Prelims:-

Question 1: (prelims)
Here is a list of words:

INN PEN PET PIE TEE TIE

[1] Three logicians are told, “I have told each of you one of the three letters in a word listed before you so that three known letters together spell the word.”

[2] Then they are told, “None of you can tell how many vowels the word has.”

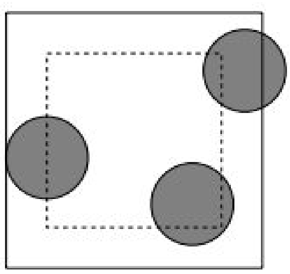
[3] Then they are told, “At this point, still none of you can tell how many vowels the word has.”

[4] Then one of the three logicians says he knew what the word is.

What is the word?

Answer: PET
Solution:
From [1] and [2], none of the three logicians was told the word had an N; otherwise a logician would know that the word had one vowel. So the word is not INN or PEN.
Then, from [1] and [3], none of the three logicians was told the word had an I; otherwise, a logician would know the word, now one of four, had two vowels. So the word is not PIE or TIE.
Then, from [1] and [4], the logician who knows the word must have been told a letter that is in only one of the two remaining words, PET and TEE. So that logician was told the word has a P and *the word is PET.*

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

$$d = \frac{1}{2}(2 - \sqrt{2})l. \qquad \square$$

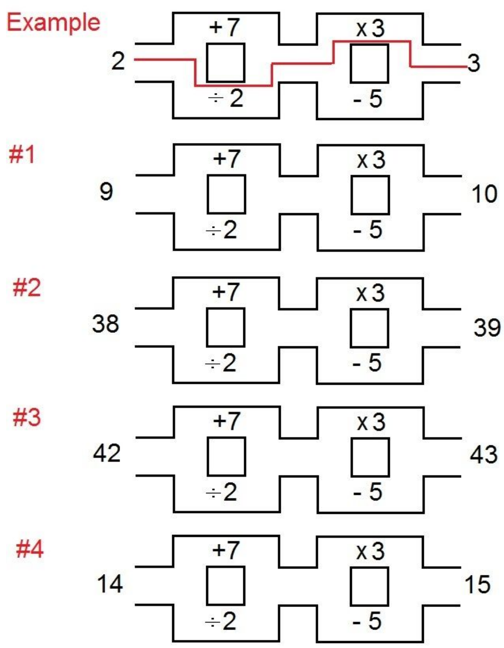
Q.2) **Prelims:** In how many ways can a number n be represented as a sum of two positive integers if representations which differ only in the order of the terms are considered to be the same?

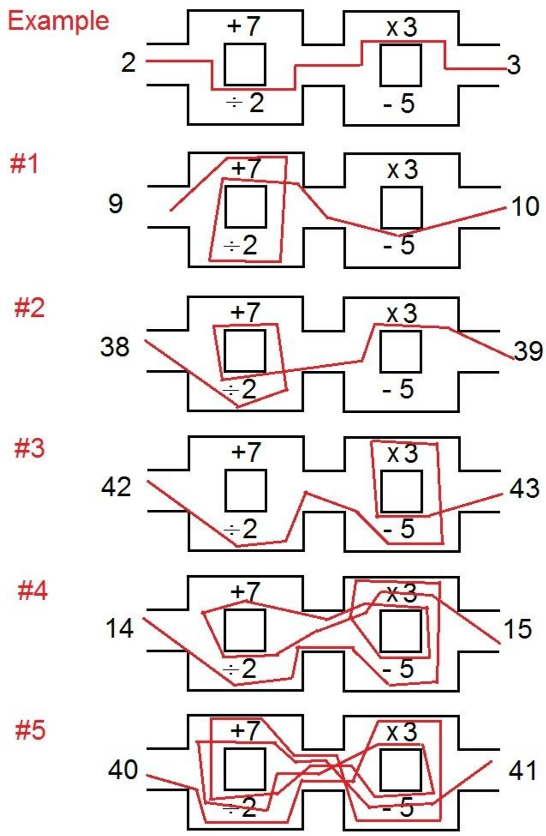
If n is represented as a sum of two positive integers n = x + y, then one of the terms must be less than or equal to n/2. This term can take the values 1,2,3, ... , [n/2]; all these cases are different since the second term will in these cases be at least n/2. Hence there are [n/2] such representations.

Question **1)(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 :





Question **2**)(buzzer 2)
There are 100 islands, each of a distinct size. 100 perfectly logical villagers live on each island, and the numbers of villagers with blue eyes on each of the islands are the distinct numbers \$0

,1,\cdots, 99,\$ with a uniform distribution.

On one of the islands, all the villagers know that everyone has either blue or brown eyes, but it is forbidden for a villager to know his/her own eye color. If a villager believes they know their own eye color on a given day, they must leave the village in exile that night.

One day a fairy visits this island and announces that at least 50 villagers have blue eyes. Unfortunately, the fairy chooses completely randomly whether to lie or to the truth, but each villager believes the fairy unless they observe a contradiction. The villagers do not discuss the fairy's statement.

What is the probability that a given random villager from the smallest island will eventually leave the island in exile but be incorrect about their eye color?

If the probability is p/q, where p,q are positive, coprime integers, give your answer as p+q.
Solution :
If the fairy told the truth, then eventually all islanders will leave in exile but correctly know their own eye colors.

If the fairy lied:

- If fewer than 48 people have blue eyes, everyone will know the fairy is lying, and that everyone else knows the fairy lied. Therefore, they will know that everyone knows more than 50 people have brown eyes, so eventually all islanders will leave in exile but correctly know their own eye color.
- If 48 people have blue eyes, the blue-eyed will know that the fairy was lying and that everyone knows the fairy lied. The brown-eyed people will know that the fairy lied, but not if the other brown-eyed know. When no one leaves in exile the first night, all the brown-eyed will know they have brown eyes. After they leave, the blue-eyed will know they have blue eyes.
- If 49 people have blue eyes, the brown-eyed will believe the fairy and leave in exile but be incorrect about their eye color. The next day, the blue-eyed will realize they actually have blue eyes.

Thus, a villager will only exile themselves and be incorrect if exactly 49 people have blue eyes (probability 1/100) and they have brown eyes (probability , when 49 have blue eyes), so the probability is 1/100*51/100.

Therefore, the answer is .10051

Question **3**)(puzzle)

The number of digits in this box that are not 1 is	________
The number of digits in this box that are not 2 is	________
The number of digits in this box that are not 3 is	________
The number of digits in this box that are not 4 is	________
The number of digits in this box that are not 5 is	________
The number of digits in this box that are not 6 is	________
The number of digits in this box that are not 7 is	________
The number of digits in this box that are not 8 is	________
The number of digits in this box that are not 9 is	________

Solution:

251825242324262526

For starters, let's first recognize that the number of digits is going to be at least 18, so if each of these answers is going to be double digits, the total number of digits will come out to be 9*3 = 27.

Next, we find that excluding 2, almost every digit is not going to appear very often, so all of the answers with the exception of 2 are going to be close to and at most 26. This means that the number of digits that are not 2 is going to be close to and at most 18.

This next bit helps optimize the counting a little bit. Since the total number of digits is 27, rather than counting up the number of digits that are not a particular one, we count up the number of times a digit appears and subtract that from 27. So if the digit 8 appears twice, then the count of non-8 digits is 27-2 = 25.

The digits 7 and 9 are only going to ever appear once, making the count 26. The digit 8 will probably only appear twice because of the 18 for answer 2. Similarly, the digit 1 will probably only appear twice. Both of these counts is 25.

This leaves us with the following *likely* scenario:

1: 25

2: 18

3: 2-

4: 2-

5: 2-

6: 2-

7: 26

8: 25

9: 26

The last 4 answers are very erratic, as changing one of them usually changes many of the others. However, we can now prove that the numbers we have fixed will not be changed by just playing with the missing digits.

