Each question now has a YouTube tutorial
Reasoning and Problem Solving Questions

Information

This booklet contains over 40 reasoning and problem solving questions suitable for KS2 classes. These are the questions that we have been putting out each day in March 2017 on Twitter in the run up to SATS.

The answers are provided with some simple notes at the back of the booklet and for some questions supplementary questions and variation has been provided.

We hope to release more questions like this over the course of next year including some open ended problems. Please keep a look out for our work. If you have not seen our schemes and assessments for primary then please take a look at our website www.whiterosemathshub.co.uk

As always we welcome any feedback on the work we are doing and the materials that we are releasing.

Thank you for taking an interest in our work.

The White Rose Maths Hub Team
Children’s Responses

Children’s responses will tell you a lot about their depth of understanding of a given topic. For example

Choose one of these symbols

\[
\begin{align*}
24 + 5 & \bigcirc \bigcirc 24 + 6 \\
18 + 3 & \bigcirc \bigcirc 17 + 4 \\
33 + 15 & \bigcirc \bigcirc 40 + 8
\end{align*}
\]

Children who reason verbally or written that 5 is less than 6 and then 24 is being added each time potentially indicate a deeper understanding of number than those who work out both sides of the inequality.

Bar Modelling – Pictorial Methods

Many of the problem solving questions in this booklet can be solved using a bar modelling method. Encourage children to use diagrams to help them solve the problem. Here is a problem where bar modelling would help.

Yasmin has 3 jars of bugs.

- There are 7 more bugs in the first jar than the second.
- There are 3 less bugs in the third jar than the second.
- There are 40 bugs in total.

How many bugs are in the first jar?

1st jar: 19
2nd jar: 12
3rd jar: 9

40 - 7 = 33
33 ÷ 3 = 11
36 - 3 = 12

If you want to find out more about bar modelling please contact the Hub.
1. Complete

40,000 + 7,000 + 600 + 7 = 

6,000 + 50 + 300 + 1 = 

5,000 + 200 + 

= 5,280

30,000 + 900 + 3 + 

= 36,905

2. Which diagram has $\frac{1}{3}$ shaded?

A

B

C

D

Explain the reason for your choice.
Explain why the other diagrams do not have $\frac{1}{3}$ shaded.
1. The area of square A is $36\text{cm}^2$.
   Find the area of one of the triangles.

2. Find the missing values
   \[ \frac{1}{3} + \frac{\square}{9} = 1 \]
   \[ \frac{1}{4} + \frac{1}{8} + \frac{\square}{16} = 1 \]

3. Calculate
   22 tens minus 22 tenths
1. Complete

\[ \frac{2}{6} + \frac{5}{6} = \frac{3}{6} \]

2. A bottle is a third full.

Mary puts 320ml of juice into the bottle.

The bottle is now full.

How much juice does the bottle hold when full?

3. Here is a rectangle.

A new shape is made up of three of these rectangles.

What is the perimeter of the new shape?
Yesterday at a museum

- $\frac{4}{5}$ of the visitors were adults.
- 120 children visited the museum.
- $\frac{3}{8}$ of the adults were male.

How many male adults visited the museum yesterday?

(You may find the bar model diagram below helpful)
1. (a) The area of a square is $64\text{m}^2$.

What is the perimeter of the square?

(b) A rectangle is 2cm longer than it is wide.

The perimeter of the rectangle is 44cm.
Find the area of the rectangle.

(You may find it useful to draw a bar model)

2. Maria has three number cards.

One of the cards has a value of 35
The other cards have a smaller value.

When you add the cards you get.

\[
\begin{align*}
\text{Red card} & + \text{Purple card} = 62 \\
\text{Green card} & + \text{Purple card} = 38 \\
\text{Red card} & + \text{Green card} = 46
\end{align*}
\]

What is the value of each card?
A group of 5 friends share a bag of sweets.

They each receive 6 sweets and there are 3 left over.

Two more friends arrive.

They share the sweets again between all 7 of them.

(a) How many do they each receive?

(b) How many are left over?
1. Anna, Zoe and Carl donated some money to charity.

- Carl donated twice as much as Anna
- Zoe donated £12 more than Anna
- Altogether they donated £188

How much money did Carl donate?

