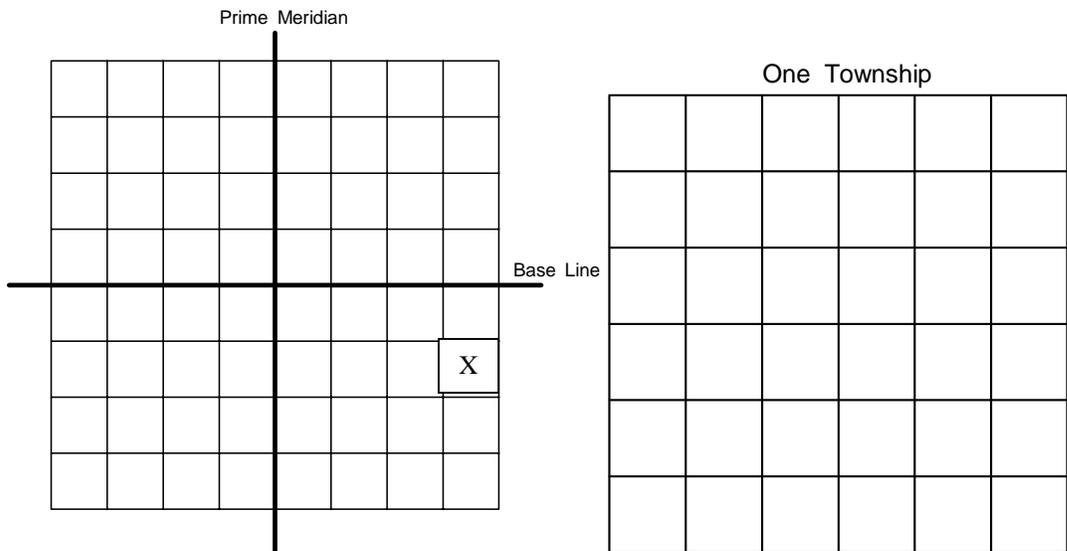
About 2285  $\text{ft}^3$   
 or 2305  $\text{ft}^3$

3. (10 pts) What magnetic bearing (provide answers in table below) is needed to retrace a line for the conditions stated in the following problems (2.1.2).

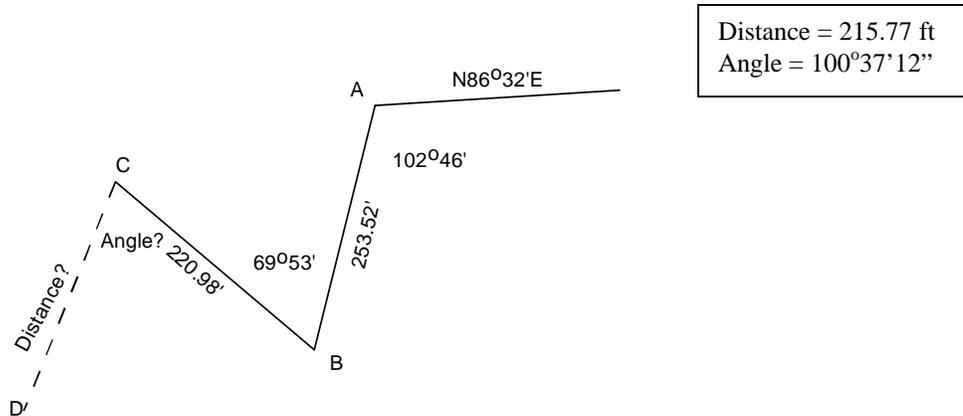
1875 Magnetic Bearing	1875 Declination	Present Declination	Present Magnetic Bearing
a) N75°25'E	3°30'E	2°20'W	
b) S45°30'E	7°15'W	5°20'E	

a) N 81°15' E b) S 58°05' E
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4. (5 pts) Using the two maps below indicate (with one x on each map) where the NE1/4, SE1/4, Section 21, T2S, R4E would be (7.4).



