

## 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.

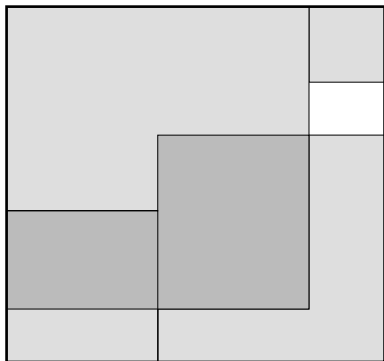
### Middle Division: Problems 2

- M1.** Imran bought a cat and dog for £60 each. Later he sold them. He made a profit of 20% on the dog. He made a loss of 20% on the cat.  
How much did Imran get altogether when he sold the cat and dog?

Later Andy bought another cat and dog. He sold them for £60 each. He made a profit of 20% on the dog. He made a loss of 20% on the cat.

Did Andy make a profit or loss on the whole deal? If so, how much?

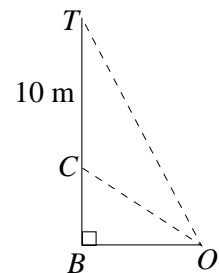
**M2.**



Four square sheets of tinted glass with sides 10 cm, 20 cm, 30 cm and 40 cm are placed in a rectangular box as shown. 70 square cm of the base of the box are left uncovered (white in the diagram).

What is the area of overlap of the sheets of glass (dark grey in the diagram)?

- M3.** An observer ( $O$ ) is watching a climber scaling a vertical rock face from a point level with the base of the rock face ( $B$ ) but some distance away. The observer looks up at an angle of  $60^\circ$  to see the top of the rock face. The observer looks up at an angle of  $30^\circ$  to see the climber ( $C$ ) when the climber is 10 metres from the top.  
How high is the rock face?



- M4.** A large equilateral triangle with sides of integer length  $N$  is split into small equilateral triangular cells each with side length 1 by drawing lines parallel to its sides. A continuous track starts in the cell at one corner of the large triangle and moves from cell to cell, always crossing at an edge shared by the two cells. The track never revisits a cell. Find, with proof, the greatest number of cells that can be visited on one track.

- M5.** In the diagram,  $PQRS$  is a square with  $XY$  perpendicular to  $QR$  and  $XP = XS = XY = 10$  cm. What is the area of the square?

