Hi, welcome to the Rabbit Hole. I first found some work based on Alice's adventures in Numberland when I worked in Nottingham and thought I'd use the premise but with a different variety of open-ended problems for the children to investigate.

I predominantly use this with year sixes but it could be used for Y5 or maybe Y4, it depends on the strength of your set.

If anybody has any ideas about what else could be included or if something doesn't work, then please email me—I am open to more ideas.

Also, if you want a copy in its original form, so you can alter things, then please email and I will gladly send you a copy.

Enjoy, hope it's useful.

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Alice in Numberland

Maths Investigations

Name

Down the Rabbit Hole

"Begin at the beginning and go on until you come to the end: then stop." **The King**

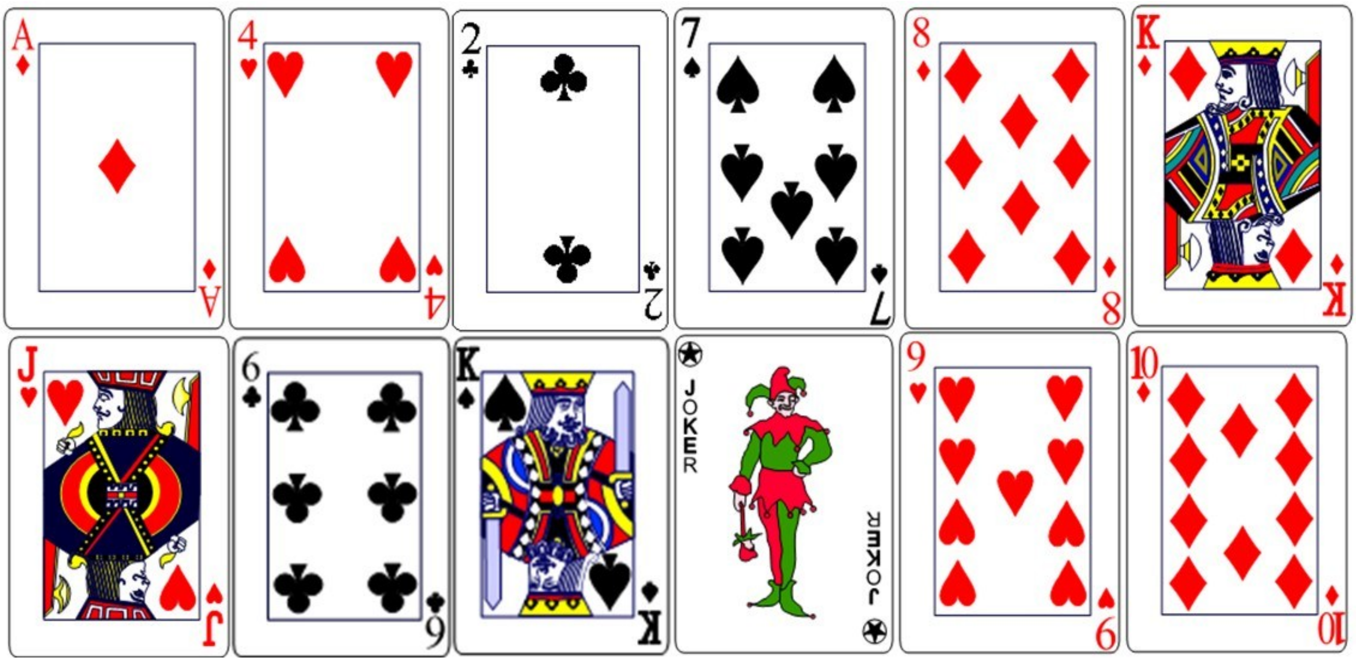
Lewis Carroll, the author of *Alice in Wonderland* and *Alice through the Looking Glass* was a very creative and imaginative writer who loved to entertain children and adults with his stories. As well as being a brilliant story-teller, Carroll was also a keen mathematician. Did you know he invented the Carroll diagram? That's right, that grid with 4 boxes in it that you use to separate shapes or numbers was invented by the same man who created Alice and her odd adventures down the rabbit hole.

In this booklet, you will find your very own adventures through the rabbit hole. There are a variety of challenges—some easy, some more tricky. So, join Alice, the Cheshire Cat, the Mad Hatter, Tweedle Dum and Tweedle Dee and all the others and jump, head-first into the rabbit hole.

"Curiouser and curiouser." **Alice**

Lewis Carroll's Diagram

As mentioned, Lewis Carroll invented the Carroll diagram along with many other fascinating creations. For your first task down the Rabbit Hole, you are challenged to sort this deck of cards out into the correct squares in the grid. One of the Queen of Hearts' guards has dropped them and he will be in serious trouble if he can't re-organise them.



	Picture cards	Non-picture cards
Black suits		
Red suits		

Extension: Can you think of your own titles for each of the rows and columns and replace the cards in them?

The White Rabbit's Ramblings

***"Oh dear! Oh dear! I shall be too late!"* The White Rabbit**

Poor Rabbit, he is once again late—for a very important date. Maybe if he adjusted his watch, then he may be on time for once. Can you help him?

