Secondary Magazine 134

1 1 4 2 5 3 6
2 1 5 4 3 2 6
3 1 3 5 2 4 6

National Centre for Excellence in the Teaching of Mathematics

Welcome to Issue 134 of the Secondary and FE Magazine

How are you spending any extra time that you have now that year 11 have left and the exams are over? Maybe you've already started your new timetable and are meeting new groups? Maybe you're already thinking about this time next year and the changes that you may need to make?

Whatever you're up to, remember to take a break, put the kettle on and take time out to read the latest edition of the NCETM Secondary and FE Magazine!

Feel free to let us know any thoughts about this magazine by email to info@ncetm.org.uk or on Twitter @NCETMsecondary.

Contents

Heads Up

At the time of writing the new A-level and AS-level specifications for mathematics and further mathematics for first teaching from September 2017 are being released. The Further Maths Support Programme has produced this helpful guide to help identify the considerations when choosing which exam board to work with.

Have you had a look at the increased mathematical demand in the new GCSE science specifications (have a look at the mathematical skills section - Appendix 3 on page 49 of this document)? The Association for Science Education has produced The Language of Mathematics in Science resources and now might be a good time to meet with your science department to talk about how you can support each other.

We are well into the conference season with the White Rose, Kent and Medway, Jurassic, and combined North West Maths Hubs all holding their annual conference in the week starting Monday 4 July. Check out the Maths Hubs website to find out about your local hub and any events that they are planning.

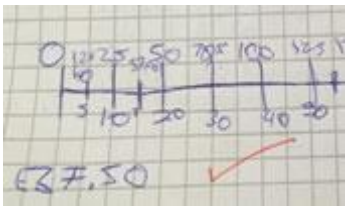
Have you seen Oxfam's secondary maths resources? They use real-life data to develop a range of mathematical skills in using fractions, decimals and percentages, in problem solving and in data handling. Interpret data presented in different ways and use statistics to create graphs and charts. More or Less Equal? is based on data gathered in Ethiopia, India, Peru and Vietnam by Young Lives, an international research project exploring the effects of poverty on young people for 15 years.

"The reason we're seeing mathematics everywhere is that our universe is a piece of mathematics."

Did you hear Marcus du Sautoy talking to Jim Al-Khalili on The Life Scientific? There's a short clip here and the whole programme can be found on the BBC iPlayer. There was also a recent Science Stories programme about Florence Nightingale and her contribution to the world of statistics.

The content of a free online course, Citizen Maths, aimed at adults and college students who've not yet achieved a Level 2 maths qualification (GCSE Grade C or above) has now been completed, with the publication of the final two of five modules, covering pattern and measurement. The course content, launched in stages over the last two years, covers five big ideas in maths. The first three were proportion, uncertainty and representation.

And finally, the NCETM website is approaching its tenth birthday, and a lot has changed during that decade, not least in how people use websites. So we thought it a good moment to get a snapshot of how you use the NCETM website. We've put together a short survey. Your answers will help us try to keep making the website match your needs and preferences. As a modest inducement we'll give £50 Amazon vouchers to the first two names out of the hat of all those who complete their survey by the deadline of **Friday 1 July**.



Classroom View

A teacher's experience of teaching the ICCAMS Maths lessons, by Helen Constantine, a secondary maths teacher working in east London

I teach a low attaining Year 7 Maths group, and before I was introduced to the ICCAMS (Increasing Competence and Confidence in Algebra and Multiplicative Structures) project, I would simplify the maths in my teaching as much as possible for my students. This worked for questions that didn't involve any real life context, but as soon as students were required to solve a problem, they struggled because they didn't have any experience in solving problems. I was a little fearful of allowing students too much thinking time in case It wasted time, and usually students who were faced with a challenging problem just asked me to come over and break it down for them anyway.

My first encounter in class with ICCAMS was with the Mathematical Stories and Models lesson:

Multiplicative Reasoning: Lesson 1A

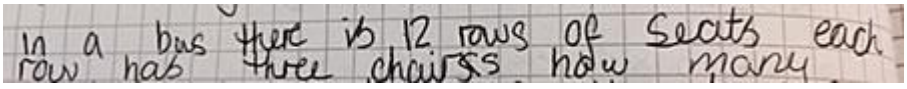
Models and stories

Here is an expression involving 12 and 3:

12×3

Think of
a. some ways of saying "12 × 3"
b. some ways of calculating 12 × 3
c. some diagrams that fit the expression
d. some stories that fit the expression.

