Junior Maths Mastery Challenge Sample

Paper E

Section A

Questions 1 to 5 carry 3 marks each.

1. Find the value of the following.

$$1 - 2 + 3 - 4 + 5 - 6 + \ldots + 2023 - 2024 + 2025$$

[Four Operations of Whole Numbers / Arithmetic]

We can rearrange the numbers as shown below.

$1 + \underbrace{3 - 2}_{1} + \underbrace{5 - 4}_{1} + \underbrace{7 - 6}_{1} + \ldots + \underbrace{2023 - 2022}_{1} + \underbrace{2025 - 2024}_{1}$

$= 1 + \underbrace{1 + 1 + 1 + \ldots + 1 + 1}_{1012}$

$= 1013$

2025 – 2 + 1 = 2024
2024 ÷ 2 = 1012
There are 1012 pairs of terms.

(A) 1012 (B) 1013 (C) 1014

(D) 1015 (E) None of the above

2. Find the value of the following.

[Four Operations of Decimals / Arithmetic]

$$1.101 + 1.202 + 1.303 + \ldots + 1.707 + 1.808 + 1.909$$

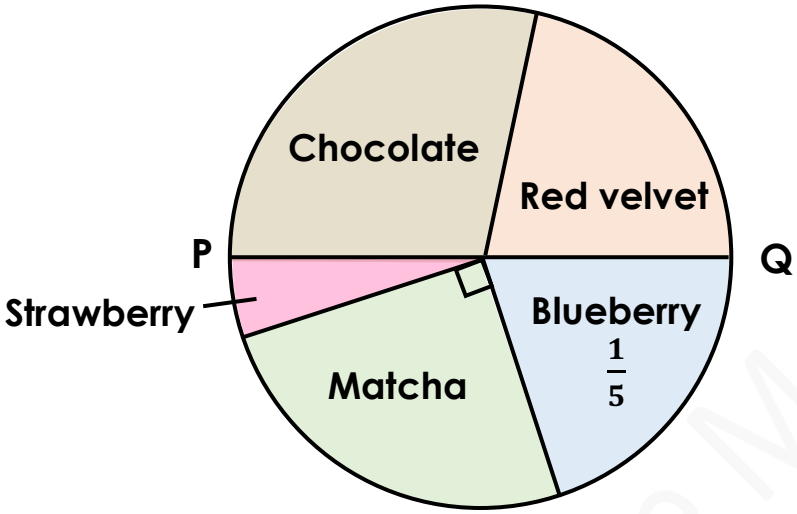
$\underbrace{\qquad\qquad}_{3.01}$ $\underbrace{\qquad\qquad\qquad}_{3.01}$

There are 9 terms. Each pair of terms gives a sum of 3.01.
9 ÷ 2 = 4 R 1
There are 4 such pairs of terms. The middle term is 1.505.
4 × 3.01 + 1.505 = 12.04 + 1.505
= 13.545
The value is 13.545.

(A) 13.509 (B) 13.545 (C) 13.59

(D) 13.905 (E) 28.595

3. The pie chart shows the number of muffins sold in a day. PQ is a straight line.



$\frac{1}{3}$ of the muffins sold were chocolate and strawberry muffins. 26 red velvet muffins were sold. How many chocolate muffins were sold?

[Pie Charts / Arithmetic]

$1 - \frac{1}{5} - \frac{1}{4} - \frac{1}{3} = 1 - \frac{12}{60} - \frac{15}{60} - \frac{20}{60}$

$= \frac{13}{60}$

$\frac{13}{60}$ of the muffins sold were red velvet muffins.

$\frac{1}{2} - \frac{13}{60} = \frac{30}{60} - \frac{13}{60}$

$= \frac{17}{60}$

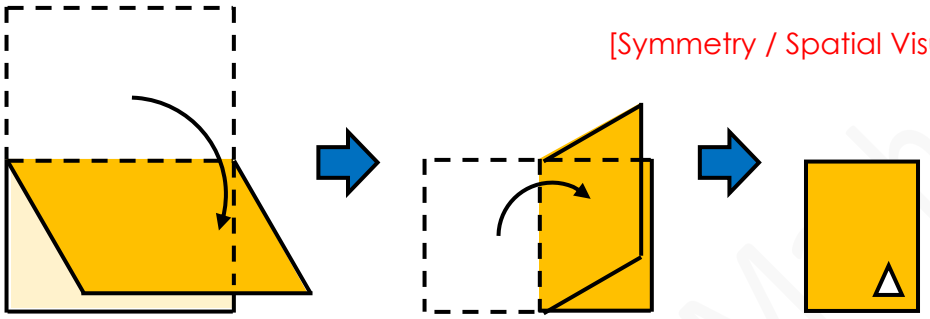
$\frac{17}{60}$ of the muffins sold were chocolate muffins.