This is an old-fashioned watch with Roman numerals instead of numbers. If the hour hand was pointing at VII and the minute hand was pointing at XII, **what time would it be?**

No wonder the Rabbit is always late, the minute hand is now on the III and the hour hand is just after the IX—the problem is that his watch is twenty minutes late, **what time should it be? Mark it on the clock.**

Finally, White Rabbit has managed to get some advice from the helpful and all-knowing Caterpillar. "*When the sun is highest in the sky, it is noon. Set your watch by that*". At noon, Rabbit sees his watch is 35 minutes fast, **draw the hands in the right place on the clock here to show what time Rabbit's watch shows.**

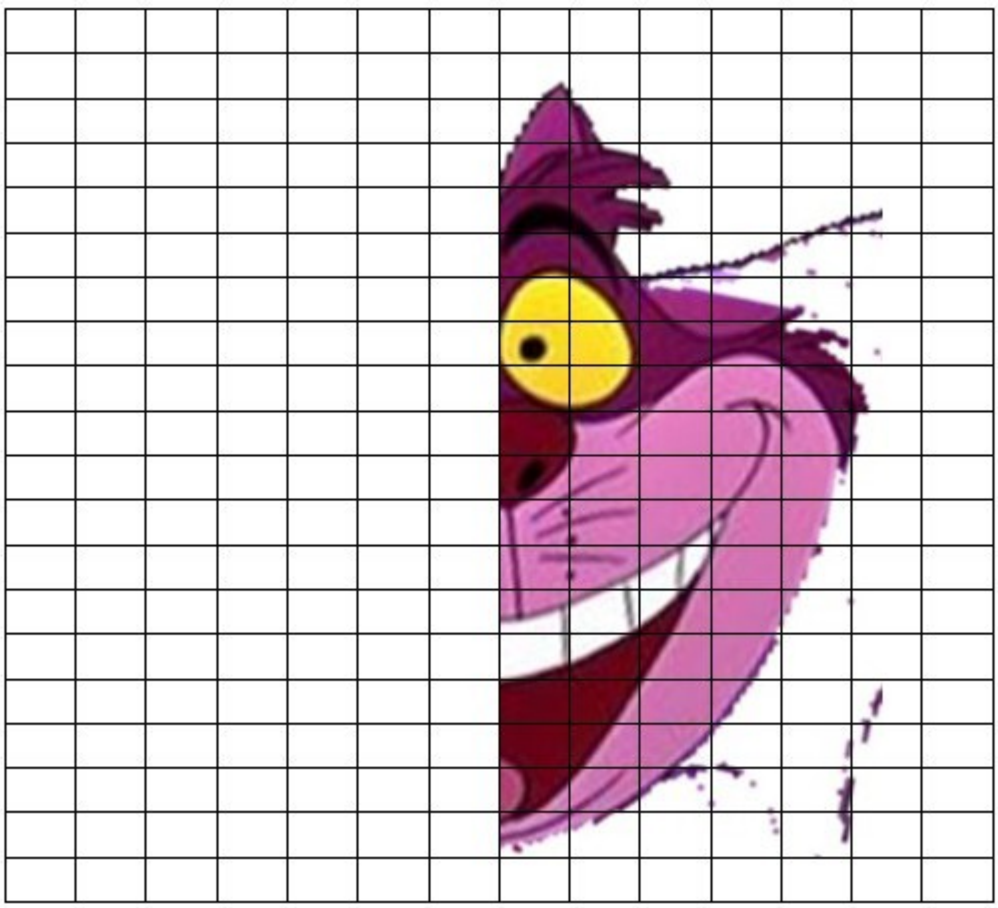
White Rabbit's Extension:
How many minutes in the hours from midday to midnight?
How many hours in three quarters of a day?
How many minutes in the third month of the year?

Smiling Symmetry | Smiling Symmetry

Hi all, you know me—the Cheshire Cat. But take a look below, half of my beautiful, smiling face is missing. Care to help me out?
Use the squares and a mirror to reflect the other side of my face and get drawing.
Ha ha hee hee ho hah ho!!

You will need: a mirror

Mirror line



"Well! I've often seen a cat without a grin; but a grin without a cat! It's the most curious thing I ever saw in my life!" **Alice**

The Mad Hatter’s Tea Party

“*Have you guessed the riddle yet?”* The Mad Hatter.

The Mad Hatter always throws the greatest tea parties but this time he has gotten himself in a right muddle—he cannot remember exactly where people sit, he only has some mixed-up information. **Who sits where?**

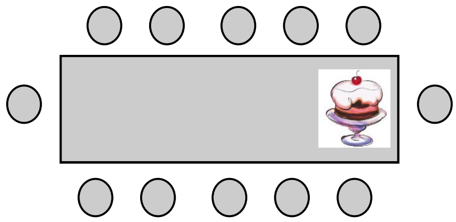
Read this information and see if you can decipher where everyone sits.

1: The Mad Hatter is not opposite Alice
2: The March Hare is not on the Dormouse’s right.
3: The Dormouse is not on Alice’s left.

After the success of the first Tea Party, the Mad Hatter decides to throw another one. This time, he invites many more people.

Extension: Use a similar method to last time and see if you can work out who sits where this time.