(You may find it useful to draw a bar model)

2. A blue strip of paper is shown above part of a ruler.

What is the length of 6 of these strips of paper?
1. 8 cans of cola cost £4.80

2. Sally and Leon each have some money.
   Sally has £80
   - Sally spends $\frac{3}{4}$ of her money
   - Leon spends $\frac{2}{7}$ of his money

   They now have the same amount of money left.
   How much money did Leon have at the start?
1 A number is made up of the following digits.

2 3 8 8 0

- The digit in the tenths place is the same as the digit in the ones place.
- The digit in the hundreds place is one more than the digit in the hundredths place.

What is the number?

2 The pie chart shows how children in Y6 travel to school.

- 35% of children travel by bus.
- 8 more children travel by bus than by car.

(a) How many children are in Y6?
(b) How many walk to school?
1. Work out

23 seconds + \( \frac{1}{12} \) of a minute = \( \square \) seconds

7 hours + 150 minutes = \( \square \) hours

2. Here are some digit cards.

4 6 8

(a) What is the largest 2-digit number you can make that is divisible by 4?

(b) What is the largest 2-digit number you can make that is divisible by 8?

3. A jar contains 30 sweets.

The weight of the jar and sweets is 620g. David eats 12 sweets.

The weight of the jar and sweets is now 440g.

How much does the jar weigh?
1. Henry makes a 3-digit number.

   My number lies between 209 and 220

   The digits sum to 9

   What number did Henry make?

2. A shopkeeper sells fruit.

   At the start of the week she has 150 oranges and 220 apples.

   On Monday, she sells
   - 10% of the oranges.
   - \( \frac{1}{5} \) of the apples

   How many more apples than oranges are now left?
What is the area of the shaded triangle?

A, B, C and D are points on the lines.

Work out

(a) $B - A = \underline{\phantom{0}}$
(b) $D - C = \underline{\phantom{0}}$
1. A toy shop sells these items.

Toy Aeroplane £12
Toy Train £23
Teddy £8

The bar chart shows how many of each item was sold last week.

How much money did the toy shop make last week for these items?

2. Mel, Martina and Pat have the same number of cards.

Mel and Martina each give Pat a quarter of their cards.
Pat now has 24 cards.
How many cards do they have altogether?
(You might find it helpful to draw a bar model)
1. Dev has a 3kg bag of flour.

He uses \( \frac{7}{10} \) kg of the flour to make a cake and uses 0.65kg to make some bread.

How much flour has he left?

2. Mina buys 3 pizzas and a bottle of cola.

A pizza costs £3.20 more than a bottle of cola.

The total cost of the items is £19.40

How much does a pizza cost?

(You might find it helpful to draw a bar model)
1. **Gavin has a tin of paint.**

   The tin is $\frac{1}{2}$ full and weighs 5.8kg.
   He paints a wall in his house.
   The tin is now $\frac{1}{3}$ full and weighs 4.4kg
   How much does the empty tin weigh?

2. **Here is a rectangle.**
   Some lines have been drawn inside.
   Work out the size of the angle marked $a$.
   Explain your reasoning.
1. If

\[ \bigcirc \times \bigstar = 30 \]
\[ \bigcirc \times \bigcirc \times \bigstar = 180 \]

Find the value of

\[ \bigcirc + \bigcirc + \bigcirc = \square \]
\[ \bigstar \times \bigstar = \square \]

2. Find the missing values.

\[ 4 \frac{2}{5} = \square \]

\[ 4 \frac{2}{5} = \square + \frac{9}{5} \]

3. Freya has some money. She buys a book for £15. She has \( \frac{3}{8} \) of her money left. How much did she have at the start?
1 A shape has been drawn on a 2cm by 2cm square grid.

Find the area of the shape.

2 Sue has some counters. A quarter of the counters are green.

She gives \( \frac{2}{5} \) of the green counters to her friend.

She has 24 green counters left.

How many red counters does she have?
1. A square is divided into smaller squares. What fraction of the shape is shaded?

2. Sophie has some marbles. The marbles are identical. The mass of an empty jar is 480g. The mass of the jar when full with the marbles is 1.2kg. What is the mass of the jar when it is half full with marbles?
1. Nimesh has 60 boxes of oranges. Each box contains 25 oranges.