60 units of muffins were sold. 13 units of red velvet muffins were sold.
13 units = 26
13 × 2 = 26
So, 1 unit = 2.
17 × 2 = 34
34 chocolate muffins were sold.

(A) 13 (B) 17 (C) 35
(D) 39 (E) None of the above

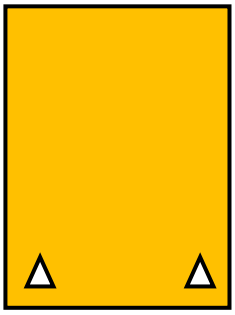
4. Alice folded a rectangular piece of paper into half, then folded it into half again, then she cut out a triangle as shown in the diagram below.

[Symmetry / Spatial Visualisation]

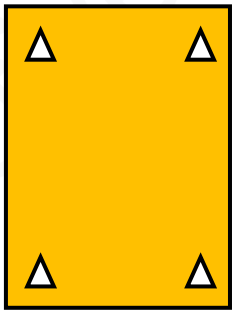


Which of the following shows the paper when unfolded?

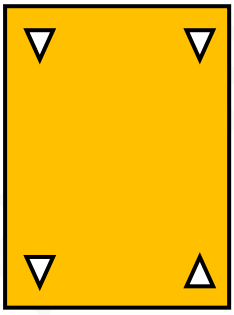
(A)



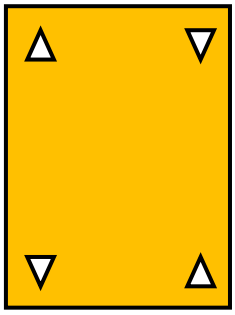
(B)



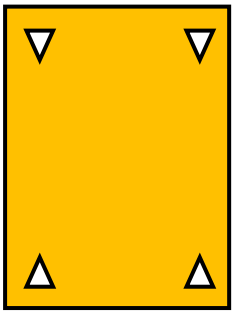
(C)



(D)



(E)



5. Square tiles are used to form some figures. The figures follow the pattern below.

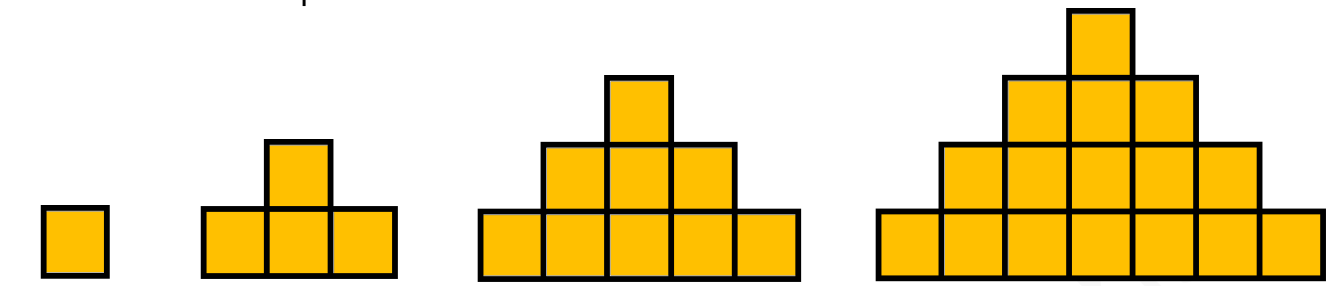


Figure 1 Figure 2 Figure 3 Figure 4

How many square tiles are used to form Figure 99?

