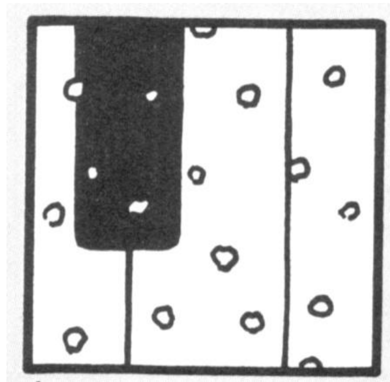
A Turvy for Trig Applications

Puzzle and Answer Key by David Pleacher



Caption for the picture:

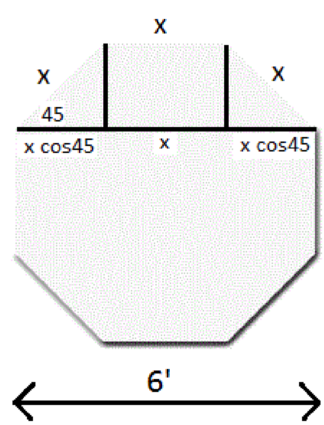
"C O O K I E   C R U M B S   O N   A   P I A N O."
10 17 17 1 6 15   10 9 5 3 11 18   17 16   19   13 6 19 16 17

Caption for the picture turned upside down:

"A B E   L I N C O L N   W A L K I N G   B Y   A
19 11 15   2 6 16 10 17 2 16   8 19 2 1 6 16 12   11 4   19

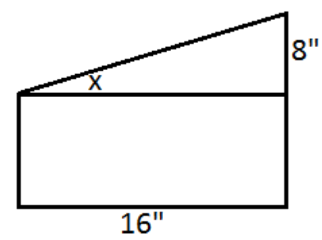
T A L L   F E N C E   I N   A   S N O W S T O R M."
14 19 2 2   7 15 16 10 15   6 16   19   18 16 17 8 18 14 17 9 3

1 - 2. The students in the class of '78 at John Handley High
135° 1. School decided to make a well for the 1977 Prom
2.48' 2. ("Midnight at the Oasis"). The shop teacher, Mr. Ritter, said that his students would build it if given the dimensions. The well was to be a regular octagon, six feet across. Determine the lengths of the eight sides (problem #1) and the measure of the angle between the sides (prob. #2).



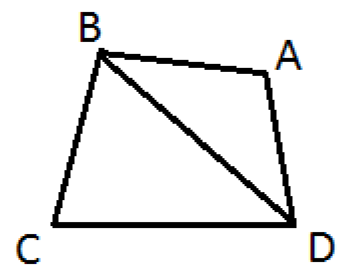
Each angle of a regular octagon is 135° using the formula, (n – 2) x 180°, and divide by 8. Then using the definition of the cosine, you can set up the equation: xcos45° + x + xcos45° = 6.
Solving, you obtain x = 2.48'.

26.6° 3. A student in my 7th period trig class was building a small greenhouse for a window. In the drawing at the right, determine the measure of angle x.



tan(x) = 8 / 16
tan(x) = .5, so x = 26.6°

4 - 5. Mr. Pleacher has an unusually shaped garden because it is in
93.3° 4. the back corner of his lot. It is nearly impossible to
32.2° 5. see the shape of the garden from ground level, so he put in several stakes at the 4 corners of his garden (called A, B, C, and D in the diagram at the right). Then he made some measurements and drew a picture of the garden. In order to make a scaled drawing of the garden, he needed to find the measures of some angles using the Law of Cosines. Determine the measures of angle C (problem #4) and angle ABD (problem #5) using the following measurements: AB = 460", AD = 330", CD = 382", BC = 454", and BD = 610". The garden is NOT rectangular shaped and is not drawn to scale.



