Cambridge Mathematics Education Project newsletter

Michaelmas term: December 2015

In this Newsletter:

Message from our Director - Lynne McClure

The end of the year is a time for reflection. Our recent external evaluation provided us with an opportunity to review what we've been doing and mostly we seem to be heading in the right direction, though of course there is always room for improvement. There's no doubt that we have completed lots of work since last January: we've written and revised more tasks in the light of teacher feedback received at the workshops and the tube map has been redesigned as a result of our thinking becoming clearer. Recently we have been almost totally focused on migrating everything over to a new version of the site - more about this below.

But we know that no matter how elegant the design of our tasks or site, the effectiveness of CMEP in the classroom depends on the expertise of the teacher. CMEP is aiming to offer something which is new and in some cases, quite threatening, to unconfident practitioners. On the new site we will be greatly increasing the extent of teacher support, especially for those who are new to the CMEP philosophy. We know that many of you already value the detailed solutions and find them helpful in planning your lessons. Our teacher notes have been received really well and so Lizzie has been working with teachers in our partner schools in devising even more support. On the new site there will be videos illustrating how CMEP plays out in the classroom. The student voice is very powerful in these and may well help to change perceptions of what students are capable of attempting and achieving. There's some good stuff there and something to look forward to whilst you're enjoying the sherry and mince pies….

Season's greetings from the team!

READ MORE

Coming Soon

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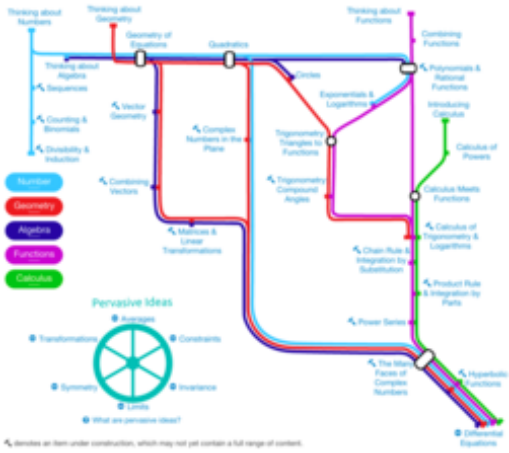

In February CMEP will be launching its brand new website under a new name! This website will replace our current one, and will have new and improved features such as a redesigned tube map, better search functionality and a chance to see some of our resources in action.

The resources will be transferred to the new site and we will continue to add to them over time, as we do currently. For a period of time, both sites will be available and you will be able to choose which site you use.

Feedback from teachers has already had an impact on the development of the project, and we would like to continue hearing from you as you explore our new website. Keep an eye out for more information coming your way in the new year.

Featured resource: What else do you know?

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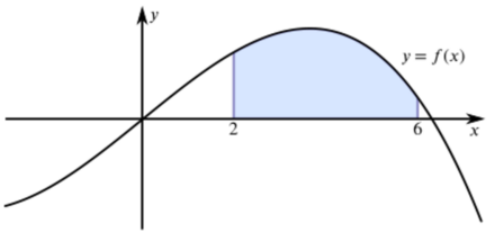

If you know that the area of the shaded region is 40 square units, which of the following can you evaluate?

- $\int_2^6 (f(x)+5)\,dx$
- $\int_2^6 (f(x)-3)\,dx$
- $\int_0^4 f(x+2)\,dx$
- $\int_2^6 f(x+2)\,dx$
- $\int_4^8 f(x+2)\,dx$
- $\int_2^6 -f(x)\,dx$
- $\int_2^6 f(-x)\,dx$

If there are any that you cannot evaluate, what additional information would you need in order to do so?

Author's notes

This problem presents an image of a part of an unknown function. Students are given the area under the curve in a specified region and asked to consider what they can deduce about a selection of related integrals involving transformations of the original function. This is a problem that challenges students to apply geometrical reasoning to something that they might usually only consider algebraically. The subtle difference between the value of the integral and the value of the area under the curve will come out when tackling this problem.

In a more general context this is a lovely problem to help students develop resilience. The minimal information supplied in the image may lead students to think that the problem is very difficult and even impenetrable. However, if encouraged to draw diagrams and reason through each integral geometrically they will be surprised at how far they can get.

Resource link

Teacher Perspective: Parabella

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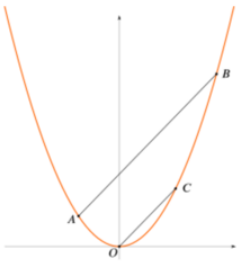
Varuna Gooriah from Fortismere School shares her experience of using Parabella with a group

Take any two points A and B on the parabola $y = x^2$.

Draw the line OC through the origin, parallel to AB, cutting the parabola again at C.

Let A have coordinates (a, a^2), let B have coordinates (b, b^2) and let C have coordinates (c, c^2).

Prove that $a + b = c$.



The parabella

Imagine drawing another parallel line DE, where D and E are two other points on the parabola. Extend the ideas of the previous result to prove that the midpoints of each of the three parallel lines lie on a straight line.

Aim of the lesson: Develop problem solving skills.

I had about 15 minutes left of a lesson and wanted pupils to try an unseen problem. This was a Year 11 class of quite able mathematicians who were working at a consistently high level but are highly resistant to problem solving.

What I did

Initially I gave them the problem and asked them to have a go. Some pupils put their hand up immediately to ask for help, but I asked them to think first and said we would discuss the problem as a class in a few minutes.

A couple of minutes later I asked the class what they could do if

they were getting stuck. One pupil suggested drawing a picture and I made the suggestion "What do you know so far about the problem? Write it down and then think again."

I gave the class another 5 minutes to think about the problem.