I initially thought the task would last ten minutes and I didn't see a lot of value in it, but when I asked students to come up with stories that would give me 12 × 3, I was shocked at how much the class struggled with the task. I knew that if I said 3 bags cost £12 each so what is the total of all 3 bags, most of the class would be able to come up with the answer of £36. So, I thought they'd find the task easy, but most of their stories involved addition of 12 and 3 and there wasn't a single sensible story produced. The next task was to show a selection of diagrams that represented 12 × 3 in various ways and immediately students related these diagrams to real life. One story that stood out to me was for a diagram that had 12 rows with 3 small blocks in each row and the student, who could only produce 12 + 3 stories previously, came up with the following:



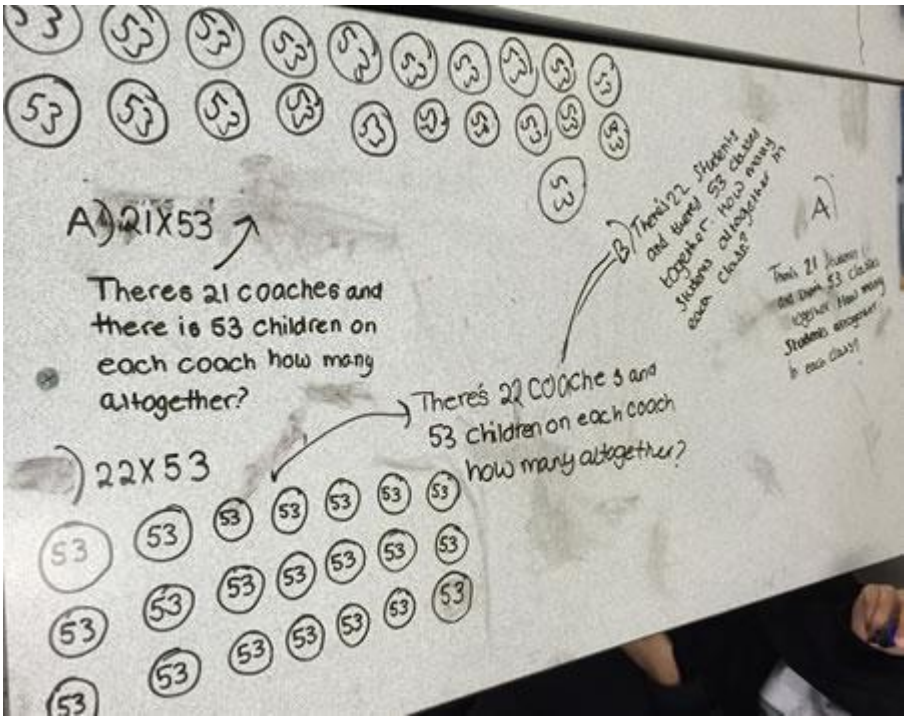
He was unable to then determine what question he was trying to ask in his story, but it was a big improvement on his first attempt. Eventually all my classes went on to look at stories and models for bigger values such as 53 × 22 and used these diagrams and stories to help them determine how to answer the following question:

Changing expressions

Look at expression A ↓.
Imagine we add 1 to one of the numbers, so we get expression B ↓ or expression C ↓.
Which is larger, B or C?

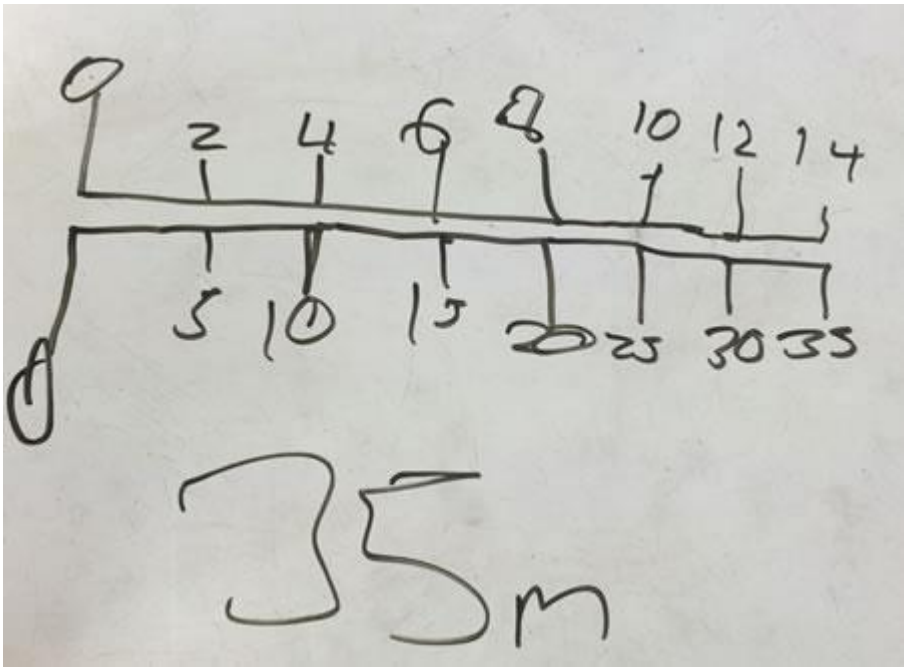
A. 21×53 B. 22×53 C. 21×54

These are the sorts of responses the students came up with:

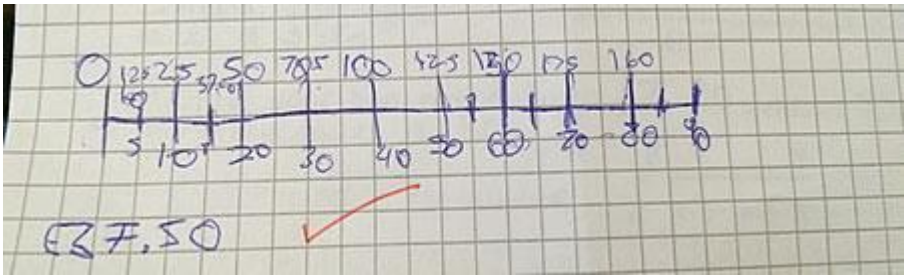


What has been most pleasing to see from all my classes is the variety of approaches I see when they attempt questions.

The student whose work is shown below was asked to find approximately how many centimetres in 14 inches if 6 inches was approximately 15 centimetres. Before looking at the Westgate Close lesson involving double number lines, the student (who correctly answered the question below) gave me an answer of 23 because 6in and 15cm have a difference of 9. The use of the double number line enabled him to visualise the problem and fill in other true equivalences that would help him reach the answer:



The student below used a double number line to calculate the cost of 15 calculators if 40 cost £100:



Students are given time to share ideas and encouraged to correct each other and compare answers and approaches within the ICCAMS lessons. I found the ideas in the lessons to be straight forward but the detail in the plans themselves meant I have been able to ask the right questions and react to each response in order to get a quick idea of where misconceptions lie and how best to address them. The lessons themselves are well thought out and there's a purpose and students can relate to what is being asked of them and draw on their own experiences to help them.

Sixteen Plus
The Return of Y12: ideas to inspire for the last few weeks

It's summer. Exams are almost over. Classrooms are hot. Students are winding down to the holidays and teachers are battling their own wind-down feeling to keep students alert. And suddenly… Y12s are back! And they are not back with new pencil cases and the fresh brightness of a new term. They are tired from exams, some not sure if they are actually taking A2 maths, and most are a bit jaded about back being in school while the sun shines. Classes are besieged with absence caused by university open days, enrichment events and sports day. Some teachers will remember the days when the 'lower sixth' was about delving into the depths of your subjects, engaging in small scale research projects and immersing yourself in learning without the pressure of exams (or else it was the year of hard socialising and minimum work because there were no exams!). Now we are faced with students that have spent the year responding to exam pressure, and have just got over that hurdle.

So the question arises of what to do with Y12s in these last few weeks while the sun beats down and the end of the year is in sight. It may be that you have been given a chunk of the A2 syllabus to cover, with the aim of getting ahead before the year starts. But maybe this is the time, without Y11 pressure, to branch out and get creative, aim to enrich and inspire those tired brains, and pull in some of those students that might be considering dropping maths.

Here, we suggest some resources that can support the more creative, open-ended and rich teaching of A2 topics, some stand-alone resources for those teachers with time to branch away from the syllabus, and some events that you might like to consider attending with your sixth formers.

Resources to support rich A2 teaching

- Rich Starting Points (Risps)
  Based around the A level maths curriculum, and usefully categorised by topic, each Risp comes with a simple PDF problem sheet for students and a PDF of teacher notes with answers, explanations and ideas. For example, Risp 26 which supports students to generate the compound angle formulae (C3 trigonometry)
- Rich tasks categorised by paper then topic at AS/A2 (NRICH)
  For example, this one to support C3 numerical methods and functions work – finding roots of tricky functions using numerical methods
- A level problem solving resources (Further Mathematics Support Programme, FMSP)
  If your students could do with some problem solving practice, the FMSP resources consist of topic-based individual worksheets, or problems for work in groups of four. No substantial knowledge of Y12 maths is assumed, but their problem solving skills will be challenged and sharpened, as well as reinforcing A level concepts.
  There are also materials for Y12/13 problem solving masterclasses – this could be time to put on a more general event for the whole cohort.

Ideas for other creative things to do with Y12 students to expand their mathematical horizons

- UK Mathematics Trust (UKMT) Senior Team Mathematics Challenge
  UKMT Senior Maths Challenge (for Y12/13) this takes place on 8 November 2016; Senior Team Maths Challenges are in November/December. Summer is the perfect time to have a go at some of the problems and develop some tactics or to pick a team for the team challenge

- Star trails and the sidereal day
  This is a resource from the Royal Observatory, Greenwich. In this activity students use star trails to calculate the true rotation period of the Earth. Students can make their own star trails inside the classroom.