1: The Dormouse needs to sit between the Mad Hatter and the March Hare.
2: The March Hare wants to sit to the Dormouse's right to keep him awake.
3: The King and Queen of Hearts get very upset if they don't sit at the ends of the table.
4: Tweedledee and Tweedledum always sit next to each other and today they are in between the Cheshire Cat and the Mock Turtle.
5: The grinning one has to be kept in check and needs to sit next to the White Rabbit
6: The Caterpillar sits across from the one who is always late and next to someone who sits at the end of a table.
7: The Dormouse and one of the twins are put in the centre because they like to pull faces at each other across the table.
8: The King's job is to serve the cake and he likes the Mock Turtle next to him to help.
9: The White Rabbit will be whispering apologies for his lateness into the Queen's right ear.
10: Alice has the spare seat.



The Caterpillar

The Caterpillar is a curious creature. It has numbers on its head and back that seem to change as it grows. The caterpillar's segments each contain numbers that follow a pattern—if the number is even, then it is halved; if the number is odd, you add 1.

The Caterpillar with a 23 on his head will have 8 segments.
For example: 23 (odd + 1), 24 (even, halve), 12, 6, 3, 4, 2, 1

Which Caterpillar will be longer—the one who has a 19 on his head or the one who has 20 on his head?

Start with a Caterpillar with 84 on his head, how many segments long will he be? Can you predict?

Can you find a Caterpillar between 1 and 100 that has the most segments?

Can you make a Caterpillar with exactly 20 segments?

Extending Caterpillar's Body

Work with a partner, give each other a 2-digit number and see who can be the first to get to number 1. Or, with a partner, predict how many segments a Caterpillar with today's date on it would be?

"What size do you want to be?" **Caterpillar**
"Oh, I'm not particular as to size, only one doesn't like changing so often, you know." **Alice**

The Mad Hatter's Tea Party—part II

You will need: 18 counters

As you know, the Mad Hatter loves his tea parties and is obsessional about order and tidiness. He always likes his cups and saucers to be laid neatly on his tablecloth.

He needs to lay out 18 cups and saucers (counters) onto the cloth so that one saucer is in one square only. Then re-arrange the saucers so that every row **and** column has an **even** number of cups and saucers in it.

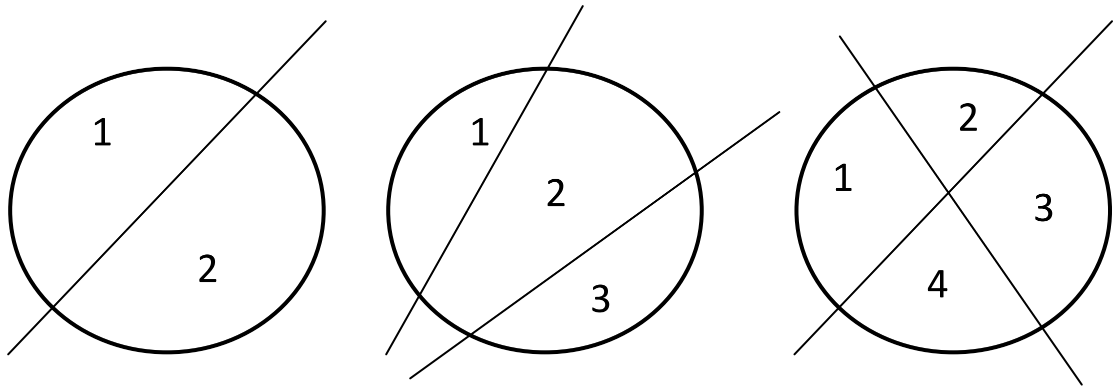
Extension: If the Mad March Hare breaks 4 cups and saucers, can you still arrange the remaining 14 into a similar **even** pattern?

The Mad Hatter's Tea Party—part III

You will need: a ruler and pencil and the cake sheet

The Dormouse loves cake and gets very cross when he thinks other people don't cut it up properly. He is very skilful when it comes to cutting cake and can cut it into the most and least available pieces.

For example: With 1 cut, you can have 2 pieces. With 2 cuts, you can have 3 or 4 pieces.