[Four Operations of Whole Numbers / Look for Patterns]

Number of tiles
Figure 1: $1 = 1 \times 1$
Figure 2: $1 + 3 = 4 = 2 \times 2$
Figure 3: $1 + 3 + 5 = 9 = 3 \times 3$
…
Figure 99: $99 \times 99 = 9801$

9801 square tiles are used to form Figure 99.

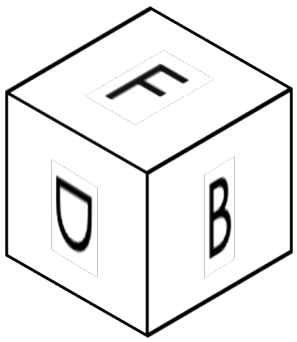
(A) 9604 (B) 9702 (C) 9801
(D) 9900 (E) None of the above

Questions 6 to 10 carry 4 marks each.

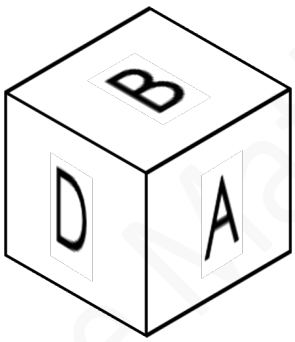
6. Four of the five cubes below belong to the same cube. Which of them does not belong to the cube?

[Nets / Spatial Visualisation]

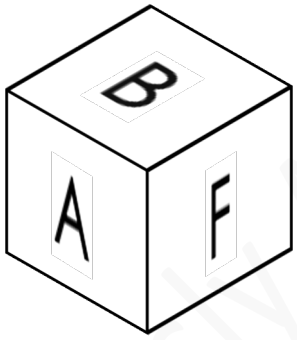
(A)



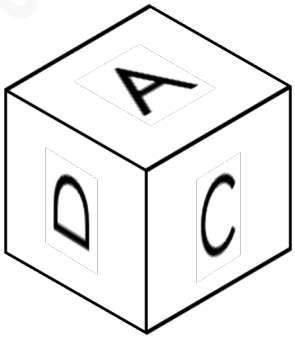
(B)



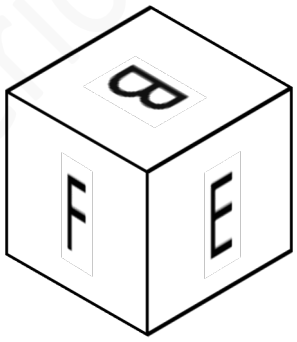
(C)



(D)



(E)



Observe that the cubes in (A) and (C) cannot belong to the same cube, so one of them must be incorrect.

If (A) belongs to the cube, then (B), (D) and (E) must also belong to the cube. But (E) is not possible.

(E) is only possible if (C) also belongs to the cube. So, (A) does not belong to the cube.

7. Jane bought a bag of rice. On the first day, she used $\frac{1}{5}$ of the rice. The next day, she used 240 grams of rice. On the third day, she used $1\frac{1}{4}$ times the total amount used in the first two days. She had $\frac{1}{4}$ of the bag of rice left. How many grams of rice did the bag contain at first?

[Multiplication of Whole Numbers, Fractions and Mixed Numbers]

First day → $\frac{4}{20}$ of the rice used
Second day → 240 g of rice used

On the third day, she used $\frac{5}{4}$ of the total amount of rice used in the first two days.
$\frac{5}{4} \times \frac{4}{20} = \frac{5}{20}$
$\frac{5}{4} \times 240 = 300$
So, she used $\frac{5}{20}$ of the rice and an additional 300 g of rice.

Left → $\frac{5}{20}$ of the rice

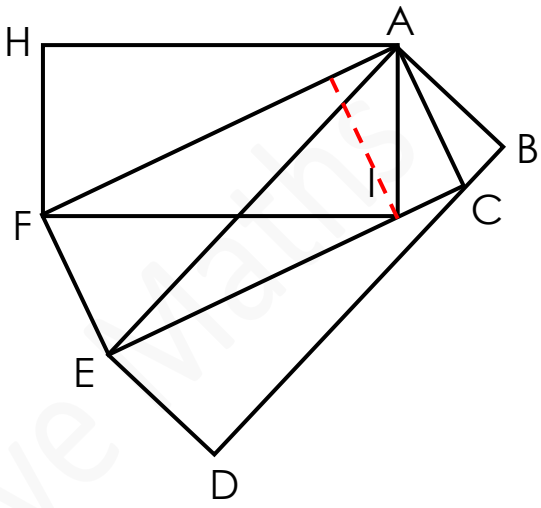
$1 - \frac{4}{20} - \frac{5}{20} = \frac{11}{20}$
She used $\frac{11}{20}$ of the rice altogether on the second day and the third day.

