The Sears Tower

This is a variant of a problem we have frequently given to students in the Emerging Scholars Program taking precalculus. I varied it a little so one of your groups will have a problem completely suitable for 9th grade. (The other groups need the definition of the tangent function.)

This is a set of problems designed to encourage cooperation while working on a nontrivial problem. There are 4 sets of 6 clues. Put the students in groups of 4, 5, or 6 and give each member of each group one of the clues. Ideally the groups have 5 members each and clue 6 (which is identified to the T.A. as irrelevant by an asterisk) is omitted. For a group of 4, put the fifth clue (the question) in the middle of the table. The four groups each get slightly different information. One gets the height of the Sears tower in feet without the antennas; a second gets the height with the antennas; these two need to compare to get the height of the antennas (in feet). The other pair will do the same things but the answer is in meters. (The height of the tower without antennas is correct; but the distances on the ground are only approximate and the height of the antennas was sheer guesswork.) At the end have the metric and English units groups compare their answers. Note that translation between the two systems is most easy by the approximation that a kilometer is 5/8 of a mile. (Sometimes .6 is used.)

Questions for discussion:

1. What are the benefits of 'jigsaw problems'?
2. What are appropriate variants for 9th graders? How to simplify?
3. How might you vary this problem for your own school?
4. What are the key mathematical ideas here?
5. What is particular is the relation to 'variable'?
6. Is this a Japanese, American or German problem?

A1 The Sears Tower is located 4 blocks East of Halsted Street on Jackson.

A2 The Corner of Halsted and Polk (Chicago Circle Center) is three blocks south of Jackson.

A3 There are eight Chicago city blocks to a mile. Each mile contains 5280 feet.

A4 A straight line from the top of the Sears tower (not including the television antennas) to the corner of Halsted and Polk makes an angle of 23.77 degrees with the ground.

A5 How many feet high is the Sears tower (without antennas)? How tall is each antenna? (You will need help from another group to answer the last part.)

A6 * It is $\sqrt{2}$ miles from Chicago Circle Center to Comiskey Park.

B1 The Sears Tower is located 4 blocks East of Halsted Street on Jackson.

B2 The Corner of Halsted and Polk (Chicago Circle Center) is three blocks south of Jackson.

B3 There are five Chicago city blocks to a kilometer.

B4 A straight line from the top of the Sears tower (including the television antennas) to the corner of Halsted and Polk makes an angle of 24.77 degrees with the ground.

B5 How many meters high is the Sears tower (with antennas)? How tall is each antenna? (You will need help from another group to answer the last part.)

B6 * It is $\sqrt{2}$ miles from Chicago Circle Center to Comiskey Park.

C1 The Sears Tower is located 4 blocks East of Halsted Street on Jackson.

C2 The Corner of Halsted and Polk (Chicago Circle Center) is three blocks south of Jackson.

C3 There are five Chicago city blocks to a kilometer.

C4 A straight line from the top of the Sears tower (including the television antennas) to the corner of Halsted and Polk is 1101 meters long.

C5 How many meters high is the Sears tower (with antennas)? How tall is each antenna? (You will need help from another group to answer the last part.)

C6 * It is $\sqrt{2}$ miles from Chicago Circle Center to Comiskey Park.

D1 The Sears Tower is located 4 blocks East of Halsted Street on Jackson.

D2 The Corner of Halsted and Polk (Chicago Circle Center) is three blocks south of Jackson.

D3 There are eight Chicago city blocks to a mile. Each mile contains 5280 feet.

D4 A straight line from the top of the Sears tower (not including the television antennas) to the corner of Halsted and Polk is 5814 feet long.

D5 How many feet high is the Sears tower (without antennas)? How tall is each antenna? (You will need help from another group to answer the last part.)

D6 * It is $\sqrt{2}$ miles from Chicago Circle Center to Comiskey Park.