

Newsletter 88: June 2010

## Introduction

This is our $88^{\text {th }}$ newsletter. You may remember that for 87 we noted that it was supposed to be unlucky for Australian batsmen, though I suspect it's only unlucky in the eyes of cricket commentators who need to have something to say.

But 88 is very lucky, if you are Chinese. The reason for this is the resemblance between the symbol 88 and the Chinese characters 暿. One of these characters means 'joy' and two together means double the amount of joy. And even 8 alone is lucky because the word for 8 sounds very much like a word that means 'wealth' (or in some dialects, fortune). But if 8 is good and 88 is even better, any succession of 8 s must be extremely lucky.

As a result of this connection, 88 'anythings' are very desirable in certain parts of China, as are 888 'anythings', 8888 'anythings' and so on. This is so much so, that people will go to any lengths to get hold of items involving the number 8 . For example, someone paid the equivalent of 270,000 American dollars for a phone number that consisted of a string of 8 s .

But this connection between luck and the number 8 is not just a private thing for individuals; it spreads over to the public domain. Do you remember the opening to the Beijing Summer Olympics? Not only was it in the year 2008 but the opening ceremony was timed to start on the $8^{\text {th }}$ day of the $8^{\text {th }}$ month at 8 seconds past 8 minutes past 8 pm . What's more, this notion of luck can be found in public buildings. The famous Twin Towers in Kuala Lumpur has 88 storeys; the same thing is true for one of the higher buildings in Hong Kong. And the big prize in some Singapore public lotteries consists of an amount of dollars that is expressible with a number of 8 s .

On the other hand, the number 4 is considered to be unlucky by some Chinese. The reason is the similarity between the pronunciation of the number and the pronunciation of the Chinese word for 'death'. Just as there may still be some buildings in the Western world that have no floor numbered 13, you can find buildings in Hong Kong that have no 'fourth floor'.

It is known for Chinese to prefer things to come in twos too. The reason is the link between the number and a Chinese character that has overtones of luck. That's why 88 is better than 8 alone. There is even a Chinese proverb that says that "good things come in pairs". Maybe the Chinese are not alone here.

So we hope that this newsletter will bring you luck, whether you are Chinese or not.
[This article is based on material that can be found at the web site http://en.wikipedia.org/wiki/Numbers_in_Chinese_culture]

## More on fractions - gaps in the number line

In the last newsletter we looked at fractions and were able to see that between any two fractions there is always another fraction. In fact there are an infinite number of fractions between two fractions. This rather suggests that all the fractions laid end to end on the number line would produce a carpet that would have no holes in it. If you could zoom in on this carpet you might reasonably expect to keep zooming in and for ever find fractions next to fractions next to fractions with no holes between.

But that isn't the case. There are gaps in the infinite string of fractions and it's all Pythagoras' fault. (OK that's a bit rough on Pythagoras but hey.)

There are a lot of theorems in mathematics. What every mathematician wants is to prove a theorem - a true statement about something they have been working on. But Pythagoras' Theorem is the only theorem that most people in the Western world know because it is in the curriculum of pretty well every country. As you probably know, Pythagoras' Theorem is about right angled triangles.

b

It says that if $h$ is the hypotenuse and $a$ and $b$ are the other two sides, then

$$
h^{2}=a^{2}+b^{2}
$$

What has this got to do with holes in fractions then? Well, suppose that the two non-hypotenuse sides are 1 . That is $a=1$ and $b=1$. Then

$$
h^{2}=1^{2}+1^{2}=2, \text { and so } h=\sqrt{ } 2 .
$$

And there is the problem: $\mathbf{V} \mathbf{2}$ is not a fraction!

Somewhere to the left of $\sqrt{ } 2$ there is a fraction and somewhere to the right of $\sqrt{ } 2$ there is a fraction. But at $\sqrt{ } 2$ there is no fraction and so there is a hole in the fractions at $\mathbf{V} \mathbf{2}$.