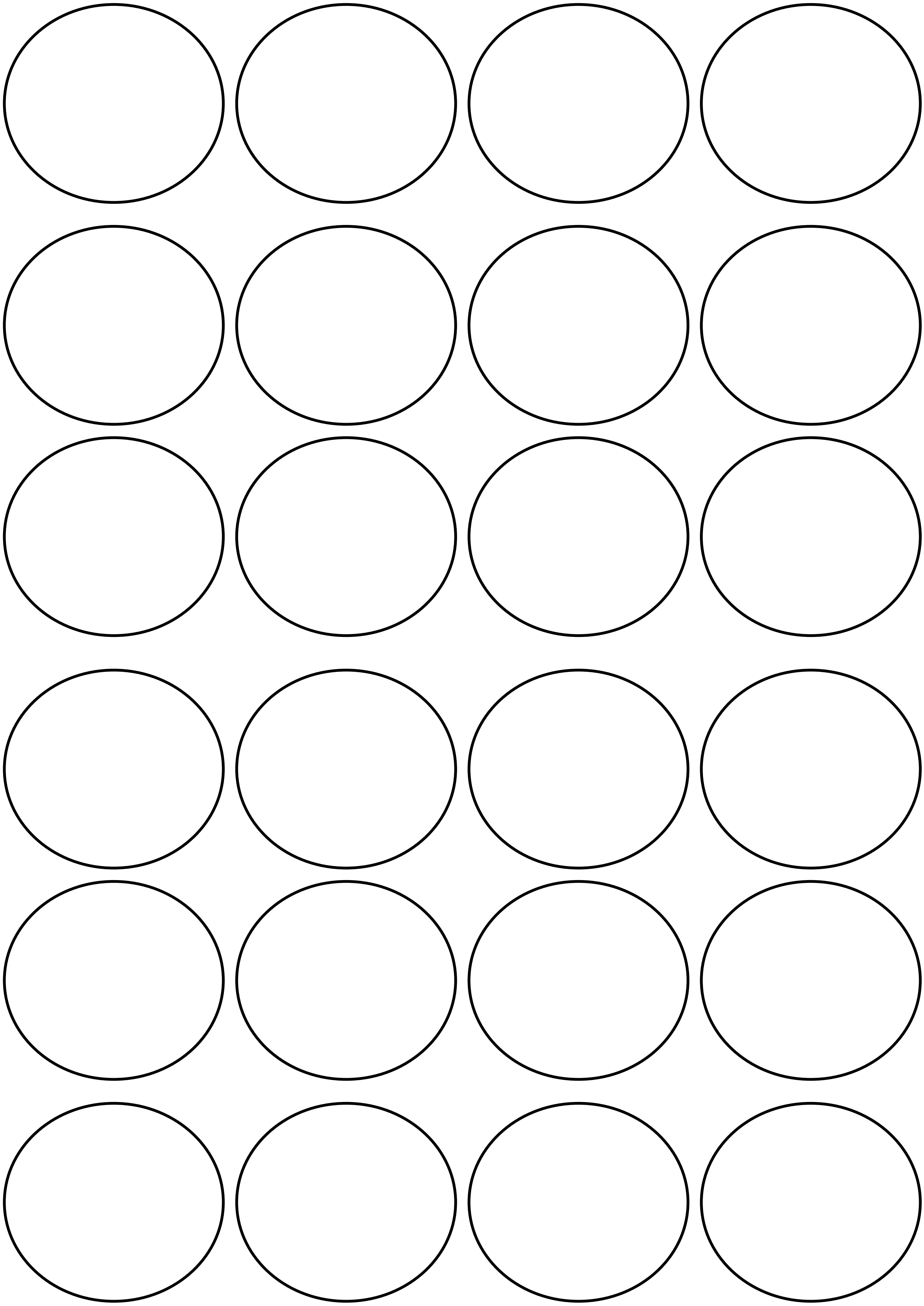
1 cut 2 cuts 2 cuts

What are the least and the most numbers of pieces you could get with 3 cuts?

Find the least and most pieces with 4, 5 and 6 cuts.

Extension: Do you see a pattern? Can you predict how many pieces from 10 cuts? What about any amount of cuts? Can you find a rule?

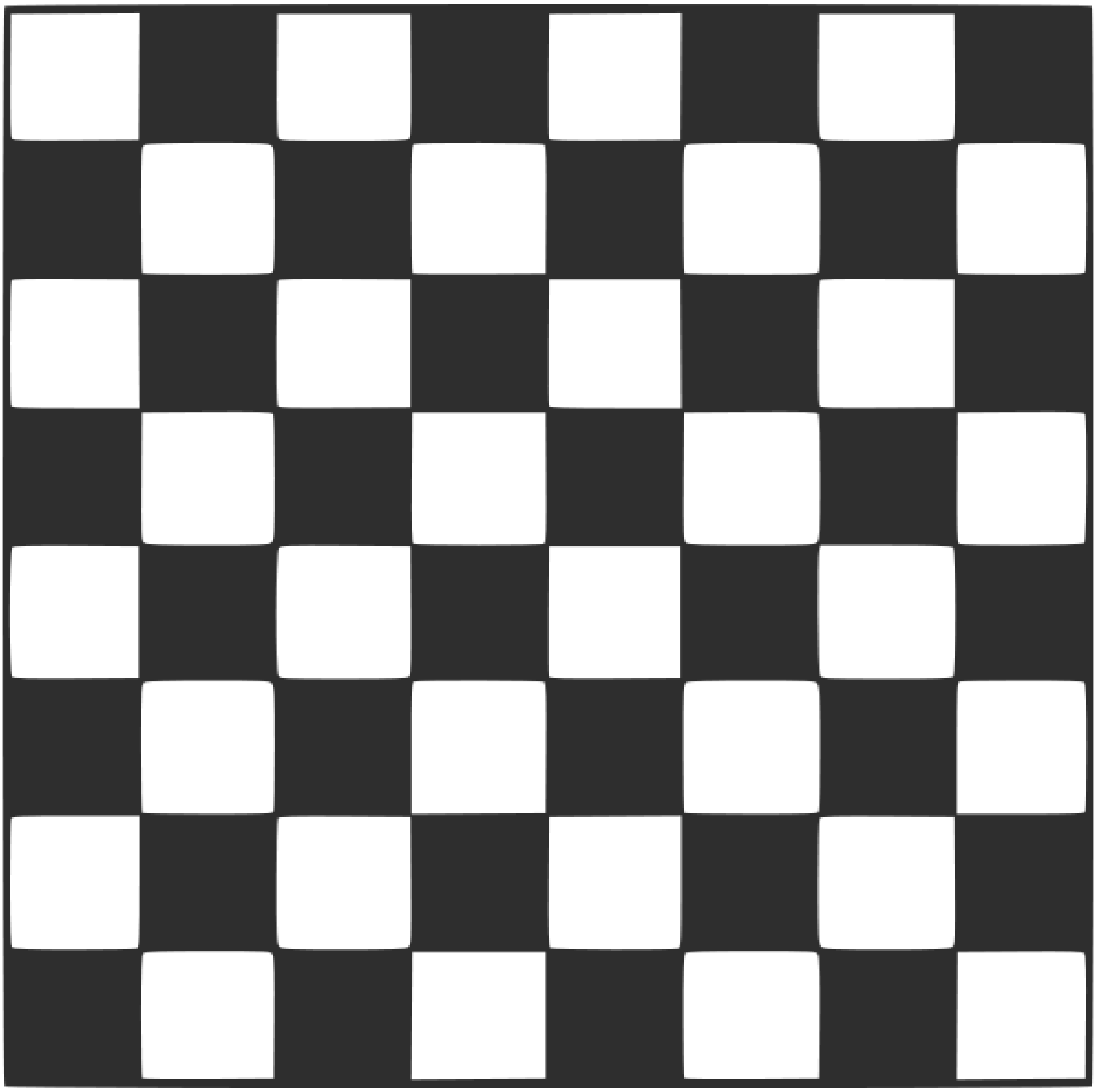
The Mad Hatter's Tea Party—part III: Cake Sheet