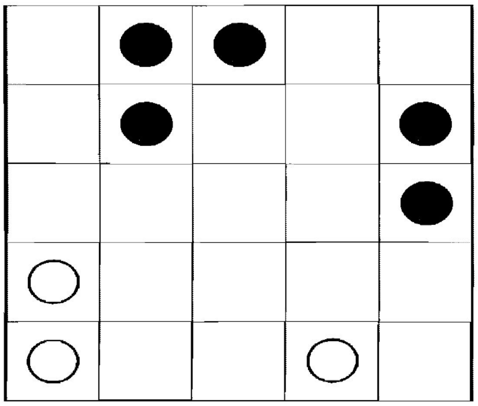
At most, digits 3 and 4 can have 5 occurrences, but if one of them did have 5, the count comes to 27-5 = 22, which does not contribute the digit needed. Therefore, they can only have 4 occurrences maximum, which brings the count of a digit to 23 at the lowest, which does not change any of the other quantities we have. The only digits that can extend past 4 occurrences is 5 or 6, since they already appear three times each, meaning they start at 24, so it is not possible for them to appear more than 4 times either. (There are one or two ambiguous cases, but working through them manually shows they don't work.)

However, just proving that these missing digits will not affect our fixed digits does not mean the answer exists. Between the possibilities of 3, 4, 5, and 6, there are 4^4 = 256 possible cases to check, in which the large majority of them can be immediately or quickly discarded. This now becomes possible to guess and check by hand, which allows us to find our final answer.

Question **4**)(prelims)
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.

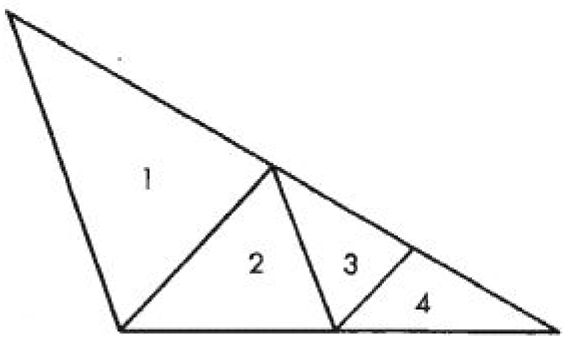
Question **5**)(prelims)
Can you place three white queens and five black queens on a 5 X 5 chessboard so that no queen of one color attacks a queen of the other color? The pattern is unique except, of course, for rotations and reflections.



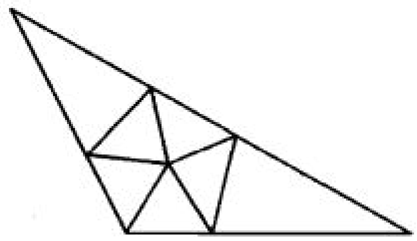
Question **6**)(prelims)

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:

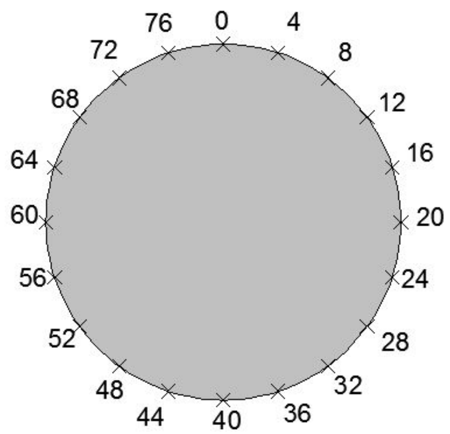


It is easy to see that seven is minimal. The obtuse angle must be divided by a line. This line cannot go all the way to the other side, for then it would form another obtuse triangle, which in turn would have to be dissected, consequently the pattern for the large triangle would not be minimal. The line 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.

Question **7**)(buzzer)
A young lady was vacationing on Circle Lake, a large artificial body of water named for its precisely circular shape. To escape from a man who was pursuing her, she got into a rowboat and rowed to the center of the lake, where a raft was anchored. The man decided to wait it out on shore. He knew she would have to come ashore eventually. Since he could run four times as fast as she could row, he assumed that it would be a simple matter to catch her as soon as her boat touched the lake's edge.
But the girl-a mathematics major at IIT gave some thought to her predicament. She knew that once she was on solid ground she could outrun the man; it was only necessary to devise a rowing strategy that would get her to a point on shore before he could get there.
She soon hit on, a simple plan, and her applied mathematics applied successfully.
What was the girl's strategy? (For puzzle purposes it is assumed
that she knows at all times her exact position on the lake.)
Solution :
If the girl's objective is to escape by reaching the shore as quickly as possible, her best strategy is as follows. First she rows so that the lake's center, marked by the raft, is always between her and the man on shore, the three points maintaining a straight line. At the same time, she moves shoreward. Assuming that the man follows his optimum strategy of always running in the same direction around the lake, with a speed four times as fast as the girl can row, the girl's optimum path is a semicircle with a radius of r/8, where r is the lake's radius. At the end of this semicircle, she will have reached a distance of r/4 from the lake's center. That is the point at which the angular velocity she must maintain to keep the man opposite her just equals his angular velocity, leaving her no reserve energy for moving outward. (If during this period the man should change direction, she can
do as well or better by mirror reflecting her path.)
As soon as the girl reaches the end of the semicircle, she heads straight for the nearest spot on the shore. She has a distance of 3r/ 4 to go. He has to travel a distance of πr to catch her when she lands. She escapes, because when she reaches the shore he has gone a distance of only 3r.

Suppose, however, the girl prefers to reach the shore not as soon as possible but at a spot as jar away as possible from the man. In this case her best strategy, after she reaches a point r/4 from the lake's center, is to row in a straight line that is tangent to the circle of radius r/4, moving in a direction opposite to the way the man is running.

Question **8**)(too long)
The year is 1984. A moon base has been established and an astronaut is to make an exploratory trip around the moon. Starting at the base, he is to follow a great circle and return to the base from the other side. The trip is to be made in a car built to travel over the satellite's surface and having a fuel tank that holds just enough fuel to take the car a fifth of the way around the moon. In addition the car can carry one sealed container that holds the same amount of fuel as the tank.
This may be opened and used to fill the tank or it may be deposited, unopened, on the moon's surface. No fraction of the container's contents may be so deposited.
The problem is to devise a way of making the round trip with a minimum consumption of fuel. As many preliminary trips as desired may be made, in either direction, to leave containers at strategic spots where they can be picked up and used later, but eventually a complete circuit must be made all the way around in one direction.
Assume that there is an unlimited supply of containers at the base. The car can always be refueled at the base from a large tank. For example, if it arrives at the base with a partly empty tank, it can refill its tank without wasting the fuel remaining in its tank.
To work on the problem, it is convenient to draw a circle and divide it into twenty parts each 4 units long. Fuel used in preliminary trips must of course be counted as part of the total amount consumed.



Solution :
Assume that each container holds 80/5 =16 units of fuel. T, he solution follows:
1. Take one container to point 73, return to base (consumes 14 units).
2. Two containers to 75, return to base (20 units).
3. Two containers to 72, return to base (32 units).
4. One container to 691/2, back to 75 (16 units).
5. One container to 671/2, back to 691/2, forward to 671/2, back to 72(16 units).
6. One container to 64, back to 671/2 , forward to 66, back to 671/2, forward to 66 (16 units).
7. One container to 57, back to 64 (16 units).
8. Return to base (16 units).

9. Five containers to 8, return to base (80 units).
10. One container to 10, back to 8, forward to 10, back to 8 (16 units).
11. One container to 16, back to 8 (16 units).
12. One container to 161/2, back to 16, forward to 161/2, back to 10 (16 units).
13. One container to 211/4, back to 161/2 (16 units).
14. One container to 25, back to 211/4, forward to 25 (16 units).
15. One container to 41 (16 units).
16. Proceed to 57 (16 units).
17. Proceed to 73 (16 units).
18. Proceed to base (7 units).

Total fuel consumption is **361/16 = 22 9/16 units**. Other variations with similar answers is allowed.

By dividing surface in 20 parts each 5 units, one can also come up with :

The moon can be circled with a consumption of 23 tankfuls of fuel.

1. In five trips, take five containers to point 90, return to base (consumes five tanks).
2. Take one container to point 85, return to point 90 (one tank).
3. Take one container to point 80, return to point 90 (one tank).
4. Take one container to point 80, return to point 85, pick up the container there and take it to point 80 (one tank).
5. Take one container to point 70, return to point 80 (one tank).
6. Return to base (one tank).

This completes all preliminary trips in the reverse direction. There is now one container at point 70, one at point 90. Ten tanks have been consumed.

7. Take one container to point 5, return to base (half a tank).
8. In four trips, take four containers to point 10, return to base (four tanks).
9. Take one container to point 10, return to point 5, pick up the container there and leave it at point 10 (one tank).
10. In the next two trips take two containers to point 20, return to point 10 (two tanks).
11. Take one container to point 25, return to point 20 (one tank),
12. Take one container to point 30, return to point 25, pick up the container there and carry it to point 30 (one tank).
13. Proceed to point 70 (two tanks).
14. Proceed to point 90 (one tank).
15. Proceed to base (half a tank),

The car arrives at base with its tank half-filled. The total fuel consumption is **23 tanks**.

