NRICH FAQs

Quick answers to commonly asked questions about NRICH

What is it?
NRICH is a website providing **free**, carefully designed mathematics enrichment resources and teaching support materials. There are thousands of resources and each month a new edition of NRICH provides a set of new problems for which students can submit their own solutions.

Who is it for?
Teachers of all Key Stages in their classrooms and all learners aged 5 to 19, not just the highest attaining students - we aim to include all.

Can I use NRICH in the classroom?
Yes! Most tasks are designed for use in the classroom and are accompanied by Teachers' Notes, giving guidance and support. Our curriculum mapping documents give suggestions for suitable tasks at various points in the curriculum (see nrich.maths.org/curriculum)

What are the problems like?
The problems are very diverse: they cover a very wide range of mathematical styles, content and level. Many contain interactive elements. For a few examples, see inside this booklet!

How do the problems differ from textbook questions?
NRICH problems are all rich mathematical tasks. They frequently allow multiple methods of solution, are open to allow exploration, conjecture and investigation, work at a range of levels of sophistication and provide intriguing and fascinating contexts.

Why is it good to use?
It is well known that rich tasks draw learners into the mathematics, providing a more meaningful, interesting and long-lasting learning experience than traditional bookwork or learning by rote.


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Director


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KS1 & 2


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KS3 & 4


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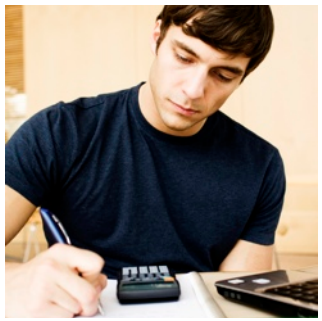
NRICH is part of the family of activities within the Millennium Mathematics Project at the University of Cambridge
mmp.maths.org

A quick introduction to KS5

NRICH



NRICH is a mathematics enrichment project run by a team of qualified teachers who specialise in rich mathematical thinking. NRICH is ideally placed to offer advice and support to both teachers and learners of mathematics, from Key Stage 1 through to Key Stage 5.

At the heart of what we do are the problems on our website nrich.maths.org. They are free, and there are thousands from which to choose.

NRICH aims to:

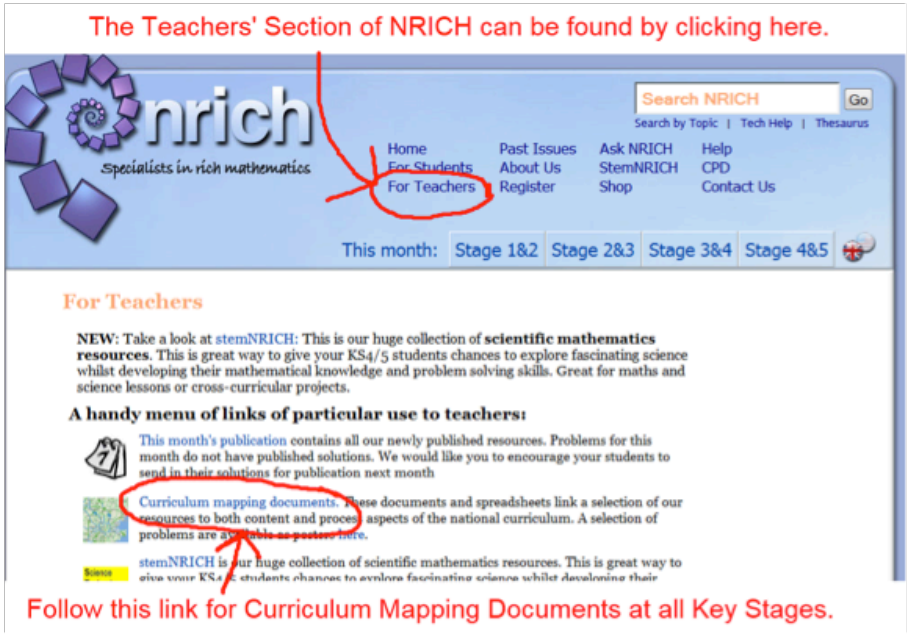
- Enrich the experience of the mathematics curriculum for all learners
- Offer challenging and engaging activities
- Develop mathematical thinking and problem-solving skills
- Show rich mathematics in meaningful contexts
- Work in partnership with teachers, schools and other educational settings

nrich.maths.org

UNIVERSITY OF CAMBRIDGE

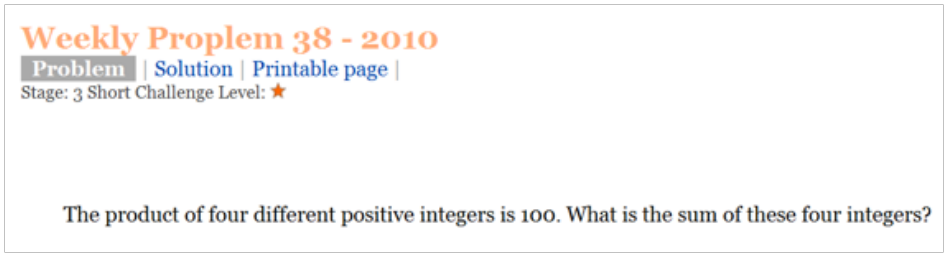
For teachers of mathematics we:

- Offer free enrichment material (problems, articles and games) that will inspire and engage **all** learners.
- Publish curriculum mapping materials and teachers' notes to aid planning and promote rich mathematical thinking in classrooms.
- Offer professional development courses and workshops which help to embed rich tasks into everyday practice.
- Help teachers to think strategically about progression in problem solving.

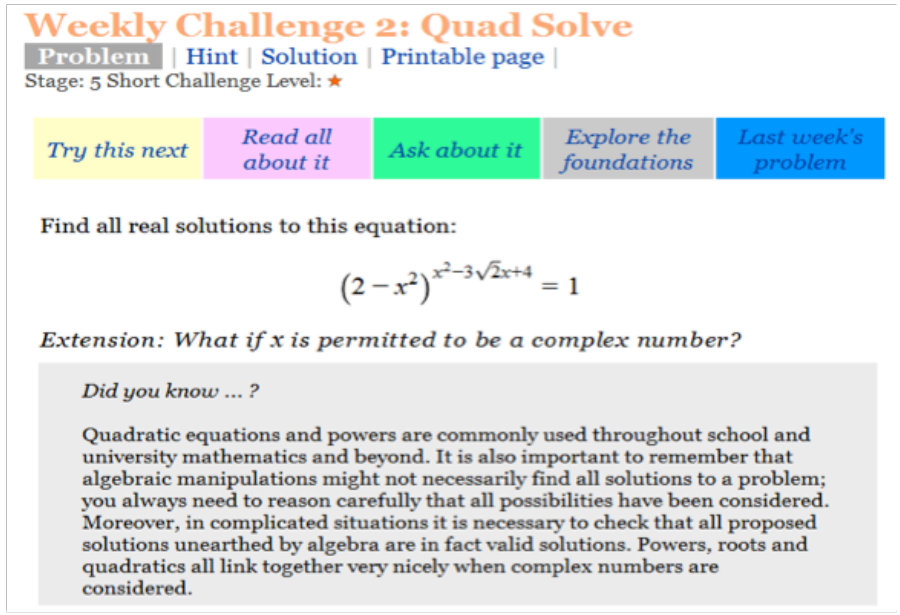


Each week...

A weekly problem is published each week to give students a short work-out:



For Post-16 and keen younger students we publish a weekly challenge with links to articles and related problems:



See http://nrich.maths.org/weeklychallenge for the live challenge

Solutions

Each problem has tabs at the top where you can access the teachers' notes, hints and solutions. During the month that a problem is featured on the site, the solution tab allows you to submit a solution.

Temperature

Problem | Teachers' Notes | Hint | Solution | Printable page |

Stage: 3 Challenge Level: ★★

The answer to this problem is yes, there IS a temperature where Celsius and Fahrenheit are equal, and it is −40 degrees.

All the solutions to this problem took one of three forms: trial-and-improvement, graphical or algebraic:

This is how Samuel from Long Buckby Junior School reasoned:

There is a temperature at which Celsius and Farenheit are the same.
It is −40 degrees, because 9/5 of −40 is −72 and −72 + 32 = −40.

I decided to look at negative numbers because starting with a positive number and multiplying it by 9/5 is going to increase it and so is adding 32 so you're always going to end up with a number greater than the number you started with.

However, if you start with a negative number, multiplying it by 9/5 decreases it, and adding 32 increases it, so I realised that with the correct number, Celsius and Fahrenheit might be the same.

I decided to go down in tens:

9/5 of −10 = −18 and −18 + 32 = 14, so that doesn't work;

9/5 of −20 = −36 and −36 + 32 = −4, so that doesn't work;

9/5 of −30 = −54 and −54 + 32 = −22, so that doesn't work.

But 9/5 of −40 = −72 and −72 + 32 = −40 so it works.

The reason it works is because multiplying by 9/5 is equivalent to adding 4/5 of it, and for −40 adding 32 is equivalent to subtracting 4/5 of it (because 32 is 4/5 of 40).

Because of this, Farenheit and Celsius are equivalent ONLY at −40 degrees.

The Four Mathemateers from Brocks Hill Primary School also used a trial and error approach, as displayed here:

First we started going down in tens of Celsius from 0, and we found out a pattern: the difference between F and C was getting closer by eights every time.

When we got to −30C the difference was only 8. So −30C is equal to −22F.
Then we tried −40C and found out that −40C was the same as −40F.

