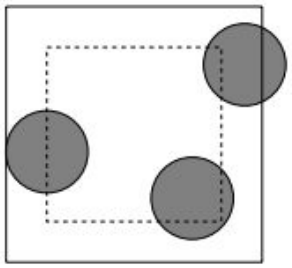
Q.1) (**Prelims):** A coin of diameter d is thrown randomly on a floor tiled with squares of side l. Two players bet that the coin will land on exactly one, respectively, more than one, square. What relation should l and d satisfy for the game to be fair?



Solution. The center of the coin falls on some tile. For the coin to lie entirely on that tile, its center must fall inside the dotted square of side length $l - 2 \cdot \frac{d}{2} = l - d$ shown in Figure 42. This happens with probability

$$P = \frac{(l-d)^2}{l^2}.$$

For the game to be fair, P must be equal to $\frac{1}{2}$, whence the relation that d and l should satisfy is

$$d = \frac{1}{2}(2 - \sqrt{2})l.$$ □

Q 2)(prelims)

Start with the number on the left.

By moving through the maze and doing any arithmetic operations that you encounter on the number, exit the maze with the result on the right.

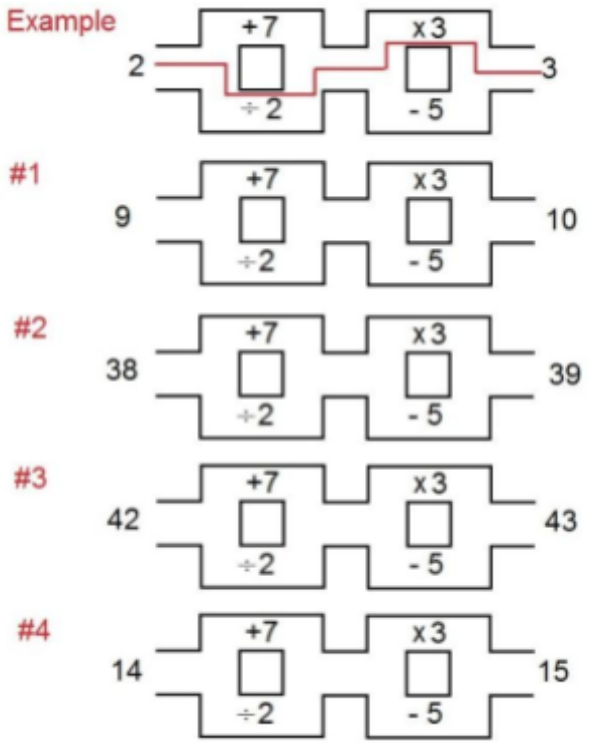
You may pass through an operation several times, but you cannot make a U-turn.

The results of all operations will be positive whole numbers.

Each maze has several solutions, but they all have one unique shortest solution.

In the example, the solution would be written as 2 / 2 x 3 = 3.

Write down the expression



Solution:

(9+7) / 2 +7 - 5
(38 / 2 + 7) / 2 * 3
(42/2 - 5) * 3 -5
(((14/2-5)*3 -5)*3 +7)/2*3

Q3)
Three on-off switches are on the wall of a building's first floor. Only one switch operates a single-bulb lamp on the third floor. The other two switches are bogus, unconnected to anything.
You are permitted to set the switches in any desired on-off order.
You then go to the third floor to inspect the lamp. Without leaving the lamp's room, how can you determine which switch is genuine?

Solution:
Call the switches A, B, and C. Turn on A and B, and turn off C. Wait 10 minutes, then turn off A. Go to the third floor. If the lamp's bulb is warm but off, switch A operates the lamp. If the bulb is cold and the lamp on, switch B operates the lamp. If the bulb is cold and unlit, C is the genuine switch.

Q4)
Can you place three white queens and five black queens on a 5 X 5 chessboard so that no queen of one color attacks a queen of the other color? The pattern is unique except, of course, for rotations and Reflections.
Solution:

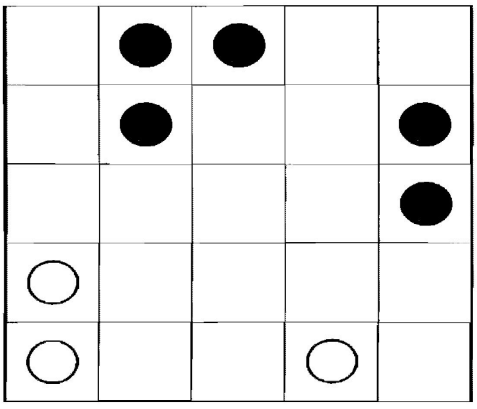
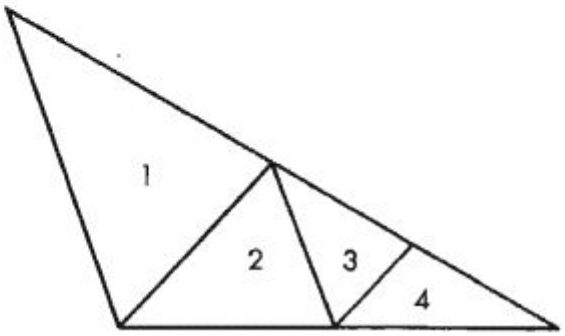