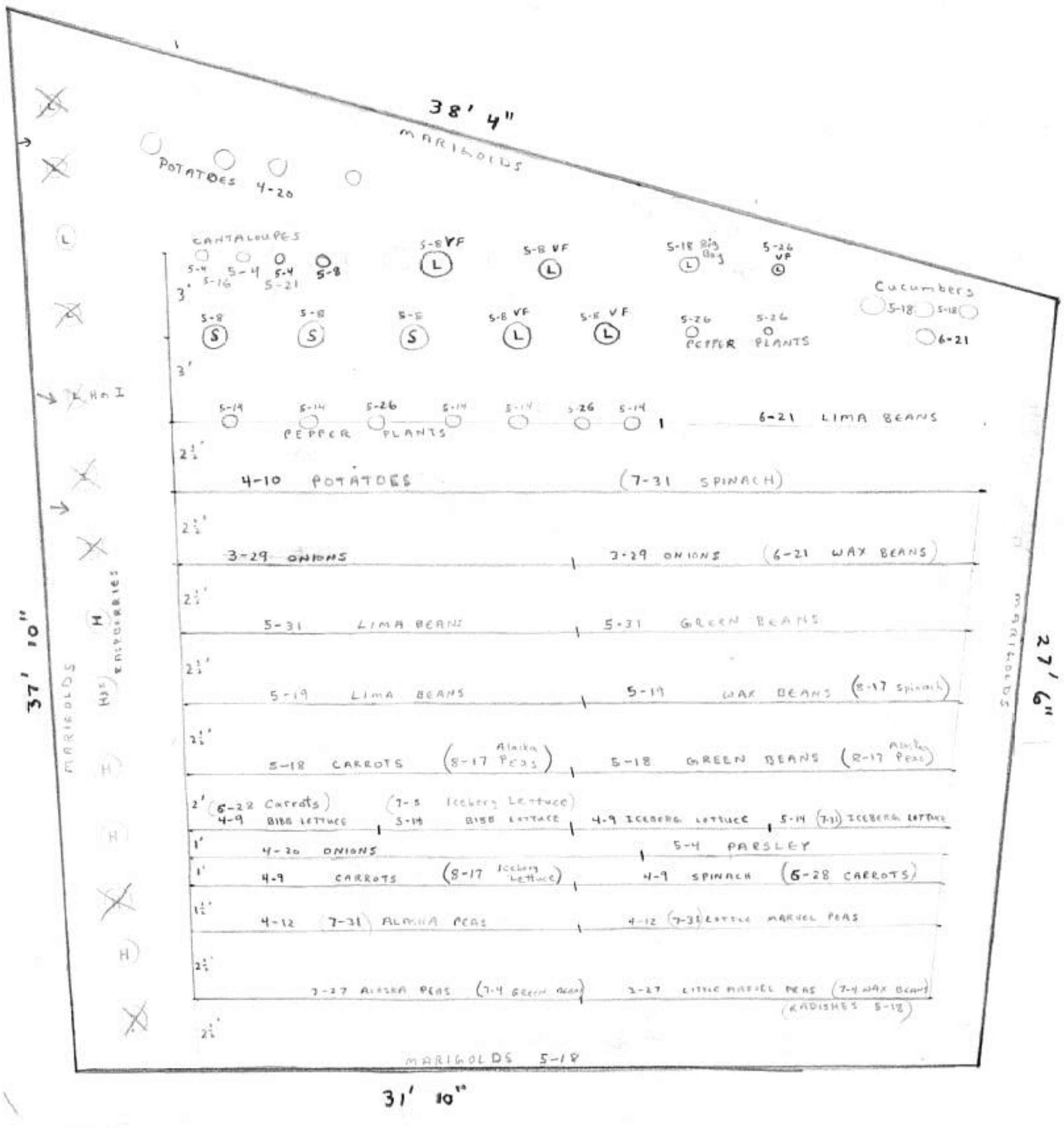
$610^2 = 454^2 + 382^2 - 2(454)(382)\cos(C)$.
So, angle C has a measure of 93.3°.
$330^2 = 460^2 + 610^2 - 2(460)(610)\cos(ABD)$
So, angle ABD has a measure of 32.2°.

A scale drawing of Mr. P's garden appears on the next page showing the angles.

SCALE 1 cm = 2 feet

PLANTS:

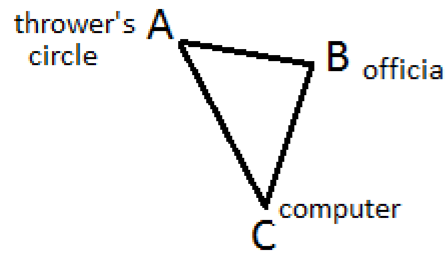
RASPBERRIES 14
PEPPERS 9
TOMATOES (VF) 5 - started 3-24, 4-6
TOMATOES (Small Fry) 3 - started 3-24
TOMATOES (Big Boy) 1
CANTALOUPES 4 - started 3-24, 3-30