$\frac{11}{20}$ of the rice = 240 g + $\frac{5}{20}$ of the rice + 300 g
$\frac{6}{20}$ of the rice = 540 g
$540 \div 6 \times 20 = 1800$
The bag contained 1800 g of rice at first.

(A) 800 g (B) 1600 g (C) 1800 g
(D) 2000 g (E) None of the above

8. The figure is made up of rectangles ABDE, ACEF and AIFH. The length of HA is 30 centimetres and the length of HF is 15 centimetres. What is the area of Rectangle ABDE?

[Area of a Triangle and Composite Figures/ Simplify the Problem]



Observe that the area of Triangle AIF is half of the area of Rectangle AIFH. The area of the triangle is also half of the area of Rectangle ACEF.
So, the area of rectangles AIFH and ACEF are equal.

Similarly, the area of Triangle ACE is half of the area of Rectangle ACEF and also half of the area of Rectangle ABDE.
So, the area of rectangles ACEF and ABDE are equal.

The area of the three rectangles are equal.

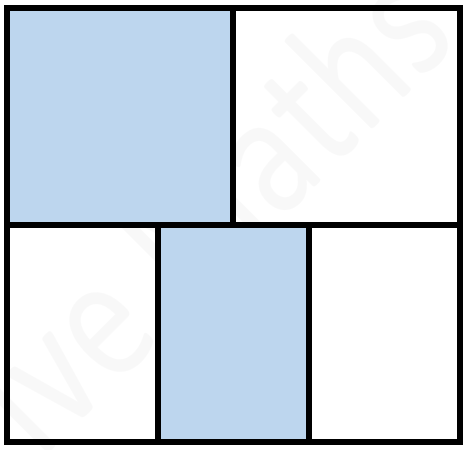
$30 \times 15 = 450$
The area of Rectangle ABDE is 450 cm^2.

(A) 270 cm^2 (B) 225 cm^2 (C) 180 cm^2

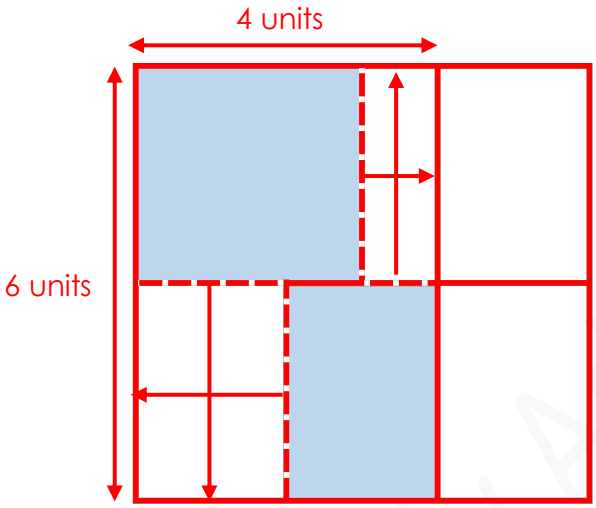
(D) 150 cm^2 (E) None of the above

9. The figure shows a square divided into two equal parts, top and bottom. The top part is divided into 2 equal parts. The bottom part is then divided into 3 equal parts. The perimeter of the shaded part is 180 centimetres. Find the perimeter of the figure.

[Area and Perimeter / Simplify the Problem]



We can shift the sides as shown below to show that the perimeter of the shaded part is equal to the perimeter of a rectangle of length 6 units and breadth 4 units.



$2 \times (6 + 4) = 20$
The perimeter of the shaded part is 20 units.

$4 \times 6 = 24$
The perimeter of the figure is 24 units.

20 units = 180
24 units = $180 \div 20 \times 24$
$= 216$
The perimeter of the figure is 216 cm.