(prelims)

Q9) 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

RAPID FIRE:

Q1)There are three boxes. One is labelled "APPLES" another is labelled "ORANGES". The last one is labelled "APPLES AND ORANGES". You know that each is labelled incorrectly. You may ask me to pick one fruit from one box which you choose.
How can you label the boxes correctly?

Solution:
Pick from the one labeled "Apples & Oranges". This box must contain either only apples or only oranges.

E.g. if you find an Orange, label the box Orange, then change the Oranges box to Apples, and the Apples box to "Apples & Oranges."

Q2(prelims))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?

Answer

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.

Q3)Using only two 2's and any combination of mathematical signs, symbols and functions can you make 5? (Rapid fire)

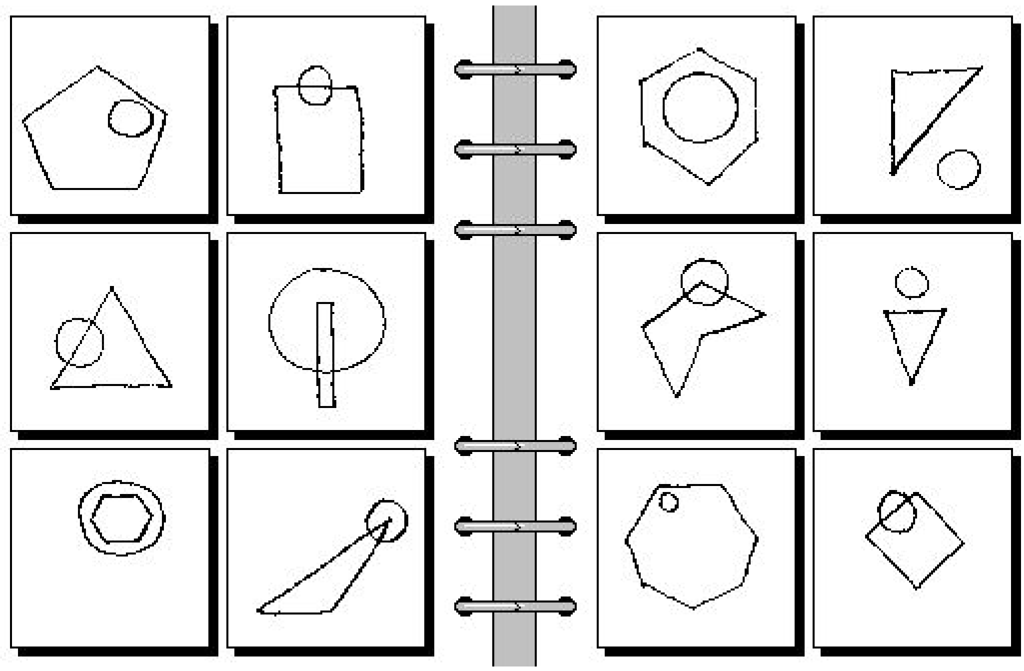
Answer

SQRT(0.2 ^ -2)

Puzzle round:

Q1) Bongard problem(prelims):

There are six boxes on the left, and another six on the right. The ones on the left conform to a pattern, or rule, that describes them. The six boxes on the right do not conform to the same pattern. The task is to find the pattern, or rule which each side follows.



Solution:
Left: The polygon stands on one of its sides.
Right: The polygon stands on one of its vertices.

Buzzer:

Q1)(prelims)When a person A walked very slowly down the down-moving escalator, he reached the bottom after taking 50 steps. As an experiment, he ran up the same escalator, one step at a time, reaching the top after taking 125 steps.
Assuming that the person went up five times as fast as he went down(that is, took five steps to every one step before), and that he made each trip at a constant speed, how many steps would be visible if the escalator stopped running?

Solution: let n be the number of steps visible when the escalator is not moving, and let a unit of time be the time it takes the person A to walk down one step. If he walks down the down-moving escalator in 50 steps, then n-50 steps have gone out of sight in 50 units of time. It takes him 125 steps to run up the escalator, taking five steps to every one step before. In this trip, 125-n steps have gone out of sight in 125/5, or 25, units of time. Since the escalator can be presumed to run at a constant speed, we have the following linear equation that readily yields a value for n of 100 steps:
$(n-50)/50=(125-n)/25$

N = 100

Q) (buzzer)(too big
Five hens each had a certain laying spot in the hen house. (Pecking order and all) Unfortunately, they were … all inconsistent layers while their farmer was on vacation. How were their eggs? 1. Mildred, who laid two eggs while the farmer was gone, and Sally, who only laid on days starting with ‘T’, roost as far away from each other as possible. 2. Henrietta’s spot was one or two spots north of Sally’s. 3. Emmy and Henrietta both laid eggs the day after the farmer left. 4. Emmy is directly to the west of Martha, who did not lay an egg on Monday. 5. Henrietta and Emmy both laid eggs the day the farmer left and the day he returned, which was a Friday. 6. The hen house has six roosts. They are arranged in a 3x2 rectangle: Three spaces in the north-to-south direction, and two in the east-to-west. 7. Mildred enjoys mornings, so she is on the side of the hen house that the sun rises from. 8. During the five days (four nights) the farmer was gone, Mildred or Martha laid an egg each day – but never both of them on the same day. 9. There is an empty roost next to Sally. 10.

Emmy and Mildred both laid eggs on Thursday, but Henrietta did not. 11. At least two eggs were laid each day the farmer was gone.
Solution:
Where hens roost:
1. The hen house is arranged in a 3x2 grid – 3 spaces N-S, 2 spaces E-W (clue 6).
2. Mildred and Sally are in two opposite corners (1). Mildred is on the east side (7), and Sally can't be on a northern corner (2), so Mildred is in the NE spot and Sally is in the SW spot.
3. There is an empty spot in the SE spot (9).
4. Since Emmy is directly to the west of Martha, Emmy is in the middle west spot and Martha is in the middle east spot (4).
5. Henrietta is one or two spots north of Sally. Since Emmy is directly north of Sally, Henrietta is in the NW corner (2).

Henrietta	Mildred
Emmy	Martha
Sally	[empty]

	Mon	Tues	Wed	Thurs	Fri
Henrietta	Yes	Yes	Yes	No	Yes
Emmy	Yes	Yes	No	Yes	Yes
Sally	No	Yes	No	Yes	No
Mildred	Yes	No	No	Yes	No
Martha	No	Yes	Yes	No	Yes

Q)(publi)
Statistical analysis and data reconfiguration. That was Chandler's job (who knew!?), and it's your job too in the grid below. Think: word search for number crunchers. Hidden among a plethora of incalculable nonsense, are twelve straight truths – some longer than others. As is the case in word searches, these arithmetic truths might read in any direction. And though these truths are distinct and different, look for their commonalities.

Solution: DISCRETE MATH (4 9 19 3 18 5 20 5_ 13 1 20 8)

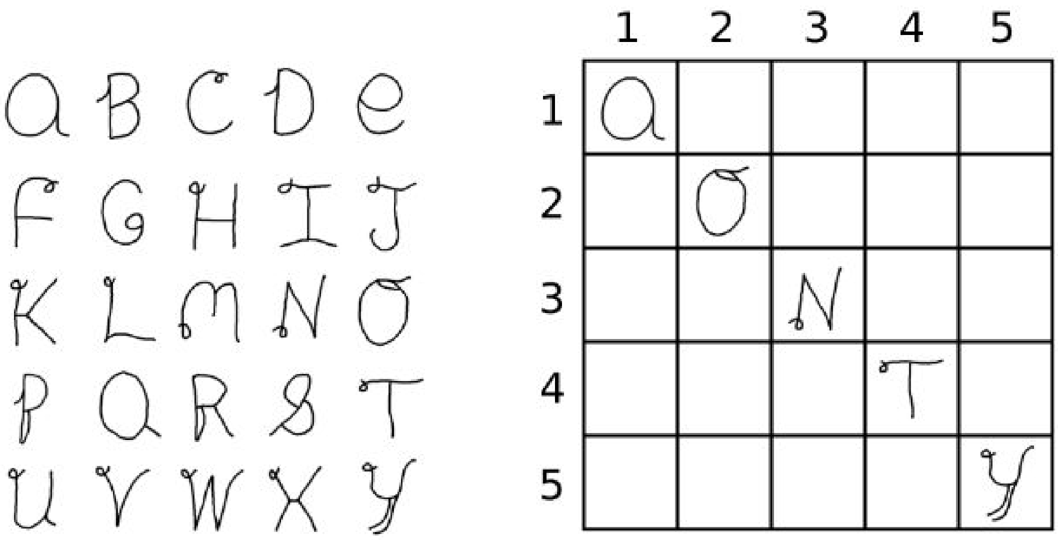
22	=	4	x	6	=	8	+	15	+	4
=	12	-	26	=	2	x	7	=	24	^
1	=	4	^	1	=	12	=	2	/	3
=	3	+	3	=	7	/	6	x	3	=
9	=	19	+	21	-	3	+	8	=	24
-	23	=	12	x	2	=	5	-	2	x
12	=	18	=	3	-	5	+	20	^	2
=	21	+	16	=	19	-	2	=	3	=
5	+	13	=	15	-	1	+	20	/	5
/	2	-	26	=	2	+	5	+	5	x
15	+	8	=	16	/	2	+	8	+	9

