KCLMS Extensions: KS4 mathematics beyond the classroom (2021-22 application questions)

The deadline for submitting applications to the KCLMS Extensions program is **Monday 10 January 2022**. You will need to go to the online form (**click here for the link**), where you will be asked to fill in some details about yourself, and upload your solutions to the application questions electronically (likely scanned or photographed).

General guidance for answering the application questions

What we are interested in is not necessarily "the answer" but how you get to the answer. You will need to write up your solutions and in that write up you will need to show us your train of thought. For example, if you think the answer to question 2 is "ten", then you need to justify it – how would you convince one of your friends that this is the correct answer, and that there aren't other possibilities out there which you have missed?

Question 1

Take a 3 by 9 rectangle. Explain how you can cut this up into 8 squares (which do not all have to have the same area).
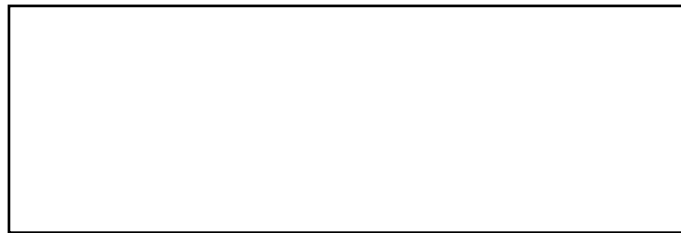
Question 2

The residents of the fictional town Symmetrica have telephone numbers which are all six digits in length, and each of them begins with the digits 81.

Jack finds the scrap of paper below, with part of Jill's telephone number on it.

How many different possibilities are there for Jill's telephone number?

Question 3

The midpoints of all three sides of a triangle have been marked. The original triangle is then erased, leaving only the three marked points.

How can the original triangle be recreated using only a compass and straightedge? Justify why your method works!

Question 4

Here's a number trick which you might have seen before.

1) Pick a three digit number whose first and last digit differ by at least 2. For example, 391 and 247 are ok, but 304 and 606 aren't.
2) Find the difference between this number and the reverse number (i.e. with the same digits but in reverse order).
3) Take this new 3 digit number, and add it to its reverse.

For example, if we start with 247, its reverse is 742. The difference between 247 and 742 is 495. Reversing this new number gives 594, and finally 495 + 594 = 1089.

Prove that you will *always* end up with 1089 at the very end.

Question 5

A particular whole number N is such that:

a) The sum of N and 180 is a square, and
b) The difference between N and 67 is a square.

What are all the possible values for the integer N?