Keep your head!

"Off with your head!" **Shrieks the Queen of Hearts.**
Slice it, snick it, take it off! The Queen is a deadly and powerful chess piece—she can move in any direction on a chess board: horizontal, vertical, diagonal and for any amount of spaces too! Can you place 8 queens on this chessboard so that none of them could take one of the others?
Think hard, you may just get to keep your head after all!

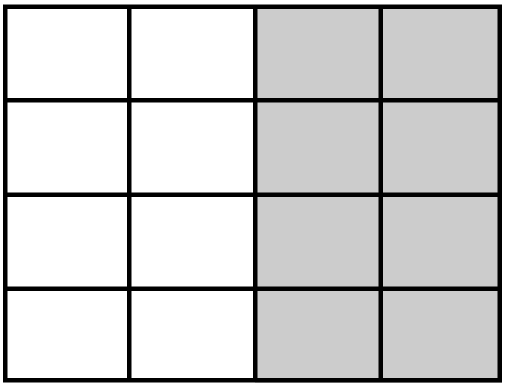
You will need: 8 counters



Mad March Hare's Morning Munchies

The Mad March Hare loves the Mad Hatter's tea parties and his favourite things to eat are biscuits. Very much like the Dormouse and his obsession with cake cutting, the Hare is particular about his biscuits.

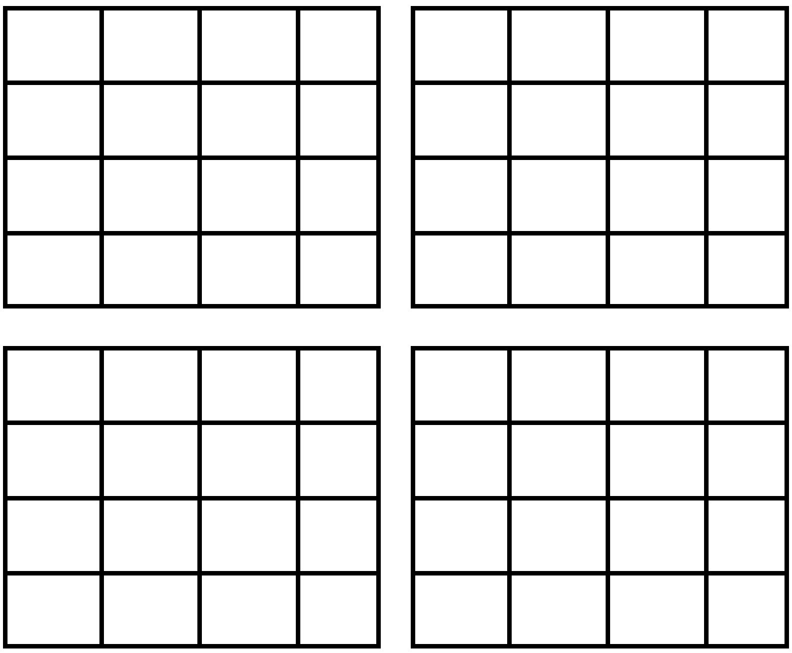
Hare has a biscuit which measures **4x4** and he wants to cut it in half. The obvious way would be like this:



Two equal halves in the shape of rectangles—each one **2x4**

The Mad Hatter, being a clever know-it-all believes there are 5 other ways in which a 4x4 biscuit can be halved to give exactly the same pattern in both halves. Poor March Hare is going mad with frustration. He keeps turning his biscuit around and around but the Hatter tells him this is just the same way but rotated!

Can you help him find the other five ways?



