

## Why use MAT and STEP and questions in general teaching?

- MAT and STEP are highly creative
- High prestige exams might provide motivation
- Might raise aspirations of some students
- Because MAT and STEP seek to identify mathematical skills that other resources don't
- Because MAT and STEP are based on the standard A level specifications and so students know that they will be applying techniques from their course.

# The MAT questions

These have been chosen from the multiple choice test questions:

- MAT is based on AS pure mathematics
- Because the questions are multiple choice 'weaker' students can find a way in
- Proper mathematical thinking is needed to eliminate answers, which can then lead to the kind of thinking that is required to solve the question

# The STEP questions

Questions have been chosen because

- They require students to engage with meaning
- Most don't require any heavy duty machinery
- They lend themselves well to exploration and play – could form the basis of investigations
- Easy to construct warm-up tasks, discussion to help students in

# Advice about supporting students

- Think of yourself in the role of Olympic coach

it's up to the student to become good at  
STEP, you can't do this for them  
you have to do your best to facilitate their  
own independent study and to help them  
make study time efficient

# Advice about supporting students

- Give the students a starting point

read the Siklos 'Advanced Problems'  
booklets

use MAT papers, UKMT, NRICH

select some STEP I questions which are  
more accessible.

# Advice about supporting students

- Make it clear to the student that the best preparation is doing papers

give the student advice about a good approach to this which would be to resist looking at worked solutions as much as possible and to only use worked solutions to get 'unstuck' after sufficient time making attempts if all else fails.

Build experience and build a toolkit

# Advice about supporting students

- Set an expectation that the student does as much work as possible themselves and only comes to you as a last port of call

part of this would be making sure know where they can get support which isn't you e.g. ASK NRICH forums, worked solutions, FMSP, university arranged support

# Advice about supporting students

- Have the students present their solutions or part solutions to STEP questions to you in any time you do get with them

this is a good use of time, it saves on marking time and reaffirms the expectation that students work independently

you can pick up on whether students are communicating their solutions sufficiently well through this.

# Advice about supporting students

- Make sure students know that solving a STEP question is a two-stage process

rough work (creative, experiment, 'relaxed')  
write-up (disciplined, think about the reader)

tell students to explain **everything** they do in their write up - this might mean they write too much but it's a good starting point.

# Advice about supporting students

- Be very supportive  
students can go through a crisis of  
confidence to begin with

remind students that preparing for and  
doing STEP is a very positive experience

the real reward is finding out what you are  
capable of when you put your mind to it

# Taking a deeper look

Example: Working with integers

In STEP you are not allowed to use a calculator

- Knowing squares and cubes up to 1000 is useful general knowledge, do you know these?
- What is the largest square less than 1000?  
Can you estimate what it is the square of?

- If a two-digit number has digits  $a$  and  $b$  then that number is actually  $10a + b$
- What are the possible last digits of square numbers?
- What are the possible last digits of cube numbers?
- What are the possible last digits of fourth powers?

If  $n$  and  $m$  are integers then

- saying ' $n$  is divisible by  $m$ ', ' $n$  is a multiple of  $m$ ', ' $m$  is a factor of  $n$ ' are all the same thing.
- a precise way of expressing this, useful in problems is:

*' $n$  is divisible by  $m$ ' if there exists an integer  $k$  such that  $n = mk$*

- How many prime numbers are there in the 120s? If there is a proper prime factor then there must be one less than 12, since  $12^2 = 144$ .
- Tests for divisibility. A number is divisible by 9 when the sum of its digits is divisible by 9. This reflects the fact that  $10 = 1 \pmod{9}$ . Similarly  $10 = -1 \pmod{11}$  so looking at the alternating sum of digits tells you whether a number is divisible by 11.

- Prime factorisations can be informative
- How many factors does the number  $345744 = 2^4 \times 3^2 \times 7^4$  have?
- What does the prime factorisation of a square number look like?

- The following factorisations could be useful

$$n^2 - m^2 = (n - m)(n + m)$$

$$n^3 - m^3 = (n - m)(n^2 + nm + m^2)$$

$$n^3 + m^3 = (n + m)(n^2 - nm + m^2)$$

- Can you use one of these and the fact that  $1729 = 7 \times 13 \times 19$  to write 1729 as the sum of two cubes?

## About MEI

- Registered charity committed to improving mathematics education
- Independent UK curriculum development body
- We offer continuing professional development courses, provide specialist tuition for students and work with industry to enhance mathematical skills in the workplace
- We also pioneer the development of innovative teaching and learning resources