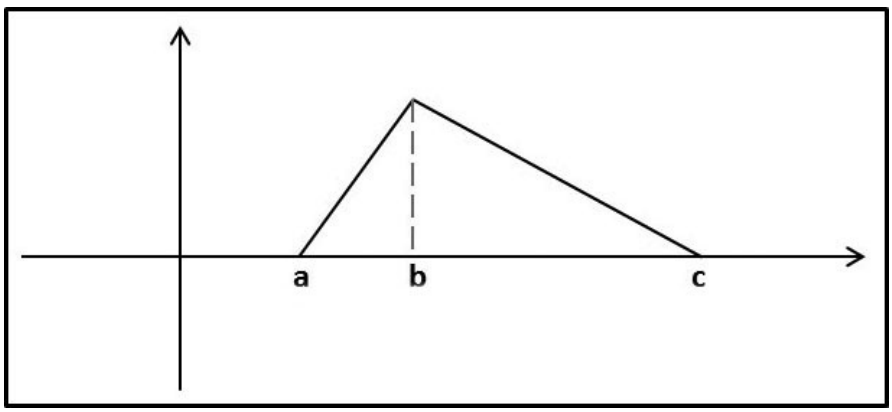
Cambridge Mathematics Education Project newsletter

Lent term: February 2016

In this Newsletter:

Message from our Director - Martin Hyland

The main focus in the project so far has been on material which lies in the Core of current A Levels. However behind the scenes we have been thinking hard about applications of mathematics and how best to present suitable resources on our website. There is lots to think about. Here is a problem, suggested to us by our colleague Stephen Siklos, by way of illustration.



Let a < b < c be real numbers. Consider the continuous probability distribution on [a,c] which is 0 at a and c and linear on [a,b] and on [b,c]. What is the mean?

A student attempting this is likely to engage in a bit of calculation before arriving at what might seem at first glance to be a surprising answer. That would be a very valuable experience, the more so if it leads to understanding of the “But of course ...” kind. A first issue is how to lead as many students as possible to make the discovery for themselves.

Secondly the problem shows one of quite a few connections between Mechanics and Probability. Teaching those subjects as alternative options and in isolation from the rest of a syllabus means all sorts of connections are lost. The new A Levels present an opportunity to do better. But there is no established practice to work with and it is best to think through the mathematics anew. That is itself a challenge.

Finally there is significant mathematical thinking in understanding the problem and its connections. What students stand to get from grappling with it is important and highly transferable knowledge. That is a good reason for wanting them to acquire the understanding for themselves. There is a great deal of significant mathematics buried in applications which are accessible at school. But again work is needed to enable students to benefit from the possibilities they represent.

Underground Mathematics

(Back to Top)

We are pleased to reveal that going forward CMEP will be called Underground Mathematics. Our new name, logo and redesigned Tubemap will be accessible from late February when our new, freely available site goes live at undergroundmathematics.org. The resources have been 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 the current site (swanage) and the new site will be available and you will be able to choose which site you use. To further help with the transition, we will also be providing a migration spreadsheet, listing all of the resources on swanage, and where they can be found on the new site.

Underground Mathematics community

(Back to Top)

The Underground Mathematics site will be accessible to all, and to assist new users we want teachers to share their experiences of using our resources with their students. We would value you, our

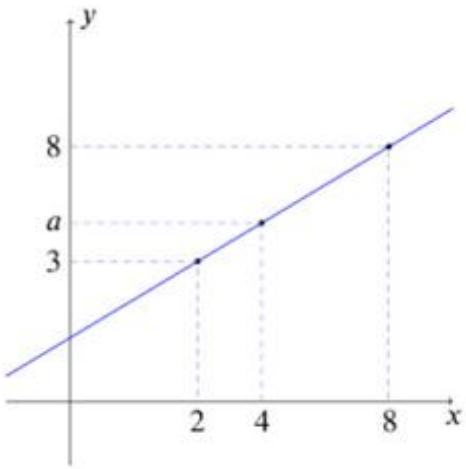
experienced users, contributing to the conversation, which you will be able to do by creating a login for the site and using the 'Discuss' link that appears at the top of the page when at a resource or station. Our new Twitter feed is @UndergroundMath, replacing @CMEPMaths, where we will tweet resource suggestions, events we are involved in, and any interesting maths we come across. The newsletter will continue to be sent out half termly to keep you up-to-date with the latest news and developments at Underground Mathematics.

Teacher Perspective

(Back to Top)

Deborah Poole, from St Leonard's School in Durham, shares her experience of using In-betweens and Straight lines.

A colleague and I attended an MEI CPD course for CMEP, which is spread over two days. Between the two days you are asked to use a CMEP resource and then feed back on how it went. I chose a selection of problems from the G1 and G2 Geometry line. We did these problems because we had just finished Core 1 and I thought these were a good way of stretching my pupils to 'think' for themselves a bit more.



As this was a slight departure from our usual lessons, I started the lesson by informing the students that they would be applying skills they had learned to problem solving, and that they should be prepared to have to think. As we started each activity I made them work in silence on their own for 5 minutes. I told them that I didn't mind if they had a blank sheet after 5 minutes, but I didn't want them to look at each other's work, as I wanted a realistic range of starting points, rather than one student thinking of what to do and the others all attempting the same thing. For In-betweens, the students came up with a number of techniques, and it was interesting to see which ones worked well for all the questions.

