Button-up

Age 5 to 7
Challenge Level 1

My coat has three different buttons.

Sometimes, I do them up starting with the top button. Sometimes, I start somewhere else.

How many ways can you find to do up my coat?

How will you remember them?

Do you think there are any more? How do you know?

One of Thirty-six

Age 5 to 7
Challenge Level 2

Can you find the chosen number from this square using the clues below?

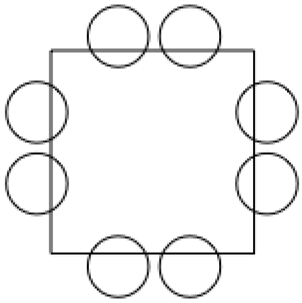
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36

1. The number is odd.
2. It is a multiple of three.
3. It is smaller than 7×4.
4. Its tens digit is even.
5. It is the greater of the two possibilities.

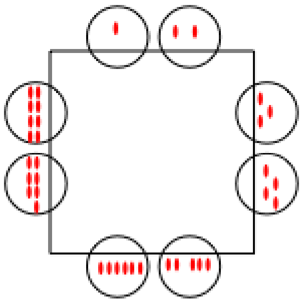
Sitting Round the Party Tables

Age 5 to 11
Challenge Level 1

So, you are at the party and sitting around the table with seven friends.



At the top left-hand corner is the friend who is giving the party. She or he has a bag of sweets and starts giving them out in a clockwise direction: one for themselves, two for the next person and three for the next and so on.



There are other similar parties going on at the same time. They have bigger square tables with more children sitting round on each side.

Explore and compare all the tables: 2 on each side, 3 on each side, 4 on each side and 5 on each side.

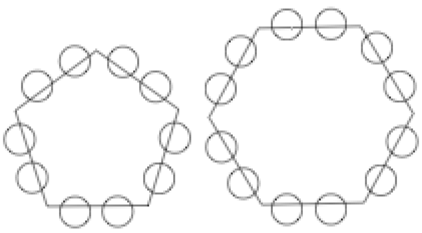
You could look at:

the total number of sweets that children sitting opposite each other have;

the total number of sweets needed for each size of the table;

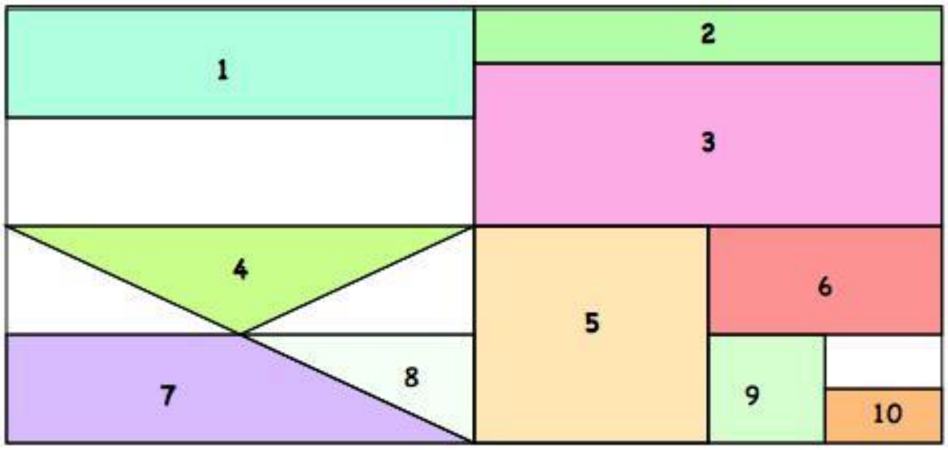
the total number of sweets belonging to children who are diagonally opposite.

Then, what about five- and six-sided tables?



Rectangle Tangle

Age 7 to 11
Challenge Level 1



The large rectangle above is divided into a series of smaller quadrilaterals and triangles. Each of the shapes is a fractional part of the large rectangle.

Can you untangle what fractional part is represented by each of the ten numbered shapes?

School Fair Necklaces

Age 5 to 11
Challenge Level 2

Rob and Jennie were making necklaces to sell at the school fair.