So the answer is −40.

We publish solutions at the end of each month

We highlight different approaches

For those learning mathematics we:

- Provide free and interesting mathematical problems, articles and games which will challenge you to think in new ways.
- Invite you to send in your solutions to our problems for publication on the website.
- Have a lively discussion board, Ask NRICH, where you can discuss mathematics and receive help and advice from a community of mathematicians.
- Give you the chance to explore a wider range of mathematical ideas than you might meet at school or college.

Find links to games and articles for students from the Student Menu here

nrich
Specialists in rich mathematics

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This month: Stage 1&2 | Stage 2&3 | Stage 3&4 | Stage 4&5

For Students

A recent addition to the site is the stemNRICH scientific mathematics section. This provides a great way to explore fascinating science whilst developing your mathematical problem solving skills

There are loads of mathematical activities on the NRICH website. This page contains links to the best places for students to get their teeth into problem solving.

This month's publication takes you to our new problems and articles. You can send in your own solutions to these problems. We will publish some of these in the following month. Will you see your name in lights?

stemNRICH is our huge collection of scientific mathematics resources. A great way to explore fascinating science whilst developing your mathematical problem solving skills.

Each month...

Each month there is a selection of new problems and articles at each stage.

What do Stage and Challenge Level mean?

'**Stage**' simply means '**Key Stage**' in the UK.

We love low threshold - high ceiling: **Challenge Level** indicates the threshold.

Challenge Level: ★ Easier to get started with, although often very rich.

Challenge Level: ★★ Harder to get started with, but again often very rich.

Challenge Level: ★★★ Reserved for very difficult or involved problems!

Teachers' notes to *Iffy Logic*

Why do this problem?

Learning to write mathematical statements clearly and simply is one of the most important skills that a mathematician needs to learn. In order to do this, a mathematician needs to have a clear understanding of the logical flow 'IF something is true, THEN something else is true'. This problem gives practice in this process. It could be accessed at any point from advanced stage 3 to stage 5 and will really help to sharpen up the students' written mathematics.

Possible approach

The interactivity lends itself to a group approach. It is important that students are given the opportunity to talk about their logical statements and to try to explain their answers verbally. To do this, you might ask someone to suggest an answer to a line in the card-sorter and then ask for feedback on whether others agree or disagree. There are multiple possible ways in which certain cards can be matched.

Key questions

- Which cards have a good chance of fitting with other cards?
- Can you explain why your logic holds for each correct answers?

Possible extension

The cards have been chosen so that the completed statements are 'obviously' true. Good students might be encouraged to think more about WHY the statements are true. Can they give a strong argument or proof?

Extension work of a similar type is provided in the question *Contrary Logic*. Activities extending the 'proof' theme are given in *Direct Logic*.

Possible support

Rather than attempt to fill in all of the boxes, students could try to make just a selection of true statements.

A full NRICH problem: *Iffy Logic*

Iffy Logic

Problem | Teachers' Notes | Hint | Solution | Printable page |

Stage: 4 Short Challenge Level: ★

Mathematical logic and thinking are grounded in a clear understanding of how the truths of various mathematical statements are linked together.

For example, for any number x the expressions $x > 1$ and $x^2 > 1$ are both mathematical statements which might be true or might be false. However, we *always* know that $x^2 > 1$ IF $x > 1$, whereas it is not always the case that $x > 1$ IF $x^2 > 1$ (consider $x = -2$, for example). Thus:

It is correct to write $x^2 > 1$ IF $x > 1$

It is incorrect to write $x > 1$ IF $x^2 > 1$

Test out your logical thinking with these statements where n and m are positive integers, assuming any obvious properties about numbers (full screen version).

n - m is not zero	Rover is a dog	n > 1	n is odd
Rover isn't a cat	n < m	n is even	n - m > 0
n cubed > 5n	n + m is odd	2n - m < 0	n > m
n squared is odd	n + 1 is odd	n > 0	n > 2

	IF
	IF
	IF
	IF
	IF AND ONLY IF
	IF AND ONLY IF
	IF AND ONLY IF
	IF AND ONLY IF

Drag the blue cards onto the grey areas to create 8 correct statements.