Several students compared gradients or ratios, while other students found the equation for the line and used that to find the missing coordinate. Writing a table of values, and looking at the relative distance between numbers was also used, but these proved more difficult when dealing with non-integer answers.

In Straight lines, students are asked to determine which of the given pieces of information describe a straight line.

1. Which of the following describe or determine a single straight line?

a. $4x - 2y = 6$

b. $y = 2$

c. The points $(1, 2)$ and $(0, -1)$

d. $y = \frac{3}{2}x$

e. The points $(-1, -4)$, $(3, 7)$, and $(8, 8)$

f. $y = 3 - 2x$

g. The point $(0, -1)$ and the constant gradient 3

h. $x = -2$

i. $y = x^2 + 2$

j. $x = 7y + 5$

k. $y - 8 = 3(x - 3)$

l. The points $\left(\frac{1}{2}, 2\right)$, $(1, 1)$, and $\left(\frac{3}{2}, 0\right)$

m. $y^2 = x^2$

n. The point $(3, 3)$ and the direction specified by the vector $\binom{1}{2}$

o. $\frac{1}{3}y - x + \frac{1}{3} = 0$

p. $xy = 1$

q. $y^2 - 4xy + 4x^2 = 0$

How did you decide?

The students all agreed that i, p and q were not straight lines. The most thinking went on around e and m. Some spotted that e was not a line, but others failed to check the gradients and incorrectly assumed that it was. Many of them dismissed m because they thought it was a curve. While some students spotted that it gave two lines as they could square root to get $y = \pm x$, others assumed the x^2 meant it couldn't be a straight line.

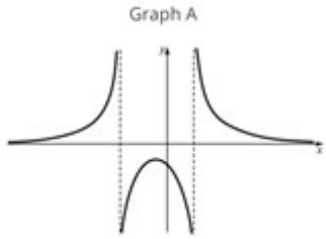
All the students incorrectly assumed that q was not a straight line. They failed to spot that it factorises to give $(y - 2x)^2 = 0$ so $y = 2x$. This prompted some interesting discussions about the different ways of writing equations of straight lines.

Reflecting on the lesson, I found that the students had enjoyed the activities, especially In-betweens, and that they sometimes surprised me with their methods, choosing routes that I had not thought about.

New and updated resources

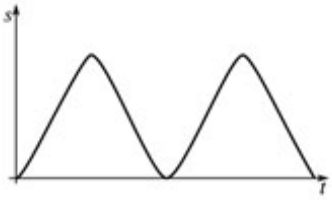
Here are some of our recent additions to the CMEP site.

Worth 1000 words (F1)



This task is intended to help students build up confidence in sketching graphs of functions by helping them to focus on how the equation of a function gives information about features of its graph. **Resource link**

Walk-sorting (C1)



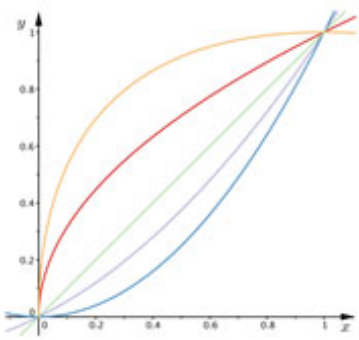
This resource invites students to match displacement–time graphs with the corresponding velocity–time graphs. Some of the graphs have not been drawn and will need to be completed. Once they have been matched can students give descriptions of what might be happening? **Resource link**

Average speed (C1)

This resource has two situations that require students to think carefully about how average speed is calculated. The first situation should help reinforce the connection between average speed and gradient, whereas the second situation highlights the difference between driving different speeds for the same amount of time, compared to the same distance. **Resource link**

Meaningful areas (C2)

Students are asked to find the areas



of regions between the graphs of the functions used in the resource Curve match. In doing this, they may discover that they can use symmetry and averages to reduce the number of calculations they need to do and explain why certain regions are the same size. **Resource link**

Meet the Team

We have quite a few conferences coming up over the next few months, notably:

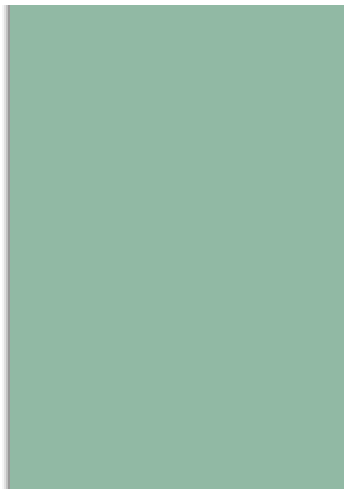
- Scottish Mathematical Council conference - Stirling, 13th March 2016 **Info**
- ATM Conference - Chesford Grange, Warwick, 29th March - 1st April 2016 **Info**
- MA Conference - University of Oxford, 1st - 3rd April 2016 **Info**
- MEI Conference - University of Bath, 30th June - 2nd July 2016 **Info**
- ICME - Hamburg University, 23rd - 31st July 2016 **Info**

Join the CMEP Community

(Back to Top)

The Cambridge Mathematics Education Project (CMEP) is an 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.

MEI run a CPD course for CMEP, entitled "Using the resources effectively in your A level classroom". This is a free two day course introducing teachers to the new Cambridge Mathematics Education Project (CMEP) on-line resources. To find out more click here.