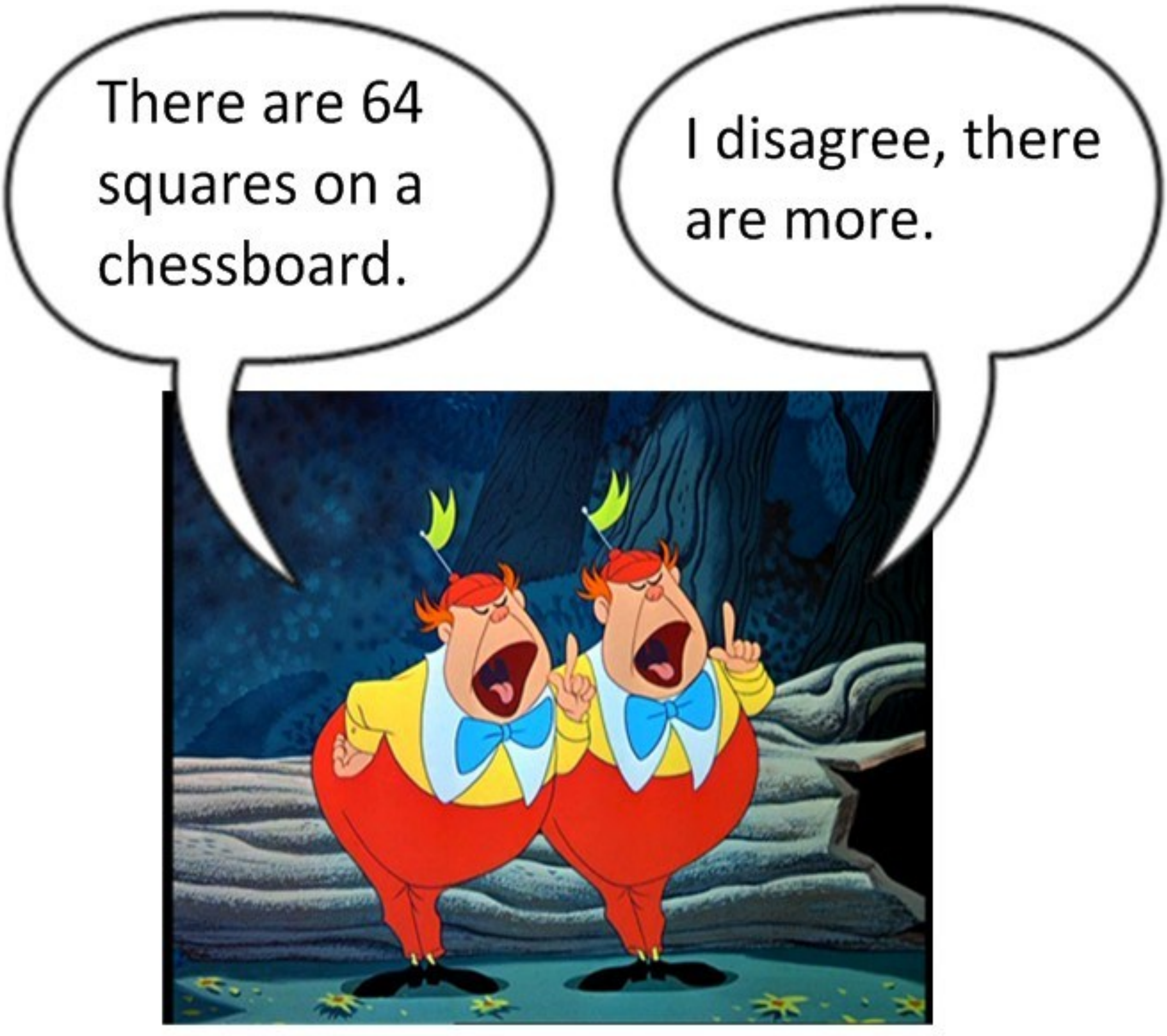
Mad March Hare’s Morning Munchies—Extra Grids

Were you able to spot a pattern? Did you find a logical way to help you find the missing biscuits?