Outdoor ideas

Hot weather produces hot classrooms and even older students will welcome the opportunity to have a lesson outside. These resources, produced by the Millennium Mathematics Project (MMP), are ideal for an Olympic year, and with a little creativity could involve a lesson outside to test mathematical models.

- Key Stage 5 Maths and Sport Resources (MMP)
  Activities based around sport using A level maths. These include the mechanics of various throwing/jumping sports, probability around drugs testing and looking at stadium lines of sight.

Enrichment opportunities

Why not take your Y12s out for the day? The following are a few suggestions – there may be more available locally:

- Y12 Mathematics Enrichment Day, 8 July, Cambridge
  Each student will take part in three different highly interactive workshops during the course of the day. Workshops are led by members of the NRICH team
- Take Maths To The Limit, Y12 Mathematics Day, 28 June, University of Bath
  Preparation for STEP and AEA papers and aiming to give students an idea of what a degree in maths might be like
- Student Maths Conferences, 6 or 14 July, University of Warwick
  Proof, Presenting Solutions, Fun Maths & STEP, guided tours of the campus. Accompanying teachers are provided with a parallel CPD programme
- Y12 Mathematical Modelling Day, 12 July, Lancaster University
  This is an event designed to encourage enthusiastic Y12 mathematicians to undertake some in-depth study through two mini projects which show different aspects of the applications of mathematics.

You may not want to take your students to the pub, but that needn't stop you suggesting this to the enthusiasts:

- MathsJam
  Second to last Tuesday of every month, in a pub near you, MathsJam is a monthly opportunity for like-minded self-confessed maths enthusiasts to get together in a pub and share stuff they like. Puzzles, games, problems, or just anything they think is cool or interesting.

Come September, they will all have new pencil cases and fresh faces, as well as the memory of inspiring maths from the summer!

Image credit
Page header by Caio Resende (adapted), in the public domain

From the Library

Are you interested in improving attainment in algebra and multiplicative reasoning? Are you worried about the Key Stage 3 dip? ICCAMS Maths may be the answer!

Professor Jeremy Hodgen, Director of the ICCAMS Maths project at the University of Nottingham, explains what ICCAMS Maths is and how you can get involved in the new Education Endowment Foundation funded project.

If you, like me, are worried about progression in mathematics at Key Stage 3, then you will be interested in the ICCAMS Maths project. In 2008, I was able to secure funding from the Economic and Social Research Council (ESRC) to work with Professor Margaret Brown, Professor Rob Coe, Dr Dietmar Küchemann and a group of teachers to develop an innovative and evidence-based approach to maths teaching. Increasing Competence and Confidence in Algebra and Multiplicative Structures, or ICCAMS Maths, the result of this research, draws on more than 40 years of research into learning and teaching school mathematics. It is designed to raise attainment in maths by helping teachers to use formative assessment to improve teaching and learning at Years 7 and 8.

ICCAMS Maths uses meaningful and intriguing contexts, whilst enabling teachers to probe how students understanding maths. For example, the first ICCAMS algebra assessment task poses the question, "Which is larger: 3*n* or *n*+3?" Most Key Stage 3 students do not say that it depends on the value of *n*. Instead, most say that 3*n* must be larger "because multiplication makes things bigger". This assessment task is followed by a lesson in which students compare two expressions in a 'realistic' context about hiring a boat.

Algebra: Lesson 1A

Boat Hire

Olaf is spending the day at a lake.
He wants to hire a rowing boat for some of the time.

Freya's Boat Hire charges £5 per hour.
Polly's Boat Hire charges £10 plus £1 per hour.

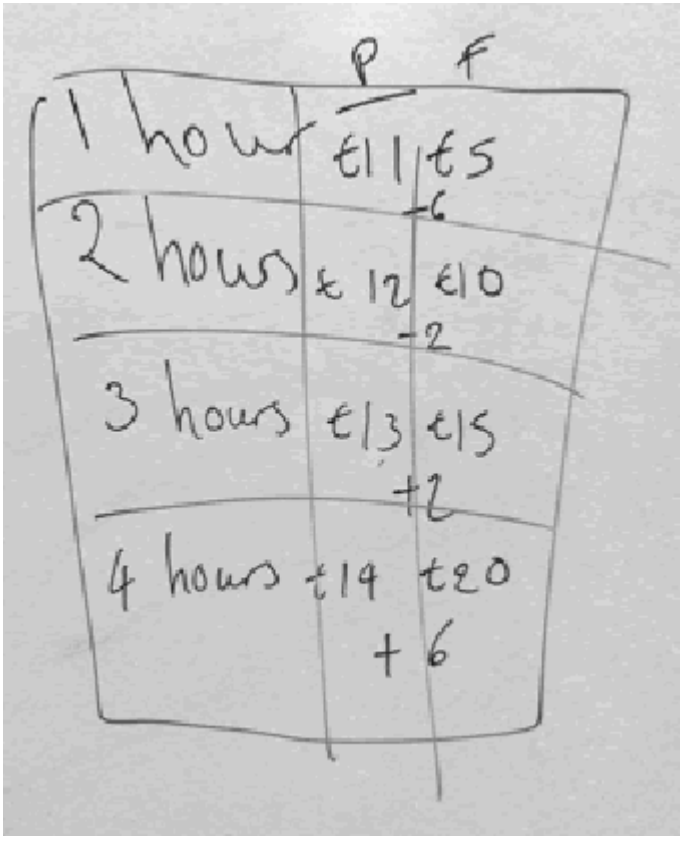
Whose boat should Olaf choose?