They decided to make them very mathematical.

Each necklace was to have eight beads, four of one colour and four of another.

And each had to be symmetrical, like this.

How many different necklaces could they make?

Can you find them all?

How do you know there aren't any others?

What if they had 9 beads, five of one colour and four of another?

What if they had 10 beads, five of each?

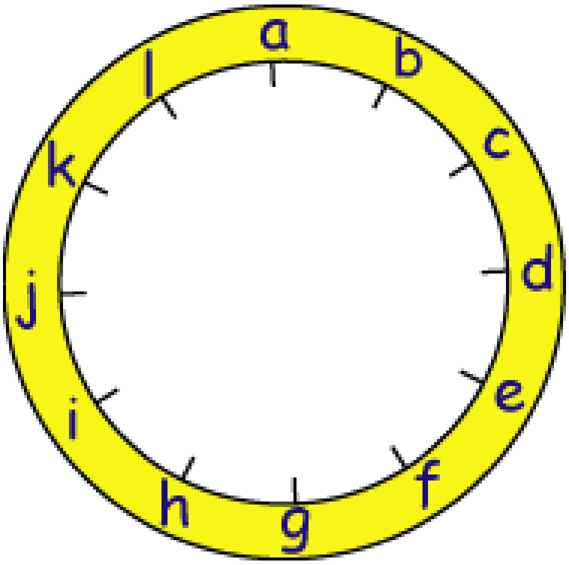
What if.....??????

A Mixed-up Clock

Age 7 to 11
Challenge Level

There is a clock-face where the numbers have become all mixed up. Can you find out where all the numbers have got to from the ten statements below?

Here is a clock-face with letters to mark the position of the numbers so that the statements are easier to read and to follow.



1. No even number is between two odd numbers.
2. No consecutive numbers are next to each other.
3. The numbers on the vertical axis (a) and (g) add to 13.
4. The numbers on the horizontal axis (d) and (j) also add to 13.
5. The first set of 6 numbers [(a) - (f)] add to the same total as the second set of 6 numbers [(g) - (l)] .

6. The number at position (f) is in the correct position on the clock-face.
7. The number at position (d) is double the number at position (h).
8. There is a difference of 6 between the number at position (g) and the number preceding it (f).
9. The number at position (l) is twice the top number (a), one third of the number at position (d) and half of the number at position (e).
10. The number at position (d) is 4 times one of the numbers adjacent (next) to it

Curious Number

Age 7 to 11
Challenge Level 3

Are you curious about numbers? Can you use your mathematical skills to find some solutions to the problems below?

Can you order the digits 1, 2 and 3 to make a number which is divisible by 3?
And when the final digit is removed again it becomes a two-digit number divisible by 2, then finally a one-digit number divisible by 1?

Can you order the digits 1, 2, 3 and 4 to make a number which is divisible by 4?
And when the final digit is removed it becomes a three-digit number which is divisible by 3.
And when the final digit is removed again it becomes a two-digit number divisible by 2, then finally a one-digit number divisible by 1?

Can you order the digits 1, 2, 3, 4 and 5 to make a number which is divisible by 5?
And when the final digit is removed it becomes a four-digit number which is divisible by 4.
And when the final digit is removed it becomes a three-digit number which is divisible by 3.
And when the final digit is removed again it becomes a two-digit number divisible by 2, then finally a one-digit number divisible by 1?

What systems are you using?
What do you know about numbers which can be divided by 3, 4, 5?
Now what about taking this further for digits 1, 2, 3, 4, 5, and 6?
What do you know about numbers which can be divided by 6, 7, 8 and 9?

You might now like to have a go at the problem Dozens.

SOLUTIONS

Button up

You found several different ways to help find the solution to this problem.