22	=	4	x	6	=	8	+	15	+	4
=	12	-	26	=	2	x	7	=	24	^
1	=	4	^	1	=	12	=	2	/	3
=	3	+	3	=	7	/	6	x	3	=
9	=	19	+	21	-	3	+	8	=	24
-	23	=	12	x	2	=	5	-	2	x
12	=	18	=	3	-	5	+	20	^	2
=	21	+	16	=	19	-	2	=	3	=
5	+	13	=	15	-	1	+	20	/	5
/	2	-	26	=	2	x	5	+	5	x
15	+	8	=	16	/	2	+	8	+	9

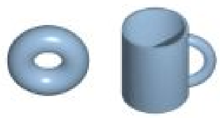
Q) (backup puzzle)

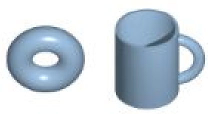
A friend passes you a note with the following strange image.

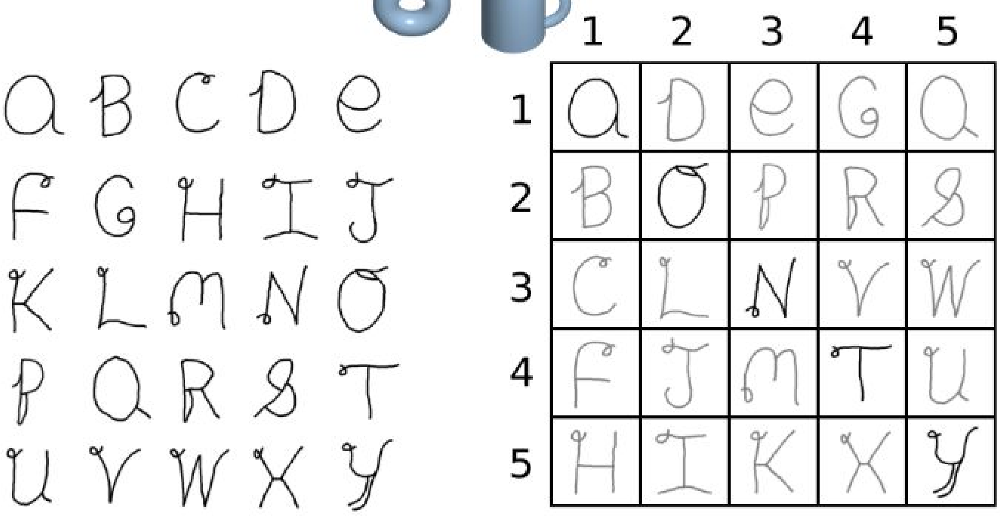
Hint: She explains that several of the letters can be morphed from one to another without adding new edges, joining new points together, or cutting edges apart. For example, the A and E in her note can be morphed back and forth because both contain exactly one loop joined with an edge. Can you decode the number pairs by identifying groups of letters than can be “morphed” from one to another? Try writing each group in alphabetical order on the corresponding rows of the grid…



43 11 44 51 52 25 11 35 13 25 22 43 13





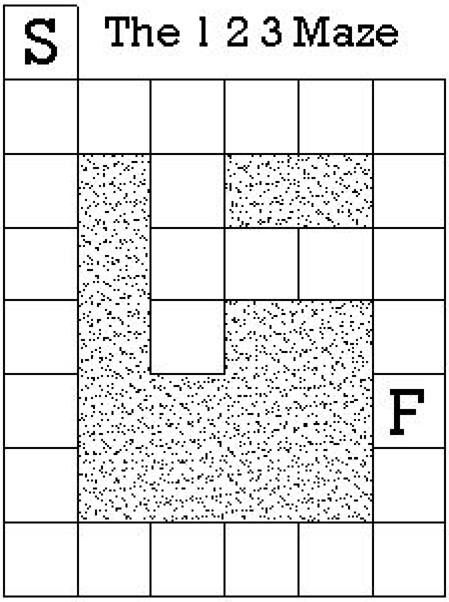


43 11 44 51 52 25 11 35 13 25 22 43 13

MATH IS AWESOME

Q)(Puzzle)

Start at S. Take 1 step in a direction, then two steps, then three steps. Repeat taking 1, 2, and 3 steps to finish at F. You may not turn a corner or turn back while taking a step.



Solution:DDDUDUUURLDRDUD or DDDDUUDURLDRDUD

Q) (buzzer)

Aryaman and Aayush are given the product and sum of two non-zero digits (1 to 9).

1. Aryaman says "I don't know the numbers".
   Aayush says "I don't know the numbers".
2. Aryaman says "I don't know the numbers".
   Aayush says "I don't know the numbers".
3. Aryaman says "I don't know the numbers".
   Aayush says "I don't know the numbers".
4. Aryaman says "I don't know the numbers".
   Aayush says "I don't know the numbers".
5. Aryaman says "I know the numbers".

what are they?

Solution : Aayush :S ; Aryaman: P

>From 1. P has an ambiguous product, which might be
36 = 9x4 = 6x6, 24 = 8x3 = 6x4, 18 = 9x2 = 6x3, 16 = 8x2 = 4x4,
12 = 6x2 = 4x3, 9 = 9x1 = 3x3, 8 = 8x1 = 4x2, 6 = 6x1 = 3x2,
or 4 = 4x1 = 2x2.

By the time P has made his announcement, Aayush has considered all the possible addends which might form his sum, and has considered all the products of those addends, yet he also does not know. So Aayush has a number that has addends which when multiplied form more than one of the possible ambiguous products. Such sums are

5 = 4+1 (product 4) or 5 = 3+2 (product 6)
6 = 4+2 (product 8) or 6 = 3+3 (product 9)
7 = 6+1 (product 6) or 7 = 4+3 (product 12)
8 = 6+2 (product 12) or 8 = 4+4 (product 16)
9 = 8+1 (product 8) or 9 = 6+3 (product 18)
10 = 9+1 (product 9) or 10 = 8+2 (product 16) or 10 = 6+4 (product 24)
11 = 9+2 (product 18) or 11 = 8+3 (product 24)

>From 2. When P learns that S doesn't know, he has already added all the single digit factors of his ambiguous sum and discovered18 but isn't sure whether S has 11 or 9
16 but isn't sure whether S has 10 or 8
12 but isn't sure whether S has 8 or 7
9 but isn't sure whether S has 10 or 6
8 but isn't sure whether S has 9 or 6
6 but isn't sure whether S has 7 or 5

Note that S cannot have 5 for if he had 5 he would be convinced that P has 6.

>From 3. P cannot have 6 for if he did he would be convinced that S has 7.
S cannot then have 7 for if he did he would be convinced that P has 12

>From 4. P cannot have 12 for if he did he would be convinced that S has 8.
S cannot have 8 for then he would know that P has 16.

>From 5. P, who has 16, decides that S has 10 and that the original numbers are 2 and 8.

Q) (prelims)
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.