Squares and Squares and Squares

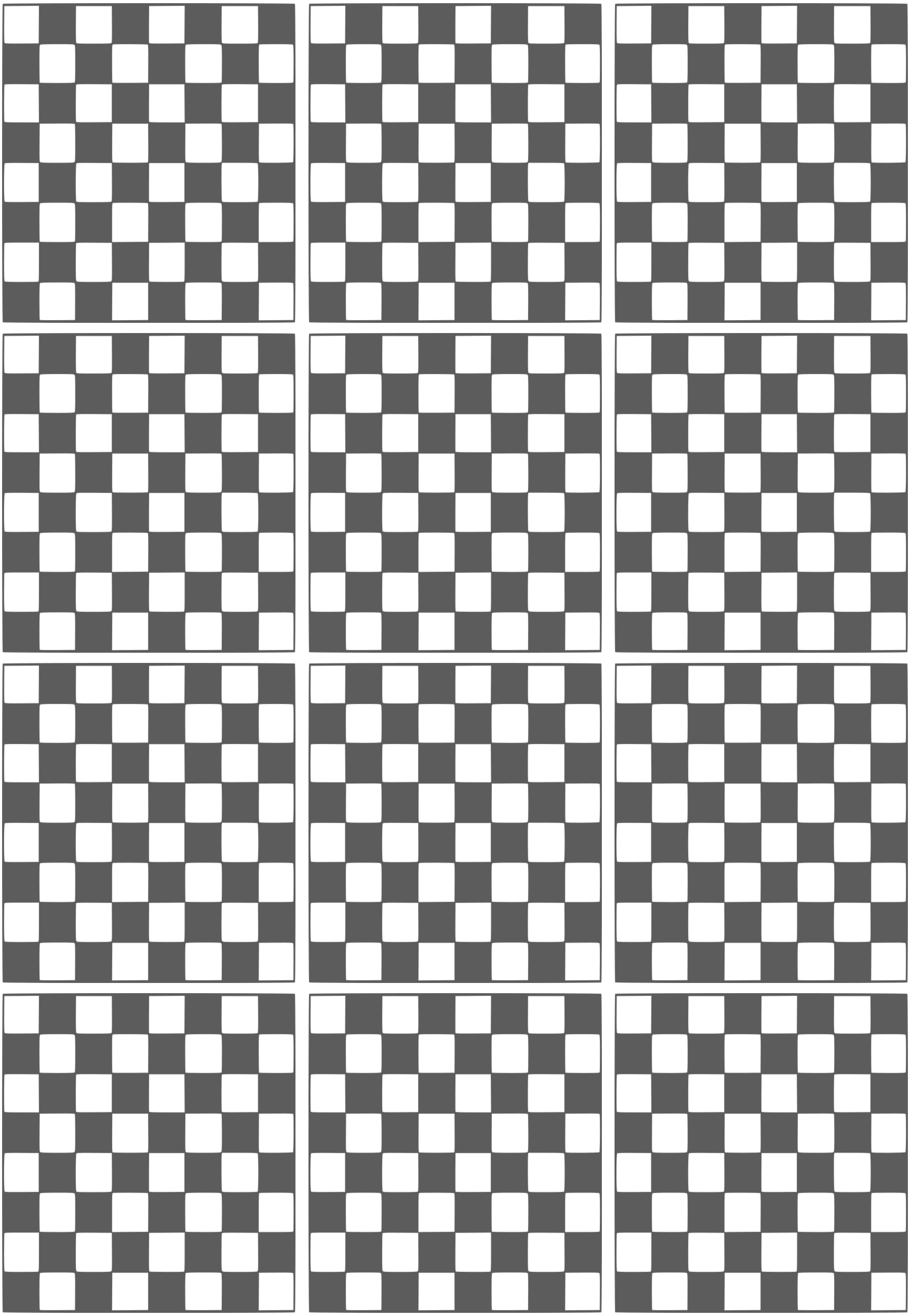
Those terrible twins: Tweedledum and Tweedledee are always disagreeing with each other and have dragged you into their arguments this time.

Tweedledee has grabbed a chess board from one of the Queen of Heart's guards and has counted all the squares.
Who is right? How do you know?