Some of you described the buttons as 'top', 'middle' and 'bottom' then made a list of all the possible ways of doing them up. For example,

If we start with the top button:
top middle bottom
top bottom middle

If we start with the middle button:
middle bottom top
middle top bottom

If we start with the bottom button:
bottom top middle
bottom middle top

Then there were those of you who labelled your buttons as 1, 2 and 3,

132,123,213,231,312,321=6 times

ONE OF 36
According to the first and second statements the only possibilities are 3, 9, 15, 21, 27 and 33.
If the third statement then says that it is smaller than 28 (7x4) then the remaining numbers off the list are 3, 9, 15, 21 and 27.
It then says that the tens digit has to be even so then the numbers 3 and 9 are immediately scraped off (because they don't have a tens digit!) leaving 15, 21 and 27. 15 has the tens digit 1 which is not even leaving the only two possibilities 21 and 27.
The last statement then says it is the bigger of the two and that is 27. So the number is 27.

PARTY TABLES

When we first looked at the problem we decided to test the difference between the amount of sweets each table needed, and we came up with these results.

Amount of people at the table.	8	12	16	20
Amount of sweets needed at table.	36	78	136	210

We looked at the results to see if there was a pattern in the difference between the amounts of sweets. Despite the fact there wasn't a pattern there we were determined to find a pattern. So we looked further into the problem and saw a pattern between the differences.

Amount of people at the table.	8	12	16	20
Amount of sweets needed at table.	36	78	136	210

42 58 74

16 16

From that we could guess the next two amount of sweets needed.

Amount of people at the table.	8	12	16	20	24	28
Amount of sweets needed at table.	36	78	136	210	300	406

42 58 74 90 106

16 16 16 16

When we saw this we thought of why it could have happened. Then we realised that a square has four sides and four squared is 16 so to get proof we checked with a triangle.

Amount of people at table.	6	9	12	15
Amount of sweets needed.	21	45	78	120

24 33 42

9 9

There is a pattern. So the difference between the difference between the difference is always nought.

RECTANGLE TANGLE

We had a large number of solutions sent in for this Rectangle Tangle challenge. Here is Zach's from U.K. which he sent in in table form:

The first thing I did was to mentally chop the picture into 4 equal quarters. Then I just used simple logic.

Shape Number	Logic	Workings	Answer
(1)	(1) is half of a quarter	*12×14=18*	(1) = *1/8*
(2) & (3)	(2) is half of (1) (2) + (3) = *14* therefore:	*12×18=116* *14−116=316*	(2) = *1/16* (3) = *3/16*
(4)	(4) is a quarter of a quarter	*14×14=116*	(4) = *1/16*
(7) & (8)	(7) + (8) is half of a quarter (7) + (8) = *18* (7) is three quarters of (7) + (8) (8) is a quarter of (7) + (8)	*12×14=18* *34×18=332* *18−332=132*	(7) = *3/32* (8) = *1/32*
(5)	(5) is half of a quarter	*12×14=18*	(5) = *1/8*
(6)	(6) is half of (5)	*12×18=116*	(6) = *1/16*
(9)	(9) is half of (6)	*12×116=132*	(9) = *1/32*
(10)	(10) is half of (9)	*12×132=164*	(10) = *1/64*

1,2,3,6 and 10 are rectangular. 5 and 9 are squares. 4 and 8 are triangles. 7 is a trapezium.The biggest shape is 3 and the smallest shape is 10.

We had many solutions from The Hayes Primary School. Here are two as a taster from Arya and Matin. The full solutions that the school sent in are here.doc (or here.pdf) and may serve as a useful discussion point in considering all the different ways of showing their solutions.

To tackle this problem I decided to work sysematically. Therefore, I first started with number 1. I looked carefully and saw the rectangle was split in half and that number 1 was a quarter of the half. The sum (calculation) would be 14 of 12 which equals 18.
Next, I looked at number 2. Easily, I could see it was a half of 1. So the answer would be 18 of 12 which equals 116.
After that, I saw that number 3 was three times the size of number 2. The calculation would be 116×3. The result of this would be 316.
Number 4 was a bit tricky. I looked at the two small triangles next to it and saw that joining them together would make number 4. This means that number 4 was a half of number 1. 18 of 12 is equal to 116.
Obviously, number 5 was a quarter of a half. 14 of 12 is equal to 18.
Number 6 was a half of number 5 so the sum (calculation) was 18 of 12. This equals 116.
Number 7 was 34 of 1. The sum was 34 of 18. As a result, the answer was 332.
Number 8 was 18 - 332 because 332 plus 8 would equal 1. The answer was 132.
Number 9 was 132 because it was a quarter of 5. 18 of 14 is equal to 132.
Finally, number 10 was a half of number 9. The sum (calculation) was 132 of 12.
The last solution was 164.
To make sure, I added up all the calculations (including the ones that weren't numbered) and reached an answer of 1.