(A) 198 cm (B) 216 cm (C) 240 cm
(D) 432 cm (E) None of the above

10. Ali, Ben, Cheryl and Don play a game 'Truth-teller and Liar'. The Truth-teller always speaks the truth and the Liar always lies.

Each of them draws a card and plays the role of either a Truth-teller or a Liar.

They make the following statements.

Ali: Exactly one of us is a Liar.
Ben: Exactly two of us are Liars.
Cheryl: Exactly three of us are Liars.
Don: All of us are Liars.

[Logical Reasoning]

At least one of them is a Truth-teller. Which of the following statements is **true**?

At least one of them is a Truth-teller.
Don must be a Liar because we are told that at least one of them is a Truth-teller.

If Ali is the Truth-teller and we let Don be the one Liar Ali is referring to, then Ben and Cheryl are Truth-tellers. This is not possible.
So, Ali is also a Liar.

Similarly, if Ben is the Truth-teller and we let Ali and Don be the two Liars he is referring to, then Cheryl is the Truth-teller. This is only possible if Ben himself is a Liar.
So, Ali, Ben and Don are the Liars and Cheryl is the only Truth-teller.

(A) Don is the only Liar.
(B) Ben is the only Liar.
(C) Ali and Don are the only Liars.
(D) Ben is the only Truth-teller.
(E) Cheryl is the only Truth-teller.

Section B

Questions 11 and 12 carry 6 marks each.

11. In the following cryptarithm, each letter represents a different digit from 1 to 9.

$$\begin{array}{cccc} & A & B \\ & C & D \\ & E & F \\ + & & G \\ \hline 1 & 0 & 0 \end{array}$$

A cryptarithm is a mathematical puzzle where the numerical digits are replaced by letters or symbols.

If AB is the largest possible 2-digit number that can be formed, what number does AB represent?

[Four Operations of Whole Numbers / Logical Reasoning]

Since we want AB to be as large as possible, we make CD and EF as small as possible.
So, we let C = 1 and E = 2.

We are left with the digits 3, 4, 5, 6, 7, 8 and 9.
B + D + F + G gives the digit 0 in the ones place.
It is not possible to get a sum of 10 from 4 digits in 3 to 9.
The possible sum is 20.
(Note that we can also get a possible sum of 30 but this will make AB smaller.)

$$\begin{array}{cccc} & A & B \\ & 1 & D \\ & 2 & F \\ + & & G \\ \hline 1 & 0 & 0 \end{array}$$

Since B + D + F + G = 20, this means A = 5.
Out of the remaining digits 3, 4, 6, 7, 8 and 9, we choose the 4 digits that add up to 20.
3 + 4 + 6 + 7 = 20
So, we let B = 7.

AB represents the number 57.

$$\begin{array}{cccc} & {\scriptstyle 2} & & \\ & 5 & 7 \\ & 1 & 6 \\ & 2 & 4 \\ + & & 3 \\ \hline 1 & 0 & 0 \end{array}$$

12. Jane writes 20 different whole numbers. The sum of these numbers is an even number.

    If any 8 numbers are picked from the numbers, the product of these 8 numbers is an even number.

    Find the smallest possible sum of the 20 numbers.

[Four Operations of Whole Numbers / Logical Reasoning]

Any number when multiplied by an even number gives an even number.

No matter how we pick 8 numbers from Jane's numbers, we will definitely pick at least 1 even number.
This is possible only if Jane writes down at least 13 even numbers and the remaining numbers are odd numbers.

Let's say Jane writes down 13 even numbers and 7 odd numbers.
But we are told that the sum of all these numbers is an even number.
This is only possible if there are even number of odd numbers.
So, Jane writes down 14 even numbers and 6 odd numbers.

We are asked to find the smallest possible sum.
So, we write the smallest possible consecutive even and odd numbers.

The 6 odd numbers are 1, 3, 5, 7, 9 and 11.
The 14 even numbers are 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26 and 28.

Using the rainbow method,
$1 + 3 + 5 + 7 + 9 + 11 = 3 \times 12$
$= 36$

$2 + 4 + 6 + \ldots + 24 + 26 + 28 = 7 \times 30$
$= 210$

$36 + 210 = 246$
The smallest possible sum of the 20 numbers is 246.