

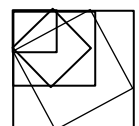
# Primary Mathematics Challenge – November 2023

## Answers and Notes

These notes provide a brief look at how the problems can be solved. There are sometimes many ways of approaching problems, and not all can be given here. Suggestions for further work based on some of these problems are also provided.

P1 A 2 ( $4 - 3 + 2 - 1 = 2$ )      P2 D (3,3)

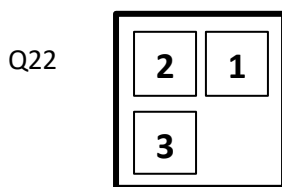
- 1 C £2 500  $5 \times £500 = £2\,500$ .
- 2 D 5 Four minibuses are not enough. Five are needed.
- 3 B 30 min In one hour the train travels 300 km so it will take 30 min to travel 150 km.
- 4 D 35 cm The length of the blade is more than 20 cm and less than 60 cm. It looks about 35 cm.
- 5 C 4 min 30 sec Two walls will take 3 minutes; three walls will take 4 minutes and 30 seconds.
- 6 C 35 The largest score from three shots is  $20 + 10 + 5 = 35$ .
- 7 E 25 Three unicycles have a total of 3 wheels. Five bicycles have a total of 10 wheels. Four tricycles have total of 12 wheels. So the total number of wheels is  $3 + 10 + 12 = 25$ .
- 8 B 2 m Torville has walked three sides of a square, and so he needs to go 2 m (west).
- 9 B £15.50 Buying one of each firework will cost  $£4.80 + £3.70 + £9.95 = £18.45$ . So ten of each will cost  $10 \times £18.45 = £184.50$ . Catherine's change will be  $£200 - £184.50 = £15.50$ .
- 10 E 16 One lemon is used with four oranges, which is 5 pieces of fruit. Four of these recipes will use 20 pieces of fruit. So 16 oranges are needed.
- 11 A 10 Working backwards and reversing the operations gives  $17 - 12 + 5 = 10$ . Now test it to make sure this is correct.
- 12 D  $50\text{ cm}^2$  The area of the whole outer rectangle is  $20 \times 10 = 200\text{ cm}^2$ . Each of the three triangles has an area of  $\frac{1}{2} \times 10 \times 10 = 50\text{ cm}^2$ . So the area of the top trapezium is  $200 - 3 \times 50 = 50\text{ cm}^2$ .
- 13 E 14 Draw a circle with the numbers 1 to 14 around. Counting, it is clear that 14 is opposite 7.
- 14 A 40 cm The three large squares have sides of length 4 cm. The two small squares have sides 1 cm. So the perimeter of the diagram has lengths of 4 cm and 3 cm. The total is 40 cm.  
Or, the three large squares have a total perimeter of  $3 \times 16 = 48\text{ cm}$ . The two small squares have a total perimeter of  $2 \times 4 = 8\text{ cm}$ , so the required perimeter is  $48 - 8 = 40\text{ cm}$ .
- 15 A Alice Lining them up, shortest to tallest gives Greta Catrin Alice Theo Ben.
- 16 D  $\frac{4}{5}$   $72^\circ$  is a fifth of  $360^\circ$ , so  $\frac{1}{5}$  of the pizza has been eaten. Therefore  $\frac{4}{5}$  remains.
- 17 D 19 Greedie eats 15 bars. He can exchange 12 of the wrappers for 3 new bars (with three wrappers left over). He eats these three bars and now has six wrappers. He exchanges four of these for a new bar and eats it. Altogether he has eaten  $15 + 3 + 1 = 19$  bars.
- 18 E 45 Approximating and cancelling,  $3500 \div 75 \rightarrow 700 \div 15 \rightarrow 140 \div 3 \approx 47\text{ km}$ .
- 19 B 24 min 18 sec After one week, Robyn took  $30 - 10\% \text{ of } 30 = 27\text{ min}$ . For the second week she took  $27 - 10\% \text{ of } 27 = 27 - 2.7 = 24.3\text{ minutes}$ . This is 24 min 18 sec.
- 20 B 2 The sum of the digits for 2024 is 8 which is not a square number. But the digits of 2025 have a sum of 9, which is a square number.
- 21 40 The mean of 15, 35, 50 and 60 is  $160 \div 4 = 40$ . Then if  $x$  is 40, the mean remains 40 and the median is 40 as well. So Imran scored 40 runs in his third innings. Or to note that the score has to be a multiple of 5; 40 works but 45 does not.
- 22 4 The **3** moves to the right. The **1** then moves down. The **2** moves to the left. Then the **3** can move up. This gives the position of the numbers in picture B.
- 23 36  $18 \times 6 \times 2 = 216$ . So all the rows, columns and diagonals multiply to 216. The number in the top right square is therefore  $216 \div 6 \div 12 = 3$ . The asterisk number is  $(216 \div 3) \div 2 = 36$ . This looks hard but a lot of cancelling can help. Can your pupils complete this magic square?
- 24 5 There are squares of sizes  $1 \times 1$ ,  $2 \times 2$  and  $3 \times 3$  with sides parallel to the edges of the array. There are squares of two further sizes, one having sides at an angle of  $45^\circ$  to the edges of the array and the other being larger and at a less obvious angle.
- 25 41 3-digit square numbers: 100    121    144    169    196    225    and so on.  
3-digit cube numbers:        125    216    343    512    729  
As the numbers on my side are all odd numbers, the difference between the number of the house of my left and the number of the house on my right is 4. The difference between