Figure A.7

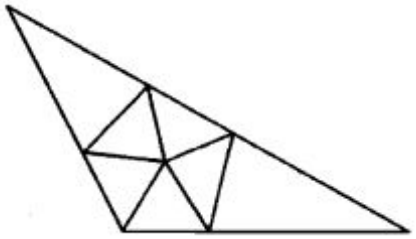
Q5)

Given a triangle with one obtuse angle, is it possible to cut the triangle into smaller triangles, all of them acute? (An acute triangle is a triangle with three acute angles. A right angle is of course neither acute nor obtuse.) If this cannot be done, give a proof of impossibility. If it can be done, what is the smallest number of acute triangles into which any obtuse triangle can be dissected?

Figure shows a typical attempt that leads nowhere. The triangle has been divided into three acute triangles, but the fourth is obtuse, so nothing has been gained by the preceding cuts.



Solution:



It is easy to see that seven is minimal. The obtuse angle must be divided by a line. This line cannot go all the way to the other side, for then it would form another obtuse triangle, which in turn would have to be dissected, consequently the pattern for the large triangle would not be minimal. The line dividing the obtuse angle must, therefore, terminate at a point inside the triangle. At this vertex, at least five lines must meet, otherwise the angles at this vertex would
not all be acute. This creates the inner pentagon of five triangles, making a total of seven triangles in all.

Q6)

If 5 3 2 = 151022

9 2 4 = 183652

8 6 3 = 482466

5 4 5 = 202541

then 9 5 5 = ?

Solution:
9×5 = 45 (first and second)
9×5 = 45 (first and third)
sum of 45+45 =90 and from this deduct center no i.e. 5 =85
hence answer is 454585

Q7)
Lee, Dale and Terry are related to each other.
(a) Among the three are Lee's legal spouse, Dale's sibling and Terry's sister-in-law.
(b) Lee's legal spouse and Dale's sibling are of the same sex.
Which one is the married man?

Solution:

Dale is the married man.
From statement (a) there are two possibilities:
1) Lee is married to Dale and Terry is Dale's sibling.
2) Lee is married to Terry and Dale is Lee's sibling.
Statement (b) rules out (2) above since Lee and Terry (the married couple) would have to be the same sex and since there is only 1 married man.
Since (1) is true then statement (a) says that Lee is Terry's sister-in-law, making Lee's spouse Dale the married man.

Q8)
You'll need a 4x4 grid of squares and four coins.
START: Put the four coins on the central four squares.
RULES: If adjacent to another coin horizontally or vertically, it may move one, two, or three spaces horizontally or vertically. If the coin is then adjacent to another coin, it may travel again as part of the same move. Jumping coins is not allowed.
GOAL: Get the four coins to the four corner squares.
Solution:
Number the board as
1 2 3 4

5 6 7 8

9 10 11 12

13 14 15 16

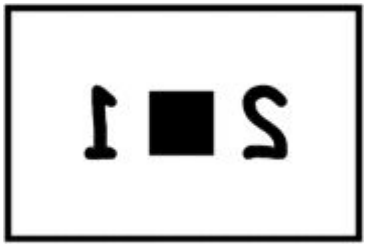
The solutions are

6 2	and	6 2
10 6		7 6
11 15		11 15
7 3 4		10 11 3 4
6 8 16		6 8 16
15 3		15 3
2 1		2 1
3 15 13		3 15 13

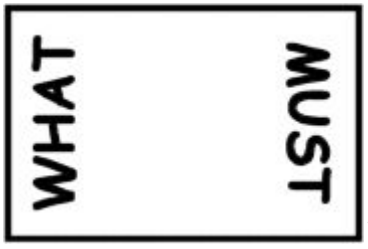
Q9)