The Boat Hire problem is 'realistic' in the sense that students can imagine such a scenario and think their way into it, even though they might never have encountered such a problem in real life, and perhaps never will. Almost all of the students that we have worked with have the task engaging, because they could make sense of it and because initially they came up with different conclusions which had to be resolved.

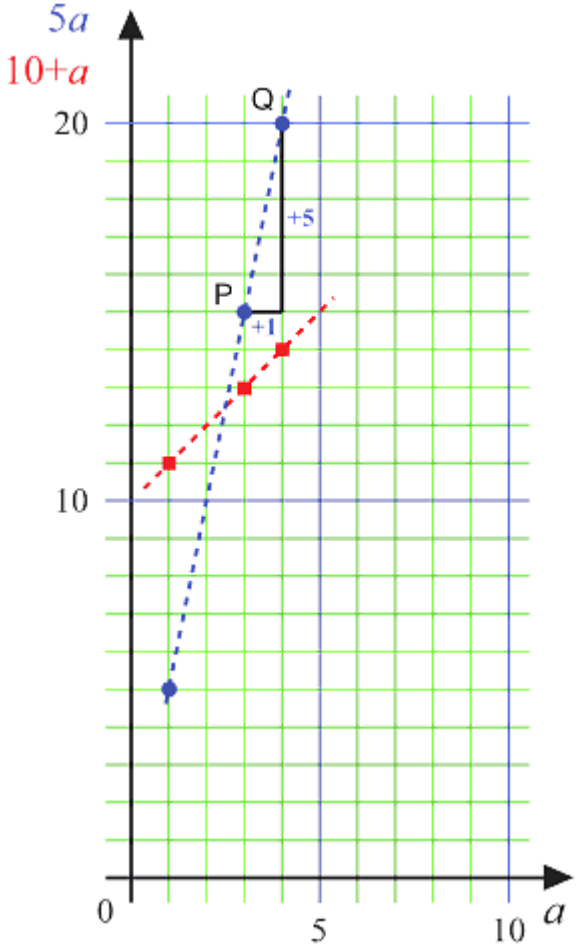
After a brief period of discussion, as a class and in small groups, the teacher is asked to record on the board the numerical data that students come up with to support their arguments. The data are first recorded 'randomly' and then (hopefully prompted by the students themselves) in an ordered table.

Students are used to using ordered tables, but this gives them an opportunity to see why such an ordering can be helpful.

Reproduced below is a pair of students' work, who, having ordered the data, noticed a pattern in the differences between Polly's and Freya's rates (-6, -2, +2, +6). Observations like this can prompt the question 'Are the hire costs ever the same?'. One way we suggest of pursuing this is to represent the relations algebraically (e.g., $5a$ and $10 + a$), which might lead students in some classes to consider how to solve the equation $5a = 10 + a$.



Students are then asked to put the data on a (Cartesian) graph. This representation is quite abstract (the 'picture' isn't of boats on a lake). But, because the graph is about a by-now familiar story, students are in a good position to relate salient features of the graph to the story and also to the other representations they have used. One such feature is the point where the two dotted lines cross; another might by the gradient of the lines (what does this tell us, and how is the same thing shown in a table or algebraic expression?); or the point where a line crosses the y-axis (or, indeed, the x-axis!); or can lines meaningfully be drawn through the points (what do the intermediate points represent, and do the resulting points satisfy the relation in the table or algebraic expressions?).



The general idea is to give students the opportunity to see that a graph can be meaningful and useful. Some students have even 'remembered' the Boat Hire problem in a later lesson and decided spontaneously to draw a graph to compare two expressions!

I do hope that you – like teachers that we have worked with - find the ICCAMS Maths approach interesting and potentially valuable. We have now been funded by the Education Endowment Foundation to conduct a major national research project to work with Durham University, the University of Manchester, NCETM and a number of Maths Hubs. This project, which is now recruiting schools, will conduct a large randomised controlled trial to evaluate the effects of ICCAMS Maths on student attainment.

If you are interested in getting involved in this trial, please do contact ICCAMS (see below).

