The Scottish Mathematical Council

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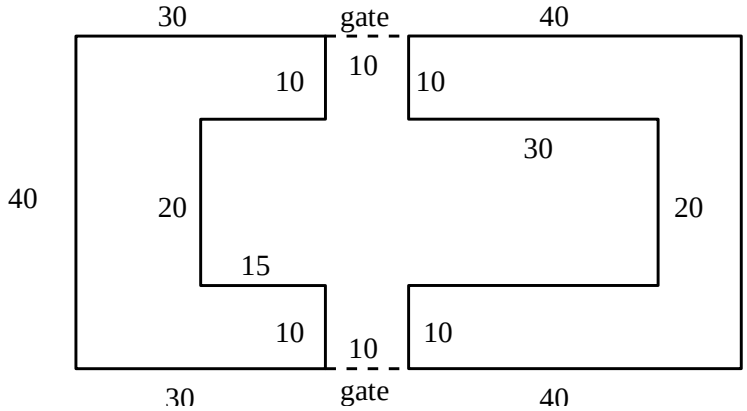
MATHEMATICAL CHALLENGE 2020−2021

Entries must be the unaided efforts of individual pupils.
Solutions must include explanations and answers without explanation will be given no credit.
Do not feel that you must hand in answers to all the questions.

Middle Division: Problems 1

M1. Jo is going on an 8-day activity holiday. Each day she can choose one of the water sports: kayaking or sailing, or land-based sports. She never does different water sports on consecutive days. She also wants to try all three options on at least one day of her holiday.
How many different schedules are possible?

M2.



This is the plan of a building which has a courtyard with two entrance gates. Passers-by can look in through the gates but may not enter. The dimensions are given in metres and all corners are right angles. What is the area of the part of the courtyard which cannot be seen by passers-by?

M3. When Max is 8 m from a lamp post which is 6 m high his shadow is 2 m long. When Max is 3 m from the lamp post, what is the length of his shadow?

M4. A parent has washed some nappies in a strong bleach solution and wishes to rinse them so that they contain as weak a bleach solution as possible. By wringing out, the nappies can be made to contain just half a litre of solution. Show that two thorough rinses, such that the solution strength is uniform, the first using 12 litres of water and the second using 8 litres of water, reduces the strength of the bleach solution to $\frac{1}{425}$ of its original value.

If 20 litres of clean water is all that is available and the parent is prepared to do only two rinses, how best should the water be divided between the two rinses?

M5. A pyramid has a square base and four equilateral triangles as its other faces. The four equilateral triangles can also make a tetrahedron. What is the ratio of the volumes of the pyramid and the tetrahedron? **Justify your answer.**

END OF PROBLEM SET 1