May 2019

YBMA News

Vol. 28 No. 3

The Newsletter of the Yorkshire Branch of the Mathematical Association

Our next meeting

Saturday, June 8th at 2pm for 2.30pm in the MALL, School of Mathematics, University of Leeds

Maths Mashup

Members of the YBMA have ten minute slots to show us some mathematics that they find particularly interesting.

We'd love to see you, and if you'd like to share, please feel free to bring some maths along with you.

All welcome – bring your friends.

followed by

our AGM for 2019 at about 3.30pm

The founder of the YBMA, Professor W.P.Milne

Officers of the Yorkshire Branch of the Mathematical Association 2018-19

President: Lindsey Sharp (lindseyelizab50@hotmail.com)

Secretary: Alan Slomson (a.slomson@leeds.ac.uk)

Treasurer: Jane Turnbull (da.turnbull@ntlworld.com)

See overleaf for *Mathematics in the Classroom*

Dates for your diary

Thursday, 3 October 2019 at 7:30pm

Let's work together: Effective collaboration in the mathematics classroom

A talk by the current Mathematical Association President, Ems Lord, who is Director of NRICH.

In this highly interactive workshop, Ems will share some of her favourite rich mathematical activities, exploring ways to maximise their potential for developing collaborative problem-solving skills. During the session, Ems will offer an insider's guide to the NRICH website, including top tips for classes hoping to see their solutions published on NRICH.

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Tuesday, 3 December 2019 at 7.30pm

Our famous Christmas Quiz

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More details of these events will be circulated later in the year.

Please bring them to the attention of your colleagues and anyone who might be interested in them.

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Saturday, 9 May 2020

Centenary Celebration

The first meeting of the Yorkshire Branch of the Mathematical Association took place on Saturday, May 8th 1920 at the University of Leeds.

We plan to celebrate this centenary with a mathematical buffet lunch on Saturday, May 9th 2020 at the University of Leeds.

Please put this date in your diary. Formal invitations will be sent early in 2020.

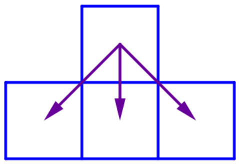
We are keen to invite former members of the Branch. If you are in contact with any of them, please ask them to contact the Secretary, (a.slomson@leeds.ac.uk) so that they can be sent invitations in due course.

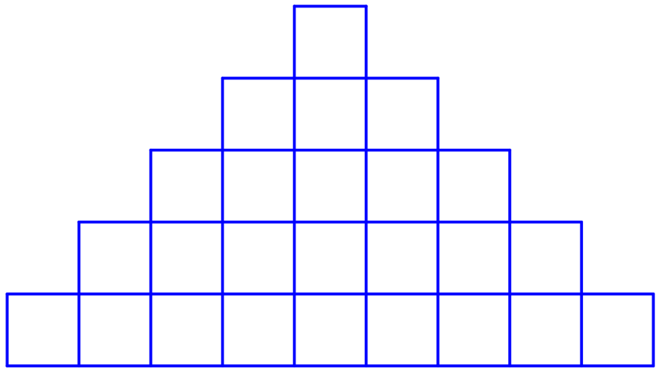
Mathematics in the Classroom

How Many Routes?

A move consists of moving from one square to one of the squares below either directly below or diagonally to the left or the right.

These three possible moves are shown in the diagram below.





Starting at the top square in the diagram on the right, in how many different ways can you reach one of the squares on the bottom row in four moves?

Of course, once you have answered this question, you will wish to generalize it.

Integers written in terms of squares.

In the last Newsletter we asked for a proof that every integer N, positive, negative and 0, may be written in terms of the first k squares where k is a positive integer. That is,

$$N = \pm 1^2 \pm 2 \pm 3^2 \pm \ldots \pm k^2.$$

for a suitable choice of k and plus and minus signs.

The observation that is the key to the proof is the identity

$$(k+1)^2 - (k+2)^2 - (k+3)^2 + (k+4)^2 \equiv 4.$$

It follows that if N may be written, as above, in terms of the first k squares, then $N + 4 = = \pm 1^2 \pm 2 \pm 3^2 \pm \ldots \pm k^2 + (k+1)^2 - (k+2)^2 - (k+3)^2 + (k+4)^2$ and $N - 4 = = \pm 1^2 \pm 2 \pm 3^2 \pm \ldots \pm k^2 - (k+1)^2 + (k+2)^2 + (k+3)^2 - (k+4)^2$, and therefore both $N + 4$ and $N - 4$ may also be written in terms of the first $k + 4$ squares.

To complete the proof it is sufficient to note that $1 = 1^2$, $2 = -1^2 - 2^2 - 3^2 + 4^2$, $3 = -1^2 + 2^2$, and $4 = -1^2 - 2^2 + 3^2$. Therefore 1, 2, 3 and 4 may be written in the required form. Since each other integer may be obtained from one of these by repeatedly adding or subtracting 4, the general result follows from the identity above.

This method will not always lead to the simplest answer. For example, from $1 = 1^2$, this method gives

$$5 = 1 + 4 = 1^2 + 2^2 - 3^2 - 4^2 + 5^2,$$

whereas

$$5 = 1^2 + 2^2$$

is more straightforward.