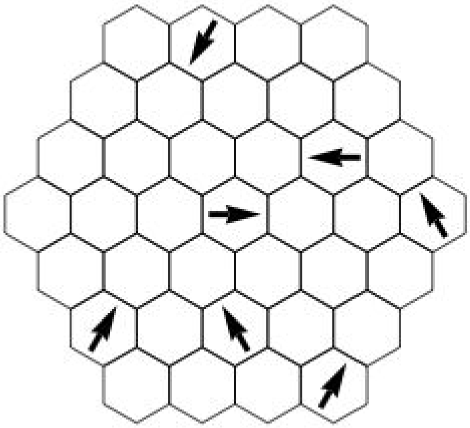
Solution:
Number the board as
 1 2 3 4
 5 6 7 8
 9 10 11 12
13 14 15 16

The solutions are

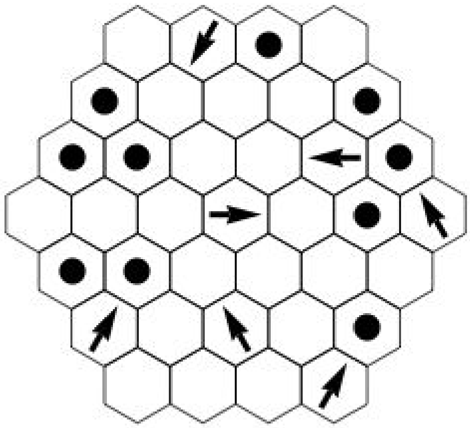
6 2	and	6 2
10 6		7 6
11 15		11 15
7 3 4		10 11 3 4
6 8 16		6 8 16
15 3		15 3
2 1		2 1
3 15 13		3 15 13

Q) (------)

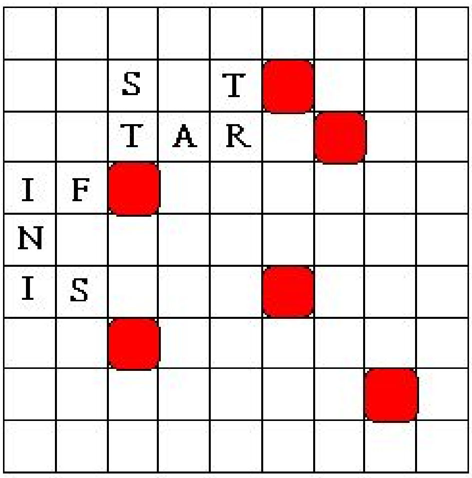
Put dots in some of the blank hexes so that each arrow points in the direction that has the most dots. Arrows point at strictly more dots than any other direction parallel to a side of the hexagon.



Solution:



Q(hard puzzle)The above is rolling U Pentomino maze. Goal is to move block from start to finish. (puzzle)



Ans:
N-W-SSS-EE-N-E-N-E-S WW-S-E-NNN-WW-S-E-S
EE-N-W-W-S-EE-NN E-S-W-S-W-N-WW-S-E E-N-WW-N-E-S-W-S

Q) (filler) or (puzzle)

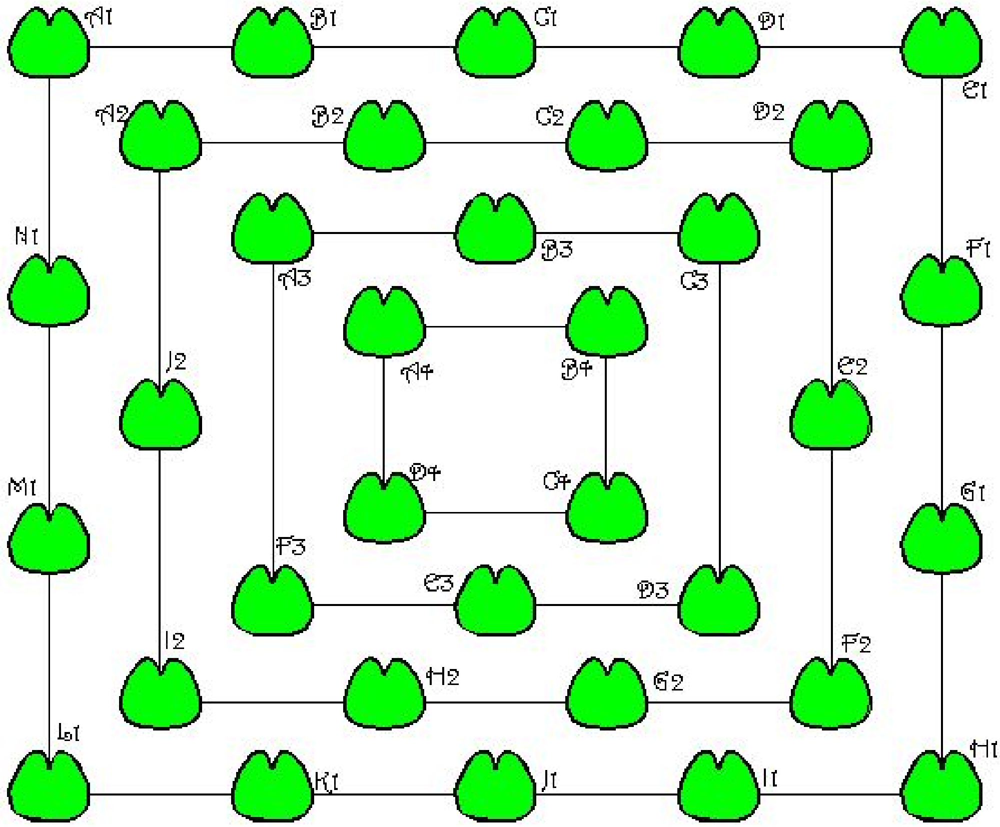
If four frogs can reach the center of the bog at once, they will turn into princes. But the lilypads need to be marked, else the princes will lose their way and drown in the bog.

Being a magic bog, several conditions must be satisfied.

1. Each of the four frogs must start at one of the outer lilypads (A1, E1, H1, L1), and mark those spaces when they enter.
2. Each route must be inward only, and the two lilypads of an inward jump must be marked. Examples: N1-A2, B3-A4, F1-D2.
3. A frog may travel as far as they like in a ring, but only one pad at a time, they may not change direction, and they may not jump onto a pad with a marker.
4. Each route to the center must use exactly 13 lilypads.
5. A frog may only jump to a nearby lilypad, either vertically or horizontally, or diagonally inward.

So, the first frog might try E1-D1-C1-C2-D2-E2-D3-C3-B3-A3-F3-E3-C4, leaving markers on E1 (C1 C2) (E2 D3) (E3 C4). The next frog would not be able to use or jump over any of the marked lily pads.

Can you get four frogs to the center, so that they may turn into princes?



The solution to "Frogs to Princes" is as follows:

Frog 1 - E1 F1 G1 H1 I1 J1 K1 L1 M1 N1 A2 A3 A4
Frog 2 - L1 M1 J2 I2 H2 G2 F2 E2 D2 C2 B2 B3 B4
Frog 3 - A1 B1 C1 D1 C2 D2 E2 F2 G2 H2 I2 F3 D4
Frog 4 - H1 I1 J1 K1 H2 G2 F2 E2 D2 C3 D3 E3 C4

Q) (filler)
Interviewer said "I shall either ask you ten easy questions or one really difficult question. Think well before you make up your mind!"
The boy thought for a while and said, "my choice is one really difficult question."
"Well, good luck to you, you have made your own choice! Now tell me this.

"What comes first, Day or Night?"

The boy was jolted into reality as his admission depends on the correctness of his answer, but he was quite smart and passed the interview.
What do you think he must have said and what would be his explanation?

Solution: The standard answer is that the candidate picks one of the two at random, the interviewer asks him to explain why, and the candidate refuses to answer because this is the second question.

Q) (wild maybe)
An evil king imprisons two people, A and B. They are placed in the king's evil castle in separate towers. Each tower has a window, and through the windows A and B can see separate parts of the castle's garden. In the garden there grows 20 trees. The prisoners can't communicate in any way with each other.

A can see 12 trees through the window in A-tower.
B can see 8 trees through the window in B-tower.

Both are told that the garden has either 18 or 20 trees, and that they together see all the trees, and that no tree is seen by both of them.

Every day, starting with the day they are imprisoned, a guard asks them a question. The guard first asks A, and if no answer is given, goes on to ask B. The question asked is: "Is there 18 or 20 trees in the garden?"

If the asked prisoner answers correctly, both prisoners are released immediately.
If the asked prisoner answers erroneously, both prisoners are executed immediately.
The prisoner can opt to not answer, in which case the guard will continue to ask the next prisoner as mentioned above. (The prisoner will opt this if it is not sure, since we assume both prisoners to be completely logical entities.)

Will the prisoners ever be released? After how many days?
Solution:
The prisoners will be released on the fifth day.