Raspberries
Indian Summer
Heritage (BEST)
Latham (WORST)

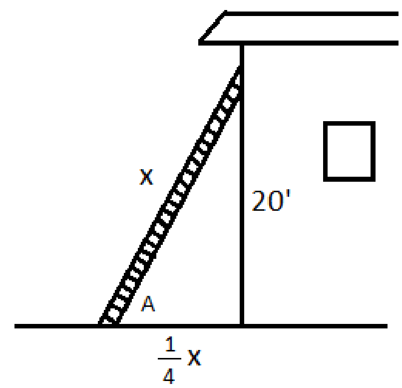
GARDEN 1975

66.2′ 6. In the 1976 Olympics, a computer was introduced to measure the distances in the track and field events of shot put, discus, and javelin. The computer was positioned at C and the shot (or disc or javelin) was thrown from point A. An official would go to the point where the shot landed (this is point B in the diagram). The official had a prism at point B. The computer sent a ray of light to the prism which was returned to the computer. This gave the distance between the computer and the official and the angle at C. The computer was programmed with the Law of Cosines to give the distance of the throw. If the computer was 110 feet from the A and the computer gives a reading of BC = 70 feet and $m\angle C = 35°$, determine AB.



$(AB)^2 = 110^2 + 70^2 - 2(110)(70)\cos(35°)$ So, AB = 66.22 feet.

7 – 8. A man wants to reach a point on his house 20 feet above
20.66′ 7. the ground. According to safety experts, a ladder
75.5° 8. should be set up by placing the bottom of the ladder ¼ of length of the ladder away from the building. Determine the length of the ladder (problem #7) and the measure of the angle that the ladder makes with the ground (problem #8).



cos(A) = ¼, so Angle A = 75.5°.

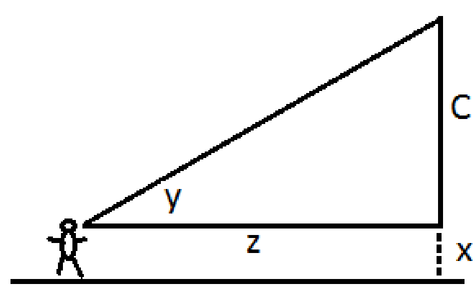
sin(75.5) = 20/x, so x = 20.66′.

7.6° 9. At what angle should a paper airplane be flown so as to just clear the geometry teacher's head if the teacher is 6 feet tall and standing 15 feet away? Assume that you are throwing the plane from a height of 4 feet (while seated at your desk).

tan(x) = 2/15, so x = 7.6°.

below 10. Launching Estes Solid Fuel Rockets.

The Estes Company sells a device to help you determine how high your rocket goes. It gives you the angle from the horizontal to the top of the rocket's flight. Explain ho you can figure its height H if you know the distance from the launching pad (z feet), the angle to the rocket (y degrees), and your height (x feet).



Total Height H = x + z tan y

1,453' 11. Determine the height of the Willis Tower in Chicago (formerly known as the Sears Tower) if the angle of elevation of its top from a point on the ground 1,177 feet from its base is 51 degrees.

$\tan(51°) = x/1177$, so $x = 1{,}453$ feet

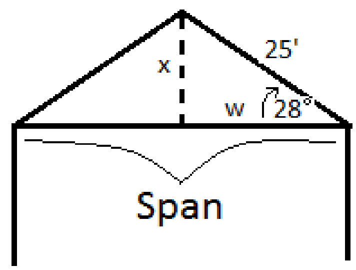
453 mi 12. Philadelphia is 420 miles due East of Columbus, Ohio. Detroit is due North of Columbus and is N 68° W from Philadelphia. How far is Detroit from Philadelphia?

$\cos(22) = 420 / x$, so $x = 453$ miles.

16.7° 13. A tennis court has a three foot high net. Standing 10 feet back from it, a ball is returned low to the ground. What is the minimum angle at which it may be returned in order to clear the net?

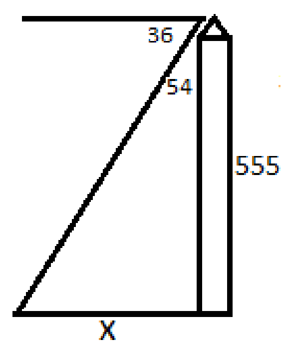
$\tan(A) = 3 / 10$, so $A = 16.7°$.