Before you think that $\sqrt{ } 2$ is a nothing number, something made up by mathematicians to tease us all, you should note that $\sqrt{ } 2$ is the length of a quite common object. Take a square of side length 1 . Then look at that square's diagonal. The length of the diagonal is precisely V2. You can see this by using Pythagoras' Theorem. So V2 has been sitting there the whole time, without most of us realising it.


Now in some ways it wouldn't be too bad if $\sqrt{ } 2$ was the only hole. But there are more, infinitely more. One way to see this is to notice that any whole number multiple of $\sqrt{ } 2$ is not a fraction either. In other words, none of $\sqrt{ } 2,2 \sqrt{ } 2,3 \sqrt{ } 2,4 \sqrt{ } 2$, and so on forever, is a fraction!

But that, as they say is not all. It turns out that $\sqrt{ } 3$ is also not a fraction. And the same can be said for $\sqrt{ } 5$ and $\sqrt{ } 6$ and $\sqrt{ } 7$ and $\sqrt{ } 10$, and so on, and so on. In fact the fractions are just filled with holes!

It just gets worse and worse though. The cube root of 2 is not a fraction, neither is the fourth root or the fifth root. And I haven't mentioned that doyen of the circle, that incredible number $\pi$. You're right: $\pi$ isn't a fraction either!

Now could this be true? There are more numbers that aren't fractions than are fractions? Or how about this: between any two fractions there is a non-fraction?

## Shabakh

So you think that the last word on multiplication is the algorithm that you learnt in school? Think again. Here is another version of that algorithm that has been known for at least 800 years, or as we shall see, maybe more.

Suppose that you want to multiply 791 by 24 . Then start out with a grid like this.

|  | 2 | 4 |  |
| :--- | :--- | :--- | :--- |
|  |  |  | 7 |
|  |  |  | 9 |
|  |  |  | 9 |
|  |  |  | 1 |
|  |  |  |  |


|  | 2 | 4 |  |
| :--- | :---: | :---: | :---: |
|  |  | $2 / 8$ | 7 |
|  |  | 8 | 9 |
|  |  |  | 9 |
|  |  |  | 1 |
|  |  |  |  |

Now repeat with the 4 and the 9 , the 4 and the 1 ; the 2 and the 7,9 and 1 . This should give you this stage of the Shabakh.
Now look at the 4 and the 7 . Since $4 \times 7=28$, put the 8 below the diagonal and the 2 above.


Now slide the lower-most 4 into the third column, last row. Then look at the diagonal just above the 4 , the diagonal that contains 2,0 and 6 . Since $2+0$ $+6=8$, add 8 in the second column last row.

Repeat this with all the other diagonals and you get this set up.

|  | 2 | 4 |  |
| :---: | :---: | :---: | :---: |
| $\underline{1}$ | $1 / 4$ | $2 / 8$ | 7 |
| $\underline{8}$ | $1 / 8$ | 3 | 6 |
| $\underline{9}$ | 0 | 6 | 9 |
|  | $\underline{8}$ | 4 | 1 |
|  | $\underline{4}$ |  |  |

And the answer to the multiplication is 18,984 .

This all works, of course, because the diagonals where we did the adding are all different powers of 10 . You might like to work out $67 \times 349$ this way. Is it any easier than the way you would normally do it?

Now, in fact there seems to be a controversy about the origins of Shabakh. We've quoted two sources on the web that talk about it. One of them says that it was invented by Al-Khwarizmi in the $9^{\text {th }}$ Century. The other says it was developed in India from the $12^{\text {th }}$ Century on and appears in Hindu works. We'll let you decide. Maybe it is a case of independent discovery. Maybe you have to question the authenticity of the web.

References: http://en.wikipedia.org/wiki/Shabakh http://www.spiritus-temporis.com/shabakh/

## Problem Solving

These problems come from the high achieving students section of the website. We have recently updated the collection of problems for students on this page: http://www.nzmaths.co.nz/activities-students

## Years 1-3



Part of a toy is made of two rectangular blocks that are both 4 cm by 8 cm . One of the blocks turns about the other by a pin that goes through the centre of each block.