And finally … some answers to some frequently asked questions about ICCAMS Maths:

Does ICCAMS work?

In the original ESRC-funded research study, we tested ICCAMS in 22 classes from 11 schools and found that the rate of learning for students in ICCAMS Maths classes was double that for students compared to a control group. The current trial is intended to evaluate whether ICCAMS Maths works at scale across a range of different schools.

Does ICCAMS Maths encourage mastery?

Our aim is that students will become fluent with maths and will be able to tackle non-routine problems successfully. We emphasise ways of ensuring that students develop conceptual understanding.

Can ICCAMS Maths be used alongside my school's existing scheme of work?

ICCAMS Maths is designed to supplement, not replace, ordinary lessons. The programme meets the requirements of the new National Curriculum and has been used with many different schemes of work (and many different textbooks).

Is ICCAMS Maths appropriate for low and high attainers?

ICCAMS Maths caters for all students across the attainment range and the lessons have been trialed in a wide range of different classes. The programme is designed to help you improve teaching and learning across all lessons and for all students by assessing what your students understand, what they find difficult and what they need to learn next.

What does ICCAMS Maths involve?

ICCAMS Maths is a two-year-programme consisting of 10 short mini-assessment tasks and 10 pairs of lessons in each of Year 7 and Year 8. We provide ICCAMS mini-assessment and lesson materials, professional development for two teachers, training materials for a school's whole maths department and ongoing support from an expert PD Lead.

How can I find out more?

Via the ICCAMS website, or contact Clare Collyer, Administrator - by email or phone 0191 334 4682.

It Stands to Reason

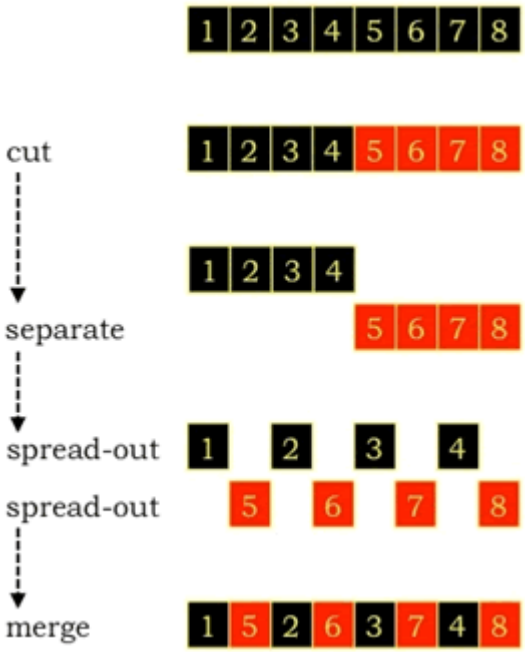
An important aim in teaching mathematics is to help pupils develop some specific strategies to use when they are challenged to solve problems that are 'new' to them (when they can't just follow a sequence of steps that they've used time-and-time-again to 'solve' previously-frequently-met, exactly-similar, problems). To provide 'space' in pupils' minds so that they can concentrate on problem-solving strategies, rather than on mathematical techniques, you can present interesting tasks that involve relatively simple techniques that most pupils will have mastered. Tasks in which pupils discover simple number patterns are ideal for this purpose.

Here we present one example task. It is demanding enough for teachers to enjoy working-on-it-together prior to challenging pupils with a wide variety of different number-pattern tasks from a source that we link to below.

Example task
In-shuffles: explore and explain

A possible introduction

This single *in-shuffle* of EIGHT items …



… changes the order from 1-2-3-4-5-6-7-8 to 1-5-2-6-3-7-4-8. It is called an in-shuffle because the items that are first and last do not change.

This is what happens if we continue to *in-shuffle* only SIX items in the same way (if we keep on repeating the same procedure) …

	1	2	3	4	5	6
1	1	4	2	5	3	6
2	1	5	4	3	2	6
3	1	3	5	2	4	6
4	1	2	3	4	5	6

The original order is restored after four *in-shuffles*!

If we continued to in-shuffle EIGHT items would we also eventually restore the original order, and if so, after how many in-shuffles?

Noticings

There are many patterns and regularities to notice and to try to explain. For example, with 14 items …

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1	8	2	9	3	10	4	11	5	12	6	13	7	14
2	1	11	8	5	2	12	9	6	3	13	10	7	4	14
3	1	6	11	3	8	13	5	10	2	7	12	4	9	14
4	1	10	6	2	11	7	3	12	8	4	13	9	5	14
5	1	12	10	8	6	4	2	13	11	9	7	5	3	14
6	1	13	12	11	10	9	8	7	6	5	4	3	2	14

… the first six in-shuffles reverse the order of all the items except the first and last. Does this suggest a conjecture about the number of in-shuffles that will restore the original order?

Also, the sum of the two central items is always 15! Why are the two central items always different colours?