   Nimesh sells 800 oranges.
   He packs the remaining oranges into boxes of 50
   How many boxes does he pack?

2. A loaf of bread costs the same as 3 apples.

   Millie buys 3 loaves of bread and 5 apples for £5.60
   How much does each item cost?
The square and rectangle have the same area.

Find the perimeter of the rectangle.

Calculate

\[ 3 - \frac{1}{2} - \frac{1}{4} - \frac{1}{8} \]

Complete

\[ 16 \times 40 = \square \times 8 \]

\[ 20\% \text{ of } \square = 12 \]

\[ \frac{2}{5} \text{ of } \square = 32 \]
1. A box contains 40 cubes.

   For every one red cube there are four blue cubes.

   2 red cubes are removed from the box.
   Some blue cubes are also removed.
   There are now 3 times as many blue as red cubes.
   How many blue cubes were removed?

2. Find the area of the shaded region.

   The shaded region is a trapezoid with dimensions 7 cm × 6 cm.
   The area of a trapezoid is given by the formula: 
   \[ \text{Area} = \frac{1}{2} \times (a + b) \times h \]
   where \(a\) and \(b\) are the lengths of the parallel sides, and \(h\) is the height.

   In this case, \(a = 7\) cm, \(b = 16\) cm, and \(h = 6\) cm.

   \[ \text{Area} = \frac{1}{2} \times (7 + 16) \times 6 = \frac{1}{2} \times 23 \times 6 = 69 \text{ cm}^2 \]
1. Alex has a bag of sweets.

He eats the same number of sweets each day.

After 2 days he has $\frac{5}{6}$ of the sweets left.

After another 4 days he has 15 left.

How many sweets are in the bag?

2. Mr Dexter buys the following.

The TV costs £130 more than the bike.

The total cost is £420

How much does the TV cost?
1. Fiona has a box of chocolates.

   The box contains 60 chocolates.

   She eats \( \frac{1}{5} \) of the chocolates.

   She gives 32 chocolates away.

   What fraction of the chocolates does she have left?

   Give your answer in its simplest form.