How much of the bottom block is covered by the top block?
When the top block turns it starts to cover more of the bottom block. What is the biggest area of the bottom block that is covered by the top block?

## Years 4-6

Part of a toy is made of two rectangular blocks that are both 4 cm by 8 cm . One of the blocks turns about the other by a hinge, H , that is in the corner of each block.
The top block, ABCH , turns clockwise through a quarter turn.

What shape does A trace out as the block turns?
Where does A end up?


Years 7-9


## Answers to Problem Solving

## Years 1-3

The top block covers a strip in the middle of the bottom block. This strip is 4 cm wide. Since the bottom block is 8 cm long the top block covers half of it.

When the top block has turned a quarter turn it will cover all of the bottom block.

## Years 4-6

A is always the same distance from $H$. So A traces out a quarter circle with radius the length of AH (which is 8 cm ).

After the block has turned, AH lies along HQ , so A is on top of the point Q .

## Years 7-9

The radius of the circle that $A$ is on is $A X$. This is half of the length of the top block. So this radius is 4 cm .
The radius of the circle that $B$ is on is $B X$. This is shown in the diagram.


We have also put in the point $T$ that is the midpoint of the side of the block. Now $\mathrm{XT}=3$ and $\mathrm{BT}=4$. Triangle AXT is a right angled triangle with side lengths 3,4 and 5 . So $B X=5$ and the radius we want here is 5 cm long.

The radius of the circle that C is on is CX . This is shown in the diagram.


Here CTX is a right angled triangle with $\mathrm{CT}=3$ because it is half of the side length of the bottom block. By Pythagoras' Theorem, $\mathrm{CX}^{2}=\mathrm{CT}^{2}+\mathrm{TX}^{2}$, so $\mathrm{CX}^{2}=3^{2}+3^{2}=18$. So $C X=V 18$ and this is approximately 4.36 cm .

## Classroom section

## Maths and Recycling

Here are some ideas you could use to make a cross strand mini unit using the context of recycling.

| Strand | AO and Level | Activity Ideas |
| :--- | :--- | :--- |
| Number | Number strategies and <br> knowledge <br> (Levels 1 and2) | Reuse items for counting activities, e.g. plastic bottle caps as <br> counters, cut egg cartons to make tens frames. <br> Order numbers on containers e.g. number of grams on packages |
| Number | Number strategies <br> (Level 3) | Calculate the percentage weight of packaging of items. <br> Calculate the percentage and fraction of materials in the class <br> bin that could be recycled (by weight, volume, or item number) |
| Number | Number strategies and <br> knowledge (Level 4) | Solve problems involving energy rates e.g. energy use <br> kilowatt/hour and water use litres/minute. |
| Algebra | Patterns \& relationships <br> (Level 1 and 2) | Make sequential patterns using recycled items, e.g. plastic, <br> glass, tin. (Level 1) <br> Find the rule of the next member in the pattern (Level 2) |
| Measurement | Measurement <br> (Levels 1 and 2) | Compare objects by their length, weight, capacity. <br> Measure objects using rulers, scales, reading labels (e.g 440g) |
| Measurement | Measurement <br> (Levels 3 and 4) | Order items by their weight or capacity. <br> Calculate the area and volume of packaging, e.g. area of <br> cardboard, volume of boxes and tins. |
| Geometry | Shape (Levels 1 and 2) | Sort a selection of recyclable objects by their appearance. <br> Discuss sorting decisions. <br> Identify plane shapes in found objects e.g. squares and <br> rectangles on boxes, oval hole in tissue boxes, circle lids |
| Geometry | Shape (Levels 3 and 4) | Draw 3D shapes and different views. <br> Flatten boxes, open out tins, and draw nets. |
| Statistics | Statistical Investigations <br> (Levels 1 and 2) | Sort items in recycling bin into categories of glass, plastic, paper, <br> card, tin and show results on a graph. <br> Communicate the results. |
|  | Statistical Investigations <br> (Levels 3 and 4) <br> (Level 3) | Survey people on sustainable living practices e.g. recycle <br> packaging, compost, water saving methods, energy saving <br> methods. <br> Level 4 include a multivariate aspect to survey. |
| (Level 4) |  |  |