Rebuses: Identify the phrase/word

Moral Support



Back to square one



What goes up must come down

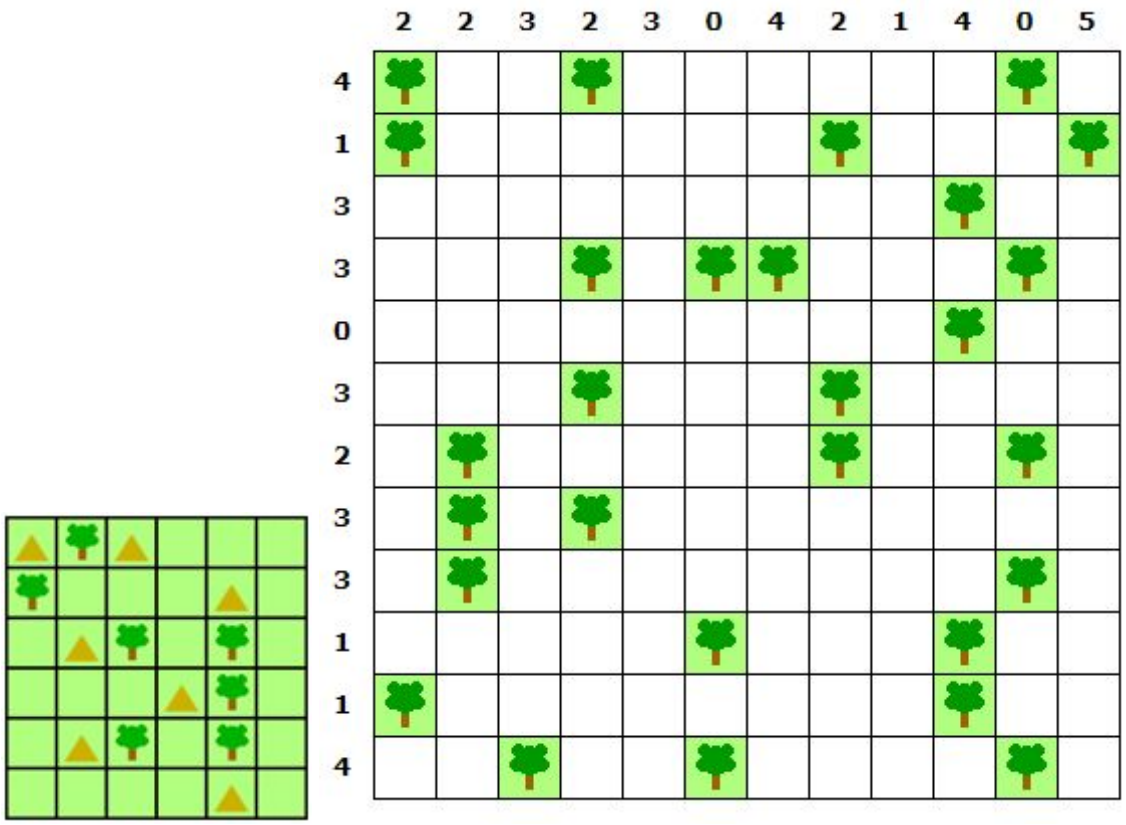
Q10)

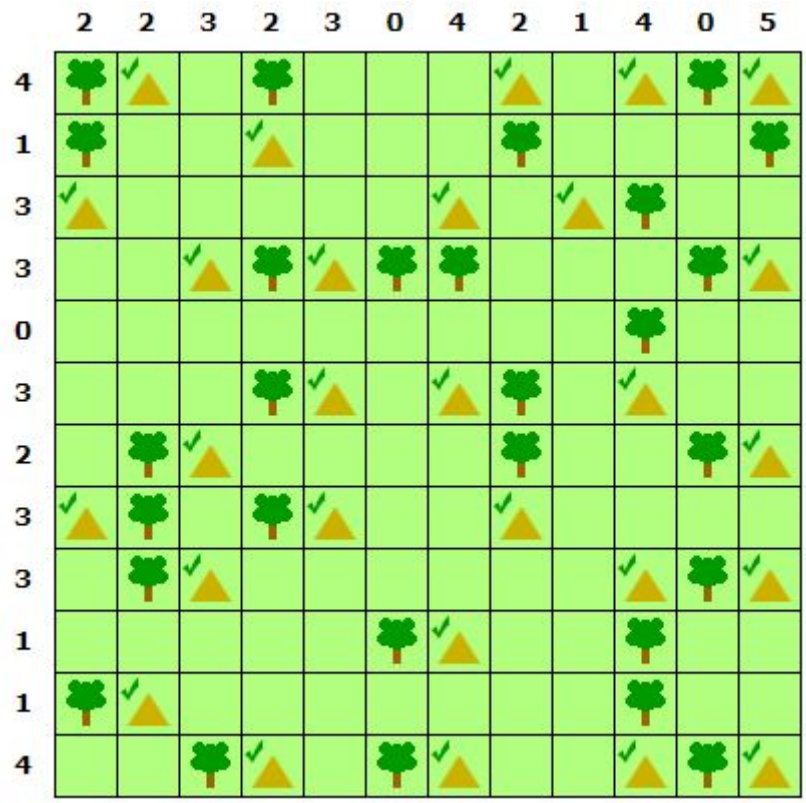
Objective and Rules

• Find all of the hidden tents.

• Each tent is attached to one tree (so there are as many tents as there are trees).

• The numbers across the top and along the side tell you how many tents are there in the respective
column or row.
• A tent can only be found horizontally or vertically adjacent to a tree.
• Tents are never adjacent to each other, neither vertically, horizontally, nor diagonally.
• A tree might be next to two tents, but is only connected to one.
• example:




2 2 3 2 3 0 4 2 1 4 0 5
4
1
3
3
0
3
2
3
3
1
1
4