2. Find the angle marked \( x \)
<table>
<thead>
<tr>
<th>Day</th>
<th>Question</th>
<th>Answer</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>47,607</td>
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<td>6,351</td>
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<td>80</td>
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<td></td>
<td>6,002</td>
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<tr>
<td>1</td>
<td>2</td>
<td></td>
<td>Because it is 1 part shaded out of 3 equal parts. Discuss with children why the other three do not show ( \frac{1}{3} )</td>
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<tr>
<td>2</td>
<td>1</td>
<td>8cm(^2)</td>
<td>Encourage children to find two different methods to get the answer.</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>( \frac{6}{9} )</td>
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<td></td>
<td>( \frac{10}{16} )</td>
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<td>3</td>
<td>217.8</td>
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<td>3</td>
<td>1</td>
<td>11</td>
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<td>3</td>
<td>2</td>
<td>480ml</td>
<td>What is 320ml equivalent to?</td>
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<td></td>
<td>3</td>
<td>56cm</td>
<td>Would the perimeter change if the top rectangle moved?</td>
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<td>4</td>
<td>1</td>
<td>9</td>
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<td><strong>111</strong></td>
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<td><strong>15</strong></td>
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<tr>
<td>2</td>
<td>180 male adults</td>
<td>Encourage children to use a bar model.</td>
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<tr>
<td>5</td>
<td>1 a</td>
<td>32m</td>
<td>What is the length of each side?</td>
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<td></td>
<td>1 b</td>
<td>120cm²</td>
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<td>1</td>
<td>35</td>
<td>27</td>
<td>11</td>
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<td>6</td>
<td>1</td>
<td>£13.30</td>
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<tr>
<td></td>
<td>2 a</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 b</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>Carl donated £88</td>
<td>Encourage children to draw a comparison bar model.</td>
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<tr>
<td></td>
<td>2</td>
<td>7.8cm</td>
<td>What is the length of one strip of paper? What would one marking be worth?</td>
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<tr>
<td>8</td>
<td>1</td>
<td>80p</td>
<td>What does one can of cola cost?</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>£28</td>
<td>How much does Sally have left? It may be useful to draw a bar model.</td>
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<tr>
<td>9</td>
<td>1</td>
<td>308.82</td>
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<tr>
<td></td>
<td>2a</td>
<td>80 children</td>
<td></td>
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<td></td>
<td>2b</td>
<td>32 children</td>
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<tr>
<td>10</td>
<td>1</td>
<td>28 seconds</td>
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<td></td>
<td>9.5 hours /9 hours 30 minutes</td>
<td>Or equivalent</td>
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<tr>
<td>2a</td>
<td>84</td>
<td></td>
<td></td>
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<tr>
<td>2b</td>
<td>64</td>
<td></td>
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<td>3</td>
<td>170g</td>
<td>What is the weight of one sweet?</td>
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<td></td>
<td>What is the weight of 30 sweets?</td>
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<tr>
<td>11</td>
<td>1</td>
<td>216</td>
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<td></td>
<td>2</td>
<td>41</td>
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<td></td>
<td></td>
<td>How many oranges did she sell? How many apples did she sell? How many of each are left?</td>
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<td>12</td>
<td>1</td>
<td>18cm²</td>
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<td></td>
<td>2a</td>
<td>B – A = 0.25</td>
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<td></td>
<td>2b</td>
<td>D – C = (\frac{6}{25})</td>
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<td>What is the area of the big right angled triangle? What is the area of the small right angled triangle? Or equivalent</td>
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<tr>
<td>13</td>
<td>1</td>
<td>£930</td>
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<td></td>
<td>2</td>
<td>48</td>
<td></td>
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<td></td>
<td>Toy aeroplane = £120 Toy train = £690 Teddy = £120 How many cards does Pat have?</td>
<td></td>
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<tr>
<td>14</td>
<td>1</td>
<td>1.65kg</td>
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<td></td>
<td>2</td>
<td>£5.65</td>
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<td>The question says (\frac{7}{10}) kilograms not (\frac{7}{10}) of the bag of flour. How much does a bottle of cola cost? (£2.45)</td>
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<tr>
<td>15</td>
<td>1</td>
<td>1.6kg</td>
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<td>Subtract fractions to find what (\frac{1}{6}) of the paint weighs.</td>
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<td>2</td>
<td>57°</td>
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<td>Encourage children to mark angles on the diagram. What do angles on a straight line add up to? What do angles in a rectangle add up to?</td>
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<td>Question</td>
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<tr>
<td>16</td>
<td><strong>Reasoning and Problem Solving Questions</strong></td>
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<tr>
<td>1</td>
<td>What is a circle equal to? What is a star equal to?</td>
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<td>2</td>
<td>22</td>
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<tr>
<td>3</td>
<td>£24</td>
<td></td>
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<td>17</td>
<td>What is the area of one square? How many squares are in the diagram?</td>
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<td></td>
<td>How many half squares are in the diagram?</td>
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<td>2</td>
<td>120</td>
<td></td>
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<tr>
<td>18</td>
<td>What fraction does she keep? How many green counters are there?</td>
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<td></td>
<td>Or equivalent</td>
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<td></td>
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<tr>
<td>2</td>
<td>840g</td>
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<tr>
<td>19</td>
<td>How many oranges does Nimesh have in total?</td>
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<td></td>
<td>How many does he have left?</td>
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<tr>
<td>2</td>
<td>Loaf of bread = £1.20</td>
<td></td>
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<td></td>
<td>Apple = 40p</td>
<td></td>
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<td>20</td>
<td>What is the area of the square? What is the length of a side of the rectangle?</td>
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<td></td>
<td>3</td>
<td>14 blue cubes were removed</td>
<td>How many red cubes are there? How many blue cubes are there?</td>
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<td>---------------------------------------------------------------------</td>
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<tr>
<td>21</td>
<td>2</td>
<td>71cm²</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>1</td>
<td>30 sweets</td>
<td>How many chocolates does she eat? How many chocolates does she have left?</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>£275</td>
<td></td>
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<tr>
<td>23</td>
<td>1</td>
<td>4/15</td>
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<tr>
<td></td>
<td>2</td>
<td>223°</td>
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