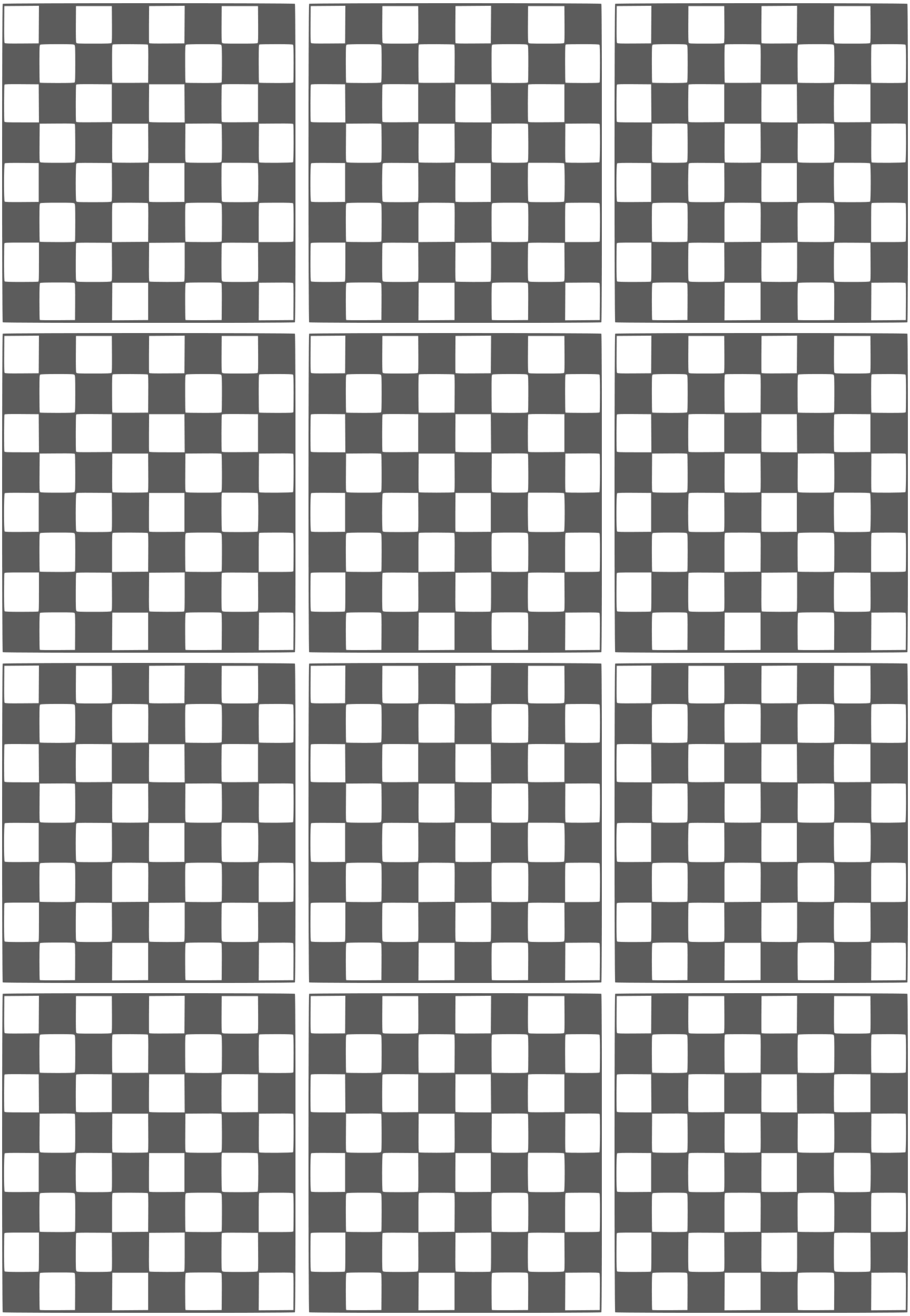


Use some of the chessboards from the next page to help you work it out.
Can you see any patterns?

Chessboards for Squares and Squares and Squares



Chessboards for Squares and Squares and Squares



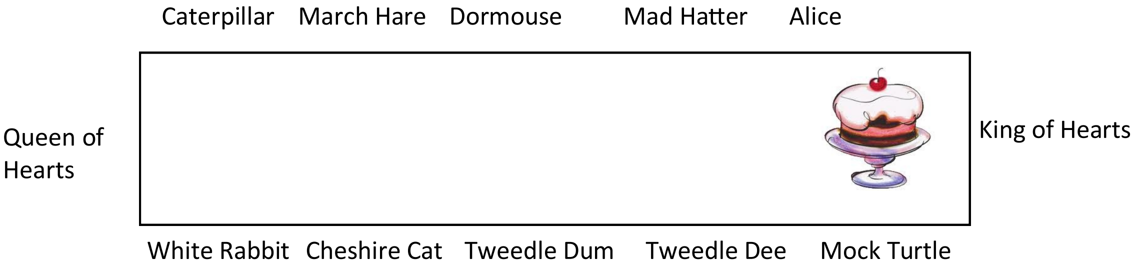
Answers

Some of the tasks are open-ended and therefore, answers are not available. Sorry.

White Rabbit's Ramblings

A: 7 o'clock
B: 9:35
C: 12:35
D: 720 minutes
E: 18 hours
F: 44,640 minutes

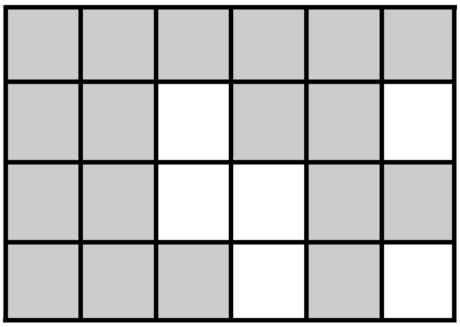
Mad Hatter's Tea Party I

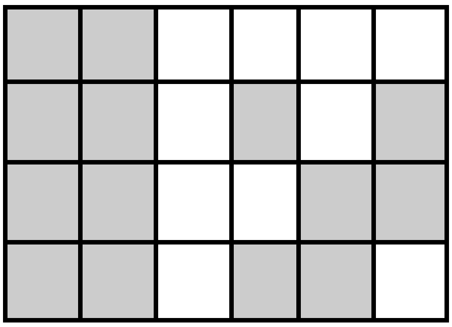


The Caterpillar

A: 19 or 20? - 19 is longer by one.
B: 84 on his head will be 11 segments long

Mad Hatter's Tea Party II





There are many different solutions but these are just a couple I've tried, (the grey squares are the saucers).

Mad Hatter’s Tea Party III

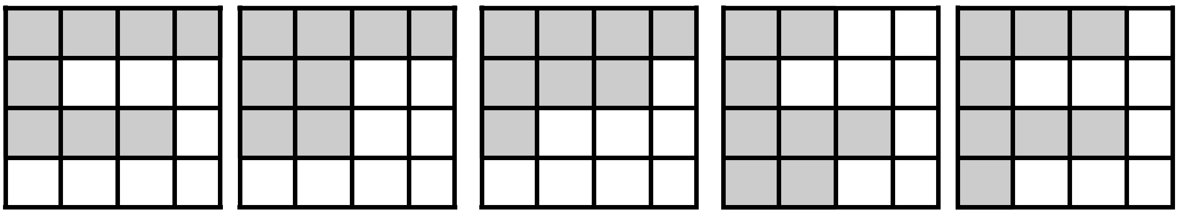
3 cuts: least = 3 slices, most = 6 slices
4 cuts: least = 5 slices, most = 8 slices
5 cuts: least = 6 slices, most = 10 slices

Basic rule is: least = 1 more slice than there are cuts, most = multiply the cuts by 2 to find the slices. Least = n+1, most = nx2

Keep your head!

			Q				
					Q		
							Q
	Q						
						Q	
Q							
		Q					
				Q			

Morning Munchies



Chessboard Squares

On a chessboard, there are 64 singles squares but larger squares can be created by having 2x2 squares, 3x3 etc.

1, 8x8 square
4, 7x7 squares
9, 6x6 squares
16, 5x5 squares
25, 4x4 squares
36, 3x3 squares
49, 2x2 squares
64, 1x1 squares

Therefore, there are actually 64 + 49 + 36 + 25 + 16 + 9 + 4 + 1 squares on a chessboard! (in total 204).