School fair necklace

We used some different coloured counting blocks (unifix) to make symmetrical patterns of eight blocks with two colours.
We figured out that with those blocks we could make six different combinations that were symmetrical (see picture). And then we figured out that it didn't matter if you cut half of it off because they are symmetrical, so the halves are exactly the same.
We found six different towers of four blocks, two of each colour (see at the bottom of the photo). So therefore there are six possible ways you can do it.

We also heard from Cole and Sachi at Randlay Primary School:

I used O,G,G,O,O,G,G,O* for number one.
For number two we did O,G,O,G,G,O,G,O.
Number three: G,O,G,O,O,G,O,G.
Number four we did O,O,G,G,G,G,O,O.
Number five: G,G,O,O,O,O,G,G.
*O stands for orange and G stands for green.
We found over five ways to do the challenge that were different and symmetrical with the same colour.

I wonder whether you can see the sixth way that you've missed out?

Lara-Jade at Bay Primary School wrote:

I started with nine beads and worked out that because it has to be symmetrical the bead at the bottom must be of one colour because the clue says four beads of one colour and five

beads of the other colour. So I thought yellow could be at the bottom and my pattern was: Y,G,Y,G,(Y),G,Y,G,Y.
Then I worked out 13 beads. I thought because it is another odd number the bead at the bottom must be the colour of bead with the most in it. So I worked out the pattern which was Y,G,Y,G,Y,G,(Y),G,Y,G,Y,G,Y.
Then I tried to work out what 10 was. Then I tried it and thought that it wouldn't work because it was even but I was wrong. So I tried it again and got the pattern right which was: Y,G,Y,G,(Y)(Y),G,Y,G,Y.
I then moved onto 12. Because 10 worked 12 MUST work so I worked out the pattern which was: Y,G,Y,G,Y,(G)(G),Y,G,Y,G,Y.
Finally, I did 11 beads. And worked out the pattern which was: G,Y,G,Y,G,(Y),G,Y,G,Y,G.

Mixed up clock

A = 2, B = 9, C = 3, D = 12, E = 8, F = 5, G = 11, H = 6 , I = 10 , J = 1, K = 7, L = 4
What did you do first?
We saw that one number was definite on the clock face (letter F). We then found that the instructions said G related to F with a difference of 6. Which meant we could then find the vertical numbers.
How did you work through the problem?
We worked through all the statements and did not do them in order. Some statements were not possible to solve until the very end.
What were the most difficult bits?
Trying to see how the letters connected with the numbers
How did you check your answer was right?
We went through each statement to see if it was true and then checked our answers with two teachers.

From Sarah at Yew Chung International School Of Beijing:

The first step of this problem is to find any definite numbers, which I found on clue 6. (Number position F is in the correct position on the clock face.) So now we know that F is 5.

Next we drew a diagram to remember what we did, we recorded our information on it.

From clue 2 (No consecutive numbers are next to each other) I know that 1-12 a-b are not in order.

From clue number 1, it gives us a good clue (No even number is between two odd number) so I know that E or G are even numbers or odd numbers. One must be even and one must be odd.

I know that G would be number 11. This is because on clue 8, (There is a difference of 6 between the number at position G and the number preceding it (F)) G must be 11 because if 5 minuses 6, it would be negative, there is no negative number on the clock. Also, 5 plus 6 equals 11.

You can figure out A because you know G. On number 3 it says the numbers on the vertical axis A and G add up to thirteen. So if G is 11, all you have to do is minus 11 from 13, which is 2.