121 and 125 is 4. My house number is therefore 123.  
 $123 = 3 \times 41$ . 41 is a prime number, and so is the largest prime factor of 123.

### Some notes and possibilities for further problems

- P1 Is there a pattern in the answers if the question is made longer?  
 a)  $5 - 4 + 3 - 2 + 1$                       b)  $6 - 5 + 4 - 3 + 2 - 1$                       c)  $7 - 6 + 5 - 4 + 3 - 2 + 1$  and so on.
- Q2 Sometimes the answers to problems need to be rounded down, but in others, like this one, they have to be rounded up to give correct practical answers. Can your pupils think of more examples of both?
- Q4 Life often requires us to make estimations which use mathematical skills. This question is not easy for pupils using a computer screen.
- Q5 Our ghost gets through walls easily. The Hatton Garden robbers used a Hilti DD 350 drill costing £3,475 to drill through some 50 cm of reinforced concrete, taking more than an hour. They drilled a hole 45 cm wide to get to the vault.
- Q8 Torville is starting from Torquay which is OK for him. Starting from Wick going north would be difficult as he would be in the sea. Are there any places on Earth where there would be difficulties with this problem?
- Q13 Can your pupils find a rule which allows them to find out which pupil is opposite pupil 1 when 30 pupils are standing round a circle?
- Q17 If Greedie has a lot of time and money, he would realize that different initial purchases end up with different numbers of wrappers left. Pupils could see what happens with starting values of 1 to 20 (say). Maybe mod 3 could be mentioned. It is not possible to end up with no wrappers left over. Which other initial numbers of *Gnasher* bars allows him to end up with only one wrapper left.
- Q18 An arctic fox walked more than 3 500 km (2 000 miles) from Norway to Canada in just 76 days. The animal was fitted with a tracking device. In 2018, it left Spitsbergen in Norway. After 1 512 km out on the sea ice, it landed in Greenland. Its journey continued to Ellesmere Island in Canada. The collar transmitted data each day for a three-hour period. Moving across sea ice and glaciers, the fox moved at an average of 46.3 km per day and on one day travelled a whopping 155 km, when it was on the ice sheet in northern Greenland.



This question is about the '3' puzzle. Can your pupils slide the numbers 1, 2 and 3 to make the pattern on the left? No – it is impossible. Then there is the '8' puzzle. You can play on-line at the Sliding Toys website. The images on the right are from The University of Edinburgh website. Can you get from the position on the left to that of the right?



The 15 puzzle is widely-known and can be played at [15puzzle.netlify.app](https://15puzzle.netlify.app). Interestingly, half of the starting positions for these puzzles are impossible to solve, no matter how many moves are made. Your pupils could try this out on the 3 and 8 puzzles. (See Wikipedia for much more maths on this!)

- Q23 There are many kinds of 'magic square'. Q23 is a multiplicative square. The square shown here uses addition to get the 'magic' number. It is taken from the NRICH website, which has more information on these squares.