A sees 12 trees, knows B sees either 6 or 8 trees, reasons that:
If B sees 6 trees then B knows A' sees either 14 or 12 trees, reasons that:
If A' sees 14 trees then A' knows B' sees either 4 or 6 trees, reasons that:
If B' sees 4 trees then B' knows A'' sees either 16 or 14 trees, reasons that:
If A'' sees 16 trees then A'' knows B'' sees either 2 or 4 trees, reasons that:
If B'' sees 2 trees then B'' knows A(3) sees either 18 or 16 trees, reasons that:
If A(3) sees 18 trees then A(3) knows B(3) sees either 0 or 2 trees, reasons that:
If B(3) sees 0 trees then B(3) knows A(4) sees either 20 or 18 trees, reasons that:
If A(4) sees 20 trees then he would announce an answer!
Otherwise if A(4) sees 18 trees then A(4) knows B(4) sees either 0 or 2 trees, reasons that:
...
Otherwise if B(3) sees 2 trees then B(3) knows A(4) sees either 18 or 16 trees, reasons that:
...
Otherwise if A(3) sees 16 trees than A(3) knows B(3) sees either 2 or 4 trees, reasons that:
...
Otherwise if B'' sees 4 trees then B'' knows A(3) sees either 16 or 14 trees, reasons that:
...
Otherwise if A'' sees 14 trees then A'' knows B'' sees either 4 or 6 trees, reasons that:
...

Otherwise if B' sees 6 trees then B' knows A'' sees either 14 or 12 trees, reasons that:
...
Otherwise if A' sees 12 trees then A' knows B' sees either 6 or 8 trees, reasons that:
...
Otherwise if B sees 8 trees then B knows A' sees either 12 or 10 trees, reasons that:
If A' sees 12 trees then A' knows B' sees either 6 or 8 trees, reasons that:
...
Otherwise if A' sees 10 trees then A' knows B' sees either 8 or 10 trees, reasons that:

...and so on where A', A'', A(3), etc. represent more deeply nested mental hypothetical prisoners.

After the first half of the first day, when A doesn't answer, the tree of possibilities is pruned since eight-times-hypothetical A(4) would have answered if he saw 20 trees.

After the second half of the first day, when B doesn't answer, the tree of possibilities is pruned again since seven-times-hypothetical B(3) wound have known A(4) saw only 18 trees and answered.

And so on, pruning one possibility each half day, until, on the morning of the fifth day, only-once-hypothetical B can only see 8 trees, allowing A to declare that there are 20 trees in the garden.

Q)(rapid)How to simulate a dice roll using just coin tosses?(Both dice and coin are perfectly fair.) The tricky part is guaranteeing that your coin toss algorithm will end. (Ie a solution that could theoretically go on forever isn't valid.)
Solution:
CHeck On your own ! One possible way is **Divide your coin into 6 sections, roll it on its side, after it drops measure which section has a point that lies the farthest away.**

Q)(buzzer give some ans)
Which of the folliwing statements are true and which are false?

1) The answers to 6 and 7 are the same.
2) 1 is false.
3) The answers to 4 and 20 are different.
4) The answers to 3 and 20 are different.
5) The answer to this statement is different from the answer to 19.
6) 2 is true.
7) 15 is true.
8) The answers to 11 and 19 are the same.
9) 10 is true.
10) 13 is false.
11 Ms Smith is allergic to penicillin.
12) 16 is true.
13) 12 is true.
14) The answer to 11 is the same as the answer to this statement.
15) At least half the statements in this puzzle are false.
16) At least half the statements in this puzzle are true.
17) The answers to 9 and 4 are the same.
18) 7 is true.

19) Ms Smith's first name is Jill.
20) The answers to 3 and 4 are different.

Solution:
1) and 2) are mutually exclusive, 6) implies 2), therefore 1) and 6) are mutually exclusive.

Thus if 1) is true then 6) is false and by 1), 7) must be false as well. Conversely, if 1) is false then 6) is true and by not 1), 7) must be false. So either way, 7) is false.

Therefore 18) is false, and by not 7), 15 is false.

But if 15 is false, then 16) must be true. Moreover, there must be no more then 9 false statements (or no less than 11 true statements).

16) implies 12) implies 13) implies not 10) implies not 9).

3), 4), and 20) admit four solutions among them, either they're all false, or exactly one of them is false.

Since 9) is false, 17) is true if 4) is false and false if 4) is true.

If 5) is true then 19) is false; if 5) if false then 19) is false; therefore 19) is false.

Similarly, if 14) is true then 11) is true; if 14) if false then 11) is true; therefore 11) is true.

Therefore 8) is false.

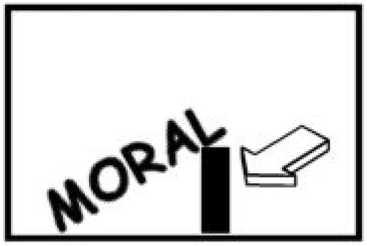
We now have:
 7)F, 8)F, 9)F, 10)F, 11)T, 12)T, 13)T, 15)F, 16)T, 18)F, 19)F
 either 1)T, 2)F, 6)F; or 1)F, 2)T, 6)T
 either 3)F, 4)F, 17)T, 20)F; 3)F, 4)T, 17)F, 20)T; 3)T, 4)F, 17)T, 20)T; or 3)T, 4)T, 17)F, 20)F
 5) and 14) free choices.

Since there are 7 known false answers and at least two more false answers among 1), 2), 3), 4), 6), 17), and 20), the only way 15) can be false is if the choices are made to minimize the number of false answers.

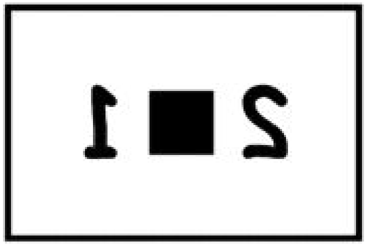
Therefore, the only consistent solution is:
 1) F
 2) T
 3) T
 4) F
 5) T
 6) T
 7) F

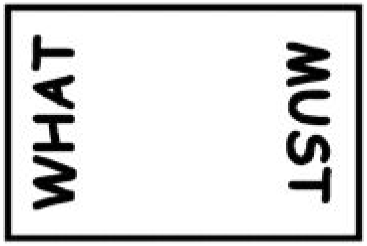
8) F
9) F
10) F
11) T
12) T
13) T
14) T
15) F
16) T
17) T
18) F
19) F
20) T

QRebuses: (prelims)



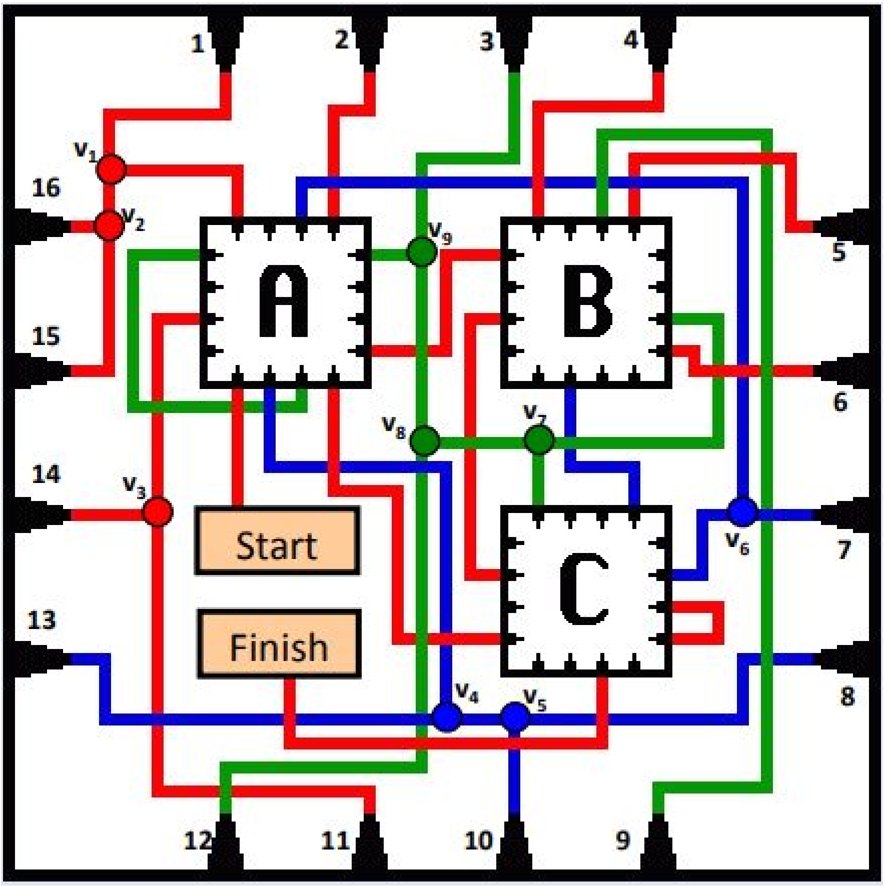
Moral Support


Back to square one



What goes up must come down

Q) (filler) or (publi)