5. (10 pts) You must perform an open traverse from a section corner at A to the point of beginning of your property at D. You know from the legal description that your property corner is 306.85 feet south and 372.26 feet west of section corner A. You can't move on a direct line from A to D so you set up at temporary points B and C. The bearing of your reference line at A, the interior angles at B and C, and the distances from B to C and B to A are given in the diagram. What angle must you turn at C (from B to D) and what distance from C to D do you need to measure to accurately locate your property corner at D. Hint: This is what you had to do in lab 10. The diagram below is not exactly to scale. (2.1.2)



6. (5 pts) A sanitary sewer is to be constructed from an existing MH #1 (invert elevation = 139.28 ft.) @ .5 percent slope (that is .5ft/100feet uphill) for a distance of 340 ft. to proposed MH #2 which is higher in elevation than MH #1. The ground elevations at 50 foot intervals are as follows: 0+00=148.21, 0+50=149.02, 1+00=147.78, 1+50=147.14, 2+00=146.54, 2+50=148.63, 3+00=150.27, 3+40=149.98. Prepare a grade sheet showing sewer invert elevations and cut distances in feet at each station. (5.10)

Cuts
8.93
9.49
8.00
7.11
6.26
8.10
9.49
9.00



9. (30 pts) The following information with respect to the diagram shown below is known (The diagram is not to scale and is only an approximation): (2.1.2)

Angle  $x$  is  $58^{\circ}32'25''$ , and angle  $y$  is  $42^{\circ}35'51''$

$X_A=1410.78$ ,  $Y_A=10890.19$ ,  $X_B=6774.16$ ,  $Y_B=13487.85$ ,  $X_C=10165.85$ ,  $Y_C=12418.81$  ft.

Using the 3-point resection method compute the coordinates at point P.

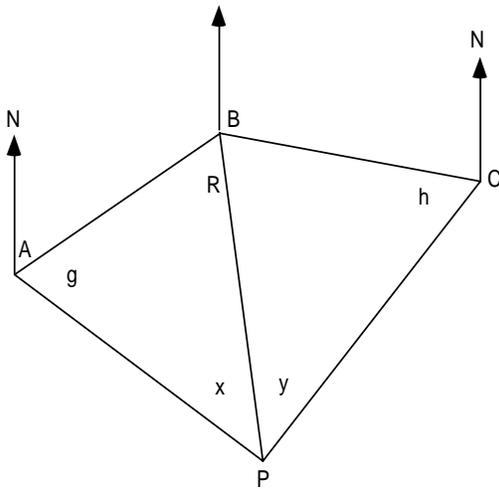
Some important equations that will be helpful include:

$$J = g + h = 360 - x - y - R$$

$$\tan(h) = \frac{\sin(J)}{K + \cos(J)}$$

$$K = \frac{\sin(x) \overline{BC}}{\sin(y) \overline{AB}}$$

$X_p = 7708.10$ $Y_p = 8488.13$
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**Equations:**

$$E_{\text{total}} = \pm E\sqrt{n}$$

$$E_{\text{total}} = \pm \sqrt{E_1^2 + E_2^2 + \dots + E_n^2}$$

$$C = 0.574M^2$$

$$C = 0.0675k^2$$

$$\text{Rough Leveling} \pm 0.4\sqrt{M}$$

$$\text{Average Leveling} \pm 0.1\sqrt{M}$$

$$\text{Excellent Leveling} \pm 0.05\sqrt{M}$$

$$\text{Law of Sines} \quad \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\text{Law of Cosines} \quad \cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$$\text{Compass Rule} \quad \frac{\text{Correction in Latitude AB}}{\text{Total Error in Latitude}} = \frac{\text{Latitude AB}}{\text{Perimeter}}$$

**Conversions:**

$$1 \text{ mile} = 5280 \text{ feet}$$

$$1 \text{ acre} = 43,560 \text{ sq. feet}$$

$$1 \text{ ft} = 12 \text{ inches}$$

$$1 \text{ chain} = 66 \text{ feet}$$

**Horizontal Curves:**

$$R = \frac{5729.58}{D}$$

$$T = R \tan\left(\frac{I}{2}\right)$$

$$LC = 2R \sin\left(\frac{I}{2}\right)$$

$$L = \frac{RI\pi}{180}$$

**Vertical Curves:**

$$TO = d \left( \frac{x}{L/2} \right)^2 \quad (\text{where TO is the tangent offset})$$

Parabolic equation:

$$y = \frac{1}{2}rx^2 + g_1x + \text{elevPVC}$$