Is the following conjecture generally true?

When the number of items is doubled, the number of in-shuffles to restore the original order increases by 1

Number of items	Number of in-shuffles to restore original order
4	2
6	…
8	3
10	…
12	…
14	…
16	4
18	…

Ways of working

Your role should be one in which you place less emphasis on detailed explanation and on knowing answers, and more emphasis on encouragement and transferable strategic guidance. So you might ask "How can you make it simpler?" rather than "Have you looked at 1, then 2, then 3?".

Pupils will benefit from plenty of opportunities to discuss, in pairs, in groups and as-a-whole-class, what they notice, and strategies that work for them. Encourage them to reflect on, and explain-through-talk-and-in-writing, their approaches to problems and their discoveries.

It is easy to underestimate how difficult it is for many pupils to express patterns directly using conventional algebra. It helps them to …

- first SAY their 'rule' in ordinary language
- then WRITE it in ordinary language
- then EXPRESS it using their own choice of symbols and shorthand
- then, and only then, try to express it conventionally and algebraically.

If pupils refer to lists of 'strategic hints', as is suggested in the material described below, it is extremely important that such hints are NOT regarded, or interpreted by anyone, as lists of questions for pupils to answer! Pupils should understand that they are there to help ONLY IF pupils get stuck! Some pupils may be able to solve problems without ever needing to look at any hints-from-a-given-list!

Encourage pupils to think of explanations and proofs as efforts to help others 'to see what you are seeing in the way that you are seeing it' *(John Mason, QCA Conference, 2001)*.

Further material

This article constitutes a brief introduction to the considerable and valuable advice (together with a very large bank of exciting classroom tasks) that you can draw on in the free-to-download resource, Problems with Patterns and Numbers, available at the Shell Centre for Mathematical Education Publications Ltd.

You can find previous *It Stands to Reason* features here

Qualifications and Curriculum

We have a double helping for you in this section this month. First, we give you a chance to prove you know your GCSE students' abilities better than some maths PhD students who took part in an Ofqual research project.

And second, we hear a personal view of how one secondary head of department is preparing for his current Year 10 students to sit the new GCSE exams next summer.

Predicting how hard students will find exam questions

How hard do your students find GCSE exam questions? If you're a teacher with any experience of preparing a class over a year or two for their exams at the end of Year 11, you've probably got a reasonably well-formed (and well-informed) view of what they'll find hard and what they'll find less of a challenge. And your hunches have probably been tested and refined as you've marked mocks and routine tests during Years 10 and 11.

The prediction of exam question difficulty is an area that the exams regulator, Ofqual, has been looking at in some depth, particularly in the run-up to the new maths GCSE (first exams next summer).

In a research exercise in 2014/2015, Ofqual asked 43 maths PhD students to rate the degree of difficulty of more than 2000 questions, taken from past GCSE papers and from sample questions submitted by the exam boards for the new GCSE next year. These predictions were then compared with the actual performance of pupils attempting the questions.

A full account of the project can be found in Chapters 1 and 2 of this report (Ofqual).

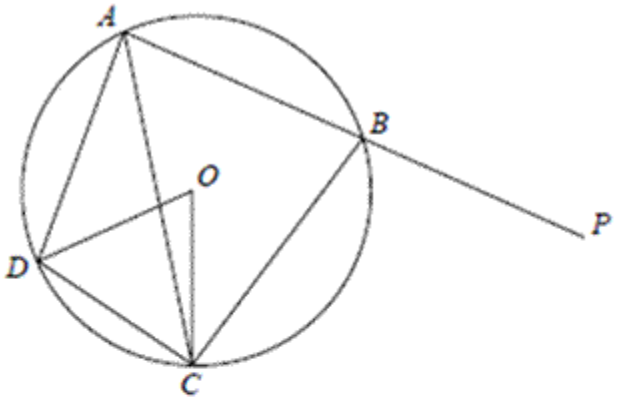
In the main, the PhD students were pretty accurate in predicting levels of difficulty.

But there were some questions which led to large numbers of under-predicting of difficulty, and others where the reverse was the case.

So, here's your chance to test your prediction skills against the PhD students.

These five questions were among those which led to relatively large scale under- or over-predicting of difficulty. See if you can guess which they were:

1



A, B, C and D are four points on a circle, centre O.
PBA is a straight line.
Angle $PBC = 100^\circ$
Angle $DAC = 23^\circ$

Show that the size of angle $OCA = 10^\circ$
You must give a reason for each stage of your working.

2

(b) What is 0.9 as a percentage?

