WESTMINSTER SCHOOL
THE CHALLENGE 2024

MATHEMATICS III

Wednesday 1 May 2024

Time allowed: 1 hour 30 minutes

You may **not** use a calculator for this paper.

All your working should be clearly shown.

You should attempt all the questions.

Please write in black or blue ink.

Write your answers in the answer booklet provided.

1 Solve the following simultaneous equations, giving your answers as mixed fractions.

$$2a + 5 = 5(a - b)$$

$$(2a + 5)(b - 4) = (a - 1)(2b + 1)$$

2 Twenty perforators can make 3885 pieces of confetti in 51 minutes.
How many perforators are needed to make 7511 pieces of confetti in 29 minutes?

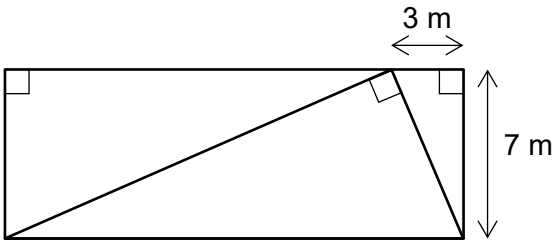
3 A shop sells three sizes of orange juice bottle made by the Innocuous Juice Company: a 0.33 litre bottle costs £1.50, a 0.9 litre bottle costs £3 and a 1.35 litre bottle costs £4.

The 0.33 litre bottles have the special offer *"three for the price of two"* while the other bottles have no special offers.

If you have £50 to spend, what is the largest amount of orange juice that you can buy?

4 My pet mouse eats 10 g of peanut butter in 4 minutes 40 seconds, and he eats 10 g of chocolate in 3 minutes 20 seconds. For his birthday, I give him a meal of peanut butter with a side of chocolate. The meal has a total weight of 85 g and he eats it in exactly 36 minutes. How much peanut butter was in the mouse's birthday meal?

5 The diagram below shows three right-angled triangles which form a rectangle.
Find the area of the rectangle. Give your answer as a mixed fraction in square metres.



6 An indoor cycling track is a loop of length 250 m. Flotsam and Jetsam compete against each other in a 'pursuit' race. They begin simultaneously at exactly opposite points on the track, cycle anticlockwise around the track, and attempt to overtake their opponent. If this happens, the race ends. Alternatively, the race ends when the first competitor completes sixteen laps of the track, if neither has overtaken the other at that time.

Flotsam and Jetsam cycle at constant speeds of 46.2 km/h and 44.7 km/h respectively. How far does Flotsam cycle before winning the race?

7 **a** Expand and simplify the expression $(3x - 1)^2$.

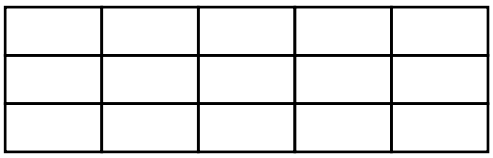
b Hence, or otherwise, find $\sqrt{89401}$.

8 If 132 nuts and 693 bolts is 8.96 kg heavier than 512 nuts and 417 bolts, then how much heavier than 665 nuts is 483 bolts?

9 Mad Max drives a Mini Cooper which travels 39 miles per gallon of petrol consumed. His friend Mild-Mannered Mike drives a Mercedes which does 52 miles per gallon.

Max and Mike are at the same location in the desert. They want to travel together as far as they can, with both vehicles. Their petrol tanks are empty, but they have a can containing 3½ gallons of petrol, which they can share. How far can they go?

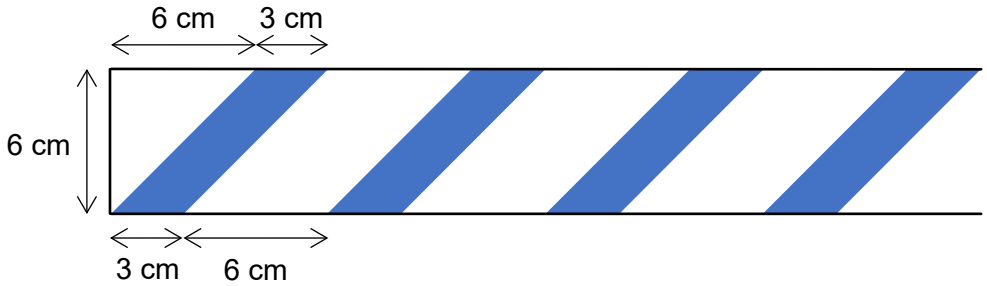
10 I am building a wall in my garden using standard cinder blocks which are 16 inches wide, 8 inches deep and 8 inches tall. Blocks are laid with their long edges horizontal and parallel to the face of the wall, and with higher blocks directly above lower blocks:



The wall will be used as a projector screen for a rectangular image whose ratio of width to height is 16:9. I have 100 cinder blocks. What is the area of the biggest image that I can project fully onto this wall?

11 35% of all snakes have pointy noses, and 61% of all snakes have pointy tails. Among snakes which have at least one pointy end, 28% are pointy at both ends. What percentage of all snakes are pointy at both ends?

12 The front side of tape for crime scenes is white with diagonal blue stripes in the shape of parallelograms, as shown below with shading representing blue ink. (The reverse side of the tape is plain white.) The tape is always cut with a straight line perpendicular to the edges of the tape.



a Find the total blue area on a piece of tape which is 140 cm long.

b Find the length of a piece of tape which contains 412 cm² of blue area.

END OF QUESTIONS

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