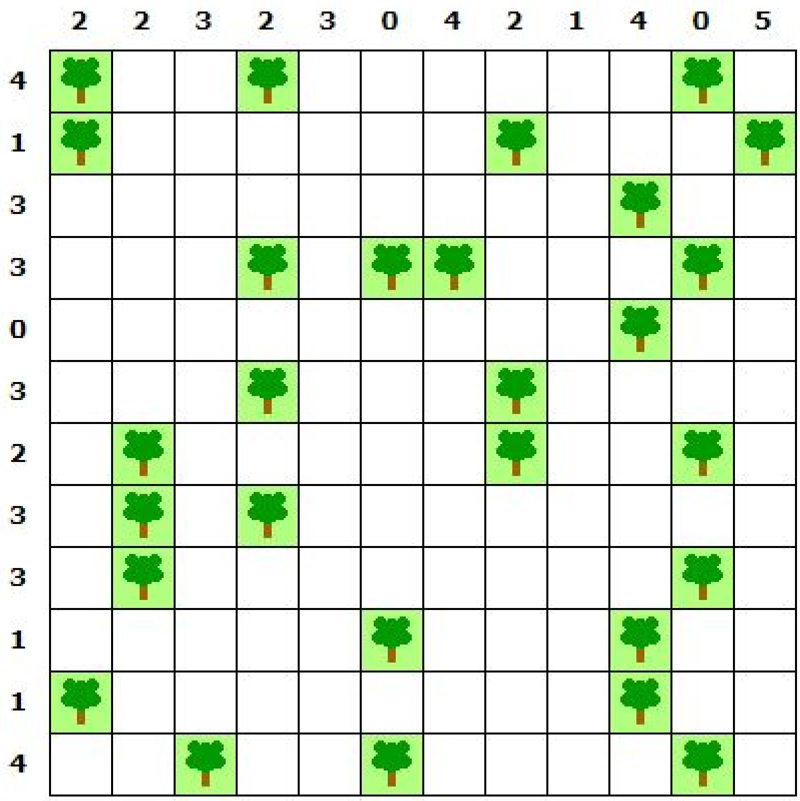
Find a path from “Start” to “Finish”.
Each smaller square is a copy of the larger square.
Note that the edges are colored only as an aid in following the paths at crossing points. Even though there are infinitely many “Finish” lines, you need to end on the largest one at the top level. Can you find the solution with the least number of transitions? Or the solution with minimal depth?

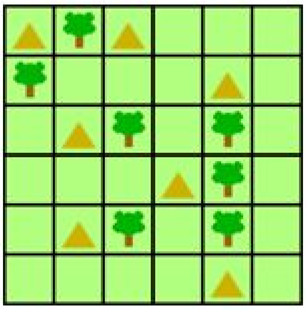
Move	Description	Stack
1.	From "Start" enter A12	-
2.	From 12 leave 3	A
3.	From A3 enter C6	-
4.	From 6 enter B8	C
5.	From 8 enter A11	CB
6.	From 11 enter A14	CBA
7.	From 14 leave 11	CBAA
8.	From A11 leave 10	CBA
9.	From A10 enter A16	CB
10.	From 16 leave 1	CBA
11.	From A1 leave 16	CB
12.	From B16 enter A8	C
13.	From 8 enter A11	CA
14.	From 11 leave 14	CAA
15.	From A14 leave 11	CA
16.	From A11 leave 10	C
17.	From C10 go to "Finish"	-

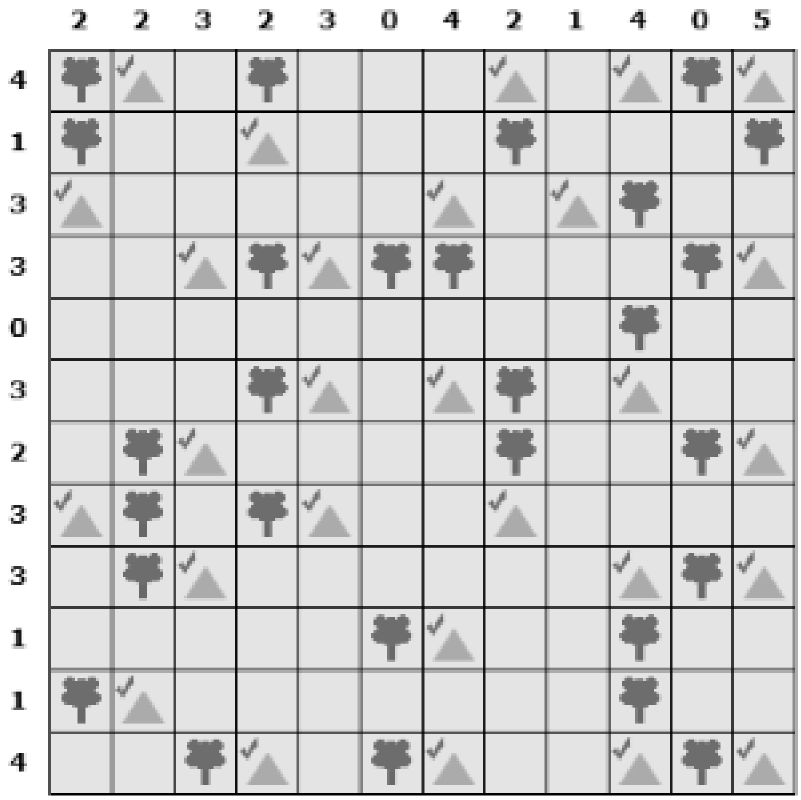
Q)(prelims)

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




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

Q)(rapid fire) Consider a random walk in the plane that starts at the origin and moves only in the positive x and positive y directions. The direction choice at each step is governed by the flip of a fair coin. The length of the first move is $\sqrt{2}$; the length of the second move is $\sqrt{2}/2$; the length of the third move is $\sqrt{2}/4$; and so on.

At the end of infinitely many steps, what is the expected distance from the origin?

Solution:

At the walk's end, the x and y coordinates sum to $2\sqrt{2}$, so the point is on L, the line segment connecting $(0, 2\sqrt{2})$ to $(2\sqrt{2}, 0)$. The points are uniformly distributed on L and so the expected distance is the integral of $(1/2\sqrt{2})\ \sqrt{[x^2 + (2\sqrt{2} - x)^2]}$ from 0 to $2\sqrt{2}$. This is $\sqrt{2}$ + ArcSinh[1], or **$\sqrt{2}$ + Ln[1 + $\sqrt{2}$]**, or 2.29559... .

Q) (rapid fire)

A simple closed curve C in the plane is called "shrinkable" if all shrunk versions of C can fit into the closure of the interior of C.