## What's new in maths?

## National Standards

National Standards come into effect in English-medium schools with pupils in Years 1 to 8 in 2010. The standards set clear expectations that students need to meet in reading, writing, and mathematics in the first eight years at school. Information gathering for Ngā Whanaketanga Rūmaki Māori - the Māori medium standards began in term one 2010. For more information about the standards see the New Zealand curriculum online section of TKI (http://nzcurriculum.tki.org.nz/National-Standards).

The NZC and National Standards section of the nzmaths website (http://www.nzmaths.co.nz/nzc-and-national-standards) provides links between the AOs in the New Zealand Curriculum and the Mathematics and Statistics standards. Elaborations are provided for all AOs from level 1-6. This section will be further developed over the next few months.

## nzmaths updates

The problems in the high achieving students section of the website have been updated. You can access this section from the home page or at http://www.nzmaths.co.nz/high-achieving-students.

Thirty new activities have been written for the Families section of the website. These will be uploaded in the next month, so keep an eye on that section: http://www.nzmaths.co.nz/families.

## Maths Week 2010

Maths Week 2010 is the $9^{\text {th }}$ to the $13^{\text {th }}$ of August. Keep an eye on the NZAMT website (www.nzamt.org.nz) for updates regarding signing up.

## Secondary Update

Secondary Update is a new quarterly newsletter that has just been sent to all secondary principals and subject associations. It contains "need to know" secondary information. The first newsletter contains details about:

- changed achievement standards
- changed literacy and numeracy requirements
- literacy and numeracy unit standards
- guides for designing New Zealand Curriculum-aligned senior learning programmes.
You can download a copy from:
http://www.educationalleaders.govt.nz/News/Download-the-Secondary-Update-newsletter
There are two small errors in the newsletter:

1. The fourth bullet point in the introduction should read "Course endorsement will be introduced..."
2. The correct link to find out more about the implementation of course endorsement is: http://www.nzqa.govt.nz/publications/circulars/secqual/2010/s2010-014.html

## Families

One way to encourage your child to enjoy maths is to work alongside them. Here are a few activities to do together.

## Shapes

How many different shapes can you draw using only squares and triangles?

Hints: try a hexagon, try combining squares and triangles, remember there are 3 types of triangles ( 3 sides the same length, 2 sides the same length, all sides different lengths), try a right angled triangle.

## Total of your Name

Write the alphabet and assign each letter a number, starting with A -1, B - $2, \mathrm{C}-3$ etc. Work out the score of your name and compare it to other family members. Discuss the strategies you used to add the numbers together.

## Legs in the House

Work out how many people and cats are in the house if there are 16 legs. There are more people than cats. Discuss how you solved the problem.
If there could be more cats than people what is the answer?

## How old?

Jake is 10 years old and his brother Ben is 2 years old. In how many years will Jake be twice as old as Ben?
Hint: Solve it together by each pretending to be one of the brother, for example, if am 10 and you are 2 , how old are you when I am 11?

In four years Rose will be three times as old as she was 12 years ago. How old is she now?

Can you make up a problem using ages in your family?

## Answers

Shapes: Lots of shapes can be made using triangles and squares, for example, rectangles, hexagon, pentagon, octagon, trapezium, parallelogram. There are multiple ways for making most of these shapes.

Legs in the house: More people than cats: 4 people and 2 cats. More cats than people $=3$ cats and 2 people.
How old? In 6 years time Jake will be 16 and Ben will be 8 . Rose is 14 because in 4 years she will be 18.18 is 3 times older than when she was 6 and that was 12 years ago.