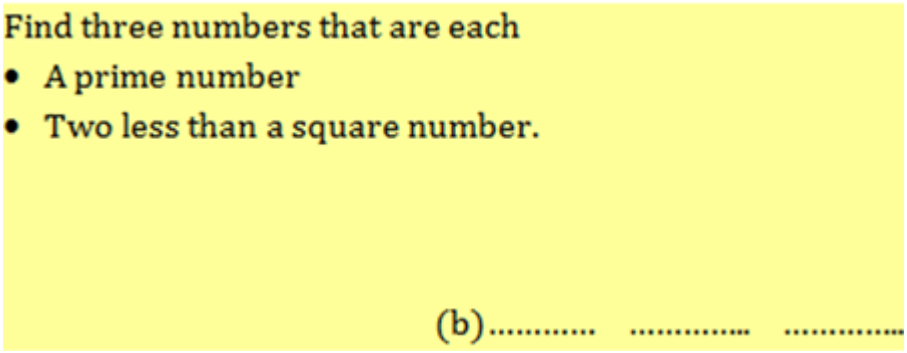
Circle your answer.

0.009% 0.09% 9% 90%

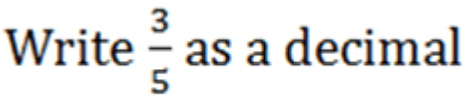
3

Solve $y - 9 = 17$

4



5



Answers: difficulty over-estimated: Questions 1 and 4; difficulty under-estimated: Questions 2, 3 and 5.

Preparing for next year's (new) GCSE: a view from one secondary Head of Department

With this summer's GCSE exams now behind us, many secondary teachers and HoDs are turning their thoughts to next year and how they might change things, to help students prepare for the new, different (and harder) exam.

This month we feature a personal view of the GCSE maths-teaching year ahead from Mike Thain, head of the maths department at John Hanson Community School, Andover, Hampshire.

As ever, one exam cycle comes to a close and my immediate thoughts turn to preparing for the next one, only this time it is slightly different. With the increased demands of the new GCSE across all abilities, the fact that ALL grades contribute to progress 8 and best 8, and the fact we can't really be sure what the papers will look like, my team and I have been grappling with how we can prepare Year 10 for what they are going to face. Here's what we have come up with so far:

1. **Prioritise numeracy skills** - we have introduced Numeracy Ninjas[1] across almost all Year 10 classes. It has been quite scary how low their mathematical fluency was, but already after only eight weeks of using it we (and more importantly they) can see significant improvements. We will continue with this at least twice a week throughout Year 11.
2. **Homework** – we have switched from MyMaths[2] to hegartymaths[3]. This site gives us quality information about individual strengths and weaknesses for all students. We are using the website for weekly homework, and to gather information that informs both planning for first teaching, but also for intervention support.
3. **A good scheme of work** – we have found Kangaroo Maths[4] to be a really good starting point for our SOW. We are currently adding to it, so that integrated into each topic are our own resources, our tracking of students' understanding, and relevant homework tasks.
4. **Use of exam questions** – these will become integral to the teaching of each topic for practice. Previously we have set half an exam paper each week for most of the academic year. Given the increased demand we will change this for September. Hegartymaths will form the basis of

homework until Christmas in order to track progress through the remaining content. Alongside, we will start using exam papers, both legacy papers and new spec samples, from January.

5. **Continue to embed PiXL[5] principles of Diagnosis, Therapy, Testing**. Prior learning tasks will be set to check students' understanding before first teaching. We will then reuse those tasks where students did less well to measure progress within that topic. This programme is being planned for all year groups moving forwards. This approach also makes homework a vital part of the learning process, rather than an 'add on'.
6. **Being honest with the students** – I am already investing a lot of time telling Year 10 and their parents that the exams are getting harder. I want them prepared for it. To help with this we are focussing even more on teaching that really tests their understanding. Constantly asking them to explain/prove why, changing the question to see if they can still answer it, getting them to work backwards through problems, writing their own questions, focussing on correct language at all times to familiarise them with the subject-specific vocabulary they need to know, the list goes on.

The new specification has made us focus even more on the quality of our teaching and learning. We have an unrelenting focus on this, and we are doing everything we can to put a downward pressure on workload so that this becomes the absolute priority. Thankfully we are in a school where reducing workload and encouraging teacher wellbeing is towards the top of the agenda.

[1] Numeracy Ninjas is a free online resource designed to improve fluency of mental calculation through regular ten-minute sessions.
[2] MyMaths is a comprehensive online resource covering KS1- 5 with teaching slides, online practice and homework and individualised pupil tracking. It is a subscription service.
[3] hegartymaths is a comprehensive online resource covering KS2-4, with teaching videos, practice, assessments and individualised pupil tracking. It is now a subscription service, though access to archive videos is free.
[4] Kangaroo Maths describes itself as 'a huge pile of free maths resources including schemes of work, BAM tasks and much, much more'. There is also a bank of resources to purchase.
[5] PiXL is 'a partnership of over 1500 schools working together to achieve the highest outcomes for students and to improve their life chances.'