.27 14. In architecture, the pitch of a roof is defined to be the ratio of the height to its span. Determine the pitch of the roof at the right.



$\cos(28) = w / 25$. So, $w = 22.07$.
$\sin(28) = x / 25$. So, $x = 11.74$. Pitch = 11.74/44.14

763.9' 15. The Washington Monument is 555 feet high. If you look out one of the top windows at an angle of depression of 36°, determine the distance that you can see from the monument.



$\tan(54) = x / 555$, so $x = 763.9'$.

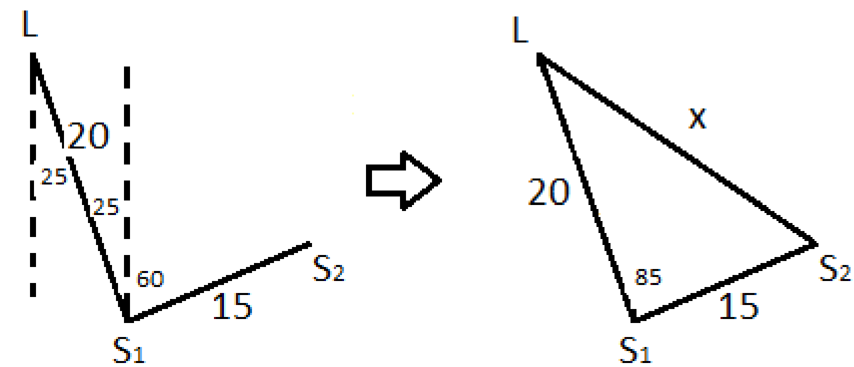
49.2° 16. If a woman 5'6" tall casts a shadow 4'9" long, determine the angle of elevation of the sun.

$\tan(A) = 66 / 57$, so the angle of elevation is 49.2°.

57.2 yd 17. A railroad track crosses a highway at an angle of 78°. A locomotive is 40 yards away from the intersection when a car is 50 yards away from the intersection. What is the distance between the train and car?

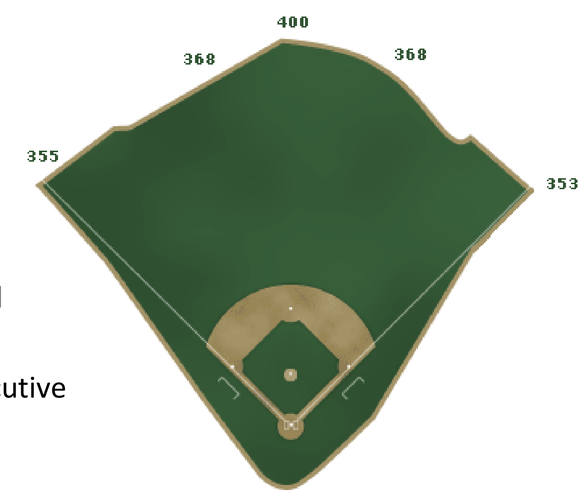
Use Law of cosines: $x^2 = 40^2 + 50^2 - 2\,(40)\,(50)\cos(78°$.

23.9 mi 18. A ship is anchored 20 miles S 25° E from a lighthouse. Determine its distance from the lighthouse after it has moved 15 miles in the direction N 60° E.



$x^2 = 20^2 + 15^2 - 2(20)(15)\cos(85°)$, so x = 23.9 miles.

342.33' 19. Wrigley Field, the home of the Chicago Cubs, was built in 1914, and is the second oldest ball park in the major leagues (see diagram at the right). The distance from home plate to the farthest point in straightaway center field is 400 feet. Determine the distance from that point in center field to third base. (Straightaway center field is an extension of the line drawn from home plate through second base. The distance between consecutive bases is 90 feet).



Let x = distance from center to 3rd base.
$x^2 = 400^2 + 90^2 - 2(400)(90)\cos(45°)$, so x = 342.33'.

Answers: (units have been omitted)

a. 342	j. 17	s. 23.9
b. 1,453	k. 2.48	t. .27
c. H = x + z tan y	l. 135	u. 32.2
d. H = x + z sin y	m. 26.6	v. 2,001
e. 763.9	n. 49.2	w. 75.5
f. 20.7	o. 57.2	x. 74
g. 453	p. 16.7	y. 93.3
h. H = x + z cos y	q. 45	z. None of the above
i. 66.2	r. 7.6	