I then asked a pupil to explain their thinking about the problem. He started from the point of view of finding the gradients (this was handy as some had forgotten which way to subtract the coordinates). He got stuck at the point of $(a^2-b^2)/(a+b)$. Another pupil then said they recognized this as a difference of squares problem and simplified the algebraic fraction to show a+b=c.

I asked if any pupils had completed the problem a different way. One pair of pupils had approached the problem slightly differently by finding the gradient of the line AB and substituting this and the point (c, c^2) into the y=mx (the form of the equation of the line OC).

We then had a brief discussion about the merits of the different methods and which one they preferred and why.

We did not get as far as the extension problem.

Reflections

It was useful for pupils to get stuck and then consider strategies for getting "unstuck".

This was a non-standard problem so they had to adapt their thinking.

Some of the pupils really enjoyed the opportunity to problem solve in a non-formulaic way. Some of the pupils did not! (They wanted me to tell them how to do it).

The problem was accessible to all and pupils could understand the problem.

What I would do next time I use this problem.

Maybe formalize the beginning of the lesson more, for example start by asking the students to 'think, pair, share' their ideas rather than immediately jumping into the problem. This will give more pupils a chance to think.

Ask a pair of pupils to come to the board and do more of the explaining and drawing rather than me. This will create a more cooperative learning environment where the teacher plays less of role as the leader and pupils can lead learning too. Pupils can model good mathematical behaviours rather than just the teacher.

Resource link

New and updated resources

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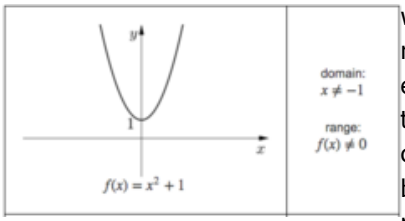
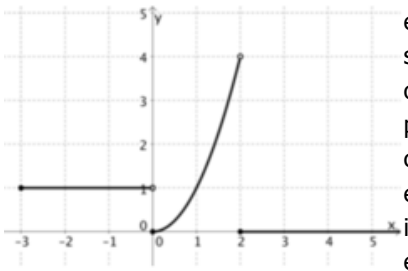
Here are some of our recent additions to the CMEP site.

Domain and range dominoes (F2)



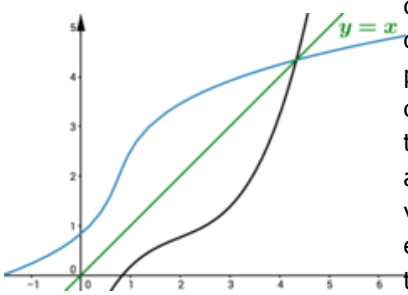
This is a card-based activity that makes students think carefully about what we mean by the domain and range of a function and how to express them precisely. To complete the arrangement of the domino cards, students need to fill in some blanks, working out some missing ranges and constructing a function to fit a description. **Resource link**

Piece it together (F1)



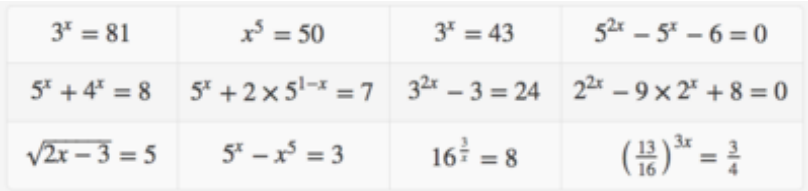
Students are asked to describe four piecewise graphs. The process of trying to describe the features of the graphs should assist students in understanding how we write equations of piecewise functions. A set of equations that match to some of the graphs is provided. In order to pair them up, students will need to create some missing graphs and equations themselves. This process is intended to highlight that the equation for a piecewise graph may be written more than one way and to show the importance of being accurate with inequality signs. **Resource link**

Reflecting on change (C5)



This resource could prompt a discussion of how we can differentiate inverse functions. The problem starts by asking students to complete certain statements about the behaviour of inverse functions, and prompts them to think about visualising or sketching some examples. There are Geogebra files that can be used to help make these ideas more precise. **Resource link**

To log or not to log? (A4)



This task is a sorting exercise requiring students to think about which tools they would use to solve a range of equations involving exponentials of one sort or another. Sometimes the use of logarithms is essential, sometimes it is one method amongst others and sometimes it will not help at all. **Resource link**

Spread the word

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If you wish to demonstrate CMEP resources with colleagues or other schools, then please let us know. We can send you postcards and leaflets to hand out. The postcards show some of our resources and the leaflet explains the project's aims and beliefs as well as providing information about the website. You can also download the leaflet **here**.

If you are working with other schools then we can provide logins for them to access the site. We would be interested to hear from those spreading the word, and would love feedback from you about the site, the resources and how you have used them. For all of the above please contact us.

Meet the CMEP team - upcoming events

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Over the next few months you can find the team here:

- 12th March 2016: Scottish Mathematical Council Conference **(see further details here)**
- 29th March to 1st April 2016: Association of Teachers of Mathematics Conference **(see further details here)**
- 1st to 3rd of April 2016: Mathematical Association Conference **(see**

further details here)

- 30th June to 2nd July 2016: MEI Conference **(see further details here)**

Join the CMEP Community

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The Cambridge Mathematics Education Project (CMEP) is a new initiative, based in the University of Cambridge's Faculty of Mathematics and funded by a grant from the DfE, which aims to enhance post-16 mathematics education.

CMEP is developing innovative resources to help support and inspire teachers and students of A-level mathematics and similar qualifications. Throughout the project, we are carefully considering both the learning needs of the students and the associated issues facing teacher. We are working closely with teachers form a range of different schools throughout the development process to gain formative feedback and input.

Schools, college and academies across the UK are warmly invited to register as CMEP Affiliate Schools. Registration as an Affiliate School gives free access to the CMEP online resource.