Question 9 is a good clue to do because you can find three numbers. (The number at position L is twice the top number A, one third of the number at position D and half of the number at position E.) First, you know what number A is so you can find L which can bring you to the letters D and E.Since A is 2, twice A is 4 which means L is 4.

To figure out D, it says that L is one third of D so you have to times L(4) by 3 which equals 12.

To get E, it says that L is half of D so you have to let L(4) times 2 which equals to 8.

Now you have the numbers of the letters L, D and E.Numbers H and I are definitely even numbers because so far, the pattern is even even odd odd and because on clue 1, it says No even number is between two odd numbers. To get the number for letter H, you need clue number 7. (The number at position D is double the number at position H.) Which also means D is half of H. If D is 12, then half of twelve is 6, which means
that H is 6.

Number 4 helps us to get the number of the letter J. On clue 4, it says (The numbers on the horizontal axis D and J add up to 13.) If D is 12, 13 minus 12 equals 1 which means that J is 1.

On clue 10, It tells us that the number position D is 4 times one of the numbers adjacent (next) to it. C and E are next to D. Since we already have E, then we need C. If D is 12, then 12 divided by 4 equals to 3. C is 3.
There is only K, B and I left. We know that I is definitely an even number because the order is even even odd odd, this is because clue one says that no even number is between 2 odd numbers. The only numbers left are 7, 9 and 10. There is only one even number so I must be 10.

Lastly, clue 5 helps you with the total answer. Clue 5 tells us that the first set of 6 numbers A-F add to the same total as the second set of 6 numbers G-L. We don't have all the numbers yet but you can still add them together to get the other numbers. A-F missing 1 number, (the number we have) 2, 3, 12, 8, 5. If you add them together, it equals to 30. G-L is missing 1 number,(the numbers we have) 4, 1, 10, 6. If you add them together, it equals 32. We need the numbers 7 and 9. 7 and 9 have the difference of 2. 32 and 30 also have the difference of 2. If A-F only has 30 and G-L has 32, then the greater number that is left(9) goes to B. The smaller number goes to G-L because without the number for letter K, G-L had a greater number after added up.

Curious numbers

This challenge caused some interesting submissions. Some thought you could rearrange the remaining numbers when you've done the first and subsequent divisions. Some were extra thoughtful and tried to explain why some were impossible to solve.

Isobel, Charlotte and Bella from St. Andrew's School, North Weald pointed out that there is one "slip up" in the first solution that was submitted. Thank you so much for being keen eyed to see the "slip up". Maybe others can find the "slip up" too.

Srimoyi from Bushey Heath Primary sent in the following:

Problem 1 : 123

Problem 2: No solution

Possible number combinations in arranging 1 2 3 & 4 is as below. First digit and third digit can be 1 or 3. Second and Fourth digit can be 2 or 4.
3 2 1 4 --> Not divisible 4 when considering all 4 DIGITS
3 4 1 2 -->Not divisible by 3 when considering 3 digits
1 2 3 4 --> Not divisible by 4 when considering all 4 digits
1 4 3 2 --> Not divisble by 3 when considering 3 digits
Hence no solution possible

Problem 3:   34125

Possible number combinations in arranging 1 2 3 4 5 is as below. First digit and third digit can be 1 or 3. Second and Fourth digit can be 2 or 4. Fifth digit has to be 5 only.

12345 --> Not divisble by 4 when considering 4 digits only
14325 --> Not divisble by 4 when considering 4 digits only
32145 -->Not divisble by 4 when considering 4 digits only
34125 ---> Answer ,works for all criteria

Thiyara from The Woodside Academy wrote:

The answer for 6 digits is 321654 or 123654 because it is divisible by every number up to 6 when you take away a number starting from the right. To work out my answer, I knew that the 5 had to go in the tens because the rule of divisibility for 5 is that the number ends in 0 or 5 and 0 was not
an option. I knew that the digits in the units, hundreds and ten thousands had to be even an the others had to be odd. So from there I used trial and error until I got an answer that worked.