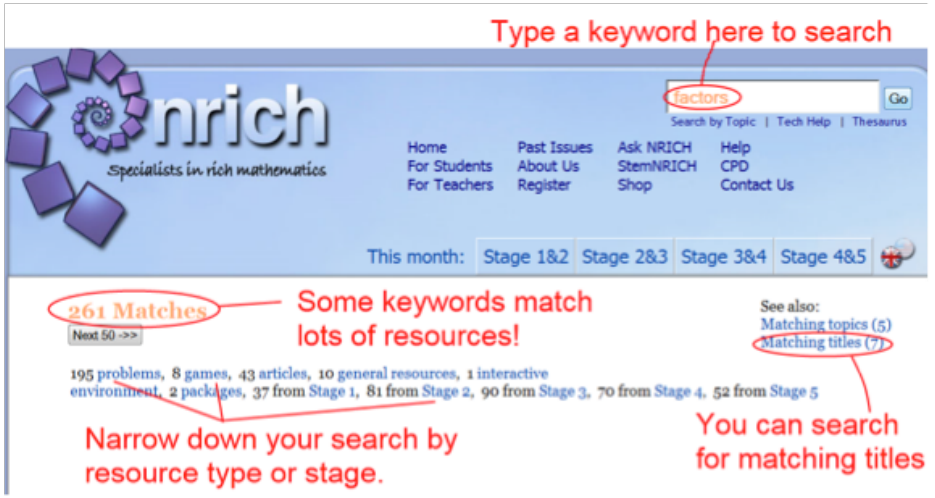
Are there multiple solutions? If not, how do you know?

How would the logic change if n and m were not necessarily positive or not necessarily integers?

Extension: Note that this activity does not prove that the statements are true. How might you go about proving that certain combinations are correct? How might you go about proving that certain combinations are incorrect?

Getting to know the NRICH site

Searching for problems and games:



Extracts from some NRICH problems

The NRICH site contains many Key Stage 5 rich mathematical resources across a wide range of topics. We have a great variety of problems - long, short, classic and modern. Here are a few extracts:

Implicitly

A function $X(r)$ is defined implicitly by the quadratic expression

$$X^2r^2 - Xr - r + 1 = 0$$

Part 1: Which of the choices $r = 1, -1, 100$ give a corresponding real value of X?

Part 2: What is the range of values of r for which there is a corresponding real value of X? What happens when $r = 0$?

Stats Statements

Are the following statistical statements sometimes, always or never true? If they are only sometimes true, can you give examples or conditions under which they are true and under which they are false? Is there some meaningful sense in which they might be 'usually' true or false? Be sure to be clear about your statistical assumptions in each case, especially in those which have a real-life basis.

1. Half of the students taking a test score less than the average mark.
2. Nobody scores higher than the average mark in a test.
3. In a large population of animals, about half of the adult animals are heavier than the average adult weight.
4. Suppose that in a game you can only score an even number of points: 0, 2, 10, 50. So, the average score over a series of games is an even number.
5. A random process is defined by a certain (unknown) probability distribution. The standard deviation of the random process is not larger than the range of the observed data.

Clickety Click and All the Sixes

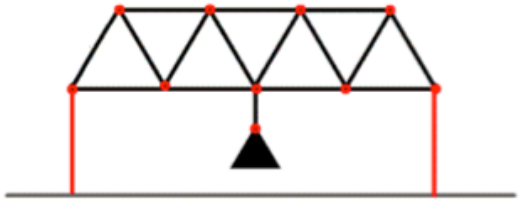
What is the sum of:

$$6 + 66 + 666 + 6666 + \cdots + 666666666\cdots6$$

where there are n sixes in the last term?

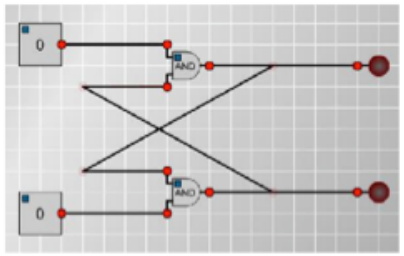
Bridge Builder

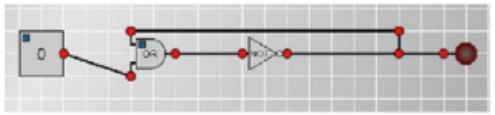
A bridge, which balances on two supports and bears a central weight, is to be made in a triangular pattern, as in the diagram. Each segment of the bridge will be either a rope, which must be under tension to be stable, or a spring, which must be under compression to be stable.The pin joints are light and move freely, but will break if subjected to any net force.



Investigate which parts of the bridge must be ropes and which parts must be springs

Circular Circuitry





What will happen when you switch on these circuits?

What will happen if you change the gates to different types?

Approximately Certain

arrange each of these in order of magnitude

The energy:

1. Used to walk up the steps of the Burk Dubai skyscraper (818m)
2. Contained in a full-sugar can of coke
3. Contained in a single atom of lead (according to Einstein's equation $E = mc^2$)
4. Needed to boil a kettle of tap water

The distance:

1. You could jump vertically up on the surface of the moon
2. You could throw a tennis-ball sized lump of lead
3. Between peaks of two sound waves causes by two successive hand claps in your fastest possble round of applause
4. You can run in 1 second

Be sure to justify your ordering with scientific and mathematical rigour.

Find many more scientific mathematics problems at nrich.maths.org/stemnrich