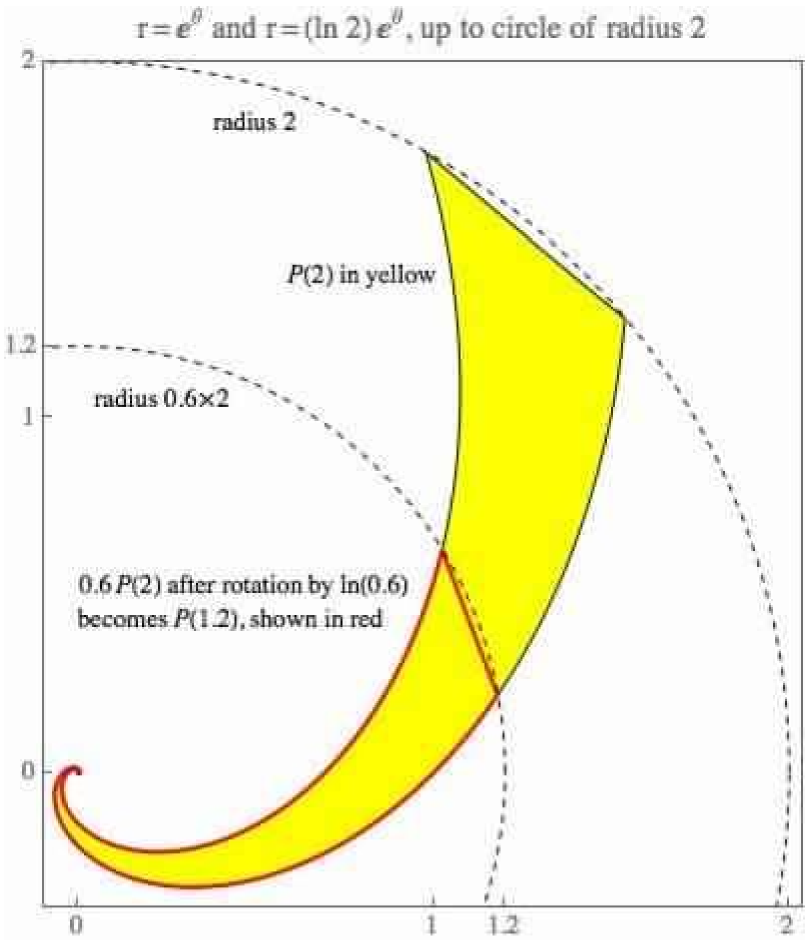
Any convex curve is shrinkable.

Any star-shaped curve is shrinkable.

Find an example of a shrinkable curve that is not star-shaped.

Solution: Consider the region P(q) formed by the two arms of the logarithmic spirals given, in polar coordinates, by $r = e^{\theta}$ and $r = (\ln 2)\ e^{\theta}$, with each extended until it strikes the circle of radius q. Then P(2) solves the problem, since any k P(2) (where $0 < k < 1$) is, after rotation by ln k, equal to P(k 2), which is contained in P(2).

Here is a diagram of this shrinkable region P(2):

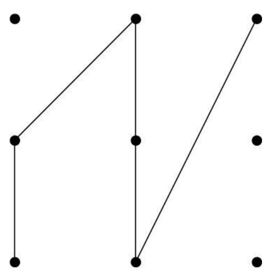


Q)(rapid fire)

Consider a 4 x 4 square lattice of 16 points. Find the longest path (in terms of number of segments) that:

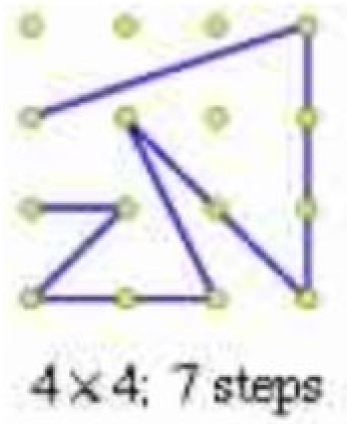
- connects lattice points in sequence with straight segments and never intersects itself (even a tangency is not allowed); and
- has each segment of strictly greater length than the segment that precedes it

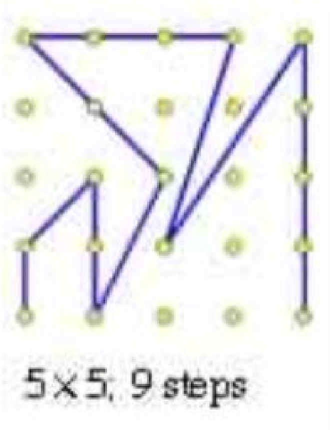
For example, on a 3 × 3 lattice, the longest such path has length 4: it is



(0, 0) → (0, 1) → (1, 2) → (1, 0) → (2, 2)

Bonus : if you get correct for 5 x 5 also! **(5pts)**





Q) (rapid fire)

A sequence of 1198 names (not all distinct) is going to be read out to you, and you are told that one name is in the majority, i.e., it occurs at least 600 times. You have a counter that starts at 0 and that you can increment or decrement whenever you hear a name. But your short-term memory is very low: you can remember only a single name at any given time (but when you hear a name you can check if it is the same as the one in your memory).

Find a strategy that, after all the names are read, will allow you to declare the name of the majority person.

Solution:

Memorize the first name you hear and increment the counter. Then compare every name you hear to the memorized name; increment the counter if they agree; decrement if not.

If the counter ever gets to 0, start over: memorize the next name you hear and increment the counter, and continue as before. The name you have memorized at the end is the majority name. Reason: If the counter never gets back to 0, it is clear that the memorized name is the majority. If it ever gets to 0, then no name has a majority so far. (The memorized name has exactly half so far, and each of the other names have at most half.) So whatever name has a majority overall will have to have a majority in the remainder of the list. That's why starting over works.

Q) (rapid fire)
A stopped clock tells the right time twice a day. How fast must a clock go for it to be right three times a day?
Solution;
Since a stopped clock already agrees with a correctly running clock twice per day,

let's just add a third time by having the clock run backwards once per day.

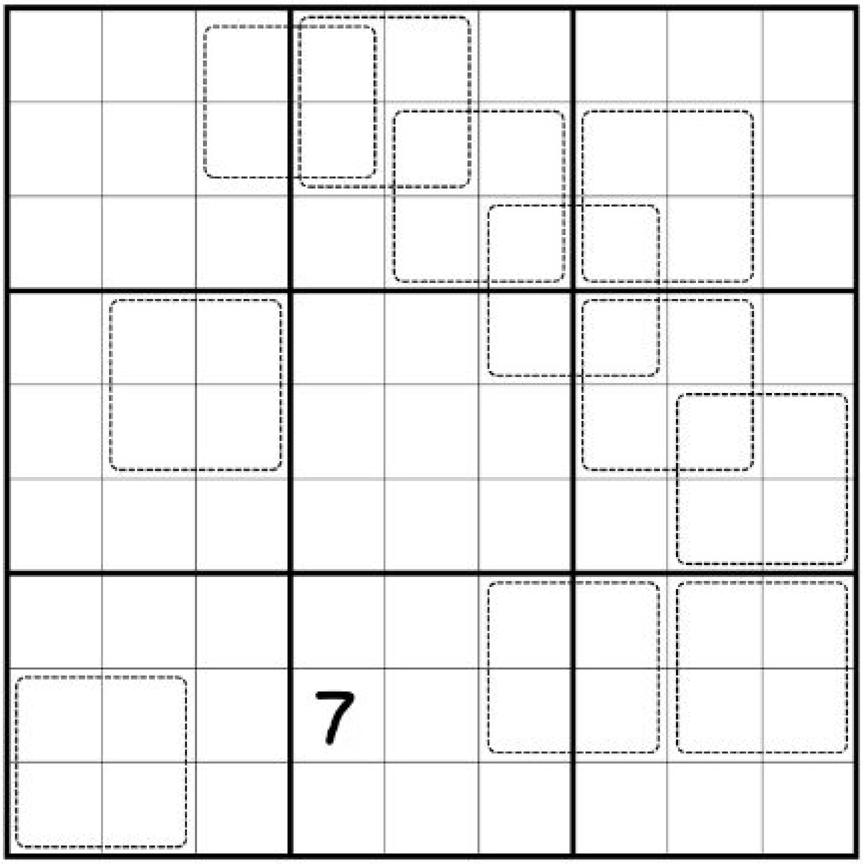
So the answer (that requires the smallest clock hand speed) is

half speed backwards.

Since the answer must be symmetrical (as long as the difference in speeds remains the same, it doesn't matter if our clock is getting ahead or behind the correctly running one), we can get the other answer by adding twice the speed difference:

$-0.5+2\times(1-(-0.5))=2.5$ times the regular speed.

Q)(filler)



The numbers in each dashed box must form a 2x2 matrix with determinant zero.
Solve the sudoku. Rules for Sudoku are :
1 Each 3x3 box must have 1 to 9 numbers.
2 Each row and column must have 1 to 9 numbers.
Solution:
In each of the 2x2 boxes with determinant 0, we have four numbers a,b,c,d between 1 and 9 such that $ad=bc, a\neq b\neq d\neq c$. This leaves surprisingly few possibilities:

2	8	6	9	3	7	1	5	4
5	7	4	6	2	1	3	9	8
3	1	9	5	8	4	2	6	7
7	6	2	3	9	8	4	1	5
1	9	3	4	7	5	8	2	6
8	4	5	2	1	6	7	3	9
4	5	7	1	6	3	9	8	2
9	3	8	7	5	2	6	4	1
6	2	1	8	4	9	5	7	3